TOPOGRAPHIC ANATOMY
AND
OPERATIVE SURGERY

FIRST EDITION

CRIMEA STATE MEDICAL UNIVERSITY

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TOPOGRAPHIC ANATOMY AND OPERATIVE SURGERY


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Dear readers,

This book is compiled with the interest of benefiting studies towards Topographic Anatomy and Operative Surgery. In coherence to the absence of an English language textbook for reference, we are hereby proud to publish the first edition of this book. It is designed with the sole desire of aiding and guiding students to the prerequisite knowledge needed for this subject. This book has step-by-step descriptions of operative surgical procedures. The insertion of illustrations and diagrams provides a broader perspective on the given subject at hand. Apart from these, the material is also written in a concise manner to increase readability and comprehensibility.

As this is the first edition, there may be some unforeseen errors or omissions in this book. Any alterations will be updated on the website http://www.mcsa-csmu.com from time to time. Suggestions and comments are always welcome from readers by e-mailing us at mcsa_csmu@yahoo.com.

Last but not least, I wish you a better understanding and a more enjoyable experience learning Topographic Anatomy and Operative Surgery with the benefit of this book.

Thank you!

Sincerely yours,

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CONTENTS

PREFACE ........................................................................................................... 3

CHAPTER ONE: INTRODUCTION ..................................................................... 5

CHAPTER TWO: THE UPPER EXTREMITY ......................................................... 16

CHAPTER THREE: THE LOWER EXTREMITY ................................................... 71

CHAPTER FOUR: THE HEAD ........................................................................... 106

CHAPTER FIVE: THE NECK ........................................................................... 136

CHAPTER SIX: THE THORAX ....................................................................... 159

CHAPTER SEVEN: THE ABDOMEN ................................................................. 194

CHAPTER EIGHT: THE LUMBAR REGION ....................................................... 261

CHAPTER NINE: THE PELVIS AND PERINEUM ............................................ 280

REFERENCES ................................................................................................. 314
CHAPTER ONE
INTRODUCTION

DETAILS OF CONTENTS

Introduction to topographic anatomy and operative surgery

Introduction to surgical instruments; separation and connection of tissues
TOPOGRAPHIC ANATOMY
Topographic anatomy is the main foundation of the operative surgery.
This subject is an applied science for clinical and surgical studies of the disposition of the
organs, tissues in different regions and layers of the human body.
It provides the main concepts of the interrelationship between the adjacent organs, skeleton
and body parts.
It is also the basis for the diagnosis and treatment of many somatic diseases.

TERMINOLOGY OF TOPOGRAPHIC ANATOMY
- Holotopy: Projection of the organs and anatomical formations (structures) on the
surface of the body and corresponding region
- Syntopy: Interrelations of the anatomical formations with one another
- Skeletopy: Interrelations of the anatomical formations with the skeleton

METHODS OF RESEARCH IN TOPOGRAPHIC ANATOMY
A) On live subjects:
- Anthropometry
- X-ray diagnostic
- Computed tomography (CT)
- Angiography
- Scintigraphy
- Thermography
- Magnetic resonance imaging (MRI)

B) On cadavers:
- Dissection
- Sawing of frozen corpses
- Sculpture
- Injection
- Corrosion
- Histological methods
- Electron microscopy
- Experimental methods

DIFFERENT FORMS OF BODY BUILDS
V. N. Shevkunenko distinguished two extreme forms of body builds and some transitional
forms. The 2 main forms are brachymorphic and dolichomorphc builds. Transitional form or
average form is mesomorphic build.
- Brachymorphic build: High position of the diaphragm, transverse position of the heart, oblique high position of the stomach, wide extraperitoneal field of the liver and high position of the caecum
- Dolichomorphic build: Low position of the diaphragm, vertical position of the heart, low horizontal position of the stomach, narrow extraperitoneal field of the liver and low position of the caecum

**OPERATIVE SURGERY**
- Operative surgery is a medical science about techniques, methods and rules of performing operations, and the usage of surgical instruments.

**SURGICAL OPERATION**
- Surgical operation is a traumatic approach to the organs and tissues of the human body with the aim to cure or to make diagnosis.
- Each of the operation consists of 3 stages. The first stage is operative access; the second stage is an operative manoeuvre and the third stage is a way out of the operation.
- During operation, the surgeon incises tissue to reach the pathological focus. This stage is not always performed. It may not be performed when the pathological focus is situated on the surface of the skin or in case of bloodless operations, for example the removal of the swollen skin, wound closure or closed reduction of the dislocation.
- An operative manoeuvre is the action taken on the pathological focus.
- A way out of the operation is the reconstruction of the cut tissues.

**CRITERIA OF ASSESSMENT OF OPERATIVE ACCESS**
- The axis of the operative action is a line which connects the surgeon's eye to the floor of the operative wound. The direction of axis of operative action determines the tissues and structures which will be injured during the operative access (refer to diagram x).
- The inclined angle of the operative action is an angle between the axis of the operative action and plane of entrance (the plane of entrance is a plane along the edges of the operating wound). It must be about 90 degrees. If it is less than 30 degrees, the operation is difficult to be performed (refer to diagram x).
- The depth of the operative wound is a distance between the plane of entrance and the floor of the wound. If it is more than 14 cm, special instruments with elongated handles are used to perform the operation (refer to diagram y).
- The angle of the operative action is formed between the edges and walls of the operative wound. It must be about 180 degrees. If it is less than 30 degrees, the operation is difficult to be performed (refer to diagram y).
- The zone of accessibility is the accessible part of the organ from different directions during operation. It is expressed in percentage or fraction. For example, the zone of accessibility may be 100% or 1 if the organ is completely accessible.
a - Inclined angle of the operative action, b - Angle of the operative action, c - Floor of the wound, d - Plane of the entrance of the wound, e - Axis of the operative action, f - Plane of the operation, h - Depth of the wound

**TERMINOLOGY OF OPERATIONS**

The name of an operation consists of the name of the pathologically changed organ and operative manoeuvre.

- Amputatio: Removal of the peripheral part of an organ, such as amputation of the limb
- Anastomosis: Creation of an artificial connection between the lumens of 2 organs, such as gastroenteroanastomosis
- Centesis: Puncture or piercing a surface, such as thoracocentesis
- Ectomy: Complete removal of an organ, such as pulmonectomy
- Implantatio: Insertion of an artificial organ or tissue into the body
- Pexy: Surgical fixation of an organ to another one, such as nephropexy
- Tomy: Incision of an organ's wall, such as laparotomy
- Plasty: Formation or plastic repair of an organ or tissue, such as pyloroplasty
- Stomy: Creation of an artificial connection between organs or an organ with the environment, such as enterostomy
- Resectio: Removal of part of an organ, such as resection of the liver
- Rrhaphy: Stitching of an organ's wall or tissue, such as myorrhaphy
- Transplantatio: Transfer of an organ or tissue from one man or animal to another man, such as transplantation of the kidney
- Sectio: Cutting of tissue, such as venesection

**CLASSIFICATIONS OF SURGICAL OPERATIONS**

A) By duration:

Urgent operations are performed within 1 - 5 hours. These operations must be performed immediately because patient is in a life threatening condition. For instance, traumatic amputation of the limbs, operations for gastrointestinal bleeding or gastric perforation.

Emergency operations are the operations, which can be postponed for 1 - 3 days. This time is used for preoperative preparation. For instance, amputation of the lower
limb due to diabetic angiopathy or if the conservative treatment is ineffective and the patient needs to be operated.

Planned operations are performed in case of ineffective conservative treatment of acute inflammatory diseases such as acute cholecystitis.

Elective operations are the operations which do not have specific time and can be performed at anytime. For example, herniotomy and plastic operations.

B) By recovery:
- Radical operations give complete recovery, such as appendectomy.
- Palliative operations do not give complete recovery but improve the patient's condition. For example, colostomy due to tumor of the large intestine with metastasis.

C) By stage:
- One-stage operations are performed to eradicate the cause of illness at once, such as cholecystectomy.
- Two-stage operations are performed when the patient's condition does not allow or other reasons prevent the removal of the pathology at once. For example, in adenoma of prostate gland and acute retention of urine, the first stage will be epicystostomy and prostatectomy (second stage) will only be carried out after 10–12 days.
- Three-stage operations are performed more often in the large intestine. For example, in case of the tumor of the large intestine and intestinal obstruction (ileus), the first stage will be colostomy to prevent rupture of intestinal wall and development of peritonitis; the second stage will be carried out about 2 weeks after the abatement of the inflammation; the third stage is the anastomosis, which can only be performed about 6 months or 1 year later when metastasis to other organs is not revealed.

D) By appearance of blood:
- With blood: This operation involves cutting of tissues by using surgical instruments, such as appendectomy.
- Without blood: This operation is conducted without causing injury to skin, such as reposition of bone fracture or reposition of joint by dislocation. It is also called bloodless operation.

E) By size:
- Minor: It is performed on a small area without an invasion of the body's cavity, such as dissection of the subcutaneous whitlow.
- Major: It is performed on a big area with an invasion of the body's cavity, such as resection of the stomach.

F) By aim:
- Curative, such as cholecystectomy
- Diagnostic, such as laparotomy
- Cosmetic, such as operation for varicose vein in the leg
GROUPS OF SURGICAL INSTRUMENTS

A) General instruments:

For dissection of tissues:

1 – Bellied scalpel, 2 – Sharp-pointed scalpel, 3 – Straight resection scalpel, 4 – Amputating knife, 5 – Blunt scissors, 6 – Sharp-pointed scissors, 7 – Cooper’s scissors, 8 – Richter’s scissors, 9 – Vascular scissors

For haemostasis:

1 – Straight Kocher’s clamp, 2 – Curved Kocher’s clamp, 3 – Straight Billroth’s haemostatic forceps, 4 – Curved Billroth’s haemostatic forceps, 5 – Straight haemostatic “mosquito” forceps, 6 – Curved haemostatic “mosquito” forceps, 7 – Dissector, 8 – Blelok’s vascular clamp

For fixation of tissues:

1 – Surgical forceps, 2 – Anatomical forceps, 3 – Tenaculum forceps, 4 – Sharp-toothed hook, 5 – Blunt-toothed hook, 6 – Farabet’s C-shaped laminar hook, 7 – Sharp single-toothed hook, 8 – Grooved probe.
9 - Bulbous-end probe, 10 - Kocher's probe, 11 - Buyalsky's spatula, 12 - Hoe for linen, 13 - Dressing forceps

For connection of tissues:

1 - Deschamp's needle, 2 - Reverden's needle, 3 - Hegar's needle-holder, 4 - Troyanov's needle-holder, 5 - Matic's needle holder, 6 - Pricking needles, 7 - Dissecting needle, 7a - Straight needle, 8 - Michelle's stapler, 9 - Forceps for removing staples, 10 - Michelle's staples

a - Position of the scalpel: 1 - Like holding a violin's bow, 2 - Like holding a table knife, 3 - Like holding an amputating knife, 4 - Like holding a pen, b - Position of the forceps
B) Special instruments:
1 – Straight Farabeuf’s raspatory, 2 – Curved Farabeuf’s raspatory, 3 – Duaen’s rib raspatory, 4 – Elevator, 5-7 – Gouges, 8 – Osteotome, 9 – Hammers, 10 – Bone curets, 11 – Retractor, 12 – Laminar saw, 13 – Arc saw, 14 – Gili-

**Needle holders:**
1 – Matic’s needle holder with a curved handle, 2 – Troyanov’s needle holder, 3 – Hegar’s needle holder with a straight rounded-end handle
Instruments for operations on the vessels:
1 – Pott’s terminal clamp, 2 – Blelok’s vascular clamp, 3 – Vishnevsky’s vascular clamp, 4 – Gepfner’s vascular clamp, 5 – Dissector, 6 – Side vascular clamp, 7 – Blelok’s vascular clamp, 8 – Non-traumatic needle

SEPARATION AND CONNECTION OF TISSUES

Types of knots:
a – Double surgical knot, b – Simple knot, c – Nautical knot

Types of separation:
a) With bleeding:
   - Sharp method: Using a scalpel
   - Blunt method: Using forceps or blunt end of a scalpel (for separation of fatty and soft tissue to prevent bleeding)

b) Without bleeding: Laser and electrocoagulation

Types of connection:
a) Stitching:
   - Materials used for stitching are classified into the absorbable and non-absorbable ones.
   - Absorbable materials include the natural (e.g. catgut sutures) and synthetic sutures. They are used in tissues which cannot be stretched, e.g. subcutaneous tissues, mucosa of the intestine. Their disadvantage is that they cause allergic reaction.
Non-absorbable materials include silk sutures. A capsule is formed around the silk sutures (a process called encapsulation) in tissues which seldom causes allergic reaction. They are used in fasciae, tendons, bones etc.

Types of surgical sutures:
- a – Interrupted suture, b – Continuous suture, c – Multanovsky’s blanket suture, d – Quilted (mattress) suture

b) Stapling:
- Staples are made up of “Tantal” which does not cause allergic reaction. They are mainly used in bones.

c) Screwing:
- It is used in orthopaedic surgery to connect the bones.

d) By medical glue
CHAPTER TWO
THE UPPER EXTREMITY

DETAILS OF CONTENTS

Topography of the scapular region, axillary region, deltoid region, subclavian region, elbow region, arm, forearm, hand and fingers

Topography of the shoulder joint, elbow joint and wrist joint

Projection of nerves and vessels of the upper extremity and access to them

Spreading of purulent processes and phlegmons on the upper extremity

Operations including puncture and arthroty of the joints of the upper extremity; amputation and disarticulation of the upper extremity; surgical manipulations on the vessels, nerves and tendons
TOPOGRAPHY OF THE UPPER EXTREMITY (EXTREMITAS SUPERIOR)
The upper extremity is divided into the following regions:
- Scapular region (regio scapularis)
- Deltoid region (regio deltoidea)
- Infraclavicular region (regio infraclavicularis)
- Axillary region (regio axillaris)
- Anterior and posterior regions of the arm (regio brachii s. humeri anterior et posterior)
- Anterior and posterior elbow regions (regio cubiti anterior et posterior)
- Anterior and posterior regions of the forearm (regio antebrachii anterior et posterior)
- Wrist region (regio carpi)
- Palmar and dorsal regions of the hand (regio palmae et dorsi manus)

TOPOGRAPHY OF THE SCAPULAR REGION (REGIO SCAPULARIS)
A) Landmarks:
- Acromion
- Superior angle of the scapula
- Inferior angle of the scapula

B) Borders:
- Superior: Horizontal line drawn through the acromion (at the level of the 7th cervical vertebra)
- Inferior: Horizontal line drawn through the inferior angle of the scapula
- Lateral: Vertical line drawn through the acromion
- Medial: Medial margin of the scapula

C) Layers:
- Skin:
  i. It is thick with limited movement.
  ii. It is innervated by the superior lateral cutaneous nerve of the arm (lateral supraclavicular nerve, dorsal rami of the upper thoracic nerve).
- Subcutaneous tissue
- Superficial fascia:
  i. It is dense and consists of many layers.
ii. It contains the fibrous tissues which connect the subcutaneous tissue and are fixed to the skin. That is why the skin has limited movement.

iii. It contains fat and cutaneous nerve.

- Deep fascia:
  i. It consists of 2 layers:
     Superficial layer covers the latissimus dorsi and trapezius muscles.
     Deep layer covers the supraspinatus, infraspinatus, teres major and teres minor muscles.

SCAPULAR ARTERIAL NETWORK
A) Anastomosis around the scapula:
   - Anastomosis occurs in 3 fossae:
     1. Supraspinous fossa
     2. Infraspinous fossa
     3. Subscapular fossa
   - It is formed by:
     i. Suprascapular artery (branch of the thyrocervical artery of the subclavian artery)
     ii. Dorsal scapular artery / deep branch of the transverse cervical artery (branch of the thyrocervical artery of the subclavian artery)
     iii. Circumflex scapular artery (branch of the subscapular artery of the axillary artery)
   - Importance:
     i. To provide collateral circulation when the subclavian artery or axillary artery is blocked / damaged
     ii. To help preserve the upper limb during injury

B) Anastomosis over the acromion:
   - Acromial branch of the thoracoacromial artery (branch of the axillary artery – 1st part)
   - Acromial branch of the suprascapular artery (branch of the thyrocervical artery of the subclavian artery)
   - Acromial branch of the posterior circumflex humeral artery (branch of the axillary artery – 3rd part)

TOPOGRAPHY OF THE AXILLARY REGION (REGIO AXILLARIS)
A) Landmarks:
   - Outlines of the pectoralis major, latissimus dorsi and coracobrachialis muscles
   - Axillary fossa is shown by lifting up the upper extremity.

B) Borders:
   - Anterior: Lower margin of the pectoralis major muscle
   - Posterior: Lower margin of the latissimus dorsi muscle
Medial: Line connecting the margin of the pectoralis major and latissimus dorsi muscles along the sagittal section of the lateral surface of the thorax at the level of the 3rd rib.
Lateral: Line connecting the margin of the pectoralis major and latissimus dorsi muscles on the medial surface of the arm.

C) Layers:
Skin:
  i. It is thin and easily movable.
  ii. It contains lots of sweat glands, sebaceous glands and hair.
  iii. It is innervated by intercostobrachial nerve.

Subcutaneous tissue:
  i. It contains the superficial axillary lymph nodes.
  ii. It is innervated by the intercostal nerve of the medial cutaneous nerve of the arm.

Superficial fascia

Deep fascia (axillary fascia):
  i. It contains nerve and vessels.
  ii. It contains the suspensory ligament of the axilla.
  iii. It separates and forms the pectoral fascia anteriorly, thoracolumbar fascia posteriorly and brachial fascia laterally.

Axillary cavity:
A) Borders:
  • Anterior: Pectoralis major muscle and clavipectoral fascia
  • Posterior: Subscapularis, latissimus dorsi, teres minor and teres major muscles
  • Medial: Thoracic wall, serratus anterior muscle and 1st until 4th intercostal muscles
  • Lateral: Surgical neck of the humerus, short head of the biceps brachii muscle and coracobrachialis muscle

B) Contents:
  • Axillary artery is divided into 3 parts and gives branches according to:
    i. Clavipectoral triangle: Thoracoacromial artery, *arteria thoracica suprema*, lateral and medial pectoral nerves
    ii. Pectoral triangle: Lateral thoracic artery and long thoracic nerve
    iii. Subpectoral triangle: Subscapular artery, anterior and posterior circumflex humeral arteries
  • Axillary vein
  • Brachial plexus:
    i. Lateral cord
    ii. Posterior cord
    iii. Medial cord
Axillary lymph nodes (5 groups):
  i. Lateral axillary lymph nodes
  ii. Central axillary lymph nodes
  iii. Medial (pectoral) axillary lymph nodes
  iv. Posterior (subscapular) axillary lymph nodes
  v. Apical (infraclavicular) axillary lymph nodes

Fatty tissue

TOPOGRAPHY OF THE DELTOID REGION (REGIO DELTOIDEA)

Deltoid tuberosity of humerus

Deltoid region
A) Landmarks:
- Anterior and posterior margins of the deltoid muscle
- Clavicle
- Acromioclavicular joint
- Acromion
- Spine of the scapula

B) Borders:
- Superior: Line drawn on the deltoid muscle from lateral 1/3 of the clavicle, acromion and lateral 1/3 of the spine of the scapula
- Inferior: Horizontal line drawn on the lower margin of the pectoralis major muscle and latissimus dorsi muscle
- Anterior: Anterior margin of the deltoid muscle
- Posterior: Posterior margin of the deltoid muscle

C) Layers:
- Skin:
  i. It is thick with limited movement.
  ii. Upper half of the deltoid muscle: Lateral supraclavicular nerve
  iii. Lower half of the deltoid muscle: Superior lateral brachial cutaneous nerve
- Subcutaneous tissue with superficial fascia:
  i. It contains moderate amount of fat.
  ii. It is divided by septa.
- Deep fascia (deltoid fascia):
  i. Superficial layer
     - It covers the outer surface of the deltoid muscle.
     - It is continuous with the pectoral fascia.
     - It divides the deltoid muscle into 3 parts, which are the clavicular, acromial (and spinal (of scapula) parts).
  ii. Deep layer:
     - It invests the deltoid nerve.
     - It is continuous with the fascia covering the triceps brachii muscle.
     - It sends numerous septa and fasciculi.
- Muscles:
  i. Unipennate: Clavicular (anterior) and spine of the scapula (posterior) parts
  ii. Multipennate: Acromial (middle) part
  iii. All fibres converge and are attached to the deltoid tuberosity.
  iv. Actions:
     - Abduction
     - Pulling the arm forwards and pronating it slightly
- Pulling the arm backwards and supinating it slightly
- Anterior part helps the pectoralis major muscle in arm flexion and medial rotation of the arm.
- Posterior part helps latissimus dorsi muscle in arm extension and lateral rotation of the arm.

**TOPOGRAPHY OF THE SUBCLAVIAN REGION (REGIO INFRACLAVICULARIS)**

- It is also called as infraclavicular region.

A) Landmarks:
- Sternum
- Clavicle
- Coracoid process
- 3rd rib
- Cephalic vein
- Pectoralis major muscle
- Deltoid muscle
- Border between pectoralis major and deltoid muscles (sulcus deltoideopectoralis)

B) Borders:
- Superior: Clavicle
- Inferior: Horizontal line drawn through the 3rd rib (in men); upper margin of the mammary gland (in women)
- Medial: Lateral margin of the sternum
- Lateral: Anterior margin of the deltoid muscle

C) Layers:
- Skin:
  i. It is thin, easily movable.
  ii. It contains sebaceous glands.
  iii. It is innervated by the supraclavicular nerve (branch of the cervical plexus).

Subcutaneous tissue:
  i. It is well-developed, especially in women.
  ii. It contains the cutaneous nerve.
  iii. It contains the thoracoacromial and thoracoepigastric veins which form the cephalic and axillary veins.

  Superficial fascia:
  i. It is thin and firm.
  ii. It is attached to the inferior margin of the clavicle and upper margin of the mammary gland, which forms the Cooper’s suspensory ligaments of the mammary gland (ligamentum suspensorium mammae).

  Deep fascia (pectoral fascia):
i. It covers the pectoralis major muscle.
ii. It divides the pectoralis major muscle into 3 parts:
   - Clavicular
   - Sternocostal
   - Abdominal
iii. Borders:
   - Superior: Clavicle
   - Inferior: Fascia of the serratus anterior and rectus abdominis muscles
   - Medial: Sternum
   - Lateral: Deltoid and axillary fasciae

Proper fascia (clavipectoral fascia):

i. It is attached to the lower margin of the clavicle, coracoid process and 1st rib.
ii. It covers the subclavius and pectoralis minor muscles.
iii. Lower part of proper fascia forms the suspensory ligaments of the mammary gland.

TOPOGRAPHY OF THE ANTERIOR REGION OF THE ARM
(REGIO BRACHII ANTERIOR)
It is also called as anterior brachial region.

A) Landmarks:
   - Deltoid muscle
   - Pectoralis major muscle
   - Latissimus dorsi muscle
   - Biceps brachii muscle
   - Triceps brachii muscle
   - Medial and lateral epicondyles of the humerus
   - Greater tubercle of the humerus
   - Sulci bicipitales lateralis et medialis

B) Borders:
   - Superior: Horizontal line drawn from the pectoralis major and latissimus dorsi muscles
   - Inferior: Imaginary line drawn with 2 fingers above the lateral and medial epicondyles of the humerus
   - Medial and lateral: Vertical lines drawn on medial and lateral epicondyles of the humerus respectively

C) Layers:
   - Skin:
     i. Lateral is thicker than the medial one. It is slightly movable.
     ii. It is innervated by the medial cutaneous nerve of the arm, lateral cutaneous nerve of the arm, superior lateral cutaneous nerve of the arm and inferior lateral cutaneous nerve of the arm.
Subcutaneous tissue:
   i. It contains the cephalic and basilic veins (at the lateral and medial margins of the biceps brachii muscle respectively).
   ii. It contains the cubital lymph nodes.

Superficial fascia:
   i. It forms a covering for the superficial veins and cutaneous nerves.

Deep fascia (brachial fascia):
   i. It forms 2 septa which are connected to the humerus, namely the lateral and medial intermuscular septa.
   ii. These 2 septa divide the brachial region into anterior (flexor) and posterior (extensor) parts.
   iii. Transverse septum separates the biceps brachii muscle from the brachialis muscle and encloses the musculocutaneous nerve.
   iv. Medial septum is pierced by the ulnar nerve and superior ulnar collateral artery to the posterior surface of the medial epicondyle.
   v. Lateral septum is pierced by the radial nerve and anterior descending branch of profunda brachii artery (arteria collateralis radialis) to the anterior surface of the lateral epicondyle.
   vi. Anteroposterior septum separates the brachialis muscle from the muscles attached to the lateral supracondylar ridge. This septum also encloses the radial nerve and anterior descending branch of the deep artery of arm (arteria profunda brachii).

Muscles:
   i. Corachobrachialis muscle
   ii. Biceps brachii muscle
   iii. Brachialis muscle

Bone:
   i. Humerus

TOPOGRAPHY OF THE POSTERIOR REGION OF THE ARM
(REGIO BRACHII POSTERIOR)
   It is also called as posterior brachial region.

A) Landmarks:
   - Deltoid muscle
   - Pectoralis major muscle
   - Latissimus dorsi muscle
   - Biceps brachii muscle
   - Triceps brachii muscle
   - Medial and lateral epicondyles of the humerus
- Greater tubercle of humerus
- Sulcus deltoideospectoralis
- Sulci bicipitales lateralis et medialis

B) Borders:
- Superior: Horizontal line drawn from the pectoralis major and latissimus dorsi muscles
- Inferior: Imaginary line drawn with 2 fingers above the lateral and medial epicondyles of the humerus
- Medial and lateral: Vertical lines drawn on the medial and lateral epicondyles of the humerus respectively

C) Layers:
- Skin:
  - It is thick and well-connected with the subcutaneous tissue.
- Subcutaneous tissue:
  - It contains the superior lateral cutaneous nerve of the arm, inferior lateral cutaneous nerve of the arm (nervi cutanei brachii lateralis et inferior) and posterior cutaneous nerve of the forearm (nervus cutaneus antebrachii posterior).
- Superficial fascia
- Deep fascia:
  - It forms a covering for the triceps brachii muscle and its tendon.
- Muscle:
  - Triceps brachii muscle
    - Humeromuscular canal (canalis humeromuscularis):
      - It is also known as canalis spiralis.
      - Radial nerve, deep artery of arm (arteria profunda brachii) and its vein pass through this canal.
- Bone:
  - Humerus

SUPERIOR TRILATERAL FORAMEN

English: Three-sided opening / upper triangular space  
Latin: Foramen trilaterum superior

A) Borders:
- Medial: Teres minor muscle
- Lateral: Medial margin of the long head of the triceps brachii muscle
- Inferior: Teres major muscle
B) Contents:
  · Circumflex scapular artery

**INFERIOR TRILATERAL FORAMEN**

English: Lower triangular space  
Latin: *Foramen trilaterum inferior*

A) Borders:
  · Medial: Long head of the triceps brachii muscle  
  · Lateral: Medial margin of the humerus  
  · Superior: Teres major muscle

B) Contents:
  · Radial nerve  
  · Deep artery of the arm

**QUADRILATERAL FORAMEN**

English: Four-sided opening / quadrangular space  
Latin: *Foramen quadrilaterum*

A) Borders:
  · Medial: Lateral margin of the long head of the triceps brachii muscle  
  · Lateral: Surgical neck of the humerus  
  · Superior: Teres minor muscle (from the posterior aspect)  
    Subscapularis muscle (from the anterior aspect)  
  · Inferior: Teres major muscle

B) Contents:
  · Axillary nerve  
  · Posterior circumflex humeral artery

**CANAL OF THE RADIAL NERVE**

English: Spiral canal, humeromuscular canal  
Latin: *Canalis spiralis, canalis humeromuscularis, canalis nervi raddialis*

Topography:
  · It is bounded by the humerus and triceps brachii muscle (both long head and lateral head).  
  · It contains the radial nerve, deep artery of the arm and its veins.

**WAYS OF SPREADING OF THE PHLEGMON**
  · Phlegmon is the suppurative (purulent) inflammation of the fatty tissue.  
  · Phlegmon passes along the pathway of nerves and vessels. It is because phlegmon has poor blood supply and low metabolic activities compared with muscles.
If the phlegmon is in the cubital fossa, it may either travel down to the wrist joint or up to the axillary region. From the axillary region, it may pass to the scapular region, then to the post compartment of the upper arm. Then, it passes along the pathway to the subclavian region and thoracic cavity. It may pass to the subpectorai space along the branches of the axillary artery. At last, it reaches the anterior mediastinum resulting in anterior mediastinitis.

If the phlegmon is in the axillary region, it may pass down to the cubital fossa or the posterior region of the upper arm along the deep brachial artery through the humeromuscular canal. Phlegmon in the thumb or little finger may pass along the ulnar and radial bursae to the Pirogov's space in the forearm. From there it passes up to the cubital fossa and other regions as mentioned above. But this happens rarely.

INCISIONS OF THE PHLEGMON

If the phlegmon is in the anterior compartment of the arm, 2 incisions are made along the lateral and medial borders of the biceps brachii muscle; if it is in the posterior compartment of the arm, an incision along the border of the triceps brachii muscle is made.

If the phlegmon is in the axillary region, an incision has to be made posterior to the projection line of the axillary artery. After cutting the skin, the dissection of the tissue must be continued by blunt way (such as using forceps or finger). It is done so to prevent damage of the brachial plexus and branches of the brachial artery which are located in the axillary region.

If the phlegmon is located in the deltoide region, an incision is performed along the anterior border of the deltoide muscle. It is dangerous to perform it along the posterior border because the axillary nerve is located near to it. The cutting of this nerve may result in the paralysis of the deltoide muscle.

PROJECTION LINES OF THE VESSELS

A) Axillary artery (arteria axillaris):
   - It passes 1.5 cm along the anterior margin of the axillary fossa (where the hair is present).

B) Brachial artery (arteria brachialis):
   - It passes from the axillary fossa to the midpoint between the medial epicondyle of the humerus and tendons of the biceps brachii muscle.

C) Radial artery (arteria radialis):
   - It passes from the medial margin of the tendon of the biceps brachii muscle or the midpoint of the cubital fossa to the pulsation point (or the point on 0.5 cm laterally from the styloid process of the radius) of the radial artery.

D) Ulnar artery (arteria ulnaris):
   - It passes from the medial epicondyle of the humerus to the lateral margin of the pisiform bone.
ACCESS TO THE VESSELS

A) Axillary artery:
Access to the axillary artery: An incision 8 – 10 cm in length is made along the medial margin of the coracobrachialis muscle to the axillary fossa.

B) Brachial artery:
Access to the brachial artery on the middle 1/3 of the arm: An incision 6 – 8 cm in length is made, 2 cm laterally from the projection line along the middle margin of the biceps brachii muscle.
Access to the brachial artery on the cubital fossa: An incision 6 – 8 cm in length is made, 2 cm proximally from the medial condyle of the humerus to the lateral margin of the forearm.

Access to the vessels
a – Access to the brachial artery on the middle 1/3 of the arm, b – Access to the brachial artery on the cubital fossa, c – Access to the radial artery on the lower 1/3 of the forearm

Incisions for ligating arteries: 1 – Common carotid artery, 2-3 – Subclavian artery, 4 – Axillary artery, 5 – Brachial artery, 6 – Radial artery, 7 – Ulnar artery
C) Radial artery:
- Access to the radial artery on the superior 1/3 of the forearm: An incision is made on the projection line along the medial margin of the brachioradialis muscle.
- Access to the radial artery on the lower 1/3 of forearm: An incision 6–8 cm in length is made along the projection line.

D) Ulnar artery:
- Access to the ulnar artery on the superior 1/3 of the forearm: An incision 8–10 cm in length is made along the projection line.
- Access to the ulnar artery on the lower 1/3 of forearm: An incision 6–8 cm in length is made on the skin along the projection (on the flexor digitorum superficialis muscle) line.

ACCESS TO THE NERVES

A) Brachial plexus:
- An incision is made at the level of the superior 1/3 along the posterior margin of the sternocleidomastoid muscle downwards obliquely to the midpoint of the clavicle. The incision is continued along the anterior surface of the clavicle laterally until it reaches the sulcus deltoidepectoralis.

B) Radial nerve:
- Access to the radial nerve on the middle 1/3 of the arm: An incision 10–12 cm in length is made from the midpoint of the posterior margin of the deltoid muscle to the lateral margin of the biceps brachi muscle.
- Access to the radial nerve on the cubital region: An incision 10–12 cm in length is made from the lateral margin of the biceps brachi muscle to the medial margin of brachioradialis muscle.

C) Axillary nerve:
- An incision is made from the midpoint of the spine of the scapula, and then is continued along the posterior margin of the deltoid muscle.

D) Median nerve:
- Access to the median nerve on the middle 1/3 of the arm: An incision 8–10 cm in length is made along the medial margin of the biceps brachii muscle.
- Access to the median nerve on the superior 1/3 of the forearm: An incision 8–10 cm in length is made from the midpoint of the cubital fossa on the projection line.
- Access to the median nerve on the lower 1/3 of the forearm: An incision is made along the median line of the forearm (medial margin of the flexor carpi radialis tendon).

E) Ulnar nerve:
- Access to the ulnar nerve on the lower 1/3 of the arm: An incision 8–10 cm in length is made from the middle point of the sulcus bicipitalis medialis to the medial epicondyle of the humerus.
Access to the ulnar nerve on the forearm: An incision is made from the medial epicondyle of the humerus to the lateral margin of the pisiform bone.

Access to the ulnar nerve on the hand: An incision is made 4 cm above and 0.5 cm lateral to the pisiform bone. And then the incision passes to the hypothenar margin in an arch shape.

Access to the nerves:
a – Access to the median nerve on the middle 3rd of the arm, b – Projection line of the ulnar nerve on the arm, c – Access to the median nerve on the lower 3rd of the forearm and hand, d – Access to the ulnar nerve on the hand

TOPOGRAPHY OF THE ELBOW REGION (REGIO CUBITI)

A) Landmarks:
- Olecranon of the ulna
- Brachioradialis muscle
- Tendon of the biceps brachii muscle
- Medial and lateral epicondyles of the humerus
- Sulci cubitales posteriores lateralis et medialis
- Sulci cubitales anteriores lateralis et medialis
- When a tourniquet is applied to the arm, the cephalic, basilic and median cubital veins are clearly visible.

B) Borders:
- A horizontal line is drawn 4 cm (or by 2 fingers) from the level which connects the medial and lateral epicondyles of the humerus.
- 2 vertical lines are drawn through the medial and lateral epicondyles of the humerus and divide the elbow region into the anterior (cubital) region and posterior region.

TOPOGRAPHY OF THE ANTERIOR CUBITAL REGION
(REGIO CUBITI ANTERIOR)

Layers:
A) Skin:
- It is thin, movable and non-pigmented.
It contains sweat glands, sebaceous glands and hair.

It is innervated by the lateral and medial cutaneous nerves of the arm, lateral and medial cutaneous nerves of the forearm.

B) Subcutaneous tissue:

- It contains lymphatic vessels with superficial lymphatic nodes and superficial venous network.
- It contains the cephalic, basilic and median cubital veins.
- Superficial cubital nodes (nodi lymphatici cubitales superficiales) are situated at the basilic vein (at the level of the medial epicondyle of humerus).
- The connection of the cephalic, basilic and median cubital veins forms an alphabet “N”.

C) Superficial fascia:

- It is connected with the superficial fascia of the arm and forearm, aponeurosis of biceps brachii muscle (aponeurosis bicipitis).
- It is connected with the deep fascia.

D) Deep fascia:

- Fascia of the biceps brachii and brachialis muscles forms the lateral and medial intermuscular septa.
- These septa are fixed to the medial and lateral epicondyles of the humerus.
- It forms a covering for the muscles of the arm and forearm.
- Inferior to the radial tuberosity, the fixation for the tendon of the biceps brachii muscle takes place. Intermuscular septa continue to form the anterior radial intermuscular septa of the forearm.

E) Muscles (3 groups of muscles):

- Lateral: Brachioradialis muscle and supinator muscle
- Median: Biceps brachii muscle (superficial) and brachialis muscle (deep)
- Medial: (1st layer) Pronator teres, flexor carpi radialis, palmaris longus and flexor carpi ulnaris muscles
- Medial: (2nd layer) Flexor digitorum superficialis muscle

F) Neurovascular bundles:

- 2 neurovascular bundles are found between groups of muscles and septa, which are lateral bundle (radial nerve and radial collateral artery) and medial bundle (brachial artery and median nerve).

  i. Brachial artery:

- Brachial artery with its veins is located in the medial margin of the biceps brachii muscle.
- It is divided into radial and ulnar arteries under the bicipital aponeurosis.

  ii. Radial artery:

- It passes through the tendon of the biceps brachii muscle.
- It is lodged between the pronator teres and brachioradialis muscles.
iii. Ulnar artery:
- It exits inferior to the pronator muscle in the upper part.
- It is later located between the superficial and deep flexors of the fingers (flexor digitorum superficialis and flexor digitorum profundus muscles).

iv. Median nerve:
- It lies on 0.5 – 1.0 cm from the medial margin of the biceps brachii muscle.
- It lies near to the ulnar artery in the upper part.
- It later perforates the pronator teres muscle.

v. Radial nerve:
- It is situated between the brachioradialis and brachialis muscles in the upper level.
- It goes downward and is divided into 2 branches, which are the superficial and deep branches of the radial nerve at the level of the lateral epicondyle of the humerus.
- Superficial branch innervates the brachioradialis and pronator teres muscles.
- Deep branch lies laterally and passes through the supinator canal (canalis supinatorius) between the superficial and deep layers of supinator muscle.

TOPOGRAPHY OF THE POSTERIOR CUBITAL REGION
(REGIO CUBITI POSTERIOR)
A) Landmarks:
- Olecranon of ulna
- Sulci cubitales posteriores lateralis et medialis
- Ulnar nerve passing along the sulcus cubitalis posterior medialis
- Head of the radius is palpated in the middle part of sulcus cubitalis posterior lateralis (especially during supination and pronation of forearm).

B) Layers:
- Skin
  - It is thick and movable.
  - It forms skin folds.
- Subcutaneous tissue:
  - It contains the superficial arteries (medial collateral artery, radial collateral artery and recurrent interosseous artery).
  - It contains the posterior cutaneous nerve of the arm, medial cutaneous nerve of the arm, posterior cutaneous nerve of the forearm and medial cutaneous nerve of the forearm.
  - Bursa of the elbow joint is located in the superior part of the olecranon of the ulna.
Bursitis may be precipitated by trauma or long-term compression of this part.

Superficial fascia:
- It is a thin layer without fixation.

Deep fascia:
- It is formed by an aponeurosis.
- It is fixed to the tendon of the triceps brachii muscle, medial and lateral epicondyles of the humerus and olecranon of the ulna.

Muscles:
- Superior: Triceps brachii and anconeus muscles
- Lateral: Extensor muscle of the wrist (Extensor carpi radialis longus, extensor carpi radialis brevis and extensor carpi ulnaris muscles) and extensor muscle of the digits (extensor digitorum and extensor digiti minimi muscles)
- Deep: Supinator muscle
- Medial: Flexor digitorum profundus and flexor carpi ulnaris muscles

TOPOGRAPHY OF THE FOREARM (REGIO ANTEBRACHII)
A) Landmarks:
- Brachioradialis muscle
- Sulci radialis et ulnaris
- Tendons of the flexor carpi radialis and palmaris longus muscles
- Styloid process of the ulna and radius

B) Borders:
- Upper: Horizontal line drawn 4 cm distal to the level of the wrist joint
- Lower: Transverse line drawn 2 cm proximal to the styloid process of the radius
- 2 vertical lines are drawn through the epicondyles and styloid processes, which divide the forearm region into the anterior and posterior regions.

TOPOGRAPHY OF THE ANTERIOR REGION OF THE FOREARM (REGIO ANTEBRACHII ANTERIOR)
Layers:
- Skin:
  - It is thin.
  - It contains sweat and sebaceous glands.
  - It is innervated by the medial and lateral cutaneous nerves of the forearm.

Subcutaneous tissue:
- It contains the cephalic vein (in the medial margin of the brachioradialis muscle) and basilic vein.
- It contains the lateral cutaneous nerve of the forearm and medial cutaneous nerve of the forearm.
- Intermediate antebrachial vein passes through the middle line of this region.
Superficial fascia:
- It is not attached to the bone.
- It covers all structures in the subcutaneous tissue.

Deep fascia (fascia antebrachii):
- It forms a covering for muscles, vessels, nerves and bones.
- It is thicker in the proximal part and thinner in the distal part.
- It sends two septa to the radius only and divides the forearm into 3 seats for muscles (anterior, posterior and lateral) in the upper half of forearm.
  i. Lateral: Brachioradialis, extensor carpi radialis longus and extensor carpi radialis brevis muscles
  ii. Posterior: Extensor digitorum, extensor digiti minimi, extensor carpi ulnaris, anconeus and supinator muscles
  iii. Anterior: (Superficial) Pronator teres, flexor carpi radialis, flexor digitorum superficialis, palmaris longus and flexor carpi ulnaris muscles, (Deep) Flexor digitorum profundus and flexor pollicis longus muscles

Borders of the fascia:
  i. Anterior: Strictly fixed to the deep fascia
  ii. Posterior: Interosseous membrane, ulna and radius
  iii. Medial: Posterior margin of ulna
  iv. Lateral: Sulcus radialis

Pirogov's space is situated in the lower half of the deep fascia.
  i. Anterior: Fascia of the flexor digitorum and flexor pollicis longus muscles
  ii. Posterior: Fascia of the pronator quadratus muscle

Muscles:
- Medial margin of the deep fascia is bounded to the posterior margin of the ulna and divides the muscles into 4 layers:
  i. 1st layer: Pronator teres, flexor carpi radialis, palmaris longus, flexor carpi ulnaris and brachioradialis muscles
  ii. 2nd layer: Flexor digitorum superficialis muscle
  iii. 3rd layer: Flexor digitorum profundus and flexor pollicis longus muscles
  iv. 4th layer: Pronator quadratus muscle

Neurovascular bundles:
- Lateral:
  i. Radial artery and vein
  ii. Superficial branch of the radial nerve:
    1. It is located on the sulcus radialis.
    2. In the upper 1/3 of the forearm, it is bounded by the brachioradialis muscle laterally and pronator teres muscle medially.
    3. In the middle and lower 1/3 of the forearm, it follows the brachioradialis and flexor carpi radialis muscles and passes downward along with radial artery.
iii. Radial artery:
1. It passes along the middle part of the elbow joint to the styloid process of the radius and enters the anatomical snuffbox.

Medial:
i. Ulnar artery
1. It passes from the tendon of the biceps brachii muscle.
2. In the middle 1/3 of the forearm, it passes under the pronator teres muscle, flexor digitorum superficialis muscle and sulcus ulnaris.
3. In the lower 1/3 of the forearm, it passes to the medial margin of the styloid process of the ulna and reaches the pisiform bone.

ii. Ulnar nerve:
1. It is located on the sulcus ulnaris and is bounded medially by the flexor carpi ulnaris muscle and laterally by the flexor digitorum superficialis in the upper 1/3 of the forearm.
2. Then it passes from the medial epicondyle of the humerus to the medial margin of the pisiform bone.
3. Dorsal branch of the ulnar nerve starts from the middle and lower 1/3 of the forearm and passes under the tendon of the flexor carpi ulnaris muscle. It passes downward and medially to the ulnar artery.

iii. Posterior interosseous artery:
1. Common interosseous artery is a branch of the upper part of the ulnar artery and is divided into the anterior and posterior interosseous arteries. Posterior interosseous artery passes through the orifice of the interosseous membrane to the posterior region of the forearm.

Median (Anterior):
i. Median nerve:
1. It passes from the middle point between the medial epicondyle of the humerus and tendon of the biceps brachii muscle, along the anterior interosseous artery to the medial margin of the styloid processes of the ulna and radius.
2. It goes downward between the pronator teres muscle and exits from the interspace of the pronator teres muscle in the upper third of forearm.
3. The middle 1/3 of the median nerve passes between the flexor digitorum superficialis and flexor digitorum profundus muscles and is strictly fixed to the posterior wall covering of the flexor digitorum superficialis muscle.
4. It is located on the sulcus medians in the lower 1/3 between the tendons of the flexor carpi radialis and palmaris longus muscles. This landmark is ideal for anesthesia of the median nerve during operation.

ii. Median (Posterior):
1. Posterior interosseous artery and nerve
TOPOGRAPHY OF THE POSTERIOR REGION OF THE FOREARM
(REGIO ANTEBRACHII POSTERIOR)

Layers:

i. Skin:
   - It is thick with limited movement.
   - It is innervated by the medial and lateral cutaneous nerves of the forearm and posterior cutaneous nerve of the forearm.

ii. Subcutaneous tissue:
   - It contains less fatty tissue.
   - Superficial veins form the main trunk of the vein (cephalic vein and basilic vein).

iii. Superficial fascia:
   - It is a weak layer.

iv. Deep fascia:
   - It is distinguished by its thickness and is strictly fixed to the ulna and radius.
   - It is an aponeurosis in the upper half of the forearm.
   - It extends downward and forms the extensor retinaculum and dorsal carpal canal.
   - It forms cellular space which contains deep branch of the radial nerve, posterior interosseous artery, posterior interosseous veins and nerve.
   - Deep branch of the radial nerve passes through the canalis supinatorius.
   - Posterior interosseous artery passes medial to the posterior interosseous nerve.

v. Muscles:
   a) Superficial muscles:
      - Extensor carpi radialis longus muscle
      - Extensor carpi radialis brevis muscle
      - Extensor digitorum muscle
      - Extensor digiti minimi muscle
      - Extensor carpi ulnaris muscle

   b) Deep muscles:
      - Supinator muscle
      - Abductor pollicis longus muscle
      - Extensor pollicis longus muscle
      - Extensor pollicis brevis muscle
      - Extensor indicis muscle

TOPOGRAPHY OF THE HAND REGION (REGIO MANUS)

A) Landmarks:
   - Styloid processes of the ulna and radius
   - Skin fold of the wrist joint
   - Metacarpal bones
   - Phalanges of fingers
B) Borders:
2 cm above the styloid process of the ulna
2 vertical lines are drawn along the ulna and radius and divide the hand region into the anterior (palmar) and posterior (dorsal) regions.

TOPOGRAPHY OF THE PALMAR REGION OF THE HAND
(REGIO PALMAE MANUS)

Layers:

i. Skin:
- It is thick with limited movement.
- Stratum corneum is well developed in this region.
- It contains sweat glands and sebaceous glands.
- It is innervated by the radial nerve, ulnar nerve and median nerve.

ii. Subcutaneous tissue:
- It contains vessels, nerves and lymphatic vessels with lymphatic nodes.
- It contains the superficial palmar branch of the radial artery.

iii. Superficial fascia:
- It is a continuation of the superficial fascia of the forearm.
- It is slightly movable and fixed to the bones.

iv. Deep fascia:
- It stretches from the palmaris longus tendon (proximally) to the ligamentum carpi volare (distally).
- It forms the palmar aponeurosis, flexor retinaculum (transverse carpal ligament), synovial sheaths of the hand and fingers.

a) Flexor retinaculum (retinaculum flexorum):
- It is the strongest and thickest fascia which is fixed to the bone.
- Between the eminencia carpi ulnaris and eminencia carpi radialis, flexor retinaculum converts the sulcus carpi into the canalis carpi.
- Then the flexor retinaculum forms the canalis carpi radialis and canalis carpi ulnaris.

b) Synovial sheaths of the hand and fingers:
  i. Synovial sheath of the thumb:
- It is situated laterally.
- This long and narrow canal encloses the tendon of the flexor pollicis longus.
- Superiorly this sheath protrudes 1 – 2 cm proximal to the flexor retinaculum.
- Inferiorly it extends on the tendon to the base of the distal phalanx of the thumb.
ii. Synovial sheath of the index, middle and ring fingers:
   - These 3 fingers have common sheaths on the palmar surface.
   - They have separate sheaths in the segment of the distal halves of the metacarpal bones. These sheaths stretch from the line of the metacarpophalangeal joints to the base of the distal phalanges.

iii. Synovial sheath of the little finger:
   - It covers the flexor digitorum superficialis and profundus muscles.
   - Superiorly this sheath protrudes 1 – 2 cm proximal to the flexor retinaculum.
   - Inferiorly it extends on the flexors until the base of the distal phalanx of the little finger.

For all fingers (digits):
   - On the phalangeal shafts, synovial sheaths of the fingers are covered by the dense annular (circular-shaped) fibrous sheaths.
   - On the phalangeal joints, synovial sheaths of the fingers are covered by the thin cruciform fibrous sheaths.
   - The tendons are connected with the walls of the thin mesotendineum, which transmit blood vessels and nerves.

Canals of the anterior region of the hand:
   a) Canalis carpi ulnaris:
      - It is formed by a fascia around the pisiform bone.
      - This canal contains ulnar artery and nerve. Then it passes under the palmaris brevis muscle.

   b) Canalis carpalis:
      - It is formed by a fascia between the flexor retinaculum and bones (scaphoid bone, trapezium bone, pisiform bone and hamate bone).
      - This canal contains median nerve, 4 flexor digitorum superficialis tendons and 4 flexor digitorum profundus tendons.
      - There are 2 separate synovial sheaths: 1 for the tendons of the flexor digitorum superficialis and profundus muscles; the other 1 for the tendon of the flexor pollicis longus muscle.
      - It forms common synovial sheaths of the flexor tendons (4 flexor digitorum superficialis tendons and 4 flexor digitorum profundus tendons) medially and a sheath for the tendon of the flexor pollicis longus muscle laterally.

   c) Canalis carpi radialis contains tendon of the flexor carpi radialis muscle.

v. Muscles:
   a) Thenar muscles (lateral muscle group):
      - Abductor pollicis brevis muscle
      - Opponens pollicis muscle
TOPOGRAPHY OF THE DORSAL REGION OF THE HAND
(REGIO DORSI MANUS)
A) Layers:

i. Skin
- It is thin and movable.
- It contains hair follicles, sweat glands and sebaceous glands. Furuncles tend to occur in this region.
- It is innervated by the ulnar, median and radial nerves.

ii. Subcutaneous tissue:
- It contains loose connective tissue and phlegmon passes from the palmar space to this region.
- It contains the cephalic (radial margin) and basilic veins (ulnar margin) which then form a vascular network between them.
- It also contains the radial nerve (superficial branch) and ulnar nerve (dorsal branch).

iii. Superficial fascia:
- It is fixed to the styloid process and bones of the wrist.

iv. Deep fascia:
- It forms the extensor retinaculum (retinaculum extensorum).
- It has 6 canals (osteofibrous canals) which are formed by the extensor retinaculum with the carpal bones.
- The 6 canals (from medial to lateral) contain:
  a) Tendon of the extensor carpi ulnaris muscle
  b) Tendon of the extensor digiti minimi muscle
  c) Tendons of the extensor digitorum and extensor indicis muscles
  d) Tendon of the extensor pollicis longus muscle
  e) Tendons of the extensor carpi radialis brevis and extensor carpi radialis longus muscles
  f) Tendons of the extensor pollicis brevis and abductor pollicis longus muscles
On dorsal part of the fingers, tendons of the extensors consist of 3 parts (median, medial and lateral). Tendons from the median part are fixed to the middle phalanges, while tendons from the medial and lateral parts are fixed to the distal phalanges.

- Aponeurotic tension is located above the proximal phalanges (around the interosseous muscles). Distal and middle phalanges can be flexed simultaneously.
- Patients suffering from the ulnar nerve palsy may show this pose: extension of the proximal phalanges, flexion of the distal and middle phalanges.

TOPOGRAPHY OF THE WRIST (REGIO CARPI)

- It is divided into the anterior and posterior compartments.

ANTERIOR COMPARTMENT OF THE WRIST

Landmarks:

i. Structures passing superficial to the flexor retinaculum (from medial to lateral):
   - Flexor carpi ulnaris tendon
   - Ulnar nerve (palmar branch)
   - Ulnar artery
   - Palmar cutaneous branch of the ulnar nerve
   - Palmaris longus tendon
   - Palmar cutaneous branch of the median nerve

ii. Structures passing deep to the flexor retinaculum (from medial to lateral):
   - Flexor digitorum superficialis tendon
   - Median nerve
   - Flexor pollicis longus tendon
   - Flexor carpi radialis tendon

*Median duo:
   - Palmaris longus tendon
   - Median nerve

*Radial trio:
   - Radial artery
   - Flexor carpi radialis tendon
   - Flexor pollicis longus tendon in the tendon sheath (radial bursa)

*Ulnar trio:
   - Ulnar artery
   - Ulnar nerve
   - Flexor carpi ulnaris tendon

*Tendon quartets:
   - Flexor digitorum superficialis tendon
   - Flexor digitorum profundus tendon
POSTERIOR COMPARTMENT OF THE WRIST

A) Structures passing superficial to the extensor retinaculum (from medial to lateral):
   • Ulnar nerve (dorsal / posterior branch)
   • Basilic vein
   • Cephalic vein
   • Radial nerve (superficial branch)

B) Structures passing beneath the extensor retinaculum (from medial to lateral):
   • Tendon of the extensor carpi ulnaris muscle
   • Tendon of the extensor digiti minimi muscle
   • Tendons of the extensor digitorum and extensor indicis muscles
   • Tendon of the extensor pollicis longus tendon muscle
   • Tendons of the extensor carpi radialis longus and extensor carpi radialis brevis muscles
   • Tendons of the extensor pollicis brevis and abductor pollicis longus muscles

TOPOGRAPHY OF THE FINGERS (REGIO DIGITI)

   • Its soft tissues are thin and muscles are absent in the fingers. (It only contains tendons of the muscles)

A) Layers:

   • Skin:
      i. It is thicker in the palmar surface and thinner in the dorsal surface.
      ii. On the palmar surface, hair follicles and sebaceous glands are absent but sweat glands are present.
      iii. On the dorsal surface, hair follicles, sebaceous glands and sweat glands are present.

   • Subcutaneous tissue:
      i. It is thin and surrounds the tendinous sheath of the flexor digitorum profundus and flexor digitorum superficialis muscles.
      ii. This sheath of the index, middle and ring fingers terminates at the level of the heads of the metacarpal bones.
      iii. For the thumb and little finger, it continues to the palm and forms the ulnar and radial bursae connecting with the Pirogov's space.
      iv. On the dorsal surface, tendon of the extensor digitorum muscle does not have any sheath and is connected deep with the phalanges.

   • Superficial fascia:
      i. It is almost absent and transformed into the fibrous bundles from the skin to tissue.

   • Deep fascia:
      i. On the phalangeal shafts, synovial sheaths of the fingers are covered by the dense annular (circular-shaped) fibrous sheaths.
ii. On the phalangeal joints, synovial sheaths of the fingers are covered by the thin cruciform fibrous sheaths.

GROOVES, CANALS AND FATTY TISSUE OF THESE REGIONS

Forearm:

A) Sulcus radialis:
   - It lies between the brachioradialis (laterally) and flexor carpi radialis muscles (medially).
   - It contains the superficial branch of the radial nerve, radial artery and vein.

B) Sulcus ulnaris:
   - It is lodged between the flexor carpi ulnaris (medially) and flexor digitorum superficialis muscles (laterally).
   - It contains the ulnar artery, vein and nerve.

C) Sulcus medianus:
   - It lies between the flexor carpi radialis (laterally) and flexor digitorum superficialis muscles (medially).
   - It contains the median nerve.

Wrist and hand:

A) Canalis carpi ulnaris:
   - It contains the ulnar artery, vein and nerve.

B) Canalis carpi radialis:
   - It contains the tendon of the flexor carpi radialis.
   - It contains the superficial branch of the radial nerve and palmar branch of the radial artery.

ARTERIAL NETWORK OF THE ELBOW JOINT

It is formed by branches of the brachial, radial and ulnar arteries.
   - It supplies the ligaments and bones of this joint.

A) Lateral epicondyle of the humerus (sulcus cubitalis lateralis):
   - Anterior part:
     i. Radial recurrent artery (branch of the radial artery)
     ii. Radial collateral artery (branch of the deep artery of the arm)
   - Posterior part:
     i. Middle collateral artery (terminal branch of the branch of the common interosseous artery deep artery of the arm)
     ii. Recurrent interosseous artery

B) Medial epicondyle of the humerus (sulcus cubitalis medialis):
   - Anterior part:
     i. Inferior ulnar collateral artery (branch of the brachial artery)
ii. Anterior ulnar recurrent artery (branch of the ulnar artery)

Posterior part:
i. Superior ulnar collateral artery (branch of the brachial artery)
ii. Posterior ulnar recurrent artery (branch of the ulnar artery)

C) Olecranon fossa:
Just superior to it:
i. Inferior ulnar collateral artery (posterior branch)
ii. Middle collateral artery (branch of the deep artery of the arm)
iii. Posterior ulnar recurrent artery (branch of the ulnar artery)

OPERATIONS FOR PHLEGMON OF THE FINGER

Incisions for drainage of purulent processes of the fingers and hand:
M - Incision lines for felon and tendosynovitis: a - Incision for tendosynovitis of the little finger and tendobursitis of the ulnar side, a' - Incisions of the little finger (lateral view), b - Incision for subcutaneous felon of the distal phalanx, c - Incisions for subcutaneous felon of the middle and base of the phalanges, d - Incision for tendosynovitis of index, middle and ring fingers, d' - Lateral view, e - Incision for tendosynovitis of the thumb and tendobursitis of the radial side
N - Incision lines for phlegmon of the hand: a - Incision for interphalangeal phlegmons, b - Incision for phlegmon of the lateral fascial compartment of the palm, c - Voino-Yasenetsky's incision for phlegmon of the median fascial compartment of the palm, d - Median incision for phlegmon of the palm, e - Incision for phlegmon in the deep (Pirogov's) fatty space, f - Incision for phlegmon of the medial fascial compartment of the palm
Tendosynovitis is inflammation of a tendon sheath.
Inflammation of the finger is called felon or whitlow (панариций).
Paronychia is an infection of the skin fold at the margin of the nail.
An incision is performed on the lateral side of the finger near the palmar surface. To prevent the ligaments from damaging, the incision must be made between the joints instead of over the joints.
If the phlegmon is in the palmar region, an incision is performed along the border of the thenar and hypothenar. It is dangerous to perform it in the proximal 1/3 of the thenar because branches of the median nerve are located here. The incision of them may cause paralysis of the thenar.

1-3: Paronychia, 1 – Incision lines, 2 – Removal of the base of the nail, 3 – Applying a draining tape, 4 – Incision of felon

SPACES OF THE FOREARM
Paron-Pirogov’s space:
- It is a quadrangular space deep in the lower part of the forearm above the wrist.
- It is located between the 3rd (flexor digitorum profundus and pollicis longus muscles) and 4th layers (pronator quadratus muscle) of muscles.
- Proximal part is connected to the oblique origin of the flexor digitorum superficialis muscle.
- Distal part is connected to the flexor retinaculum communicating with the midpalmar & thenar spaces.

SPACES OF THE HAND
- Spaces are formed between the fascia and septa of the fascia.
- They are divided into the palmar and dorsal spaces.
- Palmar spaces:
  i. Hypothenar space of the finger
  ii. Midpalmar space
  iii. Thenar space
Dorsal spaces:
   i. Dorsal subcutaneous space
   ii. Dorsal subaponeurotic / subtendinous space

Midpalmar Space:
   It is a triangular space.
   Proximal part is connected to the distal margin of the flexor retinaculum
   communicating with the forearm space.
   Distal part is connected to the distal palmar crease communicating with the 3rd and
   4th lumbrical canals.
Borders:
   i. Anterior: Palmar aponeurosis
   ii. Posterior: 3rd, 4th, 5th and metacarpal bones, fascia covering 3rd and 4th
      interosseous spaces, medial part of the transverse head of the adductor pollicis
      muscle
   iii. Medial: Medial palmar septum
   iv. Lateral: Intermediate / oblique palmar septum
Contents:
   i. Flexor tendons of the 3rd, 4th and 5th fingers
   ii. Superficial palmar arch
   iii. Digital nerve & vessels of the medial 3.5 fingers
   iv. 2nd, 3rd and 4th lumbrical muscles

Thenar Space:
   It is a triangular space under the outer 1/2 of the hollow of the palm.
   Proximal part is connected to the distal margin of the flexor retinaculum.
   Distal part is connected to the proximal transverse palmar crease.
Borders:
   i. Anterior: Short muscles of the thumb, flexor tendon of the index finger, 1st
      lumbrical muscle and palmar aponeurosis
   ii. Posterior: Fascia covering the transverse head of the adductor pollicis & 1st
      interosseous muscle
   iii. Medial: Intermediate palmar septum
   iv. Lateral: Tendon of the flexor pollicis longus muscle with the radial bursa and
      lateral palmar septum
Contents:
   i. Tendon of the flexor pollicis longus muscle with its synovial sheath
   ii. Flexor tendon of the index finger
   iii. 1st lumbrical muscle
   iv. Palmar digital vessels & nerves of the thumb & lateral side of the index
      finger

Dorsal subcutaneous space:
   It is located deep to the loose skin of the dorsal part of the hand.
Dorsal subaponeurotic / subtendinous space:
- It is situated between the metacarpal bone & extensor tendons (united by the aponeurosis).

TOPOGRAPHY OF THE SHOULDER JOINT
(Articulatio humeri / Articulatio gleno-humerae)
- Projection of the joint:
  i. Anterior: Coracoid process of the scapula
  ii. Posterior: Inferior to the acromion, between the acromial and spinal ends of the deltoid muscle
  iii. Lateral: Line drawn between the acromial end of the clavicle and coracoid process of the scapula

A) Types of joint:
  - Diarthrosis / true / interrupted / cavitated / synovial / movable joint
  - Ball and socket joint
  - Multiaxial joint
  - Simple joint

B) Bones involved:
  - Spherical head of the humerus
  - Glenoid cavity of the scapula

C) Articular capsule:
  - It extends from the labrum glenoidale of the scapula to the anatomical neck of the humerus.
  - Greater and lesser tubercles of the humerus are situated inside capsule.
  - On the internal surface of humerus, this capsule extends to the surgical neck of the humerus.
  - Contents surrounding the capsule:
    i. Anterior: Subscapularis muscle, coracobrachialis muscle and short head of the biceps brachii muscle
    ii. Posterior: Supraspinatus, infraspinatus and teres minor muscles
    iii. Lateral: Deltoid muscle and tendon of the long head of the biceps brachii muscle
    iv. Inferior: Axillary recess (recessus axillaris)
  - This capsule consists of 2 layers, which are the fibrous and synovial layers.

D) Ligaments:
  - Coracohumeral ligament:
    i. It stretches from the coracoid process of the scapula to the greater tubercle of the humerus.
  - Glenohumeral ligament:
    i. Superior glenohumeral ligament: From the apex of the glenoid cavity to the small depression above the lesser tubercle
ii. Middle glenohumeral ligament: From the middle margin of the glenoid cavity to the lower part of the lesser tubercle.

iii. Inferior glenohumeral ligament: From the inferior margin of the glenoid cavity to the inferior part of the anatomical neck of the humerus.

Transverse humeral ligament:

i. It bridges the upper part of the bicipital groove.

ii. It converts the intertubular groove into a canal.

E) Stability of the joint:

Coracoacromial arch (secondary socket for the head of the humerus):

i. It is formed by the acromion, acromial ligament and coracoid process.

Musculocutaneous cuff / rotator cuff muscles’s tendon:

i. It is formed by the supraspinatus, infraspinatus, teres minor and subscapularis muscles.

Labrum glenoidale:

i. It encircles the margin of the glenoid cavity.

Long head of the biceps and triceps brachii muscles

Atmospheric pressure

F) Movements:

- Flexion
- Extension
- Abduction
- Adduction
- Supination
- Pronation
- Circumduction - combined movement

G) Bursae:

Subscapular bursa:

i. It is lodged between the tendon of the subscapularis muscle and scapular neck.

ii. It protects the subscapular tendon.

iii. It is connected with the shoulder joint cavity.

Subdeltoid bursa:

i. It is located between the deltoid, supraspinatus muscles and fibrous capsule.

Subacromial bursa:

i. It is found inferior to the acromion and coracoacromial ligament; between them and supraspinatus muscle.

ii. It facilitates the movement of the supraspinatus muscle.

Infraspinatus bursa:

i. It communicates with the joint cavity.
Subscapular bursa (synovial) is located in the anterior surface of the capsule under the superior margin of tendon of subscapularis muscle and connects with 1 or 2 orifices.

*Vagina synovialis intertubercularis* is a synovial sheath for the tendon of the long head of the biceps brachii muscle.

It lies in the anterolateral surface, proximal to the edge of humerus (*sulcus intertubercularis*).

At the level of the surgical neck of the humerus, synovial membranes form a covering for the tendons.

The inflammatory process may spread from the joint cavity to the space around the shoulder joint: through the axillary recess to the axillary cavity; from the subscapular bursa to the subscapular osteofibrous space; through the *vagina synovialis intertubercularis* to subdeltoid space.

The surrounding muscles which cover the shoulder joint have 7 synovial bursae, in which the inflammatory process around the shoulder joint may develop.

H) Arterial supply:
- Anterior and posterior circumflex humeral arteries
- Thoracoacromial artery (deltoid and acromial branches)

I) Venous drainage:
- Anterior and posterior circumflex humeral veins
- Thoracoacromial vein

J) Lymphatic drainage:
- Supraclavicular nodes (superomedial region)
- Axillary nodes (posteroinferior region)

K) Nerve supply:
- Axillary nerve
- Suprascapular nerve

**TOPOGRAPHY OF THE ELBOW JOINT (ARTICULATIO CUBITI)**

- It consists of the *articulatio humeroulnaris, articulatio humeroradialis and articulatio radioulnaris proximalis*.
- Projection of joint: 1 cm distal to the lateral epicondyle and 2 cm distal to the medial epicondyle of the humerus

A) Types of joint:
- Diarthrosis / synovial / cavitated / true / movable / interrupted joint
- Hinge joint – Humeroulnar joint
- Pivot joint – Proximal radioulnar joint
- Ball and socket joint – Humeroradial joint
- Trochoid joint
- Combined joint – Proximal radioulnar joint
- Compound joint

B) Bones involved:
- Capitulum and trochlea of the humerus
- Head of the radius
- Trochlear notch of the ulna

C) Articular capsule:
- It is attached to the humerus at the margin of the lateral and medial ends of the articular surface of the capitulum and trochlea.
- It is weak in the anterior and posterior sides but is strengthened on each side by the collateral ligament.
- *Recessus subcircularis* is situated at the neck of the radius. In inflammation of the elbow joint, pus may spread to the deep space of the forearm.
- Contents surrounding the capsule:
  i. Anterior: Brachialis muscle
  ii. Posterior: Triceps brachii muscle
  iii. Lateral: Radial nerve, supinator muscle, anconeus muscle
  iv. Posteromedial: Ulnar nerve

D) Ligaments:
- Radial collateral ligament
- Ulnar collateral ligament
- Annular ligament of radius (*ligamentum anulare radii*)

E) Movements:
- Flexion
- Extension
  around the frontal axis

F) Bursae:
- Olecranon bursa:
  i. Intratendinous olecranon bursa: It is located in the tendon of the triceps brachii muscle.
  ii. Subtendinous olecranon bursa: It is located between the olecranon and triceps brachii tendon.
  iii. Subcutaneous olecranon bursa: It is located in the subcutaneous connective tissue over the olecranon.
- *Bursa subcutanea musculi tricipitis brachii* is situated under the ligament which is fixed to the olecranon.
- Radioulnar bursa: It is located between the extensor digitorum muscle, humeroradial joint and supinator muscle.
- Bicipitoradial / biceps bursa: It is located between the biceps tendon and anterior part of radial tuberosity.
G) Arterial supply:
- Arteries (brachial, radial and ulnar arteries) forming an anastomosis around the elbow joint

H) Venous drainage:
- Brachial vein
- Radial vein
- Ulnar vein

I) Lymphatic drainage:
- Deep cubital nodes
- Axillary nodes

J) Nerve supply:
- Ulnar nerve
- Radial nerve
- Median nerve

TOPOGRAPHY OF THE WRIST JOINT (ARTICULATIO RADIOCARPEA)

A) Types of joint:
- Diarthrosis / interrupted / synovial / true / cavitated / movable joint
- Complex joint
- Ellipsoid joint – 2 axes (sagittal & frontal)
- Biaxial joint

B) Bones involved:
- Inferior concave surface of the radius
- Discus articularis of the ulna
- Proximal row of the carpal bone (scaphoid, lunatum and triquetrum)

C) Articular capsule:
- It encloses the joint.
- It is attached to the styloid process of the radius, styloid process of the ulnar and proximal row of the carpal bones (scaphoid, lunate and triquetrum).
- Synovial membrane lines the fibrous capsule & is attached to the margins of the articular surface (numerous synovial folds are present).
- Protrusion of the synovial membrane is called the prestyloid recess. It lies in front of the styloid process of the ulna & in front of the articular disc.
- It is strengthened by the collateral, palmar & dorsal ligaments.
- Recessus sacroformis is located between the radius and ulnar which is formed by the synovial membrane of the articulatio radioulnaris distalis.
- Pronator quadratus muscle is situated anteriorly.
- Tendons of the extensor muscles are situated in the dorsal part of the wrist joint.
- On the palmar surface, the tendons form the carpal canal.

D) Ligaments:
- Collateral ligaments:
i. Radial collateral ligament: It stretches from the tip of the styloid process of the radius to the lateral side of the scaphoid. It assists with adduction.

ii. Ulnar collateral ligament: It stretches from the tip of the styloid process of the ulna to the triquetrum. It assists with abduction.

Palmar ligaments:
   i. Palmar radiocarpal ligament: It stretches from the radius to the scaphoid, lunate and triquetrum.
   ii. Palmar ulnocarpal ligament: It stretches from the ulna to the lunate and triquetrum.
   iii. Palmar radiocarpal ligament

Dorsal ligaments:
   i. Dorsal radiocarpal ligament
   ii. Dorsal radioulnar ligament

E) Movements:
   - Flexion
   - Extension
   - Adduction
   - Abduction
   - Circumduction - combined movement

F) Arterial supply:
   - Palmar carpal arches (superficial and deep)

G) Venous drainage:
   - Palmar carpal arches

K) Nerve supply:
   - Anterior & posterior interosseous nerves

**PUNCTURE OF THE SHOULD JOINT**

a – Posterior puncture of the shoulder joint, b – Anterior and lateral punctures of the shoulder joint, c – General view of puncture
A) Indication:
  - Inflammation (arthritis) with exudation

B) Contraindication:
  - Haemarthrosis

C) Procedures:
  - The patient lies on the unaffected side or sits.
  - There are three approaches: anterior, lateral and posterior.

  i. Anterior approach:
    - It is done along the coracoid process of the scapula. It can be palpated 3 cm distal to the acromial end of clavicle.
    - A needle is inserted distal to the coracoid process of the scapula. Then it is inserted 3 – 4 cm in depth, between the head of the humerus and coracoid process.

  ii. Lateral approach:
    - A needle is inserted from the acromion of the scapula along the frontal plane, inferiorly through the deltoid muscle.

  iii. Posterior approach:
    - A needle is inserted from the acromion, between the posterior margin of the deltoid muscle and inferior margin of the supraspinatus muscle, inferiorly, perpendicularly and 4 – 5 cm in depth from the point of insertion.

**ARTHROTOMY OF THE SHOULDER JOINT**

Access to the shoulder joint

A) Indication:
  - Drainage of suppurative (purulent) arthritis
B) Procedures:
- There are two approaches: anterior and posterior approaches.
  i. Anterior approach
  - The patient is placed in the supine position with the affected limb abducted.
  - Dissection of the skin, subcutaneous tissue and fascia is performed distal to the
    anterior edge of the acromion.
  - The fibres of the deltoid muscle are dissected to access the tendon of the biceps
    brachii muscle (long head).
  - The fibrous sheath covering the tendon together with the synovial sheath is opened by
    a grooved probe. Then the tendon of the biceps brachii muscle (long head) is retracted.
  - Later the tendon is dissected by a scalpel and pulled to the plica of the capsule.
  - Drainage of pus is insufficient by anterior arthrotomy alone. That is why posterior
    arthrotomy is usually done simultaneously.

  ii. Posterior approach
  - The patient lies on the unaffected side.
  - Dressing forceps (κορύφαμα) is inserted through the anterior dissection; which makes
    a protrusion of the tissues on the posterior surface of shoulder joint.
  - Dissection of the skin, subcutaneous tissue and superficial fascia is carried out from
    superior to inferior direction.
  - The deltoid muscle is separated together with its fibres; supraspinatus, infraspinatus
    and teres minor muscles are opened transversely.
  - Therefore, on further transverse separation of the infraspinatus and teres minor
    muscles, capsule of the shoulder joint is opened by the tip of the dressing forceps.
  - The dressing forceps is used to hold the drainage tube. Then, the drainage tube is
    stretched to the shoulder joint.
  - It is necessary to put sterile gauze with antibiotic solution on the anterior dissection
    for a few days.

LANGENBECK'S AND CHAULIN'S RESECTION OF THE SHOULDER JOINT

Resection of the head of the humerus
A) Langenbeck:

- An incision is made along the deltopectoral groove 6 – 8 cm in length.
- The deltoid and pectoralis muscles are retracted to expose the shoulder joint.
- An incision is made on the capsule to resect the articular surface.
- Ankylosis may occur after this operation.

B) Chaclin:

The procedures are similar to those of Langenbeck’s resection. The only difference is that the incision is made about 1 cm lateral to the deltopectoral groove with dissection of the sheath of the deltoid muscle.

Procedures:

- The patient is placed in the supine position.
- Dissection of the skin, subcutaneous tissue and fascia on the sulcus deltoideopectoralis is performed 10 – 12 cm distal to the coracoid process.
- The cephalic vein is exposed and pulled to the lateral side.
- The fascia on the space between the deltoid and pectoralis major muscles is dissected by a grooved probe. The hand is adducted, and then the ligaments and sheath of the tendons of the long head of the biceps brachii muscle are dissected. These tendons are stretched to the medial side.
- The capsule of the shoulder joint is opened along the tendon and dissected from the anatomical neck of the humerus.
- The shoulder is rotated more medially to expose the greater tubercle of the humerus. It is stretched with the supraspinatus, infraspinatus and teres minor muscles.
- Then the shoulder is abducted to expose the lesser tubercle of the humerus.
- The head of humerus is sawn with Gili’s chain saw. Its sharp edges are removed by a scalpel.
- The cut part of the humerus is sewn with the glenoid cavity of the scapula.
- The shoulder joint is fixed by plaster of paris.

**PUNCTURE OF THE ELBOW JOINT**

![Diagram of the elbow joint](image)
The patient lies on the unaffected side or sits.

- There are two approaches: posterior or posterolateral.

  i. Posterior approach:
     - The patient flexes his elbow joint at 135 degrees.
     - A needle is inserted over the olecranon to the anterior direction.

  ii. Posterolateral approach:
     - A needle is inserted downwards from the lateral epicondyle of the humerus and to the lateral direction from the olecranon, and penetrates the elbow joint directly above the head of radius.

**VOINO-YASENETSKY’S ARTHROTOMY OF THE ELBOW JOINT**

![Diagram of elbow joint]

Lateral approach to the elbow joint: a – Head of the humerus, b – Head of the radius, c – Triceps brachii muscle, d – Brachioradialis muscle.

- In purulent arthritis of the elbow joint, 3 longitudinal dissections are performed: 2 anterior and 1 posterolateral.
- The 1st longitudinal dissection is made through all the layers before it reaches the elbow joint, 1 cm to the anterior direction from to the medial epicondyle of the humerus.
- The 2nd longitudinal dissection is made on them through all layers until it reaches the capsule of the elbow joint.
- Posterior dissection is made layer by layer longitudinally to the lateral direction from the olecranon of the ulna which is closer to the lateral epicondyle of the humerus.
- A draining tube is inserted transversely to the posteromedial compartment of the elbow joint.
PUNCTURE OF THE WRIST JOINT

- A needle is inserted from the dorsal radial margin to the middle point which connects the styloid process and 2nd metacarpal bone.

GENERAL PRINCIPLES AND STAGES OF AMPUTATION AND DISARTICULATION

- Amputation: Removal of the distal (peripheral) part of the extremity by length
- Disarticulation: Removal of the distal part of the extremity at the level of joint

A) Indications:

Absolute:
- i. Crushing of the tissue
- ii. Massive gangrene
- iii. 3rd and 4th degrees of the burnt or frozen tissue

Relative:
- i. Chronic infection, such as osteomyelitis, tuberculosis and septic arthritis
- ii. Malignant tumour of the bone, such as osteosarcoma
- iii. Trophic ulcer
- iv. Congenital or acquired limb deformity
- v. Chronic vascular insufficiency of the extremities

Dissection of soft tissue for amputation of the upper extremity: 1 – Circular incision, 2 – Oval-shaped incision, 3 – Racquet incision, 4 – One-flap incision, 5 – Two-flap incision
B) Classifications of amputations:

Clinical classification by Burdenko according to time:

i. Early amputations may be primary or secondary.

ii. Primary or urgent amputations are performed during the first 24 hours. They are carried out before the development of inflammation to save the patient’s life. For example, traumatic amputation of the limb with profuse bleeding.

iii. Secondary or emergency amputations are performed during the period from the 1st day to 7th or 8th day. For example, amputation of the lower limb due to diabetic angiopathy if the conservative treatment is ineffective and an operation is required.

iv. Late or elective amputations do not have specified time of performing and may be performed at any time, every month or year. The patient can be prepared thoroughly. A complete examination is performed. For example, chronic osteomyelitis or congenital malformation of the bone.

v. Repeated amputations or reamputations are performed in postoperative complications or formation of a defective stump.

Anatomical classification according to shape of the cut tissue:

i. Guillotine amputation:

- This is the most primitive type of amputation. All tissues of the limb are divided at the same level, and the bone end is left exposed on the cut surface. Gas gangrene indicates this method.

ii. Circular amputation:

- The soft tissue and bone are cut at a right angle to the axis of the limb. The skin and muscles are divided circularly and lower than the bone, so that they provide a covering for the bone stump. This method is divided into one-stage, two-stage and three-stage amputations.

- One-stage operations involve the cutting of the skin and soft tissue; and cutting of the bone at the level of the contracted and retracted tissues.

- Two-stage amputations involve 2 stages. The 1st stage is the cutting and retraction of the skin and fasciae; the 2nd stage is the cutting of the muscles at the level of the contracted and retracted skin and fasciae; retraction of the muscles and cutting of the bone.

- Three-stage amputations involve 3 stages (for example, three-stage amputation of the thigh by Pirogov). The 1st stage is the cutting and retraction of the skin and fasciae; the 2nd stage involves the cutting of the superficial muscles at the level of the contracted and retracted skin and fasciae, and retraction of them; the 3rd stage includes the cutting of the deep muscles at the level of the contracted and retracted superficial muscles, retraction of them and cutting of the bone.

iii. Amputation by using flaps:

- This is the most widely used method of amputation. The soft tissue is cut in the form of 1 – 2 flaps, sometimes more than 2 flaps. This method is divided into one-flap, two-flap, three-flap and multi-flap amputations.
iv. Amputation using an elliptical incision:
    - The skin is cut at an angle to the axis of the limb. This method resembles
      the amputation by using flaps.

v. Amputation using a racquet incision:
    - A straight incision is carried out proximal to a circular or elliptical incision.
      This method is used especially for disarticulation of the metacarpal or
      metatarsophalangeal joint, shoulder or hip.

C) According to tissue used to cover the bone-saw line:
    - Fasciocutaneoplastics method, in which the bone-saw line is covered by the skin,
      subcutaneous fatty tissue and fasciae.
    - Fascioplastics method, in which the bone-saw line is covered by the fascia. This
      fascia is transformed into the bone after some time.
    - Tendoplastics method, in which the bone-saw line is covered by the tendon of the
      muscles, for example, the amputation of the thigh with the covering of bone-saw
      line by the quadriceps tendon.
    - Myoplastics method, in which the antagonist muscles are stitched to the bone-saw
      line.
    - Fascioperiosteoplastics method, in which the periosteous is included in the
      fasciocutaneous flap.
    - Osteoplastics method, in which the bone-saw line is covered by the bone with the
      periosteous.

D) General principles of amputation and disarticulation:
    - An attempt should always be made to conserve as much tissue as possible as even
      a small stump can be of tremendous value to a patient.
    - Removal of the bone should be reduced to the absolute minimum just to be covered
      by healthy skin.
    - There should not be any tension when stitching the flaps.
    - The scar should be placed dorsally, meaning that the palmar flap should be longer to
      retain the tactile sensation.
    - In case of the middle and distal phalanges, it is a rule to amputate through the
      phalanx rather than to disarticulate the joints. It is done so to conserve the attachment
      of the tendons of the flexor and extensor muscles of the phalanges.
    - The flexor and extensor tendons should not be stitched across the bone stump. This
      will limit the finger movements.
    - In case of a patient who works, metacarpal heads should be preserved even if the
      amputation of the index and little fingers is performed. For the cosmetic purpose,
      the margin of the metacarpal bone should be divided obliquely, so that it would be
      very difficult to realize that a finger is missing.
Techniques of dissection of the soft tissue for amputation: a - Guillotine amputation, 1 - Bone, 2 - Periosteum, 3 - Muscle, 4 - Deep fascia, 5 - Subcutaneous tissue, 6 - Skin, b - One-stage amputation, c - Two-stage amputation, d - Three-stage amputation, e - Fascioplasty amputation: fascia covers the bony stump of 1 side and skin covers another side, f - Tendoplastic amputation.

E) Stages of amputation and disarticulation
- Dissection of the skin
  - Cutting the soft tissues of the extremities
  - Ligature of the vessels (arteries and veins)
  - Cutting the periosteum
  - Cutting the bone
  - Cutting the nerves to prevent the phantom pain
  - Stump formation - suturing of the soft tissue above the bone

ESTIMATION OF LENGTH OF THE SKIN FLAPS FOR AMPUTATION

Amputation is usually done at the level of the forearm and leg.
- The term fascioplasty, myoplasty or osteoplasty are implied depending on the layers which are included in the flaps.
- Length of flaps depends on the level of injured soft tissue.
- In amputation of the lower extremities, posterior stump is covered by an anterior long flap.
- In primary amputation, the flap is obtained from any surface (where the skin is preserved).
- In case of absence of skin to cover the stump, autoplasty of skin is done (skin taken from other part of the patient’s body).
- Fascioplasty amputation is usually done on the upper extremities and the bony stump is covered by fascia.
- Fascia provides fixation for muscle and prevents the adhesion of skin to the bone.
- Osteoplasty amputation is usually done on the lower extremities.

One flap method:
By using the formula $L = 2 \pi R$, where $L =$ length of circumference, $\pi = 3.14$, $R =$ radius of circumference, $D =$ diameter, we have,

$L = 2 \pi R$
$= 2 \pi (D/2)$
$= 3.14 D$
$\sim 3D$

$D = L/3$
For example, if $L = 36 \text{cm}$,

$D = 36/3 \text{ cm}$
$= 12 \text{ cm}$

So, 1 flap must be at least $12 \text{cm}$ to cover all the bones.

**AMPUTATION OF THE ARM**

- Pirogov proposed to amputate the arm with conical circular method.
- Depending on the indications, the flap is created from the long posterior flap or long anterior flap.

A) Amputation of the arm (on the middle or lower 1/3):
- Dissection of the skin, subcutaneous tissue, and fascia is carried out. The anterior long and posterior short flaps are made.
- They are stretched proximally and muscles are dissected by a scalpel.
- It is better to dissect the biceps brachii muscle more distally, because, if this muscle is dissected on proximal part, the muscle length will be shortened.
- 2 % Novocain solution is injected anterior to the radial nerve.
- Muscles are stretched and protected by a retractor.
- Periosteum is dissected around the bone 3 mm longer than the cut edge of the bone and is separated with a raspatory.
- The bone is then cut.
- The brachial artery, deep artery of the arm, and collateral arteries of the elbow joint are ligated at the stump.
- The median nerve, radial nerve, ulnar nerve, musculocutaneous nerve, and medial cutaneous nerve of the forearm are cut off.
- The stump is sewn layer by layer, fascia by a catgut suture and skin by a silk suture.

B) Amputation of the arm (in the upper 1/3) by Farabef:
- Dissection of the skin, subcutaneous tissue, and fascia is carried out along the sulcus deltoideopectoralis until the inferior margin of the pectoralis major muscle to separate this muscle from the humerus.
- The sheath of the coracobrachialis muscle is dissected and the brachial artery is ligated.
- The soft tissue is cut until the bone along the anterior, inferior and posterior margins of the deltoid muscle. This muscle is then separated from the humerus; the bony-muscular flap is stretched proximally.
- The tendon of the teres major muscle is dissected.
- The soft tissue is dissected along the posteromedial surface of the humerus until it reaches the bone and all the soft tissues are retracted by a retractor.
The periosteum is dissected and retracted distally, and then the humerus is cut 3 – 4 mm distal to the edge of the cutting of the periosteum.
The median nerve, ulnar nerve, radial nerve, musculocutaneous nerve, and cutaneous nerve of the arm and forearm are dissected.
The axillary nerve (innervating the deltoid muscle) is preserved.
The stump is sewn layer by layer, fascia by a catgut suture and skin by a silk suture.

AMPUTATION OF THE FOREARM

Patient is placed in the supine position.
General anaesthesia is administered.

A) Amputation of the lower 1/3 of the forearm:
Circular dissection of the skin, subcutaneous tissue and fascia is done 4 cm distal to the place where the bone is cut.
The skin, subcutaneous tissue and fascia are retracted by a cuff (манжета) to form a conical shape.
Both medial and lateral margins of the retracted part are dissected.
A small amputating scalpel is used to separate the muscles from the bone: wrist is flexed and the scalpel is held at a right angle to the bone and muscles; and then the wrist is extended, the tendons and flexor muscles are distended. This procedure may shorten the muscles and cut the tendons and muscles on the dorsal surface of the forearm.
The muscles are retracted.
A two-edge scalpel is inserted between the ulna and radius to dissect the interosseous membrane. Then the periosteum of the radius and ulna is stretched distally by a raspatory.
2 dissections of the median part (linceum biffissum) is done until the middle length.
The soft tissue is retracted proximally.
The bone of the forearm (supination of the forearm) is sawn 2 – 3 mm distal to the dissected periosteum.
All vessels are clamped but nerves (median nerve, ulnar nerve, interosseous nerve, superficial branch of the radial nerve and cutaneous nerve of the forearm) are not cut.
The wound is sutured layer by layer, fascia by a catgut suture and skin by a silk suture.
A draining tube is inserted around the edge of the wound.
The hand is immobilized by plaster of paris.

![Amputation at the level of the middle and lower 1/3 of the forearm](image)
a – Dissection of the skin, b – Resection of the soft tissue with an amputating knife, c – Proximal retraction of the muscle and exposure of the periosteum
B) Amputation of the upper 1/2 of the forearm:

- The flaps of the anteroradial and posteroulnar are made equal to the length of the radius (r) at the level of the amputation with skin length 3 – 4 cm (anteriorly) and 1.5 cm (posteriorly).
- The flap consists of the skin, subcutaneous tissue and fascia.
- The superficial layer of the muscles is first dissected on the anterior region of the forearm. Then the deep layer is dissected.
- On the posterior region of the forearm, all muscles are dissected from the superficial to deep layers at once.
- The bone of the forearm is sawn (supination of forearm) 2 – 3 mm distal to the dissected periosteum.
- All vessels are clamped but nerves (median nerve, ulnar nerve, interosseous nerve, superficial branch of the radial nerve and cutaneous nerve of the forearm) are not cut.
- The wound is sutured layer by layer, fascia by a catgut suture and skin by a silk suture.
- A draining tube is inserted around the edge of the wound.
- The hand is immobilized by plaster of paris.

DISARTICULATION OF THE PHALANX AND FINGER

Disarticulation of the finger:
Incision lines: on the thumb – by Malgine, on the index and little fingers – by Farabef, on the middle finger – racquet incision, on the ring finger – by Liupiya

During the disarticulation of the finger, the scar has to be located on the free (non-working) surface: thumb – dorsal and radial surfaces, index finger – dorsal and radial surfaces, middle and ring fingers – dorsal surface, little finger – dorsal and ulnar surfaces.
A) Malgene’s disarticulation of the thumb:
- Dissection of the skin and subcutaneous tissue is performed at the level of the metacarpophalangeal joint on the dorsal surface until the interphalangeal fold on the palmar surface and further to the beginning of the dissection on the dorsal surface.
- The thumb is retracted with a hook on the dorsal dissection to expose the metacarpophalangeal joint.
- A scalpel is placed on the palmar surface around the joint capsule at 45 degrees.
- The most important moment of this operation is to protect the muscle of the thumb and retract it to the sesamoid bone, which is located in the anterior surface of the joint capsule.
- The tendons of the flexor and extensor of the thumb are sewn and the wound is sutured.
- After this operation, the function of the hand decreases by 50%.

B) Farabel’s disarticulation of the index and little fingers:
- Dissection of the skin and subcutaneous tissue is done on the dorsal surface of the index finger from the lateral surface to the direction of the radius, and then the space between the index and middle fingers is dissected. On the palmar surface, a transverse dissection on the ulnar edge of the metacarpal joint is made until the beginning of the dissection on the dorsal surface.
- The same dissection is performed on the little finger.
- The flap is dissected. The tendons of the extensors are dissected distal to the head of the metacarpal bone, and then the metacarpophalangeal joint and its ligaments are dissected by a scalpel.
After the capsule is seen the tendon of flexors is dissected distally.
- The arteries are ligated and the nerves of the dorsal and palmar branches are dissected.
- The tendon of the flexors and extensors is sutured.
- The head of the metacarpal bone is preserved.
- The wound is sutured in order to cover the head of the metacarpal bone.

C) Disarticulation of the middle and ring fingers (racquet form):
- Racquet-shaped dissection starts from the dorsal metacarpal bone in an oblique direction along the base of the phalanges (on the palmar surface), later along the palmar crease and the other side of the base of the phalanges to the longitudinal dissection on the dorsal region.
- A flap consisting of the skin and subcutaneous tissue is retracted from the base of phalanx proximally by a hook.
- Distal to the head of the metacarpal bone, the tendons of the extensors are dissected.
- The joint capsule is dissected on the dorsal, medial, lateral and palmar surfaces.
- The tendons of the flexors and soft tissues are dissected and cleared off.
- The vessels are ligated. The nerves are dissected from the proximal part of the head of the metacarpal bones.
- The tendons of the flexors and extensors on the head of the metacarpal bones are sutured.
- The wound is sutured.

OPERATIONS ON THE VESSELS, NERVES AND TENDONS
A) Sutures of the arteries:

Rules:
- The sutures can be circular suture or side-suture.
- The stitches must be hermetically done and strong.
- The sides must not constrict vessels.
- Tunica intima must be connected (both proximal and distal ends).
- The threads must be absent from the vessels in the lumen to prevent thrombosis.
- The cross section of the vessels after suture must be same as others.

Lateral (side-) sutures of the arteries:
- Indication: Injury less than 1/3 of the vessel.
- The vessels are separated from the surrounding tissue. The vessels are clamped in the upper and lower parts of the injury.
- After dissection of the edges of the damaged part of the vessels through all layers transversely, a silk suture is applied 1.5 - 2 mm from one to another.
- In case of bleeding between sutures, flaps from the fascia or vein are sutured.
- There are circular methods by Carrel and by Morozova.
a) Carrel's circular method:

![Diagrams](image)

- Triplicate fixation sutures on the edges of the vessels.
- Continuous blanket sutures.
- Interrupted sutures.

**Indication:** Extensive injury to the vessel.

*The main trunk of artery is separated to prevent damage of the adventitious layer and its branches.*

*The proximal and distal parts of the injured vessel are clamped.*

*3 sutures (P-shaped) are applied to stitch from intima to intima.*

*A needle is inserted to the vascular lumen and the vessel is irrigated with isotonic solution - sodium chloride solution.*

*An assistant holds the handle of the forceps and directs the next suture to the surgeon. Then the assistant holds the vessels with forceps and stitches them.*

*The assistant also holds the suture to prevent it from getting loose.*

*The last stage is to suture 1 of the edges, tie up the suture and prevent its corrugation.*

*The same method is applied to another 2 sutures.*

*Before tying up the suture, the distal clamp is slightly opened. When the suture is tied, the distal clamp is opened completely and the bleeding part is wiped off with gauze.*

*Usually bleeding ceases after a few minutes. An extra suture is applied if bleeding persists for a long time.*

b) Morozova's circular method:

This method is similar to Carrel's circular method; the only difference between them is 2 sutures are used for fixation in Morozova’s method.

c) Soloviev's method:

P-shaped sutures are applied.
d) Polyantsev’s method:
   Polyantsev proposed to suture the artery with invagination of its margin with the help of a metallic ring.

e) Čudov’s metallic stapling:
   It is a mechanical suture which resembles the stapling method.

B) Operations on the veins:
   Indication: Varicose vein in the lower limb

i. Conservative method:
   - Elastic stocking and bandage
   - It is used when varicocities are widespread or diffuse and appear to be unrelated to the saphenous system.

ii. Sclerotherapy:
   - Injection of sclerotic solution with:
     a) Soap solution: Ethanolamine
     b) Hypertonic solution: Glucose, Sodium chloride solution
     c) Organic compounds: Quinine, Urethane

iii. Operative method:
   - Elimination of the shunt from the deep venous system:
   1. Troyanov-Trendelenburg’s operation:
      This operation is a preventive measure for the thromboembolism. The incision is performed about 4 – 5 cm distal to the inguinal ligament and parallel to it. The great
saphenous vein is found and double ligated near the place of emptying into the femoral vein.

The accessory veins, which drain the blood from the lateral and medial surfaces of the thigh, are ligated and cut. This operation is cosmetic but not radical and a radical operation is necessary in the future.

2. Linton's operation:
   - This method implies subfacial ligation of the communicant veins along the entire surface of the internal surface of the leg.

3. Cockett's operation:
   - Cockett proposed to ligate the varicose vein through the puncture of the skin. The ligature is brought in and turned out after passing around the vein through the perforating one. Recanalization of the ligated veins is performed later.

   - Removal of the superficial varicose vein:
     - Madelung's operation: Long dissection along the vena saphena magna
     - Narrat's operation: Multiple dissections for resection of the veins
     - Babcock's operation: Elimination of the veins by a probe

   - Elimination of the circulation and obliteration of the superficial veins:
     - Linser-Sitar's method: Multiple injections of sclerosants in small doses

C) Operations on the nerves:

There are 2 methods, which are neurorrhaphia and neurolysis.

The final decision of choosing between these 2 methods is decided after the physical examination with electrical instruments.

Indications: Tumour; trauma; formation of a scar after amputation; compression of tissue by a scar or bony callus

i. Neurorrhaphia

   - Indications: Complete anatomical interruption of the nerve and presence of cicatricial tissue

   - 3 types: Primary, early postponed and secondary sutures

   a) Primary suture:
      - This method is applied during primary treatment of the wound with suturing of the edge of the damaged nerve.
      - The end of the damaged nerve is dissected with a scalpel. A fine needle and thin silk suture are applied 2 – 4 mm from the edge of the nerve to its epineurium.
      - The nerve is sutured by 2 to 4 stitches. Then surgeon and assistant stretch the sutures near the edge of the nerve leaving a distance 1 – 2 mm between them. The suture is tied up (interrupted suture).
      - In case of large defect of the nerve or length of the nerve is shortened, the position of the extremity is changed. For example, elbow joint is flexed; the median nerve or
radial nerve is sutured on the surface of the flexors. In case of damaged ulnar nerve, a suture can be applied from the dorsal surface of the elbow joint to the anterior surface. After suturing the nerve, fixation and immobilization of extremities are done with plaster of paris for 3 to 4 weeks.

The main principle of this operation is to suture the 2 edges of the nerve (peripheral to central part) in the shortest distance. This may lead the restoration of the nervous function and accelerate the myelin production.

b) Early postponed suture:
- This method is used after 3 to 4 weeks, if the primary suture (as stated above) is not done.

Early postponed suture is easier than the secondary one. When a secondary suture is performed, the injured nerve is difficult to be found and separated.

c) Secondary suture:
- It is performed from 4 to 6 months until a few years.
- The cicatricial tissue (scarring) is dissected around the nerve and the edges of dissection are sutured.
- This method is made with a large dissection and may displace the healthy nerve to the injured part.
- The edges of the damaged nerve are sutured to accelerate the proliferation of their peripheral part.
- If the distance of the 2 edges of the nerve is too long, then the position of the extremity is changed. In case of extensive defect, transplantation of the nerve is performed.

ii. Neurolysis:
- It is separation of the nerve from the cicatricial tissue.
- This operation is performed, for which the nerve is separated from the cicatricial tissue and the function of the nerve is disturbed.
- The patient lies on the back (supine position) or on the abdomen.
- The skin is dissected 8 – 10 cm from the projection of the nerve. The fascia and cicatricial tissue are separated with a blunt hook to penetrate the intermuscular space.
- The upper and lower parts of the damaged nerve are separated, and held with plastic handles (резиновые полоски-держалка). The cicatricial tissue is dissected on the nerve and is separated from the nerve.
- The nerve is lifted slightly with the plastic handles. Then the nerve is checked by conduction with sterile electrodes.
- In case of presence of conduction, the nerve is wiped with moist gauze and the cicatricial tissue is removed completely.
- If case of absence of conduction, neurorrhaphia is performed on the distal part of the injured nerve (by dissecting and suturing it).

A catgut suture is performed on the nerve.
D) Sutures of the tendons:

The operation on tendons consists of dissection of the tendon (*tenotomia*), transplantation of the tendon (*tenoplastika*), and suture of the tendon (*tenorrhaphia*).

*Tenorrhaphia* is difficult because dissection of the tendon may cause its splitting.

If many sutures are performed on the tendon, this may cause disturbance of its blood supply; and interrupted sutures may cause sliding of the tendon.

Indication: Trauma

Depending on the time of operation, it can be divided into primary, secondary early and secondary late sutures.

Primary suture is performed from 6 – 24 hours after the trauma. This operation is not performed in severe contamination and large defect of the tendon; otherwise the function of the tendon will be extremely restricted.

Secondary early suture is performed from 2 to 3 weeks after the trauma. Secondary late suture is performed after the wound healing.

![Diagram of tendon sutures](image)

Tendon sutures:

- a - by Lange,
- b - by Kunie,
- c - by Blokha and Bonne,
- d - by Kazakova

i. Tendon suture on the synovial sheath:

- During the primary treatment of the wound the tendon is held by forceps and dissected until it reaches the normal structure of tendon.
- The proximal part of the tendon is connected with its muscular end; therefore this may cause shortening of the muscle.
- The tendon is found, and the edges of the wound are dissected longitudinally.
- The end of the tendon is retracted and the lateral sutures are performed to connect both ends of the tendon.
- There is another method of suturing: both ends are connected with a thick silk suture 1 cm from the cut edge (for strong connection).
ii. Tendon suture on the synovial sheath:
   a) Lange’s P-shaped suture
   b) Kuneo’s suture
   c) Kazakova’s suture
   d) Blokha-Bonne’s suture

Types of tendon sutures:
a – Dreyer’s suture, b – Hikoladon’s suture, c – Mazne’s suture, d – Rotter’s suture, e – Rozova’s suture, f – Wilm’s suture

**LIGATION OF THE ARTERIES BY LENGTH**
- If the distal part of the artery bleeds, the proximal part of this artery and its main branch are ligated.
- For example, if the hand bleeds, the brachial artery is ligated.

**CONCEPT OF THE COLLATERAL AND REDUCED BLOOD SUPPLY**

A) Concept of the collateral blood supply:
- The artery which has a collateral branch is ligated to enable blood supply to its distal part, for example, the elbow region.
- Ligature of the artery is performed distal to its branches. Blood supply is reperfused by collateral anastomoses.

B) Concept of the reduced blood supply:
- When the artery is ligated, tissue is devoid of blood supply. However the vein still flows and carries the extracellular fluid away from the tissue. It will thus cause damage to the tissue. In order to prevent this, the artery and 1 of the 2 accompanying veins have to be ligated together.
CHAPTER THREE
THE LOWER EXTREMITY

DETAILS OF CONTENTS

Topography of the gluteal region, thigh, knee, popliteal fossa, leg and foot; operations on these regions

Topography of the hip joint, knee joint and ankle joint

Projection of nerves and vessels of the lower extremity and access to them

Spreading of purulent processes and phlegmons on the lower extremity

Operations including puncture and arthrotomy of the joints of the lower extremity; amputation and disarticulation of the lower extremity; operation for varicose veins
TOPOGRAPHY OF THE LOWER EXTREMITY (EXTREMITAS INFERIOR)
Borders of the lower extremity (limb):
A) Anterior:
  - Pubic symphysis – pubic tubercle – inguinal ligament – anterior superior iliac spine
  - Iliac crest
B) Posterior:
  - Imaginary line drawn from the posterior superior iliac spine to the middle point between the 2nd and 3rd sacral vertebrae
  - The border between the perineum and the lower extremity is the groove of the thigh.

The lower extremity is divided into the following regions:
- Gluteal region (regio glutea)
- Anterior and posterior femoral regions (regiones femoris anterior et posterior)
- Anterior and posterior regions of the knee (regiones genu anterior et posterior)
- Anterior and posterior regions of the leg (regiones crus anterior et posterior)
- Anterior, posterior, lateral and medial regions of the ankle joint (regiones articulationis talocruris anterior, posterior, lateralis et medialis)
- Dorsal foot region (regio dorsi pedis)
- Region of the sole (regio plantae pedis)

TOPOGRAPHY OF THE GLUTEAL REGION (REGIO GLUTEA)
A) Borders:
- Superior: Iliac crest
- Inferior: Gluteal fold
- Medial: Spinous process of the sacrum and coccyx
- Lateral: Imaginary line drawn from the anterior superior iliac spine to the greater trochanter

B) Layers:
- Skin:
  i. It is thick.
  ii. Hair follicles are found mainly on the medial side.
  iii. Sweat glands are distributed mainly on the lateral side.
  iv. Sebaceous glands are found mainly on the middle side.
- Subcutaneous tissue:
  i. The superficial fascia separates this tissue into 2 layers.
ii. The superficial layer is attached to the skin and forms cellular structure.
iii. The deep layer is a fatty space which continues to the lumbar region superiorly (massa adiposa lumboglutealae).
iv. It contains branches of the superior and inferior gluteal arteries.

   Fascia (fascia glutea):
   i. It covers the underlying muscles and divides them into 3 layers:
   a) 1st layer (1.5 muscles):
      - 1/2 layer of the gluteus maximus muscle (covers the inferior part of the posterior side of the iliac crest to the greater trochanter)
      - 1/2 layer of the gluteus medius muscle (covers the iliac crest posteriorly)
   b) 2nd layer (4.5 muscles):
      - 1/2 layer of the gluteus medius muscle
      - Full layer of the superior and inferior gluteus muscles, piriformis muscle, obturator internus muscle and quadratus femoris muscle
   c) 3rd layer (2 muscles):
      - Full layer of the gluteus minimus and obturator externus muscles

C) Localization of neurovascular bundles:
   - The sacrotuberosus and sacrospinous ligaments form the greater and lesser sciatic foramina.
   - The greater sciatic foramen is divided into the supra- and infrapiriform foramina by the piriformis muscle. The main neurovascular bundles lie in these 2 spaces.

   i. Suprapiriform foramen (foramen suprapiriforme):
      - The superior gluteal artery, veins and nerve pass through this foramen.
      - They supply the muscles of the deep layer (2nd and 3rd).

   ii. Infrapiriform foramen (foramen infrapiriforme):
      - There are 3 neurovascular bundles in this foramen.
      - The 1st bundle consists of the sciatic nerve and arteria comitans nervi ischiadicci.
      - The 2nd bundle consists of the inferior gluteal artery, inferior gluteal vein and inferior gluteal nerve.
      - The 3rd bundle consists of the internal pudendal artery, internal pudendal vein and pudendal nerve.

D) Projection of the neurovascular bundles:
   - Superior gluteal artery:
      - It passes through the line between the superior and middle 1/3 from the posterior superior iliac spine to the greater trochanter.
ii. It is divided into branches, which are the superior and deep branches at the level of the greater sciatic foramen and lie on the periosteum of the wing of the ilium.
iii. The short branches run to the piriformis muscle and form an anastomosis with the inferior gluteal artery.
iv. The superficial branch is divided on the medial surface of the gluteus maximus muscle.
v. The deep branch goes to the space between the gluteus medius and minimus muscles.

Inferior gluteal artery:
i. It runs from the posterior superior iliac spine downwards and laterally to the medial margin of the ischial tuberosity.
ii. It is surrounded by the inferior gluteal veins and nerve.
iii. Around the infraspinous foramen, the sciatic nerve lies lateral to these bundles (artery, veins and nerve) while the pudendal vascular bundles lie medial to them.
iv. Later these neurovascular bundles penetrate to the fascia and gluteus maximus muscle.

Pudendal neurovascular bundles:
i. They consist of the internal pudendal artery, veins and pudendal nerve.
ii. They pass through the infraspinous foramen medially.
iii. Around the infraspinous foramen, these bundles lie between the sacrotuberous ligament and ischial bone, which form the superior margin of the lesser sciatic foramen.
iv. Then these bundles pass through the lesser sciatic foramen inferiorly to the sacrotuberous ligament on the medial surface of the ischial tuberosity.
v. The sacrotuberous ligament covers the obturator internus muscle and fascia. This fascia forms the pudendal (Alcock's) canal, where the pudendal neurovascular bundles pass through.
vi. The pudendal nerve passes downwards and medially from the vessels.

Sciatic nerve:
i. It is situated laterally in the infraspinous foramen.
ii. The posterior cutaneous nerve of the thigh (nervus cutaneus femoris posterior), sciatic artery and arteria comitans nervi ischiadici pass medial to the sciatic nerve.
iii. In the lower margin of the gluteus maximus muscle, this nerve is located superficially and is covered by the fascia lata only.
iv. Anesthesia of the sciatic nerve is located on the middle point between the medial margin of the ischial tuberosity and greater trochanter of the femur.

TOPOGRAPHY OF THE HIP JOINT (ARTICULATIO COXAE)
The hip joint is the articulation between the acetabulum (os coxae) and head of the femur.
It is a simple, ball and socket and multiaxial joint; it is reinforced by:
i. Intracapsular ligaments:
   - Ligamentum capitis femoris
   - Ligamentum transversum acetabulae

ii. Extracapsular ligaments:
   - Iliofemoral ligament (Bigelow’s Y ligament)
   - Pubofemoral ligament
   - Ischiofemoral
   - Zona orbicularis

The acetabular labrum increases the size of the articular surface. The largest lymph node in this region is the Pirogov-Rosenmüller’s node.

Weak places of the joint capsule:
   i. Anterior weak place of this capsule is located between the iliofemoral ligament and pubofemoral ligament.
   ii. Posterior weak place of this capsule is located under the inferior margin of the ischiofemoral ligament, from the ischial tuberosity and acetabulum to the trochanteric fossa. The obturator externus muscle is located here.

Purulent processes of the para-articular space may spread to fasciae of the adjacent muscles through these weak places.

Purulent process of the joint capsule may spread to:
   i. Anterior direction:
      - To the medial compartment of the thigh, through the space between the pubic bone and pectineus muscle from the medial margin of the iliopsoas muscle.
      - To the suprapatellar bursa from the lateral margin of the iliopsoas muscle (pus sometimes passes between rectus femoris and vastus intermedius muscles).
      - To the adductor canal (canalis adductorius) along the femoral vessels (it is more threatening).

   ii. Posterior direction:
      - To the posterior direction under the gluteus maximus muscle through the fissure between the quadratus femoris and inferior gemellus muscles.
      - To the gluteal region along the obturator internus muscle, medial circumflex artery and veins under the gluteus maximus muscle.
      - To the gluteal region and fissure between the gluteus medius and minimus muscles along the lateral circumflex artery and veins, from the space between the sartorius and rectus femoris muscles or from the tensor fasciae latae muscle.

   iii. Other directions:
      - To the lesser pelvis from the lateral surface of the obturator externus muscle along the obturator artery, veins and nerve through the obturator canal.
      - To the medial side of the thigh through the postero-inferior weak place of the hip joint along the fascia of the obturator internus muscle (where the adductor muscle is located here). From here, pus may penetrate to the lesser pelvis along the obturator canal.
To the posterior thigh and lateral margin of the greater trochanter of the femur (it penetrates to the anterior surface of the thigh and fascia of the gluteus maximus muscle).

TOPOGRAPHY OF THE ANTERIOR AND POSTERIOR FEMORAL (THIGH) REGIONS (REGIONES FEMORIS ANTERIOR ET POSTERIOR)

A) Borders:
   - Anterior – Pubic symphysis, inguinal ligament, anterior superior iliac spine, imaginary line between the anterior superior iliac spine and greater trochanter
   - Posterior – Gluteal fold, fold between the perineal side fold and medial side of the thigh to the pubic symphysis
   - Inferior – Circular line drawn at the level of 2 fingers above the patella
   - Lateral – 2 vertical lines drawn till the lateral and medial epicondyles

B) Layers:
   - Skin:
     i. It is thick and movable.
     ii. There are more hair follicles and sweat glands in males.

   - Subcutaneous space:
     i. It contains the superficial epigastric artery, external pudendal artery, superficial circumflex iliac artery and veins of the same name.
     ii. The great saphenous vein passes to the medial side of the whole lower extremity and enters the femoral vein through the saphenous opening (fossa ovale).

   - Muscles:
     i. Anterior compartment of the thigh contains the quadriceps femoris, sartorius and pectineus muscles; also known as the extensor compartment of the thigh.
     ii. Posterior compartment of the thigh contains the sciatic nerve, semimembranosus, semitendinosus and biceps femoris muscles; also known as the hamstring compartment.
     iii. Medial compartment of the thigh contains the adductor magnus, adductor longus, adductor brevis and gracilis muscles.

FEMORAL (SCARPA’S) TRIANGLE (TRIGONUM FEMORALE)

   It is a musculofascial triangle on the anterior region of the thigh.

Borders:
   1. Superior: Inguinal ligament
   2. Medial: Medial edge of the adductor longus muscle
   3. Lateral: Sartorius muscle

The femoral triangle contains the femoral artery, vein and nerve. The vascular bundle projection of the femoral artery and vein is from the midpoint of the inguinal ligament to the medial epicondyle of the femur (Ken’s line).

The floor of this triangle is formed by the pectineus and iliopsoas muscles. Between the pectineus and iliopsoas muscles, sulus illopectineus, femoral artery and veins are lodged in this sulus.
NEUROVASCULAR BUNDLES OF THE FEMORAL TRIANGLE

A) Femoral artery (arteria femoralis):
   - It passes from the midpoint of the inguinal ligament to the femoral triangle. Compression of the midpoint of the inguinal ligament can thus stop bleeding from this artery.
   - It is covered anteriorly by the fascia cribrosa of the saphenous opening. This artery is situated lateral to the femoral vein.

B) Femoral nerve (nervus femoralis):
   - It is situated lateral to the femoral artery and separated by the iliopsoas muscle.
   - Superficial branches of this nerve perforate the fascia lata through the sheath of the sartorius muscle and innervate the skin (rami cutanei anteriores).
   - Deep branches of this nerve intersect with the lateral circumflex femoral artery and innervate the quadriceps femoris tendon and pectineus muscle.

C) Deep femoral artery (arteria profunda femoris):
   - It has 2 branches called the medial circumflex femoral artery (arteria circumflexa femoris medialis) and lateral circumflex femoral artery (arteria circumflexa femoris lateralis).

D) Medial circumflex femoral artery (arteria circumflexa femoris medialis):
   - It passes posteromedial to the femoral artery and vein. It is divided into superficial and deep branches on the medial margin of the iliopsoas muscle.
   - Superficial branch (ramus superficialis arteriae circumflexae femoris medialis) passes to the gracilis muscle.
   - Deep branch (ramus profunda arteriae circumflexae femoris medialis) penetrates the space between the pectineus and obturator externus muscles. It is then divided into the ascending and descending branches, which pass to the posterior surface of the thigh.
   - The ascending branch enters the gluteal region in the space between the obturator externus and quadratus femoris muscles. It anastomoses with the gluteal arteries.
   - The descending branch enters the space between the obturator externus and adductor minimus muscles. It anastomoses with perforating branches of the deep artery of the thigh and obturator artery.

E) Lateral circumflex femoral artery (arteria circumflexa femoris lateralis):
   - It is divided into the ascending and descending branches.
   - The ascending branch (ramus ascendens arteriae circumflexae femoris lateralis) passes to the space between the sartorius and rectus femoris muscles; and ascends to the space between the iliopsoas and gluteus medius muscles. Its branches anastomose with the superior gluteal artery to form an arterial network on the greater trochanter of the femur (rete trochanterica).
   - The descending branch (ramus descendens arteriae circumflexae femoris lateralis) passes under the rectus femoris muscle. It passes between the rectus femoris and vastus intermedius muscles and to the arterial network of the knee joint, where it anastomoses with the branches of the popliteal artery (arteria poplitea).
Dissection for ligating arteries:
1 – Iliac artery, 2-3 – Femoral artery, 4-5 – Tibial artery

**PROJECTION LINES OF THE VEESSELS**

A) Femoral artery (*arteria femoralis*):
   It passes from the midpoint between the pubic symphysis and anterior superior iliac spine to the *tuberculum adductorium femoris* (Ken’s line).

B) Posterior tibial artery (*arteria tibialis posterior*):
   It passes from the point, 1 cm posterior to the medial margin of the medial epicondyle of tibia, to the midpoint between the Achilles tendon and medial malleolus.

C) Anterior tibial artery (*arteria tibialis anterior*):
   It passes from the midpoint between the head of the fibula and tibial tuberosity to the midpoint between the medial and lateral malleoli.
ACCESS TO THE VESSELS

A) Femoral artery:
   An incision 10 – 12 cm in length is made from the midpoint of the inguinal ligament, 1 – 2 cm above it along the projection line.

B) Popliteal artery:
   A vertical incision 10 – 12 cm in length is made to the midpoint of the popliteal fossa. (The incision is deviated slightly medially from the midline to prevent damage of the small saphenous vein.)

C) Posterior tibial artery:
   Access to the posterior tibial artery on the superior 1/3 of the leg: A vertical incision 10 – 12 cm in length is made from the midpoint of the popliteal fossa downwards.
   Access to the posterior tibial artery on the middle 1/3 of the leg: An incision 10 – 12 cm in length is made from the medial margin of the tibia along the projection line downwards.

D) Anterior tibial artery:
   Access to the middle 1/3 of the leg: An incision 8 – 10 cm in length is made along the projection line.

SUBINGUINAL SPACE
   It consists of 2 lacunae divided by the arcus iliopsectineus.
   The lacuna vasorum is located medially in this space while lacuna musculorum laterally.

   Borders of the lacuna vasorum:
   i. Superoanterior: Inguinal (Poupart’s) ligament
   ii. Medial: Lacunar (Gimbernat’s) ligament
   iii. Lateral: Arcus iliopsectineus
   iv. Posterior: Pectineal (Cooper’s) ligament

   The lacuna vasorum contains the femoral ring which forms a femoral canal in herniation.

   Borders of the lacuna musculorum:
   i. Superoanterior – Inguinal ligament
   ii. Medial – Arcus iliopsectineus
   iii. Posterior – Iliac bone

   The lacuna musculorum contains the iliopectineus (Hyrts’l’s) muscle and femoral nerve.

FEMORAL RING (ANNULUS FEMORALIS)
   It is the opening into the femoral canal.

   Borders:
   i. Anterior: Inguinal ligament
   ii. Posterior: Pectineal ligament
   iii. Medial: Lacunar ligament
   iv. Lateral: Femoral vein
If a femoral hernia develops, the herniated gut will form the femoral ring.

**FEMORAL CANAL (CANALIS FEMORALIS)**

- Femoral canal has a pyramidal shape. Its borders are:
  1. Anterior: Superficial layer of the fascia lata
  2. Posterior: Deep layer of the fascia lata
  3. Lateral: Fascia on the femoral vein

  Femoral canal will only exist when the femoral hernia occurs. This is a pathological canal.

- The loose connective tissue (*septum femorale*) is situated between the femoral vein and lacunar ligament. Femoral hernias thus tend to occur here. They occur more frequently in females because the femoral ring is wider due to their broader pelvis.

  This canal has 2 rings, which are the superficial and deep femoral rings:
  1. Superficial ring: Saphenous opening (*fossa ovale* or *hiatus saphenus*) or falciform margin of the fascia lata with cornu superior and inferior
  2. Deep ring: *Annulus femoralis profundus*

  Superficially the saphenous opening is covered by the *fascia cribrosa*.

- Anomaly of the obturator artery: In the deep femoral ring, the obturator artery (branch of the inferior epigastric artery or the internal iliac artery) may be found in case of anomaly. This vessel may pass to the pelvic opening of the obturator canal.

  In this case, an arterial anastomosis is formed around the deep femoral ring with the obturator artery, which is known as *corona mortis*. Removal of this ring (herniotomy) in strangulation of the femoral hernia was carried out in former times and caused death due to severe bleeding after cutting this vessel.

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Femoral canal:

- **a** – *Arcus iliopectineus*, **b** – Femoral artery, **c** – Femoral vein, **d** – *Annulus femoralis*, **e** – Lacunar ligament, **f** – *Fibrae intercrurales*, **g** – Saphenous opening, **h** – Great saphenous vein, **i** – *Cornu inferius*, **j** – *Margo falciformis*, **k** – *Cornu superior*, **l** – *Fascia cribrosa*, **m** – *Fascia lata*, **n** – Inguinal ligament, **o** – Iliopsoas muscle
ADDUCTOR CANAL
(SUBARTORIAL CANAL, HUNTER’S CANAL, CANALIS ADDUCTORIUS)
- It is a musculofascial canal that contains a large neurovascular bundle of the anterior thigh.
- Borders:
  i. Lateral: Vastus medialis muscle
  ii. Medial: Adductor magnus muscle
  iii. Anterior: Lamina vastoadductoria located between the vastus medialis and adductor magnus muscles
- The sartorius muscle, superficial and adductor longus muscles cover this canal.
- It begins proximally at the inferior angle of the femoral triangle and ends distally at the adductor hiatus.
- The adductor canal contains 3 foramina:
  i. Superior foramen: Femoral artery and vein pass here and are bounded by the superior margin of the lamina.
  ii. Inferior foramen: Popliteal artery and vein pass here (hiatus adductoris).
  iii. Anterior foramen: Saphenous nerve and arteria et vena genus descendens pass to the lamina vasoadductoria.

TOPOGRAPHY OF THE KNEE (REGIO GENUS)
- Circular line drawn with 2 fingers’ width above and below the patella; 2 vertical lines drawn from the epicondyles dividing the knee region into the anterior and posterior (popliteal) knee regions

TOPOGRAPHY OF THE ANTERIOR REGION OF THE KNEE
(REGIO GENUS ANTERIOR)
A) Landmarks:
- Patella
- Tendon of the quadriceps femoris
- Patellar ligament
- Plicae alares (folds of fatty tissue on 2 sides above the patella)
- Head of the fibula
- Gerdy’s tubercle (insertion of the iliobibial tract)
- Lateral condyle of the femur

B) Borders:
- Superior: Circular line drawn 6 cm above the patella
- Inferior: Circular line drawn at the level of the tibial tuberosity
- Medial: Line drawn through the posterior margin of the medial epicondyle of the femur
- Lateral: Line drawn through the posterior margin of the lateral epicondyle of the femur

C) Layers:
- Skin:
i. It is rough, movable, full of folds and contains sweat and sebaceous glands.

Subcutaneous tissue:

i. It contains less fat.

ii. The great saphenous vein, saphenous nerves and its infrapatellar branches pass here.

iii. There are several bursae in this layer, which are the bursa prepattellaris subcutanea, bursa infrapatellaris subcutanea and bursa tuberositas tibii.

iv. There is no superficial fascia.

Fascia:

i. On the anterior surface of the knee joint, it passes from the patella and tendon of the quadriceps femoris muscle to the retinaculum patellae mediale (which is fixed to the margo infraglenoidalis tibiae) and retinaculum patellae laterale (which is fixed to the Gerdy's tuberecle).

ii. There are several bursae under this fascia, which are the bursa prepattellaris subfacialis, bursa prepattellaris subtendinea, bursa infrapatellaris profunda and bursa suprapatellaris.

iii. The bursa prepattellaris subfacialis and bursa prepattellaris subtendinea are located on the anterior surface of the patella. The bursa suprapatellaris is located under the tendon of the quadriceps femoris muscle.

iv. The bursae serve the following functions:
   - Antishock
   - Protective function
   - Lubricating function
   - Circulating function

v. Rete articulare genus is located on the anterior surface of the knee joint under this fascia. It is an arterial network which is part of the descending genicular artery.

vi. Rete patellaris is also located in the fascia of the patellar region.

TOPOGRAPHY OF THE POPLITEAL REGION (REGIO GENUS POSTERIOR)

A) Landmarks:

   On the posterior surface during flexion of the leg on the knee joint, semitendinosus and semimembranosus muscles are palpated medially and superiorly; tendon of the biceps femoris muscle is also palpated superiorly and laterally.

B) Borders:

   Superior: Circular line drawn 6 cm above the patella
   Inferior: Circular line drawn at the level of the tibial tuberosity
   Medial: Line drawn through the posterior margin of the medial epicondyle of the femur
   Lateral: Line drawn through the posterior margin of the lateral epicondyle of the femur

C) Layers:

   Skin:
i. It is thin and forms folds during flexion.

Subcutaneous tissue:

i. It contains lymph nodes (superficial popliteal nodes).

ii. It contains the saphenous nerve, lateral sural cutaneous nerve and posterior cutaneous nerve of the thigh.

Superficial fascia

Deep fascia (fascia poplitea):

i. It is a continuation of the fascia lata.

ii. It serves as an aponeurosis covering the muscles.

iii. When this fascia is tensed, pulse from the popliteal artery is felt.

iv. When this fascia is removed, the popliteal fossa is revealed.

NEUROVASCULAR BUNDLES

A) Tibial nerve (nervus tibialis):

It descends directly through the middle of the popliteal fossa along the popliteal vessels and enters the canalis cruropopliteus. It passes downward along with the posterior tibial artery and veins till it reaches the medial malleolus.

After passing through the medial malleolus, the tibial nerve is divided into the lateral and medial plantar nerves. In the popliteal fossa, the tibial nerve gives rise to the medial sural cutaneous nerve which innervates the skin of the posteromedial surface of the leg.

On the leg, the tibial nerve supplies 3 deep muscles (posterior tibial, flexor hallucis longus and flexor digitorum longus muscles).

Posterior to the medial malleolous, the tibial nerve gives rise to the cutaneous branches (rami calcanei mediales).

B) Popliteal artery (arteria poplitea):

It gives off branches around the knee joint, which are the superior medial genicular, superior lateral genicular, middle genicular, inferior medial genicular and inferior lateral genicular arteries.

The superior medial genicular artery passes under the semimembranosus tendon and tendon of the adductor magnus muscle to the superior condyle of the femur.

The superior lateral genicular artery passes under the tendon of the biceps femoris muscle along the knee joint to the superior margin of the lateral condyle of the femur.

The middle genicular artery (unpaired) branches out from the popliteal artery at the level of the fissure of the knee joint and reaches the cruciate ligaments.

The inferior medial genicular artery passes under the medial collateral ligament and the femur. Then it passes under the tibial collateral ligament, tendons of the gracilis, sartorius and semitendinosus muscles, and medial head of the gastrocnemius muscle.

The inferior lateral genicular artery passes to the lateral meniscus. Then it passes under the fibular collateral ligament. It is covered by the gastrocnemius muscle.

4 compartments of the popliteal artery are distinguished (around the knee joint):

i. The 1st compartment lies in the space between the semimembranosus and vastus medius muscles. The tibial nerve is located 1 – 2 cm lateral to the popliteal artery.
ii. The 2nd compartment lies in the space between the semimembranosus and gastrocnemius muscles. It gives rise to the arteries of the knee joint and muscles.

iii. The 3rd compartment lies on the oblique popliteal ligament (ligamentum popliteum obliquum). It gives off branches to the muscles.

iv. The 4th compartment is bounded anteriorly by the space between the inferior margin of the popliteus muscle and posterior tibial muscle; posteriorly by the tendinous arch of the soleus muscle.

**SPREADING OF THE PHLEGMON**

- The fatty space of the popliteal fossa communicates with the superior compartment of the thigh and space under the gluteus maximus muscle along the sciatic nerve.
- It communicates with the adductor's canal and femoral triangle along the femoral artery and vein.
- It also communicates with the deep space of the posterior region of the knee along the popliteal vessels and tibial nerve.

![Diagram of the lower extremity showing dissection areas](image_url)

Scheme of dissection for phlegmon of the lower extremity:

- a – Dissection on the anterior surface of the thigh: 1 – Opening into the compartment of the adductor muscles, 2, 4 – Opening into the compartment of the extensors muscles, 3 – Opening of the sheath of the sartorius muscle, 5 – Opening of the sheath of the iliopsoas muscle.
- b – Dissection on the posterior surface of the thigh: 1, 3 – Opening into the compartments of the flexor muscles, 2, 4 – Opening into the compartment of the extensors, 5 – Opening into the compartment of the adductor muscles.
- c – Dissection for opening of the anterior muscular compartment of the foot.
- d – Dissection for opening of the posterior muscular compartment of the foot.
- e – Dissection lines for opening of deep phlegmon of the sole.

**POPLITEAL FOssa (FOSSA POPLITEA)**

- It is a shallow depression on the posterior surface of the knee.

Borders:

i. Superomedial: Tendons of the semimembranosus and semitendinosus muscles

ii. Superolateral: Tendon of the biceps femoris muscle

iii. Inferior: Medial and lateral heads of the gastrocnemius muscle

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84
Its floor consists of the popliteus muscle (constant) and plantaris muscle (inconstant). This fossa contains the fatty tissue in which the deep lymph nodes are lodged. The neurovascular bundles from the superficial to deep are as follows: tibial nerve (from the sciatic nerve and passes straight down into the popliteal fossa), popliteal vein and popliteal artery.

KNEE JOINT (*ARTICULATIO GENUS*)

It is the articulation between the medial and lateral condyles of the femur with the medial and lateral articular facets of the tibia.

It is a scondylar and biaxial joint reinforced by the intracapsular ligaments and extracapsular ligaments:

A) Intracapsular ligaments:
   i. Anterior cruciate ligament – from the lateral condyle to the anterior intercondylar area
   ii. Posterior cruciate ligament – from the medial condyle to the posterior intercondylar area
   iii. Transverse ligament of the knee – between menisci

B) Extracapsular ligaments:
   i. Medial – Tibial collateral ligament
   ii. Lateral – Fibular collateral ligament
   iii. Anterior – Patellar ligament and tendon of the quadriceps femoris muscle
   iv. Posterior – Oblique popliteal ligament and arcuate popliteal ligament

   Medial ("c" shaped) and lateral ("o" shaped) menisci are contained within the joint capsule.

ARTERIAL NETWORK OF THE KNEE JOINT

The following 3 groups of the arteries participate in the formation of the genicular anastomosis around the knee joint:

- Descending genicular artery (branch of the femoral artery)
- Superior medial genicular, superior lateral genicular, inferior medial genicular, inferior lateral genicular, middle genicular arteries (branches of the popliteal artery)
- Anterior tibial recurrent artery, posterior tibial recurrent artery, circumflex fibular branch (branches of the anterior tibial artery)

TOPOGRAPHY OF THE LEG (*REGIO CRURIS*)

It is bounded by the lower border of the region of the knee joint superiorly; a circular line is drawn through the lateral and medial *malleoli* inferiorly.

The leg is divided into the anterior and posterior regions of the leg.

TOPOGRAPHY OF THE ANTERIOR REGION OF THE LEG (*REGIO CRURIS ANTERIOR*)

A) Borders:
   - Medial: Lateral margin of the leg
   - Lateral: Sulcus between the soleus and fibular muscles
B) Layers:

Skin:
- It is thinner on the tibia than other regions.

Subcutaneous tissue:
- It contains branches of the small saphenous vein, lateral sural cutaneous nerve and superficial fibular (peroneal) nerve laterally.
- It contains the great saphenous vein and saphenous nerve medially.

Fascia:
- It is similar to the aponeurosis and covers the extensor muscles of the leg and fibular muscles.
- It stretches from the periosteum of the anterior surface of the tibia and is attached to the anterior and posterior intermuscular septa and to the fibula.
- Anterior intermuscular septum is attached to the anterior margin of the fibula and divides muscles of the leg into the anterior and lateral compartments.
- Posterior intermuscular septum is attached to the posterior margin of the fibula and divides muscles of the leg into the lateral and posterior compartments.

Muscles and neurovascular bundles:
- Anterior compartment:
  - Tibialis anterior muscle
  - Extensor hallucis longus muscle
  - Extensor digitorum longus muscle
  - Fibularis (peroneus) tertius muscle
  - Anterior tibial artery and veins
  - Deep fibular (peroneal) nerve
- Lateral compartment:
  - Fibularis (peroneus) longus muscle
  - Fibularis (peroneus) brevis muscle
  - Superficial fibular (peroneal) nerve

Cross section of the leg:
1 - Tibialis posterior muscle, 2 - Flexor digitorum longus muscle, 3 - Flexor hallucis longus muscle, 4 - Tibialis anterior muscle, 5 - Extensor hallucis longus muscle, 6 - Extensor digitorum longus muscle, 7 - Peroneus longus muscle, 8 - Peroneus brevis muscle, 9 - Soleus muscle, 10 - Lateral head of the gastrocnemius muscle, 11 - Plantaris muscle, 12 - Medial head of the gastrocnemius muscle; a - Transverse intermuscular septum, b - Deep fascia of the leg, c - Interosseous membrane, d - Anterior intermuscular septum, e - Posterior intermuscular septum, f - Deep fascia of the leg
**CANALIS MUSCULOPERONEUS SUPERIOR**

It is located between the portions of the fibularis (peroneus) longus muscle and fibula. It stretches from the lateral condyle of the femur to the head of the fibula. The common fibular (peroneal) nerve passes through this canal and divides it into the superficial and deep fibular (peroneal) nerves.

**CANALIS MUSCULOPERONEUS INFERIOR**

- **Borders:**
  - i. Anterior: Tibialis posterior muscle
  - ii. Posterior: Flexor hallucis longus muscle
  - iii. Medial: Fibula
  - iv. Superior - peroneus longus muscle
  - v. Inferior - peroneus brevis muscle

- **Contents:** Fibular artery and its vein

**TOPOGRAPHY OF THE POSTERIOR REGION OF THE LEG**

**(REGIO CRURIS POSTERIOR)**

**A) Borders:**

- Medial: Vertical line passing through the medial condyle of the tibia
- Lateral: Vertical line passing through the lateral condyle of the tibia

**B) Layers:**

- **Skin:**
  - i. It is thin and may easily form skin folds.
  - ii. It is innervated by the saphenous nerve.

- **Subcutaneous tissue:**
  - i. The small saphenous vein, medial sural cutaneous nerve and lateral sural cutaneous nerve pass through this layer.

- **Fascia:**
  - i. It is divided into 2 layers, which are the superficial and deep layers.
  - ii. Superficial fascia covers the triceps surae muscle (soleus muscle and gastrocnemius muscle).
  - iii. Deep fascia (transverse intermuscular septum) covers the deep flexor muscles extensor muscles, which are located in the deep space of the posterior fascial compartment of the knee. This space is bounded anteriorly by the tibia, fibula and interosseous membrane.

- **Muscles:**
  - i. Superficial posterior compartment:
    - Triceps surae muscle (soleus muscle and gastrocnemius muscle)
    - Plantaris tendon
  - ii. Deep posterior compartment:
    - Flexor digitorum longus muscle
    - Tibialis posterior muscle
- Flexor hallucis longus muscle
- Popliteus muscle
- Posterior tibial artery and veins
- Tibial nerve
- Fibular (peroneal) artery and veins

**NEUROVASCULAR BUNDLES**

A) Posterior tibial artery:

A line is drawn from the point between the heads of the gastrocnemius muscle to the medial margin of the Achilles (calcaneal) tendon. The initial part of the posterior tibial artery is covered by the superior margin of the soleus muscle which passes above the tendinous arch of the soleus muscle.

It passes to the malleolar canal and space between the tendons of the flexor digitorum longus and flexor hallucis longus muscles.

It is divided into the medial and lateral plantar arteries in the sulcus of the medial margin of the calcaneus. The medial and lateral plantar arteries pass along with the medial and lateral plantar nerves.

The medial plantar artery, vein and nerve pass to the junction of the fasciae of the median and medial parts. These neurovascular bundles give off branches to the muscles of both parts (median and medial parts) and also give rise to the superficial and deep branches.

The lateral plantar artery passes between the tendons of the flexor digitorum brevis and quadratus plantae muscles.

The medial plantar nerve innervates the muscles of the great toe, flexor digitorum brevis muscle, 2 medial lumbrical muscles and gives rise to nervi digitales plantares propriae. These nerves pass to the skin of the 1st, 2nd, 3rd and medial margin of the 4th toes.

The lateral plantar nerve innervates the muscle of the little toe, adductor hallucis muscle, quadratus plantae muscle, 2 lateral lumbrical muscles and all interosseous muscles. This nerve gives rise to nervi digitales plantares propriae, which pass to the little toe and lateral margin of the 4th finger.

B) Anterior tibial artery:

A line is drawn from the point between the head of the fibula and tibial tuberosity to the point between the malleoli.

This artery passes to the anterior compartment through the opening of the interosseous membrane and is situated at the medial margin of the fibula 4 – 5 cm under the head of the fibula.

It gives off arteria recurrents tibialis anterior and forms an anastomosis with arteria genus descendens and arteria genus inferior medialis. Then it gives off the anterior medial malleolar artery and anterior lateral malleolar artery.

C) Fibular artery:

The initial part of this vessel is situated on the posterior surface of the tibialis posterior muscle along the lateral margin of the tibial nerve.
D) Deep peroneal nerve:
- It is located lateral to the vessels on the knee, then penetrates the anterior intermuscular septum and lies lateral to the vessels at first, then crosses anterior to the vessels at the level of the middle point of the malleoli and passes medial to the vessels of the 1st interdigital space.
- At the level of the intermalleolar line, this nerve gives off a motor branch to the extensor digitorum brevis muscle. It passes (motor branch) with the lateral tarsal artery.

E) Dorsalis pedis artery:
- This artery is projected from the middle point of the malleolus to the 1st interdigital space.
- Then it lies between the fascial coverings of the tendons of the extensor digitorum muscles and fascia interossea.
- Before entering the 1st intermetatarsal space (межплюсневый промежуток), this artery gives rise to the arcuate artery. The arcuate artery gives rise to arteriae metatarsae dorsales, from which arteriae digitales dorsales branch off.

**CANALIS CRUROPOPPLITEUS**
- It is bounded anteriorly by the tibialis posterior muscle posteriorly by deep layer of the fascia of the leg and soleus muscle, laterally by the flexor hallucis longus and medially by the flexor digitorum longus muscle.
- The entrance of this canal is bounded anteriorly by the popliteus muscle and posteriorly by the tendinous arch of the soleus muscle.
- There are 2 exits of this canal which are the superior, anterior and inferior openings.
- The anterior tibial artery penetrates the anterior compartment of the leg through the anterior opening in the interosseus membrane.
- The inferior opening is formed by the tibialis posterior muscle anteriorly and Achilles tendon.
- The posterior tibial artery, posterior tibial vein and tibial nerve pass to the medial malleolar canal through the inferior opening.

**ANKLE JOINT (ARTICULATIO TALOCRURALIS)**
- It is the articulation between the distal tibia, medial malleolus of the tibia, lateral malleolus of the fibula and talus.
- It is a synovial hinge joint; the ankle is reinforced by
  i. Deltoid (medial) ligament (consists of anterior tibiotalar, tibiocalcaneal, tibiocalcaneal and posterior tibiotalar parts)
  ii. Collateral (lateral) ligament (consists of anterior talofibular ligament, calcaneofibular ligament and posterior talofibular ligament)
- Due to the shape of the talus, the ankle is most stable when the foot is dorsiflexed; the ankle is often injured when the foot is plantar flexed.
- This lateral surface of the joint is innervated by the sural nerve; medial surface by the saphenous nerve; anterior surface by the deep fibular nerve.
- This joint is supplied by 3 arteries, which are the anterior tibial, posterior tibial and fibular arteries.
In arthritis, pus may accumulate on the anterior surface of the ankle joint.

TOPOGRAPHY OF THE FOOT (REGIO PEDIS)

- The region of the foot is divided into the plantar and dorsal regions.
- A line is drawn from the middle point of the calcaneus to the head of the 5th metatarsal bone.

Borders:
- Medial: Middle point of the calcaneus to the head of the 1st metatarsal bone
- Lateral: Middle point of the calcaneus to the head of the 5th metatarsal bone
- The toes are divided into the plantar and dorsal surfaces by the U-shaped (arch-like) lines.

TOPOGRAPHY OF THE PLANTAR REGION OF THE FOOT (REGIO PLANTAE PEDIS)

Layers:
A) Skin:
- It is thick, especially on the tuberosity of the calcaneus and heads of the metatarsal bones.

B) Subcutaneous tissue:
- It contains the common plantar digital arteries and nerves (arteriae et. nervi digitales plantares communes), cutaneous branches of the medial plantar arteries and nerves, cutaneous branches of the lateral plantar arteries and nerves.

C) Proper fascia:
- In the middle part of the sole, this fascia represents the plantar aponeurosis (plantaris aponeurosis). The plantar aponeurosis is especially dense in the sole, where the fibres of the flexor digitorum brevis muscle begin.
- In the median part of the sole, these superficial and deep fatty spaces are distinguished. The superficial fatty spaces are situated between the tendons of the flexor digitorum longus and flexor digitorum brevis muscles. The deep fatty space is situated between the flexor digitorum longus tendon and flexor digitorum brevis muscle.
- The median part of the sole communicates with:
  i. Subfacial space of the dorsal part of the foot by means of dorsalis pedis artery and lateral plantar artery.
  ii. Interdigital fatty spaces and dorsal surface of the toes along the lubrical muscles.
  iii. Subcutaneous fatty tissue of the sole along the plantar metatarsal arteries and proper plantar digital arteries.
  iv. Medial part of the sole along the tendon of the flexor hallucis longus muscle.
  v. Lateral part of the sole along the tendon of the flexor digiti minimi muscle and lateral plantar vessels.
Deep space of the posterior part of the knee along the tendon of flexor hallucis longus muscle and neurovascular bundle. The neurovascular bundle passes through the malleolar canal.

The medial part of the sole contains the abductor hallucis muscle, flexor hallucis brevis muscle and tendon of flexor hallucis longus muscle. Fibrous-septal canal (фиброзной перегородкой канали) is divided into the anterior and posterior parts. The flexor digitorum longus tendons pass to the anterior part. The quadratus plantae muscle is located in the posterior part.

The lateral part of the sole contains the abductor digit minimi and flexor digiti minimi brevis muscles.

TOPOGRAPHY OF THE DORSAL REGION OF THE FOOT
(REGIO DORSI PÆDIS)

Layers:

A. Skin:
   - It is thin and movable.

B. Subcutaneous tissue:
   - The fat is less developed here.
   - Edematous fluid tends to accumulate here.
   - It contains a vascular network known as rete venosum dorsale pedis which anastomoses with the dorsal venous arch (arcus venosus dorsalis pedis). They collect the blood from veins in the intermetatarsal spaces.
   - The dorsal venous arch is drained into the small saphenous vein which passes along the lateral margin of the foot; it is also drained into the great saphenous vein which passes along the anterior surface of the medial malleolus (in which venepuncture or venesection of this vein is carried out).

C. Superficial fascia:
   - It is less developed.
   - It contains the branches of the saphenous nerve.
   - It contains the branches of the sural nerve which innervate the skin of the lateral margin of the foot and little toe.
   - Between these nerves, there are several branches of the superficial fibular nerve. They are medial dorsal cutaneous, intermediate dorsal cutaneous and lateral dorsal cutaneous nerves.

D. Deep fascia:
   - It is a continuation of the fascia cruris.
   - The extensor hallucis brevis and extensor digitorum brevis muscles are situated under this fascia. It lies on the metatarsal bones and dorsal interosseous muscles.
   - If the fibularis tertius muscle (musculus peronei tertius) exists, its tendon is attached to the base of the 5th metatarsal bone.
OPERATIONS FOR VARICOSE VEINS OF THE LOWER EXTREMITY

The varicose dilation or varicose disease occurs as a result of valvular incompetence of the perforating veins of the lower limbs, which cause blood discharge from the profound venous system to the superficial one. Under normal condition, the valves of the perforating veins prevent from such discharge. The blood discharge into the superficial venous system produces an increase of the pressure and dilatation of the venous wall. The congestion of the venous blood causes inflammation in the venous wall and thus forms a thrombus – thrombophlebitis. These dystrophic processes progress with the formation of trophic ulcers.

The treatment of the varicose disease is to prevent the communication between the superficial and deep venous systems.

A) Indications:
   - Varicose disease
   - Trophic ulcer

B) Contraindication:
   - Thrombophlebitis

C) Aims:
   Elimination of the shunt from the deep venous system:
   i. Troyanov-Trendelenburg’s operation:
      - This operation is a preventive measure for the thromboembolism. An incision is made about 4 – 5 cm below the inguinal ligament and parallel to it. The great saphenous vein is found and double ligated near the place of emptying into the femoral vein.
      - The accessory veins, which drain the blood from the lateral and medial surfaces of the thigh, are ligated and cut. This operation is cosmetic but not radical and a radical operation is necessary in the future.

Ligature of the communicating veins:
   a – Line of dissection, b – Cockett’s method, c – Linton’s operation
ii. Linton's operation:
   - This method implies subfacial ligation of the communicant veins along the entire surface of the internal surface of the leg.

iii. Cockett's operation:
   - Cockett proposed to ligate the varicose vein through the puncture of the skin. The ligature is brought in and turned out after passing around the vein through the perforating one. Recanalization of the ligated veins is performed later.

Madelung's method: Removal of the varicose vein (great saphenous vein) of the thigh with subcutaneous tissue between the 2 ligatures (b,c). Removal of the varicose vein of the foot with deep fascia (d).

a - General view of Madelung's method.

Removal of the superficial varicose vein:

i. Madelung's operation:
   - Long dissection along the *vena saphena magna*

ii. Narrat's operation:
   - Multiple dissections for resection of the veins

iii. Babcock's operation:
   - Elimination of the vein by means of a probe

Elimination of the circulation and obliteration of the superficial veins:

i. Linser-Sicar's method: Multiple injections of sclerosants in small doses
THREE-STAGE AMPUTATION BY PIROGOV

A) Indications:
   Absolute indications:
   i. Gangrene
   ii. Compression and crushing
   iii. Burn (IV degree)

   Relative indications:
   i. Vascular disease of the limb
   ii. Diabetes mellitus
   iii. Thrombosis of the vessel

B) Amputation includes the following steps:
   The 1st step is dissection and retraction of the skin.
   The 2nd step is dissection of the superficial muscles.
   The 3rd step is dissection of the deep muscles.
Incision lines of the skin on the dorsal surface of the foot for amputation and disarticulation of the foot and toe:

- a – Pirogov’s method,
- b – Shopar’s method,
- c – Lisfranc’s method,
- d – Amputation of the metatarsal bones,
- e – Garanzho’s disarticulation of the toes

GRITTI-SHIMANOVSKY’S OSTEOPLASTIC AMPUTATION OF THE THIGH

A) Indications:
- Crushing of the leg without damage of the knee
- Vascular disease of the leg

B) Procedures:
- The patient is in dorsal decubitus.
- General anaesthesia is administered.
- A U-shaped incision is made on the anterior region of the knee. It starts 2 cm proximal to the lateral epicondyle of the femur and passes down, below and over the tibial tuberosity; then continues medially and terminates 2 cm above the medial epicondyle.
- The soft tissue is divided along the line; the proper patellar ligament is cut proximal to the tibial tuberosity.
- The posterior flap is cut at the level of the transverse fold in the popliteal fossa with slightly convex down. The flap is divided and pulled up; the soft tissues (muscles, vessels and nerves) are intersected at the level of the articular cleft.
- The synovial membrane of the knee joint in the anterior flap has to be removed.
- The soft tissues of the anterior and posterior flaps are retracted above the level of the epicondyles and the femur is dissected. All tissues are managed according to the general principles of amputations.
- The bone-saw lines of the femur and patella are attached to each other by the catgut sutures. The proper patellar ligament is connected with the tendons of the flexor muscles. The interrupted silk sutures are applied to the skin.
C) Advantages:
   The stump allows considerable weight bearing, and thus permits considerable independence without prosthesis (Pirogov’s amputation). Gritti-Shimanovsky’s operation is useful for some patients with ischaemic limbs who appear to have good perfusion below the knee but do not have a posterior flap of the skin. They are thus allowed to undergo below-knee amputation.

D) Disadvantages:
   The operation is complicated; necrosis of the tuber of the calcaneus occurs in some cases due to damage to the calcaneal vessels.

PIROGOV’S OSTEOPLASTIC AMPUTATION OF THE LEG
This is the amputation of the leg in the distal ⅓ part, for example through the ankle joint.

A) Indications:
   Gangrene
   Severe injury to the bone and soft tissue
   Tuberculosis

B) Procedures:
   The 1st incision is made from the inferior margin of the medial malleolus to the lateral malleolus on the dorsal surface of the foot.
   The 2nd incision is made from the inferior margin of the medial malleolus downwards to the sole and then upwards to the lateral malleolus. This incision is cut deeply until it reaches the calcaneus.
   The lateral ligaments are dissected through the opening of the 1st incision.
   The posterior part of the capsule of the ankle joint is cut after the foot is flexed.
   The calcaneus is sawn by an arc saw until the level of the 2nd incision.
   The damaged part of the foot is removed.
   Anterior tibial artery and veins are ligated on the anterior flap while the posterior tibial artery and veins are ligated on the inferior flap. The deep fibular nerve is then dissected.
The distal end of the foot is sawn horizontally. The lateral sharp edge of the fibula is smoothened by using a gouge.
- The calcaneus is sawn and triple catgut sutures are applied to the stump of the tibia.
- Tendons, ligaments and fasciae are stitched by triple catgut suture as well. The skin is stitched by silk suture.
- The plaster of paris is applied.

C) Pirogov’s amputation can be considered as the modification of Syme’s amputation. Its benefit compared with Syme’s amputation is that, after the amputation the patient can still have the same length of the leg.

![Diagram of Pirogov's osteoplastic amputation]

Pirogov’s osteoplastic amputation:
- a – Scheme of the operation, b – Incision lines of the skin and soft tissue

**AMPUTATION OF THE LEG BY LENGTH**

Amputation of the leg can be carried out at various levels. Pirogov’s and Syme’s methods are the amputation of the lower 1/3 of the leg. Amputation of the upper and middle 1/3 of the leg is also carried out.

A) Amputation of the upper 1/3 of the leg is carried out at the level of 5 – 7 inches below the knee joint:
- **Indications:** Gangrene, severe injury to the bone and soft tissue, tuberculosis
- **Procedures:**
  i. Incision of the skin with a larger anterior flap than the posterior flap is made (sometimes the same lateral length or a larger anterior flap is preferred).
  ii. The fibula is cut 2.5 cm shorter than the tibia (but usually it is totally removed) due to its fast rate of growth. The crest of the tibia is beveled.
  iii. It should be noted that the muscles of the posterior and anterolateral sides are large. When cutting through these muscles, they cannot be divided, except the *musculus gastrocnemius* and *musculus plantaris*.

B) Amputation of the middle 1/3 of the leg:
- Basically it is the same as the upper 1/3 except that the fibula is not removed. *Musculus tibialis anterior* is cut to cover the tibia. Other muscle groups are
retracted higher and the bone-saw line. The muscular bellies are slid gradually downward and forward to the line.

**SHARP'S AMPUTATION OF THE FOOT**

It is a transmetatarsal amputation.

A) Indications:
- Ischemic gangrene associated with diabetes mellitus
- Arteriosclerosis with a well-demarcated line
- Infection

B) Procedures:
- An incision of the skin with a larger plantar flap than the dorsal flap is made.
- The periosteum is cut 1 – 2 mm.
- The metatarsal bones are sawn.
- The ends of the bones are polished to prevent damage to the soft tissue.
- The flaps are sutured.

C) If only 1 toe is involved (usually 1st or 5th), we can consider using Garanzho’s method.

![Sharp's amputation of the foot:](image)

a – Dissection line of the skin (same dissection line for Lisfranc’s method), b – Retraction of the dorsal flap and sawing of the metatarsal bones

**DISARTICULATIONS ON THE FOOT BY LISFRANC, CHOPART AND GARANZHO**

A) Indications:
- Injury
- Gangrene due to peripheral vascular insufficiency
- Atherosclerosis
- Obliterating endarteritis
- Diabetes mellitus
- Severe infection

i. Lisfranc’s disarticulation:
- Level of the joint: Tarsometatarsal joint (Lisfranc's joint)
- Key of the joint: *Ligamentum cuneometatarsus media* (surgeon may cut through the 2nd metatarsal bone)

Lisfranc's method: a - Dissection line of the skin, b - Disarticulation of the tarsometatarsal joint

ii. Chopart's disarticulation:
- Level of the joint: Transverse tarsal joint (Chopart's joint)
- Key of the joint: *Ligamentum bifurcatum* (*ligamentum calcaneonaviculare et ligamentum calcaneocuboideum*)

In both methods (Lisfranc's disarticulation and Chopart's disarticulation), a skin incision can be made with a larger plantar flap than the dorsal flap.

iii. Garanzho's disarticulation (removal of 1 or all toes):
- Indications:
  - Crushing of all toes or necrosis due to frostbite leading to dislocation of the metatarsophalangeal joints. This occurs in rheumatoid arthritis more frequently, and amputation of the toes may sometimes be preferred to forefoot arthroplasty.

Garanzho's disarticulation of all toes: a - Dissection line of the skin, b - Opening of the metatarsophalangeal joints, c - Skin flap after removal of the metatarsophalangeal joints, d - Suture of the skin flap
B) Procedures:

- The patient is in dorsal decubitus.
- General anaesthesia is administered.
- The dorsal and plantar incisions run across the toes sweeping into the web spaces as they pass across the foot.
- The longitudinal incisions are continued along the lateral and medial borders of the foot to the level of the heads of the 1\textsuperscript{st} and 5\textsuperscript{th} metatarsal bones.
- The skin's flaps are retracted for complete uncovering of the metatarsophalangeal joints.
- All toes are flexed to the sole; the line of the metatarsophalangeal joints is dissected by 1 dorsal incision. All toes are divided together by the curved scissors.
- The cartilage of the metatarsal heads is not removed. The digital arteries are ligated in the spaces between the metatarsal bones.
- The dorsal and plantar flaps are connected with each other by the interrupted silk sutures.

**PUNCTURE AND ARTHROTOMY OF THE HIP JOINT**

A) Puncture of the hip joint:

- The puncture of the hip joint is carried out in 2 approaches.

  i. Lateral approach:
  - This is a more frequently used method, with the patient placed in the supine position.
  - A needle is inserted strictly to the anteroposterior direction, from the point of the middle line on the tip of the greater trochanter of the femur to the point between the medial and median 1/3 of the inguinal ligament.
  - The needle is pulled out from the point of pulsation of the femoral artery, to the medial margin of the sartorius muscle.

Access to the hip joint:

a – Smith-Peterson's method, b – Matted's method, c – Koeter's method
ii. Anterior approach:

- A needle is inserted above the greater trochanter and directed transversely till the head of the femur.
- Upon reaching the head of the femur, the needle is directed upwards and this will reach the capsule of the hip joint.
- In inflammation of the hip joint (purulent coxitis) with pus formation, drainage of pus by arthrotyomy is insufficient. That is why in severe cases of purulent coxitis, resection of the head of the femur is more often manipulated.

Puncture of the hip joint:

a: 1 – Anterior approach, 2 – Lateral approach above the greater tubercle of the femur; b – Lateral approach (frontal section)

B) Langenbeck's resection of the hip joint:

- The patient is placed in the supine position with the operative leg flexed.
- Dissection of the skin and soft tissue is performed layer by layer, between the posterior superior iliac spine and tip of the greater trochanter of the femur, to the posterior margin 5 – 6 cm distal to the tip of the greater trochanter of the femur.
- The fascia is dissected with blunt instruments; fibers are separated from the gluteus maximus muscle to reach the space between the gluteus medius and piriform muscles, and penetrate to the capsule of the hip joint.
- A T-shaped dissection is done and the joint capsule is opened to expose the neck of the femur. This makes the dissection of the ligament of the head of the femur easier.
- After this, the extremity is rotated laterally, the head of femur is dislocated and sawn with Gigli's saw. Damaged parts of the acetabulum and sharp edges are removed.
- After resection, the neck of the femur is fixed to the acetabulum and sewn together at the edge of the removed capsule.
- Wound is sewn layer by layer and the extremity is fixed by plaster of paris.
A) Puncture of the knee joint:
- It is carried out 1 – 2cm from the apex or base of the patella.
- If the puncture is done superiorly, the needle is inserted downward and into the joint, between the posterior surface of the patella and epiphysis of the femur.

B) Voino-Yasenetsky’s arthrotomy of the knee joint:
- The knee joint is opened by 4 incisions.
  
  i. Anterior incision:
  - 2 anterolateral incisions are made (refer to the diagram of arthrotomy).
  - The skin, subcutaneous tissue, fascia, and retinaculum patellae are dissected by a grooved probe.
  - The capsule of the knee joint is stretched and opened along of the length of the dissected skin.

  ii. Posterior incision:
  - Dressing forceps is inserted through the anteromedial opening (which is made earlier) to the space between the medial condyle of the femur and the medial part of the capsule of the knee joint.
  - Then, the dressing forceps is pushed until the protrusion of skin is seen.
  - A posteromedial incision is made on the protrusion of skin.
  - However, the posterolateral incision is not made to avoid damage to the common fibular nerve.
Arthroscopy of the knee joint:

a – 2 parallel incisions with suturing of the skin to the bursa, b – 2 cm from the superior margin of patella laterally (1), an incision is made from the point (2) upwards for 5–6 cm and from the point (2) downwards at the level of the middle part of the patella, c – Tekstor’s incision, d – After Tekstor’s incision, the patella is retracted upwards.

C) Tekstor’s resection of the knee joint:

- The patient is placed in the supine position with the leg bent.
- An arc-shaped dissection (“U”) of the skin, subcutaneous tissue and superficial fascia on the anterior surface of knee joint is made to connect the posterior edges of the medial and lateral condyles of the femur. This dissection passes 1 cm below the tibial tuberosity.
- Above the tibial tuberosity, the ligaments of patella are dissected.
- The joint capsule is opened and the soft tissue with the patella is folded upwards. All the components of knee joint are thus exposed.
- All the damaged cartilages, bones and sharp edges are removed by a saw.
- Lastly, the flap is sutured layer by layer.

**PUNCTURE, ARTHROTOMY AND RESECTION OF THE ANKLE JOINT**

A) Puncture of the ankle joint:

- It is carried out anteriorly on the medial or lateral malleolus.
- For puncture on the lateral malleolus, a needle is inserted between the lateral malleolus and extensor digitorum longus muscle (2 cm superior to the lateral malleolus).
- As for the puncture on the medial malleolus, the needle is inserted between the medial malleolus (1 cm superior to the medial malleolus) and extensor hallucis longus. Both needles penetrate to the trochlea on the respective side and to the surface of the medial or lateral malleolus.
B) Voino-Yasenetsky’s arthrotomy of the ankle joint:
   - The joint is cut in 3 dissections.
   - The patient is placed in the supine position.

i. Anteromedial dissection:
   - An anteromedial dissection is made 3 – 4 cm longitudinally along the lateral edge of
     medial malleolus.
   - Then the retinaculum of the extensorum superiorius muscle is cut by a grooved
     probe inwards from the osteofibrous canal of the tibialis anterior muscle.
   - Then the capsule is stretched and opened.

ii. Anterolateral dissection:
   - An anterolateral dissection is made 3 – 4 cm longitudinally, laterally from the tendon
     of the extensor digitorum longus muscle by a grooved probe.
   - Then the retinaculum of the extensorum superius muscles is cut between the talus
     and lateral malleolus.
   - The capsule is opened with scalpels. A draining tube is inserted for further draining
     of the joint with antibiotic solution.

iii. Posteromedial dissection:
   - A posteromedial dissection on the skin, subcutaneous tissue and superficial fascia
     is done posteriorly from the medial malleolus 6 – 8 cm.
   - The retinaculum of the flexorum muscles is opened by a grooved probe.
     The neurovascular bundles (posterior tibial vessels and nerve) are stretched
     anteriorly with a blunt hook anteriorly.
   - The neurovascular bundles are placed on the capsule of the ankle joint between
     the extensor digitorum longus and extensor hallucis longus tendons.
   - This dissection introduces the drainage tube transversely to the lateral malleolus.
     The affected limb is immobilized with the foot flexed.
C) Kocher’s resection of the ankle joint:

- Dissection of the skin, subcutaneous tissue and superficial fascia is carried out 9 – 10 cm above the lateral malleolus and 1 cm posteriorly from the fibula, posteriorly from the lateral malleolus.
- The lateral malleolus is flexed and dissected until the tuberosity of the 5th metatarsal bone.
- Retinacula of the *musculi peroneorum suprior et inferius* are dissected.
- The fibrous sheath of the fibularis (peroneus) longus and fibularis (peroneus) brevis muscles and tendons are opened by a grooved probe and stretched anteriorly.
- The capsule of the joint is separated and fixed underneath the periosteum.
- The soft tissue is pulled anteriorly, and then the same procedure is performed posteriorly from the tibia.
- The foot is rotated laterally and stretched. Then the ligaments are dissected from the lateral malleolus to the direction of the calcaneus and talus.
- Then, the foot is extended more laterally and the talus is dislocated. The degree of removal depends on the degree of lesions (partial or full removal).
- Total removal of the talus is called astralectomy (аstralectомия).
- The bone is sutured layer by layer. The affected limb is immobilized.
CHAPTER FOUR
THE HEAD

DETAILS OF CONTENTS

Topography of the cerebral department, facial department and lateral region of the head

Coverings of the brain

Topography of the anterior, middle and posterior cranial fossae

Topography of the parotid gland

Connections of fatty spaces of the head

Air sinuses of the head

Operations including trepanation of the skull, antrotomy (mastoidotomy), frontal and maxillary sinusotomies; incisions of phlegmons on the lateral region of the face; primary surgical processing of wounds in the cerebral department of the head
BORDERS BETWEEN THE HEAD AND NECK

A line is drawn from the following anatomical structures to separate the neck from the head:

i. Mental protuberance (*protuberantia mentalis*)
ii. Inferior margin of the mandible
iii. Angle of the mandible (*angulus mandibulae*)
iv. Mastoid process (*processus mastoideus*)
v. Posterior margin of the mastoid process
vi. Superior nuchal line (*linea nuchae superior*)
vn. External occipital protuberance (*protuberantia occipitalis externa*)

BORDERS BETWEEN THE CEREBRAL AND FACIAL DEPARTMENTS

A line is drawn from the following anatomical structures:

i. Zygomatic process of the frontal bone (*processus zygomaticus*)
ii. Frontal process of the zygomatic bone (*processus frontalis*)
iii. Zygomatic arch (*arcus zygomaticus*)
iv. External acoustic meatus
v. Anterior margin of the mastoid process
vi. Apex of the mastoid process

The cerebral department is divided into 3 regions:

i. Fronto-parieto-occipital region
ii. Temporal region
iii. Mastoid region

Departments of the cerebral division of the head:
1 – Retromandibular fossa, 2 – Mastoid region, 3 – Zygomatic region, 4 – Occipital region, 5 – Temporal region, 6 – Parietal region, 7 – Frontal region, 8 – Orbital region, 9 – Nasal region, 10 – Infraorbital region, 11 – Oral region, 12 – Mental region, 13 – Buccal region, 14 – Parotid region
TOPOGRAPHY OF THE FRONTO-PARIETO-OCcipital Region (Regio frontoparietoooccipitalis)

A) Borders:
   - Anterior: Glabella and supraorbital margin of the frontal bone
   - Posterior: Superior nuchal line and external occipital protuberance
   - Bilateral: Superior temporal line (linea temporalis superior)

B) Layers:
   - Skin:
     i. It is mostly covered by hair.
     ii. It is less movable because it is strengthened by the galea aponeurotica.
   - Subcutaneous tissue:
     i. It contains the cutaneous nerve and subcutaneous vessels (supraorbital veins, frontal veins, superficial temporal arteries, posterior auricular arteries and veins, occipital artery and veins).
     ii. It has cellular structures separated by the fibrous septa.
   - Superficial fascia:
     i. It connects with the galea aponeurotica.
     ii. It covers the frontal belly of the epicranius muscle, epicranial aponeurosis and occipital belly of the epicranius muscle, which are fixed to the glabella.
   - Subaponeurotic fatty tissue:
     i. It is very thin.
     ii. Each border corresponds to its region.
   - Periosteum:
     i. It is loosely connected with the bone.
     ii. It is tightly connected with sutures of the skull.
     iii. It contains fatty tissue.
     iv. Haemorrhage may occur and spread to all directions if this layer is damaged.
   - Bones:
     i. There are frontal (paired), occipital (paired) and parietal (unpaired) bones.
     ii. It contains emissary veins.
     iii. Each bone consists of 3 layers:
        - External lamina
        - Diploe (it contains veins)
        - Internal lamina (lamina vitrea)

TOPOGRAPHY OF THE TEMPORAL REGION OF THE HEAD (Regio temporalis)

A) Borders:
   - Anterior: Zygomatic process of the frontal bone and frontal process of the zygomatic bone
   - Superior: Superior temporal line
   - Inferior: Zygomatic arch
B) Layers:
   - Skin:
     i. It is thin and movable.
     ii. It contains lots of sweat and sebaceous glands.
     iii. It is innervated by the auriculotemporal nerve (branch of the mandibular division of the trigeminal nerve) and zygomaticotemporal nerve (branch of the maxillary division of the trigeminal nerve).
   - Subcutaneous tissue:
     i. It is thin.
     ii. It contains the superficial temporal artery, superficial temporal vein and cutaneous nerves.
   - Superficial fascia:
     i. It is a continuation of the galea aponeurotica and is connected with the superior temporal line.
   - Deep fascia:
     i. It is also known as the temporal aponeurosis and is tightly connected with the temporal muscle.
     ii. The inferior part of the temporal aponeurosis is divided into 2 laminae (external and internal).
     iii. Both laminae are connected with the zygomatic arch.
     iv. The interaponeurotical fatty space is bounded between the internal and external laminae.
   - Muscle:
     i. The temporal muscle is situated in this region and is connected with its tendon to the coronoid process of the mandible.
     ii. This muscle is supplied by the anterior and posterior branches of the deep temporal artery.
     iii. It is innervated by the mandibular division of the trigeminal nerve.
     iv. The subaponeurotic fatty space is situated in the inferior margin of the tendon.
   - Periosteum
   - Bone:
     i. It consists of the external and internal laminae.

TOPOGRAPHY OF THE MASTOID REGION OF THE HEAD
(REGIO MASTOIDEA)

A) Borders:
   - Anterior: Anterior margin of the mastoid process
   - Posterior: Posterior margin of the mastoid process
   - Superior: Continuation of the zygomatic arch

B) Layers:
   - Skin:
i. It is thin and movable.
ii. It contains lots of sweat and sebaceous glands.
iii. It is innervated by the great auricular nerve from the cervical plexus and the lesser occipital nerve from the cervical plexus.

Subcutaneous tissue:

i. It is a thin layer.
ii. It contains the posterior auricular artery and vein, occipital artery and vein and posterior auricular lymph nodes.

Superficial fascia

Deep fascia:

i. It is tightly connected with the skull.
ii. It covers the sternocleidomastoid muscle.

Bone:

i. It is mastoid process of the temporal bone.
ii. It is compact and contains cellulae mastoideae (the largest cell is called the antrum mastoideum).

**SHIPO’S TRIANGLE**

It contains the antrum mastoideum, which connects with the tympanic cavity (cavum tympani).

The superior wall is divided by the bone with the middle cranial fossa.

The medial wall contains the prominentia canalis semicircularis lateralis and prominentia canalis facialis.

The posterior wall is closely connected with the sigmoid sinus (the mastoid process is poorly developed in case of brachycephaly).

Borders:

- Anterior: Posterior margin of the external acoustic porus and spina supraremitacta
- Posterior: Mastoid crest (crista mastoidea)
- Superior: Continuation of the zygomatic arch

Shipo’s triangle:

1 – Projection of the sigmoid sinus, 2 – Cellulae mastoideae (projection), 3 – Projection of the facial nerve, 4 – Spina supraremitacta, 5 – Linea temporalis (Facial nerve, middle meningeal artery or sigmoid sinus may be damaged during mastoidotomy)
Meninges of the Brain

A) Layers:
   - Dura mater: Outer layer with thick and dense fibrous membrane
   - Arachnoid mater: Intermediate layer with delicate membrane
   - Pia mater: Inner layer with delicate and vascular membrane

B) Functions:
   - Protecting the brain from any mechanical injury
   - Forming a supporting framework for arteries, veins and venous sinuses
   - Enclosing a fluid-filled cavity which is known as the subarachnoid space
   - Maintaining the balance of the extracellular fluid in the brain

C) Structures:
   - Dura mater (*dura mater encephali*):
     - It is known as the pachymeninx.
     - It is divided into 2 layers which are the external (periosteal) layer and the internal (meningeal) layer. The external layer covers the internal layer of the skull while the internal layer is a strong fibrous membrane and continues with the spinal dura mater at the foramen magnum.
     - It sends 4 processes inside the skull cavity:
       - *Falx cerebri*:
         - It is attached to the margins of the *sulcus sinus sagittalis superioris*.
         - The superior sagittal and inferior sagittal sinuses lie on it.
       - *Tentorium cerebelli*:
         - It is attached to the margins of the *sinus sulcus transversi*.
         - It covers the superior surface of the cerebellum.
         - It supports the occipital lobes of the brain.
       - *Falx cerebelli*:
         - It lies on the middle line along the *crista occipitalis interna*.
       - *Diaphragma sellae*:
         - It forms a covering over the *sella turcica* and covers the hypophysis.
   - Arachnoid mater (*arachnoidea encephali*
     - It is not fixed to the sulci.
     - It covers the cranial and spinal nerves in loose sheaths until they exit from the skull.
   - Pia mater (*pia mater encephali*):
     - It dips into all sulci and fissures of the brain.
     - It contains the blood vessels and vascular plexuses.
     - It is an incomplete membrane since it has 3 openings (Magendie’s and Luschka’s foramen).
     - It forms the * tela choridea* of the 3rd and 4th ventricles.
INTERMENINGEAL SPACES
- It is bounded by the meninges and divided into 3 spaces which are the epidural space, subdural space and subarachnoid space.

A) Epidural space:
- It is also known as the peridural or extradural space.
- It is situated between the skull (externally) and dura mater (internally).
- Epidural hematoma is revealed in bleeding.
- During anaesthesia of the epidural space, narcotic drugs do not penetrate the medulla oblongata; the respiratory function is thus preserved.

B) Subdural space:
- It is situated between the dura mater (externally) and arachnoid mater (internally).
- It connects with the subdural space in the spinal cord.

C) Subarachnoid space:
- It is also known as the leptomeningeal space.
- It is situated between the arachnoid mater and pia mater.
- It also connects with the subarachnoid space in the spinal cord and ventricles of the brain.
- It contains the cerebrospinal fluid (CSF).
- It is well developed on the base of brain and forms wide reservoirs for the CSF and is known as the cisternae. There are cerebellomedullary cisterna, interpeduncular cisterna, chiasmatic cisterna and cisterna of the lateral sulcus.

SINUSES OF THE DURA MATER OF THE BRAIN
- The dura mater contains several reservoirs which collect blood from the brain. They are known as the sinuses of the dura mater (sinus durae matris).
- These sinuses are venous canals devoid of valves and located in the thickness of the dura mater at the attachment of its processes to the skull.
- They differ from veins as the walls are composed of stretched layer of the dura mater, thus they do not collapse even after cutting or injury.
- The inflexibility of the walls of the venous sinuses provides free drainage of the venous blood in changes of intracranial pressure.
- The sinuses are divided into paired and unpaired ones.
- The paired sinuses are:
  i. Superior petrosal sinus (sinus petrosus superior)
  ii. Inferior petrosal sinus (sinus petrosus inferior)
  iii. Transverse sinus (sinus transversus)
  iv. Sigmoid sinus (sinus sigmoideus)
  v. Cavernous sinus (sinus cavernosus)
  vi. Sphenoparietal sinus (sinus sphenoparietalis)
- The unpaired sinuses are:
  i. Superior sagittal sinus (sinus sagittalis superior)
ii. Inferior sagittal sinus (sinus sagittalis inferior)
iii. Straight sinus (sinus rectus)
iv. Basilar sinus (sinus basilaris)
v. Occipital sinus (sinus occipitalis)
vi. Anterior intercavernous sinus (sinus intercavernosus anterior)
vii. Posterior intercavernous sinus (sinus intercavernosus posterior)

TOPOGRAPHY OF THE ANTERIOR CRANIAL FOSSA
(FOSSA CRANII ANTERIOR)

A) Borders:
   - Anterior: Frontal bone
   - Both sides: Frontal bone
   - Posterior:
     i. Free posterior border of the lesser wing of the sphenoid bone
     ii. Anterior clinoid process
     iii. Anterior margin of the sulcus chiasmatis

B) Floor:
   - In the median plane:
     i. Anterior: Cribriform plate of the ethmoid bone
     ii. Posterior: Superior surface of the anterior part of the sphenoid (jugum sphenoidale)
   - On each side:
     i. Anterior: Orbital plate of the frontal bone
     ii. Posterior: Lesser wing of the sphenoid bone

C) Other features:
   - The cribriform plate of the ethmoid bone separates the anterior cranial fossa from
   - The jugum sphenoidale separates the anterior cranial fossa from the sphenoidal
     - The orbital plate of the frontal bone separates the anterior cranial fossa from the

D) Attachment:
   - The falx cerebri is attached to the crista galli
   - The free margin of the tentorium cerebri is attached to the anterior clinoid process.

E) Support:
   - The orbital surface of the frontal bone supports the frontal lobe of the brain.

F) Clinical importance:
   - Fracture of the anterior cranial fossa may cause bleeding and discharge of the
     cerebrospinal fluid through the nose.
   - A black eye may occur due to discharge of blood into the eyelid.
TOPOGRAPHY OF THE MIDDLE CRANIAL FOSSA (FOSSA CRANII MEDIA)

A) Borders:

   Anterior:
   i. Posterior border of the lesser wing of the sphenoid bone
   ii. Anterior clinoid process
   iii. Anterior margin of the sulcus chiasmatis

   Posterior:
   i. Superior border of the petrous part of the temporal bone
   ii. Dorsum sellae of the sphenoid bone

   Lateral:
   i. Greater wing of the sphenoid bone
   ii. Anteroinferior angle of the parietal bone
   iii. Squamous part of the temporal bone

B) Floor:

   In the median plane: Body of the sphenoid bone
   On each side: Squamous part of the temporal bone and anterior surface of the petrous part of the temporal bone

C) Other features:

   Optic groove (sulcus chiasmatis) transmits the optic nerve to the optic canal; from there, the optic nerve reaches the optic orbit.
   The tuberculum sellae separates the optic groove from the hypophyseal fossa.
   The superior orbital fissure opens anteriorly to the orbit.
   On the greater wing of the sphenoid bone:
   1) The foramen rotundum opens anteriorly to the pterygopalatine fossa.
   2) The foramen ovale opens inferiorly to the infratemporal fossa.
   3) The foramen spinosum opens inferiorly to the infratemporal fossa.
   On the anterior surface of the petrous part of the temporal bone:
   1) The hiatus and groove for the greater petrosal nerve opens to the foramen lacerum.
   2) The hiatus and groove for the lesser petrosal nerve opens to the foramen ovale.

D) Attachment:

   The diaphragma sellae is attached to the tuberculum sellae.
   The margin of the tentorium cerebelli and petrosphenoidal ligament is attached to the posterior clinoid process.
   The margin of the tentorium cerebelli is attached to the superior border of the petrous part of the temporal bone.

E) Support:

   The middle cranial fossa supports the temporal lobe of the brain.
   The hypophyseal fossa supports the hypophysis cerebri.

F) Clinical information:
Fracture of the middle cranial fossa may cause:
   i. Bleeding and discharge of the cerebrospinal fluid through the ear.
   ii. Bleeding through the nose or mouth (sphenoid involved).
   iii. The facial and vestibulocochlear nerves may be damaged if fracture occurs through the internal acoustic meatus.
   iv. Vertigo occurs if the semicircular canal is damaged.

**TOPOGRAPHY OF THE POSTERIOR CRANIAL FOSSA**

*FOSSA CRANII POSTERIOR*

A) Borders:
   - Anterior: Superior border of the petrous temporal bone
     - Both sides:
       i. Mastoid process of the temporal bone
       ii. Mastoid angle of the parietal bone
     - Posterior: Squamous part of the occipital bone

B) Floor:
   - In the median plane:
     i. Anterior: Clivus
     ii. Posterior: Squamous part of the occipital bone
     iii. Middle: Foramen magnum
   - On each side:
     i. Condylar part of the occipital bone
     ii. Posterior surface of the petrous part of the temporal bone
     iii. Mastoid process of the temporal bone
     iv. Mastoid angle of the parietal bone

C) Other features:
   - On the petrous part of the temporal bone, the internal acoustic meatus is closed laterally by the *lamina cribosa* which separates it from the internal ear.
   - On the mastoid part of the temporal bone, the mastoid foramen opens into the upper part of the sigmoid sulcus.

D) Attachment:
   - The apical ligament of the dens, upper vertical band of the cruciate ligament and *membrana tectoria* are attached to the lower part of the clivus.
   - The *falx cerebelli* is attached to the internal occipital crest.

E) Support:
   - The posterior cranial fossa supports the hindbrain (which consists of the cerebellum, pons & medulla).
   - The subarcuate fossa supports the flocculus of the cerebellum.

F) Clinical importance:
   - Fracture of the posterior cranial fossa causes bruising over the mastoid region extending down over the sternocleidomastoid muscle.
### Localization of the Cranial Nerves in the Cranial Base

<table>
<thead>
<tr>
<th>Cranial nerves</th>
<th>Foramens (apertures)</th>
<th>Cranial fossae</th>
</tr>
</thead>
<tbody>
<tr>
<td>I (Olfactory)</td>
<td>Lamina cribosa of the ethmoid bone</td>
<td>Anterior</td>
</tr>
<tr>
<td>II (Optic)</td>
<td>Canalis opticus</td>
<td>Middle</td>
</tr>
<tr>
<td>III (Oculomotor)</td>
<td>Superior orbital fissure</td>
<td></td>
</tr>
<tr>
<td>IV (Trochlear)</td>
<td>Superior orbital fissure</td>
<td></td>
</tr>
<tr>
<td>V1 (Ophthalmic)</td>
<td>Superior orbital fissure</td>
<td></td>
</tr>
<tr>
<td>V2 (Maxillary)</td>
<td>Foramen rotundum</td>
<td></td>
</tr>
<tr>
<td>V3 (Mandibular)</td>
<td>Foramen ovale</td>
<td></td>
</tr>
<tr>
<td>VI (Abducent)</td>
<td>Superior orbital fissure</td>
<td></td>
</tr>
<tr>
<td>VII (Facial)</td>
<td>Internal acoustic meatus</td>
<td>Posterior</td>
</tr>
<tr>
<td>VIII (Auditory)</td>
<td>Internal acoustic meatus</td>
<td></td>
</tr>
<tr>
<td>IX (Glossopharyngeal)</td>
<td>Foramen jugulare</td>
<td></td>
</tr>
<tr>
<td>X (Vagus)</td>
<td>Foramen jugulare</td>
<td></td>
</tr>
<tr>
<td>XI (Accessory)</td>
<td>Foramen jugulare</td>
<td></td>
</tr>
<tr>
<td>XII (Hypoglossal)</td>
<td>Canalis hypoglossi</td>
<td></td>
</tr>
</tbody>
</table>

### Localization of the Vessels in the Cranial Base

<table>
<thead>
<tr>
<th>Cranial fossae</th>
<th>Foramens (apertures)</th>
<th>Vessels</th>
</tr>
</thead>
<tbody>
<tr>
<td>Anterior</td>
<td>Foramen caecum</td>
<td>Emissary vein to the superior sagittal sinus</td>
</tr>
<tr>
<td></td>
<td>Anterior ethmoidal foramina</td>
<td>Anterior ethmoidal artery, vein and nerve</td>
</tr>
<tr>
<td></td>
<td>Posterior ethmoidal foramina</td>
<td>Posterior ethmoidal artery, vein and nerve</td>
</tr>
<tr>
<td>Middle</td>
<td>Canalis opticus</td>
<td>Ophthalmic artery</td>
</tr>
<tr>
<td></td>
<td>Foramen ovale</td>
<td>Accessory meningeal artery</td>
</tr>
<tr>
<td></td>
<td>Foramen spinosum</td>
<td>Middle meningeal artery and vein</td>
</tr>
<tr>
<td></td>
<td>Foramen lacerum</td>
<td>Internal carotid artery</td>
</tr>
<tr>
<td></td>
<td>Groove or hiatus for the greater</td>
<td>Petrosal branch of the middle meningeal</td>
</tr>
<tr>
<td></td>
<td>petrosal nerve</td>
<td>artery</td>
</tr>
<tr>
<td></td>
<td>Superior orbital fissure</td>
<td>Superior ophthalmic vein</td>
</tr>
<tr>
<td></td>
<td>Canalis caroticus</td>
<td>Internal carotid artery</td>
</tr>
<tr>
<td>Posterior</td>
<td>Foramen magnum</td>
<td>Medulla oblongata, meninges, vertebral</td>
</tr>
<tr>
<td></td>
<td></td>
<td>arteries, meningeal branches of the</td>
</tr>
<tr>
<td></td>
<td></td>
<td>vertebral artery</td>
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<tr>
<td></td>
<td>Foramen jugulare</td>
<td>Inferior petrosal sinus, sigmid sinus and</td>
</tr>
<tr>
<td></td>
<td></td>
<td>posterior meningeal artery</td>
</tr>
<tr>
<td></td>
<td>Condylar canal</td>
<td>Emissary vein passing from the sigmid sinus</td>
</tr>
<tr>
<td></td>
<td></td>
<td>to the vertebral veins in the neck</td>
</tr>
<tr>
<td></td>
<td>Foramen mastoidenum</td>
<td>Mastoid emissary vein from the sigmid sinus</td>
</tr>
<tr>
<td></td>
<td></td>
<td>and meningeal branch of the occipital artery</td>
</tr>
<tr>
<td></td>
<td>Internal acoustic meatus</td>
<td>Labyrinthine artery</td>
</tr>
</tbody>
</table>
BLOOD SUPPLY OF THE BRAIN

The arterial supply is mainly from the internal carotid artery and vertebral artery. The brain is supplied by 2 circulations, which are the Willis' circle and Zakharchenko's circle.

The anterior communicating artery, 2 anterior cerebral arteries, 2 posterior communicating arteries and 2 posterior cerebral arteries form the Willis' circle.

A) Internal carotid artery (arteria carotis interna):
- Anterior cerebral artery (arteria cerebri anterior)
- Middle cerebral artery (arteria cerebri media)
- Posterior communicating artery (arteria communicans posterior)

B) Vertebral artery (arteria vertebralis):
- Posterior inferior cerebellar artery (arteria cerebelli inferior posterior)
- Basilar artery (arteria basilaris)
- Posterior cerebral artery (arteria cerebri posterior)

<table>
<thead>
<tr>
<th>Arteries</th>
<th>Origins</th>
<th>Distributions</th>
</tr>
</thead>
<tbody>
<tr>
<td>Internal carotid</td>
<td>Common carotid artery at the superior border of the thyroid cartilage</td>
<td>It gives branches to the walls of the cavernous sinus, pituitary gland, and trigeminal ganglion. It provides primary supply to the brain.</td>
</tr>
<tr>
<td>Anterior cerebral</td>
<td>Internal carotid artery</td>
<td>It supplies the medial, lateral and inferior surfaces of the cerebral hemispheres, except the occipital lobe.</td>
</tr>
<tr>
<td>Anterior communicating</td>
<td>Anterior cerebral artery</td>
<td>It helps to form the cerebral arterial circle.</td>
</tr>
<tr>
<td>Middle cerebral</td>
<td>Continuation of the internal carotid artery distal to the anterior cerebral artery</td>
<td>It supplies most of the lateral surface of the cerebral hemispheres and anterior portion of the temporal lobe, except the occipital lobe and inferior temporal gyrus.</td>
</tr>
<tr>
<td>Vertebral</td>
<td>Subclavian artery</td>
<td>It supplies the cranial meninges and cerebellum.</td>
</tr>
<tr>
<td>Basilar</td>
<td>Formed by the union of the vertebral arteries</td>
<td>It supplies the brain stem, cerebellum and cerebrum.</td>
</tr>
<tr>
<td>Posterior cerebral</td>
<td>Terminal branch of the basilar artery</td>
<td>It supplies the inferior aspect of the cerebral hemisphere (tentorial surface), medial part of the temporal lobe and occipital lobe.</td>
</tr>
<tr>
<td>Posterior communicating</td>
<td>Posterior cerebral artery</td>
<td>It supplies the optic tract, cerebral peduncle, internal capsule and thalamus.</td>
</tr>
</tbody>
</table>

SULCI, GYRI AND LOBES OF THE BRAIN

The cerebrum is folded into gyri, which are separated from each other by sulci. This increases the surface of the cortex.

On superolateral surface of the brain, 3 main sulci are found:

The central sulcus (sulcus centralis s. Rolandi) separates the frontal lobe and parietal lobe.

The lateral sulcus (sulcus lateralis s. Sylvii) has 2 branches, which are the ramus ascendens and ramus anterior.
The parieto-occipital (sulcus parietooccipitalis) is an incomplete sulcus and does not stretch far on the superior lateral surface.

Several lobes are distinguished:
A) The frontal lobe is divided into the following gyri by the precentral gyrus, superior frontal and inferior frontal gyri:
   - Gyrus precentralis
   - Gyrus frontalis superior
   - Gyrus frontalis inferior – It can be divided into 3 parts, which are the pars opercularis, pars triangularis, and pars orbitalis.

B) The parietal lobe is divided into the following gyri by the postcentral and intraparietal sulci:
   - Gyrus postcentralis
   - Lobulus parietalis superior
   - Lobulus parietalis inferior – It has 2 parts, which are the gyrus supramarginalis and gyrus angularis.
C) The temporal lobe is divided into the following gyri by the superior temporal and inferior temporal sulci:

- Gyrus temporalis superior
- Gyrus temporalis medius
- Gyrus temporalis inferior

D) The occipital lobe has the transverse occipital and calcarine sulci.

**KRONLEIN-BRYSOV’S SCHEME**

- 2 horizontal lines (a and b) are drawn on the supraorbital and infraorbital borders.
- 3 vertical lines are drawn: on the posterior margin of the mastoid process (c), temporal mandibular joint (d) and the middle point of the zygomatic arch (e).
- Brusov’s lines are drawn obliquely: The 1st oblique line (f) is drawn on the intersection point between (b) and (e) to the intersection point of (a) and (c). The 2nd oblique line is drawn on the intersection point between (b) and (e) to the intersection point of (a) and (d). The 2nd line forms 45 degrees with the line (b).
PRIMARy SURGICAL PROCESSING OF WOUNDs IN THE HEAD

A) Introduction:
- Types of wounds: Non-penetrating (without damage to the dura mater) and penetrating (damage to the dura mater)
- During blunt-object injury, the internal surface may change, resulting in displacement of the internal lamina of the skull.
- Types of skull displacement: crack, split, fragment and pressure

B) Aims:
- To stop bleeding
- To remove the foreign body
- To prevent soft tissue infection

C) Indications: Open (broken bones) or closed (damage to the soft tissue dura mater) wounds

D) Procedures:
- The hair is shaved from the skull.
- The wound is sterilized with ether to remove the oil for general anaesthesia.
- Hydrogen peroxide is used before anaesthesia for antibacterial purpose.
- Anaesthesia is administered.
- An ellipsoid cutting of 0.3 – 0.5 cm is made onto the periphery of the wound.
- Bleeding is stopped by finger compression, then by clamp, ligature or coagulants.
- The soft tissue is separated from the skull by a hook or retractor; bony pieces or fractures and foreign bodies are removed.
- The Luer’s forceps are used to clean and reveal the unaffected dura mater.
- If compression of the skull takes place, the internal lamina will be extensively damaged; thus osteoplastic trepanation will be carried out to remove the damaged internal lamina.
- After cleaning the dura mater and wound, the meningeal vessels are checked for pulsation. If it is blue or dark red in colour, there may be a haematoma. In this case, the meninges and blood clot are removed. The exposed subdural space is cleaned with physiological solution.
The dura mater is stitched with a thin ligature, while the bone (during osteoplastic trepanation) by a cutgut suture.

- The *galea aponeurotica* is sutured with a polymer thread.
- The skin is stitched by interrupted silk sutures.

**TREPANATION OF THE SKULL**

There are 2 types of skull trepanation, which are the decompressive and osteoplastic ones.

**Decompressive trepanation (Cushing’s trepanation):**

- It is a palliative operation.

**A) Indications:**

- Raised intracranial pressure leading to tumour
- Oedema of the brain due to trauma

**B) Aim:** To make a definite part of vault in defect of the skull and dura mater

**C) Location:** It is located in the temporal region.

**D) Procedures:**

i. The patient lies on the side with the leg slightly bent in the knee and hip joints on the same side. A shoe-like dissection of the skin and subcutaneous tissue on the temporal region is made according to lines of attachment of the temporalis muscle.

ii. The base of the flap is opened till the zygomatic arch (sometimes a vertical dissection is made).

iii. The temporal aponeurosis, interaponeurotic fat and temporalis muscle are dissected vertically till the periosteum.

iv. They are separated with a raspatory into a field of 6 cm².

v. While retracting the wound with a hook, an orifice is made by using the Duaen’s trepanator in the central part which is free of periosteum. Firstly a sharp drill is applied, and then a conical-shaped drill is used.

vi. The hole is widened with the Luer’s cutter.

vii. The widening of this orifice in the anteroinferior direction is dangerous due to the possibility of damaging the middle meningeal artery.

viii. If damage of this artery occurs, its peripheral end will be stitched with blanket (обивной) ligatures; While its central end which lies in the bone canal is closed by applying wax paste in this canal.

ix. A lumbar puncture is performed before opening the dura mater.

x. Each portion of the cerebrospinal fluid withdrawn should not exceed 10 – 30 ml. This is to prevent the shift of the brain stem to the *foramen magnum*.

xi. The dura mater is opened with a cross like dissection.

xii. The size of the trepanated orifice depends on the intracranial pressure: A wider orifice is needed in a higher intracranial pressure.

xiii. The operative dissection is sutured layer by layer, excluding the dura mater.
Cushing’s decompressive trepanation:
a – Shoe-like dissection of the skin and dissection line on the temporal muscle (straight line), b – Retraction of the cutaneoaponeurotic flap, temporalis muscle and periosteum with a raspatory, c – Resection of the temporal bone with a cross-like incision on the dura mater

Osteoplastic trepanation (olivecron’s trepanation):

A) Indications:
- Bleeding of the middle meningeal artery (urgent operation to save the patient’s life)
- Haematoma
- Tumour

B) Procedures:

i. During trepanation, a shoe-like dissection with the base of flap is made on the zygomatic arch in order to ligate the main trunk and posterior branches of the middle meningeal artery. Damage may occur to the anterior branch in extensive dissection.

ii. Dissection of the skin, aponeurosis, periosteum and osteal flap is carried out in 3 stages.

iii. 1st stage: The skin, subcutaneous tissue, aponeurosis, and muscle are dissected. The length of the base of the flap must not be less than 6 – 7 cm, and 1 cm from the eye socket and tragus of the ear. The cutaneomusculoaponeurotic flap is pulled downwards after the bleeding stops.

iv. 2nd stage: The osteoperiosteal flap dissection is made 1 cm inwards from the edges of the skin dissection. 5 – 7 openings are made with a trepanator. The temporal bone is opened carefully as it is thin and the trepanator may easily penetrate through the bone and thus, injury to the brain tissue may occur. The Gigli’s saw is introduced through the openings with the Polenov’s thread saw guide (проводник Поленова). The bone is sawn at 45 degrees so that when the skull is covered back, it will not fall back to the brain. The separation of the bone by the Dalgren’s cutting forceps (кусач-
ki kostnye Dal'grena) is performed if the saw guide fails to guide the Gigli's saw. During the trepanation, bleeding from the emissary vein may occur especially from the transverse and sagittal sinuses. 3% hydrogen peroxide solution is used to stop this bleeding. The cross-like dissection of the dura mater is performed only after removal of 30–40 ml of the cerebrospinal fluid by lumbar puncture. The cutting edge of the dura mater must be at least 0.5–1 cm from the edges of the bone.

v. 3rd stage: The surface of the dura mater is cleaned with physiological solution. The haematoma is removed, and the arteries and their branches are ligated. This is the main aim of the operation. Then, the dura mater is sutured. The arteries are ligated with a thin silk suture. The wound is sutured layer by layer.

Osteoplastic trepanation of the skull in the fronto-parieto-temporal region:

a – Dissection line on the soft tissue (shoe-like incision) and puncture points. b – Sawing of the skull with the Gigli's saw with the help of a saw guide between the skull and dura mater. c – Opening of the dura mater. d – Scheme of the Polenov's thread saw guide between the skull and dura mater

ANTROTOMY (MASTOIDOTOMY)

This is the trepanation on the mastoid process.

A) Indications:

- Mastoiditis or antritis
- Complication of purulent inflammation in the middle ear

B) Aim:
To remove purulent exudation, granulation and drainage of the antrum mastoideum.

C) Special instruments:
- Voyachek’s surgical set of gouges and chisels (долота и стамески из набора Воячека) and a bulbous-end probe (пуговчатый зонд)

D) Procedures:
- i. The patient is placed in the supine position with the head turned to the unaffected side and fixed, and the ear is retracted anteriorly.
- ii. General or local infiltrative anaesthesia by 0.5% Novocain solution is administered.
- iii. The skin with subcutaneous tissue is dissected 1 cm from the auricle.
- iv. The periosteum and its surrounding tissues are cut, and then Shipo’s triangle (треугольник Шипо) is exposed.
- v. The periosteum is retracted with a raspatory.
- vi. The outer layer of the bone is removed with a grooved gouge.
- vii. Once the antrum mastoideum is exposed, pus and granulation are removed with the Folkman’s spoon.
- viii. Then, drainage is made.
- ix. Finally, the skin is sutured (depression on the skin can be seen).

Mastoidotomy
a – General view of the trepanation, b – Opening of the antrum mastoideum

FRONTO- AND MAXILLARY SINUSOTOMY
A) Indications:
- Inflammation of the frontal sinus
- Inflammation of the maxillary sinus (Highmoritis)

B) Special instruments:
- Voyachek’s surgical set of gouges and chisels (долота и стамески из набора Воячека)

C) Anaesthesia:
- Local anaesthesia can either be per os or parenteral.
There are 2 methods of anaesthesia:

i. Central:
   - It is injection of Novocain solution near the foramen rotundum.

ii. Peripheral:
   - It is administered near the tuber maxillae.
   - It is administered in the infraorbital region near the infraorbital artery.

Ritter-Janssen’s frontotomy:

i. An arch-shaped dissection is made along the base of the nose and supraorbital margin of the soft tissue.
ii. The Voyachek’s chisel is used to make a small hole on the superiomedial wall of the orbital cavity.
iii. Then, the Folkman’s spoon is used to remove pus from the frontal sinus.
iv. Finally, the skin is stitched.

Maxillary sinusotomy:

i. It is also known Highmorotomy.
ii. The anterior wall of the maxilla is trepanated.
iii. The upper lip is lifted.
iv. A dissection is made under the lip from the incisivae until the 2nd and 3rd upper molars.
v. A hole is made in the bone by using the Voyachek cutter.
vi. The sinus is cleaned by using the physiological solution drainage.
vii. After that, the Folkman’s spoon is used to remove pus.

* Do not damage the infraorbital foramen as the trigeminal nerve and orbital artery are situated nearby.

* After frontal sinusotomy, the frontal sinus is fully covered by connective tissues permanently. The sinus cavity remains after the maxillary sinusotomy.

TOPOGRAPHY OF THE LATERAL REGION OF THE FACE
(Regio facialis lateralis)

The superficial lateral region of the face is divided into:
- Cheek region (regio buccalis)
- Parotid masseteric region (regio parotideo masseterica)
- The deep facial region (regio facialis profunda) is situated deeper than the superficial one.

TOPOGRAPHY OF THE SUPERFICIAL LATERAL REGION OF THE FACE
(Regio facialis lateralis superficialis)

A) Landmarks:
   - Zygomatic bone and arch
   - Lateral margin of the eye socket

B) Borders:
   - Superior: Zygomatic arch and inferior margin of the eye socket
   - Inferior: Inferior margin of the mandible
   - Anterior: Nasolabial folds, nasobuccal folds and commissure of the lips
   - Posterior: Mastoid process
TOPOGRAPHY OF THE CHEEK REGION (*REGIO BUCCALIS*)

A) Borders:
- Superior: Infraorbital margin
- Inferior: Inferior margin of the mandible
- Medial: Nasobuccal and nasolabial folds
- Lateral: Anterior margin of the masseter muscle

B) Layers:
   i. Skin:
      - It is thin.
      - It contains lots of sweat and sebaceous glands.
      - It is closely connected with the subcutaneous tissue.
      - It is innervated by the infraorbital nerve, buccal nerve and mental nerve.
   ii. Subcutaneous tissue:
      - It is thick and well developed if compared with other parts of the face.
   iii. Superficial fascia:
      - It covers the parotid duct and neurovascular bundles.
      - It covers the Bichat's body (*corpus adiposum buccae*) which lies between the buccinator and masseter muscles. It has 3 processes, which are the ophthalmic, temporal and pterygopalatine processes. These processes penetrate the parts according to their names.
   iv. Deep fascia:
      - It covers the muscles, especially the buccinator muscle which is known as the buccopharyngeal fascia.
   v. Muscles:
      - There are mimic muscles (the orbicularis oculi, zygomatic major, zygomatic minor and levator labii superioris muscles), buccinator and masseter muscles.
      - The buccinator muscle is covered interiorly by the mucous membrane. This muscle is pierced by the parotid duct at the level of the 1st upper molar.

C) Neurovascular bundles:
   i. Facial artery:
      - At the beginning part of this artery, it lies on the subcutaneous tissue of the cheek region.
      - It passes the space between the mimic muscles and terminates at the angular artery.
      - The branches of the facial artery anastomose with the transverse facial artery and infraorbital artery.
   ii. Facial vein:
      - The angular vein and nasofrontal vein are the sources of the venous blood of the facial vein. They pass to the superior ophthalmic vein and then to the cavernous sinus.
      - The facial vein anastomoses with the pterygoid venous plexus. In thrombosis of the facial vein, the thrombus may flow to the cavernous sinus of the dura mater in the retrograde direction.
   iii. Facial nerve:
      - It is a mixed nerve. It sends motor branches to the deep layer of the subcutaneous tissue and mimic muscles.
iv. Infraorbital neurovascular bundle: This bundle passes out from the infraorbital foramen. The infraorbital artery penetrates through the inferior orbital fissure, and then passes to the fossa cantina. The infraorbital vein flows to the inferior ophthalmic vein or pterygoid venous plexus. The infraorbital nerve is a terminal branch of the maxillary nerve. It passes through the infraorbital foramen and innervates the skin and mucous membrane of the upper lip, maxilla and teeth from the upper row.

v. Mental neurovascular bundle: This bundle passes through the mental foramen of the mandible. The mental nerve is a terminal branch of the inferior alveolar nerve (from the mandibular nerve of the trigeminal nerve). It innervates the skin and mucous membrane of the lower lip. The mental artery is a branch of the inferior alveolar artery (from the maxillary artery). The mental vein flows to the inferior alveolar vein.

TOPOGRAPHY OF THE PAROTID MASSETERIC REGION
(REGIO PAROTIDEOOAMASSETERICA)

A) Borders:
   - Anterior: Anterior margin of the masseter muscle
   - Inferior: Mandible base
   - Posterior: Imaginary line drawn from the mandible angle to the apex of the mastoid process
   - Superior - zygomatic arch

B) Layers:
   i. Skin:
      - It is thin and is covered by hair in males.
      - It contains sweat and sebaceous glands.
      - It is innervated by the auriculotemporal (from the mandibular nerve) and great auricular nerves (from the cervical plexus).

   ii. Subcutaneous tissue:
      - It is thick.
      - It contains the anterior auricular lymph nodes.

   iii. Superficial fascia:
      - It is a thin layer and is not connected to the bone.

   iv. Deep fascia:
      - It is known as the fascia parotideomasseterica.
      - It is fixed to the zygomatic arch, inferior margin and angle of the mandible.
      - It forms a covering for the masseter muscle which extends anteriorly to the capsule of Bichat’s body.
      - It covers the parotid gland superficially and penetrates this gland.
      - The superficial muscles (masseter, medial pterygoid and sternocleidomastoid muscles) and deep muscles (posterior belly of the digastric muscle), deep fascia and neurovascular bundles around the parotid gland form a musculofascial space (spatium parotideum).
The 1st weak place of the **spatium parotideum** is situated on the superior surface of it. In purulent parotitis, pus may pass through this weak place to the external acoustic meatus.

The 2nd weak place of the **spatium parotideum** is located on the medial surface of it, between the styloid process and internal pterygoid muscle to the peripharyngeal space (окологлоточное пространство). Pus may flow from the **spatium parotideum** to peripharyngeal space and vice versa.

### v. Muscles:

The masseter muscle is situated here. The blood supply is provided by the masseteric artery from the maxillary artery. It is innervated by the masseteric nerve from the mandibular nerve.

The masseteric maxillary space (жевательно-челюстное пространство) is situated between the masseter muscle and mandible. This space continues superiorly to the zygomatic arch, superficial surface of temporal muscle until the place of fixation of the superficial layer of the temporal fascia.

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Parotid gland and peripharyngeal space by horizontal dissection:

1 - Mandible, 2 - Masseter muscle, 3 - Parotid duct, 4 - Masseteric fascia, 5 - Facial nerve, 6 - Superficial parotid lymph nodes, 7 - Facial artery, retromandibular vein and deep parotid lymph node, 8 - External jugular vein, 9 - Parotid gland, 10 - Superficial parotid lymph nodes, 11 - Digastric muscle, 12 - Sternocleidomastoid muscle, 13 - Posterior part of the peripharyngeal space, 14 - Superior group of the deep cervical lymph nodes, 15 - Internal jugular vein and glossopharyngeal nerve, 16 - Superior cervical ganglion of the sympathetic trunk, vagus nerve and accessory nerve, 17 - Prevertebral muscle, vagus and accessory nerves, 18 - Retropharyngeal lymph nodes and retropharyngeal space, 19 - Internal carotid artery and hypoglossal nerve, 20 - Pharyngeal-vertebral aponuesis (Sharpe's septum), 21 - Stylopharyngeal aponuesis, 22 - Styloid process, 23 - Pharyngeal process of the parotid gland, 24 - Pharyngeal aponuesis, 25 - Anterior part of the peripharyngeal space, 26 - Palatine tonsil, 27 - Superior pharyngeal constrictor muscle, 28 - Medial pterygoid muscle

*The small diagram on the left shows the level of horizontal dissection on the face.*
C) Neurovascular bundles:
   i. Facial nerve:
      Upon exiting the stylomastoid foramen, it penetrates through the capsule of the parotid gland, and then it is divided into the superior and inferior branches.
      The temporal, zygomatic, and buccal branches are the superior branches of the facial nerve; while the marginal, mandibular, and cervical branches are its inferior branches.
      It forms the parotid plexus inside the parotid gland.
   ii. Auriculotemporal nerve:
      It is a branch of the mandibular nerve.
      It penetrates through the posterior surface of the parotid capsule and ascends vertically and anteriorly from the external acoustic meatus to the temporal region.
      It gives branches to the parotid tissue, external acoustic meatus and tympanic membrane.
   iii. External jugular vein:
      The vein of the parotid gland, superficial temporal, middle temporal, deep temporal, maxillary and transverse facial veins flow into the retromandibular vein and then into the external jugular vein.
      The external jugular vein passes through the space between the styloglossus, stylohyoid, and stylopharyngeus muscles.

TOPOGRAPHY OF THE DEEP FACIAL REGION
(Regio Facialis Profunda)

A) Borders:
   Superior: Greater wing of the sphenoid bone
   Medial: And medial pterygoid muscle
   Anterior: Tuber maxillae
   Posterior:
      Lateral - ramus mandibulae

B) Structure:
   The *spatium temporopterygoideum* is situated in the deep region of the face, which is bounded by the temporalis muscle and lateral pterygoid muscle. It contains the maxillary artery and pterygoid plexus.
   The *spatium interpterygoideum* is situated between the medial and lateral pterygoid muscles. It contains the mandibular, auriculotemporal, buccal, lingual and inferior alveolar nerves.
   The interpterygoid fascia (межкрыловидная фасция) covers the external surface of the medial pterygoid muscle. The inferior alveolar artery, vein and nerve pierce through this fascia. The lingual nerve is also covered by this fascia. That is why injection of anaesthetic solution to the mandibular foramen, the inferior alveolar nerve is affected but the lingual nerve remains unaffected.
   The pterygoid plexus anastomoses with the cavernous sinus, emissary, and inferior ophthalmic veins. From the pterygoid plexus, blood flows to the retromandibular vein and then into the internal jugular vein.
The maxillary artery is a branch of the external carotid artery which passes along the lateral pterygoid muscle and gives off many branches. It gives rise to the superior branch (middle meningeal artery) and inferior branch (inferior alveolar artery) at the beginning part; the next part of this artery gives rise to the buccal artery, anterior and posterior branches of the deep temporal artery, medial and lateral pterygoid arteries. In the pterygopalatine fossa, it gives rise to the infraorbital artery which passes through the infraorbital canal. The terminal branches of the infraorbital artery are the anterior superior alveolar and posterior superior alveolar arteries which enter the tuberosity of the maxilla.

The mandibular nerve exits from the foramen ovale. It is covered by the lateral pterygoid muscle and branches of the inferior alveolar nerve. It passes through the space between the pterygoid muscles. It then passes to the opening of the mandibular canal. The lingual nerve is another branch of the mandibular nerve which adjoins with chorda tympani nerve and innervates the mucous membrane of the tongue. Other branches of the mandibular nerve include the deep temporal nerve (to the temporalis muscle), buccal nerve (to the buccinator muscle, skin and mucous membrane of the cheek) and auriculotemporal nerve (to the temporal region through the parotid gland).

The maxillary nerve is the 2nd branch of the trigeminal nerve and passes to the pterygopalatine ganglion located in the pterygopalatine fossa. The greater and lesser palatine nerves are branches of this ganglion, which innervate the hard and soft palates respectively. The posterior nasal branches pass to the nasal cavity through the sphenopalatine foramen.

**FACIAL NERVE AND ITS BRANCHES**

- It is a mixed nerve.
- It contains motor nuclei, sensory nuclei and parasympathetic nuclei.
- It is divided into the motor and sensory roots.
- The motor root is formed by the axon of the motor nuclei and innervates the facial expression and part of the sublingual muscle.
- The sensory root (intermediate nerve) emerges from the brain as a thin trunk with proper fascial nerve and auditory nerve. Later its peripheral process continues as the chorda tympani and also connects with the major petrosal nerve. Its peripheral process conducts gustatory sensitivity of the anterior 1/3 of the tongue and soft palate.

In the petrous part of the temporal bone, the facial nerve passes through the facial canal and gives off several branches:

<table>
<thead>
<tr>
<th>Nerves</th>
<th>Innervation</th>
</tr>
</thead>
<tbody>
<tr>
<td>Greater petrosal nerve</td>
<td>Lacrimal and mucosal glands of the nose, palate and pharynx</td>
</tr>
<tr>
<td>Nerve to the stapedius muscle</td>
<td>Stapedius muscle</td>
</tr>
<tr>
<td>Chorda tympani</td>
<td>Mucous membrane of the dorsum of the tongue (anterior 1/3)</td>
</tr>
</tbody>
</table>

--- 130 ---
There are branches after leaving the *foramen stylomastoideum*:

i. Between the stylomastoid process and parotid gland:

<table>
<thead>
<tr>
<th>Nerves</th>
<th>Divisions</th>
<th>Innervation</th>
</tr>
</thead>
<tbody>
<tr>
<td>Posterior auricular nerve</td>
<td>a. Anterior auricular branch</td>
<td>Posterior and superior auricularis muscles, antitrigricus muscle</td>
</tr>
<tr>
<td></td>
<td>b. Posterior occipital branch</td>
<td>Occipital belly of the occipitofrontalis muscle</td>
</tr>
<tr>
<td>Stylohyoid branch</td>
<td></td>
<td>Stylohoideus muscle</td>
</tr>
<tr>
<td>Digastric branch</td>
<td></td>
<td>Posterior belly of the digastric muscle</td>
</tr>
</tbody>
</table>

ii. Upon entering the depth of the parotid gland, it is divided into 2 main branches: superior branches (temporal and zygomatic), and inferior branches (buccal, mandibular and cervical branches). Then, it radiates to the muscles of the face.

<table>
<thead>
<tr>
<th>Nerves</th>
<th>Innervation</th>
</tr>
</thead>
<tbody>
<tr>
<td>Temporal branch</td>
<td>Anterior auricular muscle, frontal belly of the occipitofrontalis muscle and orbicularis oculi muscle</td>
</tr>
<tr>
<td>Zygomatic branch</td>
<td>Orbicularis oculi and zygomatic muscles</td>
</tr>
<tr>
<td>Buccal branch</td>
<td>Zygomatic major and minor, buccinator, levator labii superior, depressor labii inferior, levator angulus oris, depressor angulus oris and orbicularis oris muscles</td>
</tr>
<tr>
<td>Mandible branch</td>
<td>Depressor labii inferior and mentalis muscles</td>
</tr>
<tr>
<td>Cervical branch</td>
<td>Platysma muscle</td>
</tr>
</tbody>
</table>

**CONNECTIONS OF THE FATTY SPACES OF THE HEAD**

A) Connection between the *spatium temporopterygoideum* and *spatium interpterygoideum* with:

- Fatty space of the temporalis muscle
- Fatty space of the buccal region (Bichat’s body)
- Fatty space of the orifices on the cranial base, pterygopalatine fossa, and eye socket

B) *Spatium parapharyngeale*:

- It is bounded by the pharynx medially, pterygoid muscle and parotid gland laterally.
- This space is divided into 2 compartments, which are the anterior and posterior compartments.
- It connects with:
  i. Fatty space of the cranial base
  ii. Fatty space of the hyoid bone
- In inflammation, pus may spread from the space between the teeth of the lower jaw and fat space of the *spatium interpterygoideum* to the *spatium parapharyngeale* and *spatium parotidum*.
- In inflammation of the *spatium parapharyngeale*, the patient may complain of dysphagia and even asphyxia in severe cases.
If the infection of the anterior compartment of the *spatium parapharyngeale* penetrates through the *aponeurosis stylopharyngea*, it may spread to the anterior mediastinum through the *spatium vasonervorum.*

If the infection is situated in the posterior compartment of the *spatium parapharyngeale,* pus may spread to the posterior mediastinum along the oesophagus.

The infection of the posterior compartment is dangerous, because necrosis of the internal carotid artery or development of septic thrombosis in the internal jugular vein may take place.

C) *Spatium retropharyngeale:*
- It is bounded by the pharynx and prevertebral fascia.
- It stretches from the cranial base to level of 6th cervical vertebra, where the *spatium retrovesiceral* of the neck is situated.
- It is divided into the left and right compartments. That is why abscess of the *spatium retropharyngeale* is always situated only in 1 side.

**TOPOGRAPHY OF THE PAROTID GLAND (GLANDULA PAROTIS)**

A) English: Parotid gland

B) Latin: *Glandula parotis*

C) Greek: /

D) Russian: Окологузая железа

E) Morphology:
- It is the largest salivary serous gland.
- It has a lobular structure which consists of 7 lobules.
- The parotid duct (*ductus parotideus*) is situated on the external surface of the masseter muscle, 2 – 2.5 cm inferiorly from the zygomatic arch. It pierces through the buccinator muscle, which is close to the anterior margin of the masseter muscle. The opening of the parotid gland into the oral cavity is usually located between the 1st and 2nd upper molar teeth.
- 3 lines are drawn from the *ala nasi,* angle of the mouth and external acoustic meatus. The parotid duct can be found in this region.
- There are 2 weak places of the parotid gland, which are the pharyngeal process and near the external acoustic meatus.

F) Functions:
- Digestion of the starch by the salivary amylase (ptyalin)
- Participating in immune response by secretory Ig A

G) Holotopy:
- Projected to the parotid region
H) Skeletopy:
- On the external skull at the level of the 2nd cervical vertebra.

I) Syntopy:
- Anterior: Masseter muscle and medial pterygoid muscle
- Posterior: Mastoid process and sternocleidomastoid muscle
- Superior: Zygomatic arch, cartilaginous part of the external acoustic meatus and posterior surface of the temporomandibular joint
- Inferior: Posterior belly of the digastric muscle
- Medial: Masseter muscle, mastoid and styloid process

J) Arterial supply:
- Superficial temporal artery

K) Venous drainage:
- Retromandibular vein

L) Lymphatic drainage:
- Parotid lymph nodes

M) Nerve supply:
- Sympathetic: Sympathetic trunk
- Parasympathetic: Auriculotemporal nerve (from the otic ganglion)

FATTY SPACES OF THE FACE

A) Superficial region of the face:
- Orbital space
- Parotid masseteric space
- Bichat's body
  - Fatty space of the fossa canina
  - Fatty space of the floor of the oral cavity

B) Deep region of the face:
  - Spatium temporopterygoideum
  - Spatium interpterygoideum
  - Fatty space of the pterygopalatine fossa

C) Parapharyngeal space:
  - Retropharyngeal space
  - Anterior parapharyngeal space
  - Posterior parapharyngeal space

PURULENT PROCESSES OF THE FACE
- Phlegmon of the orbital region
- Phlegmon of the zygomatic region
Phlegmon of the adipose body of the cheek region
Phlegmon of the retromandibular fossa
Phlegmon of the submandibular region
Phlegmon of the subtemporal and pterygopalatine fossae
Phlegmon of the temporal region:
  - Superficial: Between the skin and temporal aponeurosis
  - Middle: Between the aponeurosis and temporal muscle
  - Deep: Under the temporal muscle
  - It spreads through all the layers.
Subaponeurotic phlegmon of the vault of the head
Submasseteric phlegmon (under the masseter muscle)
Phlegmon of the pterygomandibular space: Between the ramus mandibulae and
medial pterygoid muscle
Phlegmon of the diaphragm of the mouth
Phlegmon of the tongue
Abscess of the hard palate
Abscess of the sublingual space
Phlegmon of the orbit
Phlegmon of the parapharyngeal space
Retropharyngeal abscess
Abscess of the submental space
Anterior or posterior paratonsillar abscess
Purulent parotitis

INCISIONS OF PURULENT PROCESSES ON THE LATERAL REGION
OF THE FACE
A) Indications: Purulent process of the fatty space

B) Procedures:
  - A radial incision is made under the facial nerve to avoid injury to the facial nerve
    and its branches. The incision may start from the external acoustic meatus to the
    temporal region along the zygomatic arch, to the nose, to the commissure of the lips
    and to the angle of the mandible.
  - According to Voino-Yasenetsky, in purulent process of the retromandibular region
    (parotitis and parapharyngeal phlegmon), an incision of the skin and fascia is made
    near the angle of the mandible. The cervical branch of the facial nerve may be damaged
    after the incision by this method (but it does not cause any serious complication).
  - A transverse incision from the inferior margin of the lobule of ear (2 cm anterior
    from it) to the angle of the mouth is performed in purulent process of the neck in the
    region of the masseter muscle, especially in parotitis. This incision may cause injury
    to the facial nerve. But this happens very rarely.
  - An incision 2 – 3 cm from the ala nasi to 4 – 5 cm from the lobule of the ear is
    performed in purulent process of the parapharyngeal fatty space with the corpus
    adiposum buccae. The incision has to be performed superficially; because a
    deep dissection may cause injury to the facial nerve. The facial nerve is damaged
rarely by this incision. Thus, an incision on the mucous membrane of the buccal maxillary fold (inside the oral cavity) is better in the purulent process of the parapharyngeal fatty space.

A typical incision from the zygomatic process of the frontal bone to the lobule of the ear is performed in purulent process of the temporal region.
CHAPTER FIVE
THE NECK

DETAILS OF CONTENTS

Topography of the neck
Triangles and fasciae of the neck
Fatty spaces of the neck
Neurovascular bundles of the neck
Topography of the larynx, pharynx, thyroid gland, trachea and oesophagus
Vagosympathetic Novocain blockade

Operations including incisions of phlegmons on the neck; conicotomy and tracheostomy; surgical access to the oesophagus; resection of the thyroid gland
TOPOGRAPHY OF THE NECK

A) English: Neck

B) Latin: Collum

C) Greek: Cervix

D) Russian: Шея

E) Morphology:

It is an unpaired and the smallest body part between the chest and head.

Borders:

- Superior: Inferior border of the head
- Inferior: Jugular notch, superior margin of the clavicle, acromion of the scapula, imaginary line between the acromion and spinal process of the 7th cervical vertebra

Departments:

- Anterior
- Posterior

Borders between the anterior and posterior departments:

- Imaginary line drawn between the apex of the mastoid process and acromion; or
- Frontal plane passing through the transverse processes of the cervical department of the vertebral column; or
- Lateral margins of the trapezoid muscle

Triangles of the neck:

1 - Submental triangle, 2 - Submandibular triangle, 3 - Carotid triangle, 4 - Omotracheal triangle, 5 - Omotrapezoid triangle, 6 - Omoclavicular triangle, 7 - Pirogov's triangle, a - Trapezius muscle, b - Sternoleidomastoid muscle, c - Inferior belly of the omohyoid muscle, d - Superior belly of the omohyoid muscle, e - Posterior belly of the digastric muscle, f - Anterior of the digastric muscle
TRIANGLES OF THE NECK
The sternocleidomastoid muscle divides the neck into the anterior and posterior triangles. The anterior triangle lies in front of the muscle and the posterior triangle lies behind it.

I) Anterior triangle:
- It is covered by the skin, superficial fascia, platysma, and deep fascia. The cervical branch of the facial nerve and transverse cutaneous nerve run across this triangle.
  i. Borders:
   - Anterior: Midline of the neck
   - Posterior: Anterior border of the sternocleidomastoid muscle
   - Superior: Lower margin of the body of the mandible
  ii. It is subdivided by the anterior and posterior bellies of the digastric muscle and the superior belly of the omohyoid muscle into:
   - Submental triangle
   - Submandibular triangle
   - Carotid triangle
   - Omotracheal triangle
*The submental and submandibular triangles are located in the suprathyroid region.
*The carotid and omotracheal triangles are located in the infrathyroid region.

Submental triangle (trigonum submentale):
A) Borders:
  - Posterior and inferior: Limited by the hyoid bone
  - Lateral: Limited by the anterior belly of the digastric muscle

B) Layers:
  i. Skin:
   - It is thin and has sweat glands and sebaceous glands.
   - It is innervated by the ramus superior nervi transversus colli from the cervical plexus.
  ii. Subcutaneous tissue:
   - It is absent.
  iii. Superficial fascia
  iv. Proper fascia:
   - It is absent.
  v. Submental lymph nodes:
   - They receive lymph from the tip of the tongue, the frontal teeth and gums, middle part of the inferior lip and soft tissue of the chin.

Submandibular triangle (trigonum submandibulare or trigonum hyomandibulare):
A) Borders:
  - Superior: Mandible base
  - Inferior: Anterior and posterior bellies of the digastric muscle
B) Layers:

i. Skin
- It is thin and movable.
- It has hair, sweat glands and sebaceous glands. It is innervated by the *ramus superior nervi transversus colli*.

ii. Subcutaneous tissue:
- It contains the skin nerves and platysma muscle of the facial expression.

iii. Superficial fascia:
- It creates the fascia sheaths for the skin nerves, vessels and platysma.

iv. Proper fascia:
- It runs up to the hyoid bone, and then is divided into 2 laminae above the hyoid bone.

v. Fatty space:
- It contains the submandibular salivary glands, submandibular lymph nodes, facial artery and vein and fatty tissue.

vi. Deep lamina of the fascia:
- It covers the mylohyoid muscle. The lymph nodes of this region receive lymph from the superior lip, superior teeth gums, inferior angle of the lower lip, lateral part and back of the tongue, lateral inferior teeth and gums.

Carotid triangle (*trigonum caroticum* or *trigonum Beclère*):

A) Borders:
- Medial: Superior belly of the omohyoid muscle
- Lateral: Medial margin of the sternocleidomastoid muscle
- Superior: Posterior belly of the digastric muscle

B) Layers:

i. Skin:
- It is thin and movable
- It has sweat glands and sebaceous glands.
- It is innervated by the inferior and superior branches of the *nervus transversus colli*.

ii. Subcutaneous tissue:
- It contains the skin nerves, external jugular vein and platysma muscle.

iii. Superficial fascia:
- It covers the arteries, veins and nerves.

iv. Proper fascia

v. Deep fascia:
- It is absent.

vi. Endocervical fascia:
- It consists of 2 laminae. They are the lamina parietalis and lamina visceralis. The lamina parietalis creates the sheaths for the main vascular nervous bundle of the
This bundle consists of the internal jugular vein, common carotid artery and the vagus nerve.

Omotracheal triangle (*trigonum omotracheale*)

**A) Borders:**
- Superolateral: Superior belly of the omohyoid muscle
- Medial: Anterior median line of the neck
- Inferior: Anterior border of the sternocleidomastoid muscle

**B) Layers:**

- **i. Skin:**
  - It is thin, movable and innervated by the inferior branch of the *nervus transversus colli*.

- **ii. Subcutaneous tissue:**
  - It contains the anterior jugular vein and platysma muscle.

- **iii. Superficial fascia:**
  - It covers the platysma muscle.

- **iv. Proper fascia:**
  - In the superior part of this triangle, the proper fascia connects firmly with the deep fascia to form the *linea alba colli*.
  - Inferiorly, the 2 laminae of the proper fascia separate.
  - The proper fascia runs anteriorly to the sternum while the deep fascia runs posteriorly behind the sternum.
  - Between them, a triangular fatty space is formed. It is named the *spatium interaponeuroticum suprasternale*.
  - There are fatty tissue, *arcus venosus jugulare* and small lymphatic nodes in this fatty space.
  - This fatty space is closed and does not connect with other spaces.
  - It runs laterally to the sternocleidomastoid muscle along the *arcus jugulare* creating the *saccus retrosternocleidomastoides* named by Hruber.

- **v. Deep fascia:**
  - It covers the paired muscles:
    - Sternohyoid muscle
    - Sternothyroid muscle
    - Omohyoid muscle
    - Thyrohyoid muscle

- **vi. Endocervical fascia:**
  - Between the parietal and visceral laminae of this fascia, there is a fatty space called the *spatium previscerale*.
  - In front of the trachea and larynx, this fatty space connects with the anterior mediastinum.
  - The visceral lamina of the endocervical fascia covers the following inner organs:
- Cervical department of the trachea
- Larynx
- Thyroid gland
- Parathyroid glands
- Oesophagus
- Pharynx

II) Lateral triangle:
- This triangle is divided into the omoclavicular and omotrapezoid triangles by the inferior belly of the omohyoid muscle

A) Borders:
- Anterior: Posterior border of the sternocleidomastoid muscle
- Posterior: anterior border of the trapezius
- Inferior: Middle 1/3 of the clavicle
  - It is covered by the prevertebral layer of the deep fascia. From above downward, it is formed by the musculi semispinalis capitis, splenius capitis, levator scapulae, and scaleneus medius.

B) Contents:
- Arteries:
  - Subclavian artery (3rd part)
  - Superficial cervical artery
  - Suprascapular artery
  - Occipital artery
- Veins:
  - External jugular vein and its tributaries
  - Subclavian vein
- Nerves:
  - Brachial plexus
  - Spinal part of the accessory nerve
  - Branches of the cervical plexus

NEUROVASCULAR BUNDLES OF THE NECK
- They are situated mainly in the borders of the carotid triangles, with relations to their elements:
  - Medial: Common carotid artery
  - Lateral: Internal jugular vein
  - The vagus nerve is situated between the common carotid artery and internal jugular vein.
### CLASSIFICATIONS OF THE CERVICAL FASCIAE

<table>
<thead>
<tr>
<th>Designation of the fasciae</th>
<th>Formation</th>
</tr>
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<tbody>
<tr>
<td>By Shevkunenko</td>
<td></td>
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<tr>
<td>By Pirogov</td>
<td></td>
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<tr>
<td>By Paris Nomina Anatomica (PNA)</td>
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<tr>
<td><strong>1st – Superficial cervical fascia (fascia coli superficialis)</strong></td>
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</tr>
<tr>
<td><strong>2nd – Superficial layer of the cervical fascia proper (lamina superficialis fasciae coli propriae, Hruber’s fascia)</strong></td>
<td>1st layer of the cervical fascia</td>
</tr>
<tr>
<td><strong>3rd – Deep layer of the cervical fascia proper (lamina profunda fasciae coli propriae, Risha’s fascia)</strong></td>
<td>2nd layer of the cervical fascia</td>
</tr>
<tr>
<td><strong>4th – Endocervical fascia (fascia endocervicalis, Pirogov's fascia)</strong></td>
<td>2nd layer of the cervical fascia</td>
</tr>
<tr>
<td>a) Lamina parietalis b) Lamina visceralis</td>
<td></td>
</tr>
<tr>
<td><strong>5th – Prevertebral fascia (fascia prevertebralis)</strong></td>
<td>4th layer of the cervical fascia</td>
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### VISHNEVSKY’S VAGOSYMPATHETIC NOVOCAIN BLOCKADE

A) Indications:
- Trauma of the thorax especially in open or closed pneumothorax
  - Combined injury to the thorax and abdominal cavities
  - Major thoracic operation which is highly traumatic, for example: pulmonectomy, heart transplant and etc.
B) Aim: To prevent pulmonary shock.

C) Procedures:
- The patient is placed on his back with a small pillow under his scapula. The head is turned opposite to the side of the blockade, while the hand on the side of the blockade is pulled downward.
- The crossing point of the sternocleidomastoid muscle and the external jugular vein is determined. The surgeon then places his left index finger to this place at once, and presses into the soft tissue slowly until he feels the anterior surface of the cervical vertebra. During this procedure, the neurovascular bundle and other structures are displaced medially.
- Without decreasing the pressure of the index finger above, the surgeon introduces Novocaine anaesthesia into the skin (which forms a lump) with a thin syringe (2 g). After that, the surgeon changes to another longer needle also with a 2 g syringe on this lump. Then the surgeon changes the syringe to a 10 g syringe and injects 0.25 % Novocain solution through this lump, and pushes the needle slowly forward into the depth of the tissue to anterior surface of the vertebra, and at the same time injects the solution.
- After making the infiltrate, the solution flows through the vessels. When the tip of the needle reaches the vertebra, the pressure in the needle falls, the surgeon must quickly pull out the needle by 1 – 2 mm.
- Then, the piston is pulled out to reveal blood in the syringe, and 40 – 50 ml of 0.25 % Novocain solution is introduced. The solution creeps through the prevertebral fascia, and comes into contact with the epineurium of the free nerve ending and sympathetic nerve, and often the phrenic nerve.
- The signs of correct manipulation include hyperemia of the face and sclera, and often the Claude-Bernar-Horner’s syndrome: myosis (pupil constriction), ptosis (closed eyelids) and enophthalmos (falling of the eyeball backward into the orbital cavity).

FATTY SPACES OF THE NECK
- They can be divided into 2 types, which are the closed and open spaces.
  - The closed spaces include:
    - Spatium parotideomassetericum
    - Spatium hyomandibulare
INCISIONS OF PHLEGMONS ON THE NECK

Abscesses and phlegmons of the neck can be divided into the superficial and deep ones.

Besides the general complication (sepsis and severe intoxication), deep inflammatory foci of the neck may spread to the anterior or posterior mediastinum, compressing the trachea or larynx, and large vessels of the neck.

Thus, the main principle of getting rid of the abscess is to open up the focus on time and drain the focus of abscess.

After dissection of the skin, the fascia is separated with blunt instruments for example the grooved probe (желобчатый зонд) to avoid damage to the vessels. Besides bleeding from the vessels, damage to the vein may also cause air embolism. After opening of the purulent focus, dressing forceps (корпцианг) is inserted to widen the focus and make the drainage easier.

Lastly, a tampon is applied to the wound or a drainage tube is fixed (only away from the vessels) at the lower margin of the wound.

Localization of abscesses in the neck:
1 – Retropharyngeal abscess, 2 – Intraspinal (extradural) abscess, 3 – Abscess in the posterior compartment of the neck which exits from the vertebra, 4 – Abscess between the trachea and oesophagus, 5 – Presternal abscess which exits from the sternum, 6 – Abscess in the spatiun interaponeuriticum suprasternale, 7 – Deep abscess in the spatiun previscerale which is located in the anterior mediastinum, 8 – Abscess between the vertebra and oesophagus (causes damage of the vertebra)
A) Procedures:

Phlegmon of the submandibular region (подчелюстная область): The skin, subcutaneous tissue and superficial fascia are dissected by a scalpel along the parallel margin of the mandible, and then the deeper structure is separated by blunt instruments. This dissection may damage the superficial arteries and veins.

Phlegmon of the floor of the oral cavity: A dissection is made from the lower margin of the mental protuberance to the hyoid bone longitudinally. The skin, subcutaneous tissue, superficial and deep fasciae of the neck are dissected; later, the deeper structure is separated by blunt instruments to the median raphe between the mylohyoid muscles.

Phlegmon around the large vessels: A dissection is made on the anterior or posterior margin of the sternocleidomastoid muscle. The tissue situated below the muscle is separated carefully with blunt instruments to avoid damage to the neurovascular bundles. In purulent process exceeding the boundary of the lateral triangle of the neck, an incision is made on the clavicle from the posterior margin of the sternocleidomastoid muscle parallel to the anterior margin of the trapezius muscle. The phlegmon of the neurovascular bundle sheath must be opened widely with the combinative dissection by Kutner on the superior part of the sheath and by de Kerven on the inferior part of the sheath.

Kutner's operation: Dissection of the skin, subcutaneous tissue, platysma muscle and superficial fascia is carried out from the mastoid process downward along the anterior margin of the sternocleidomastoid muscle. The covering for the sternocleidomastoid muscle is cut 1 - 1.5 cm lower than the mastoid process. The cutaneous muscular flap is separated from the vessels carefully and retracted. The accessory nerve is not damaged during this manipulation. Gauze is put under the flap after the operative intervention on the internal jugular vein.

de Kerven's operation: Dissection of the skin, subcutaneous tissue, platysma muscle and superficial fascia is performed from the mastoid process along the anterior margin of the sternocleidomastoid muscle to the clavicle, and then turned to a horizontal direction parallel to the clavicle until the anterior margin of the trapezius muscle, forming a right angle. The covering for the sternocleidomastoid muscle is cut 2 - 3 cm above the clavicle after the introduction of the grooved probe on the anterior and posterior walls of the fascia. Between the 2 ligatures, the external jugular vein is cut. The cutaneous musculocutaneous flap is divided from the vessels and retracted. 2 ligatures are made above and under the thrombus. The superior part of the vein is cut lower than the ligature, while the inferior part of the vein is cut above the ligature.

Phlegmon of the spatium previscerae: A transverse dissection through the coverings of the neck, 2nd and 3rd layers of the fasciae, anterior muscle of the neck, and parietal layer of the fascia of the 4th layer. In case of injury to the larynx or trachea, tracheotomy must be done.

Phlegmon of the spatium retroviscerae: A dissection is made similar to the approach to the oesophagus. After the dissection, the patient's head is inclined forward to prevent pus from flowing into the respiratory tract.
**TOPOGRAPHY OF THE LARYNX**

A) English: Larynx

B) Latin: Larinx

C) Greek: Lariggea

D) Russian: Горлень

E) Morphology:

It consists of 7 – 11 cartilages (average 9).

The cartilages are divided into the paired and unpaired ones.

i. Unpaired: Thyroid cartilage (*cartilago thyroidea*), epiglottic cartilage (*cartilago epiglottica*) and cricoid cartilage (*cartilago cricoidea*).


The larynx consists of 3 parts:

i. Vestibulum

ii. *Pars glotica* (between the vocal plica and vestibular plica)

iii. *Pars subglotica* (from the vestibular cord to the trachea)

Muscles of the larynx:
i. Function: They move the cartilages and thus change the width of its cavity and the width of the rima glottis.
ii. According to their functions, they are divided into:
   - Constrictors (thyroarytenoid, transverse arytenoid and oblique arytenoid muscles)
   - Dilators (posterior cricoarytenoid and thyroepiglottic muscles)
   - Muscles altering density of the vocal ligaments (cricothyroid and vocalis muscles)

Ligaments and joints of the larynx:

i. Ligaments:
   - Median thyrohyoid ligament (ligamentum thyrohyoideum medianum)
   - Lateral thyrohyoid ligament (ligamentum thyrohyoideum laterale)
   - Hyoepiglottic ligament (ligamentum hyoepiglotticum)
   - Thyroepiglottic ligament (ligamentum thyroepiglotticum)
   - Cricothyroid ligament (ligamentum cricothyroideum)
   - Vocal ligament (ligamentum vocale)
   - Vestibular ligament (ligamentum vestibulare)

ii. Joints:
   - Cricothyroid joint
   - Cricothyroid joint
   - Corniculate cartilage
   - Arytenoid cartilage (synchondrosis)

F) Functions:
   - Production of voice
   - Acting as part of the upper respiratory tract

G) Holotopy:
   - Neck region; anterior department

H) Skeletopy:
   - 4th – 6th cervical vertebrae

I) Syntopy:
   - Anterior: Sternohyoid muscle, sternothyroid muscle, omohyoid muscle, cervical fascia, superior part of the lateral lobes of the thyroid gland and previsceral fatty space
   - Posterior: Laryngeal part of the pharynx and oesophagus
   - Superior: Hyoid bone and root of the tongue
   - Inferior: Trachea
   - Lateral: Omohyoid muscle, common carotid artery, vagus nerve and internal jugular vein

J) Arterial supply:
   - Superior laryngeal artery (from the superior thyroid artery)
   - Inferior laryngeal artery (from the inferior thyroid artery)
K) Venous drainage:
  - Superior laryngeal vein (drained into the superior thyroid vein)
  - Inferior laryngeal vein (drained into the inferior thyroid vein)

L) Lymphatic drainage:
  - Above the vocal folds: Superior thyroid vessels to the anterosuperior group of the deep cervical nodes
  - Below the vocal folds: Posteroinferior group of the deep cervical nodes and prelaryngeal nodes

M) Nerve supply:
  - Vestibulum and pars glottica: Superior laryngeal nerve (from the vagus nerve)
  - Pars subglottica: Inferior laryngeal nerve (laryngeal recurrent nerve from the vagus nerve)

**TOPOGRAPHY OF THE TRACHEA**

A) English: Trachea

B) Latin: *Trachea*

C) Greek: Tracheia

D) Russian: Трахея, дыхательное горло

E) Morphology:
  - The anterior 2/3 of the tracheal wall is made up of the C-shaped cartilaginous rings.
  - The posterior 1/3 is devoid of the cartilage and is made up of the trachealis muscle and fibrous tissue.

F) Function:
  - For air passage

G) Holotopy (in the neck):
  - Anterior department along the middle line of the neck.

H) Skeletopy:
  - Lower border of the 6th cervical – Upper border of the 5th thoracic vertebrae

I) Syntopy (in the neck):
  - Anterior: Isthmus of the thyroid gland
Posterior:
  i. Oesophagus
  ii. Musculus longus colli
  iii. Recurrent laryngeal nerve in the tracheo-oesophageal groove

Bilateral:
  i. Corresponding lobe of the thyroid gland
  ii. Common carotid artery within the carotid sheath

J) Arterial supply:
   Superior thyroid artery

K) Venous drainage:
   Inferior thyroid vein (drained into the left brachiocephalic vein)

L) Lymphatic drainage:
   Pretracheal and paratracheal nodes

M) Nerve supply:
   Sympathetic nerves: Cervical ganglion
   Parasympathetic (from the recurrent laryngeal nerve):
     i. Sensory branches to the mucous membrane
     ii. Motor branches to the trachealis muscle

TOPOGRAPHY OF THE PHARYNX

A) English: Pharynx
B) Latin: Pharynx
C) Greek: Pharynx
D) Russian: Глотка
E) Morphology:
   It is divided into 3 parts:
     i. Nasopharynx
     ii. Oropharynx (mesopharynx)
     iii. Laryngopharynx (hyopharynx)
   Before entry into the pharynx, there are 6 tonsils which form the Pirogov's lymphoepithelial ring:
     i. Paired:
        - Palatine tonsil
        - Tubal tonsil

--- 149 ---
ii. Unpaired:
   - Lingual tonsil
   - Pharyngeal tonsil

   Layers:
   i. Serous layer
   ii. Submucous layer:
      - Outer longitudinal layer (formed by 3 elevators)
      - Inner circular layer (formed by 3 constrictors)
   iii. Mucous layer
   iv. Muscles of the pharynx:
      - 3 elevators:
        1. Palatopharyngeus muscle
        2. Stylopharyngeus muscle
        3. Salpingopharyngeus muscle
      - 3 constrictors:
        1. Superior constrictor muscle
        2. Middle constrictor muscle
        3. Inferior constrictor muscle

F) Functions:
   - Conducting food to the oesophagus
   - Conducting air to the larynx and lungs

G) Holotopy:
   - Superior part: In the facial department of the head
   - Inferior part: In the neck

H) Skeletopy:
   - Base of the skull – 7th cervical vertebra

I) Syntopy:
   - Superior: Base of the skull
   - Inferior: Oesophagus
   - Anterior: Nasal cavity, oral cavity, larynx, soft palate and epiglottis
   - Posterior: (Basilar part of the occipital bone) Upper part of the 6th cervical vertebra, deep cervical vertebra column, medulla oblongata, spinal cord and sympathetic trunk
   - Lateral: Styloid process, common carotid arteries, internal carotid arteries and external carotid arteries, accessory nerve, vagus nerve and hypoglossal nerve

J) Blood supply:
   - Ascending pharyngeal branch of the external carotid artery
   - Ascending palatine and tonsillar branches of the facial artery
   - Dorsal lingual branches of the lingual artery
   - Greater palatine, pharyngeal and pterygoid branches of the maxillary artery
K) Venous drainage:
   - Internal jugular vein
   - Facial vein

L) Lymphatic drainage:
   - Retropharyngeal lymph nodes
   - Deep cervical lymph nodes

M) Nerve supply:
   - Pharyngeal branch of the vagus carrying fibres of the cranial accessory nerve
   - Pharyngeal branches of the glossopharyngeal nerve
   - Pharyngeal branches of the superior cervical sympathetic ganglion
   - Glossopharyngeal nerve (innervates the stylopharyngeus muscle)
   - External and recurrent laryngeal nerve (innervates the inferior constrictor muscle)
   - Maxillary nerve (innervates the nasopharynx)
   - Lesser palatine and glossopharyngeal nerves (innervates the soft palate and tonsil)
   - Greater petrosal nerve, branch of the facial nerve and lesser palatine branches of the pterygopalatine ganglion

TOPOGRAPHY OF THE OESOPHAGUS
A) English: Oesophagus, gullet

B) Latin: Oesophagus

C) Greek: Oisophagos

D) Russian: Пищевод

E) Morphology:
   - It consists of 3 main parts, which are the cervical, thoracic and abdominal parts.
   - Layers:
     i. Adventitious layer
     ii. Muscular layer
        - External layer consists of longitudinal fibres.
        - Internal layer consists of circular fibres.
     iii. Submucous layer
     iv. Mucous layer
   - Along its course, there are 3 constrictions:
     i. 1st constriction: 6th cervical vertebra – mouth of the gullet
     ii. 2nd constriction: 5th thoracic vertebra crossing the bronchi and aortic arch
     iii. 3rd constriction: 10th thoracic vertebra entering the hiatus oesophagus
   - Between the constrictions there are 2 dilatations:
     i. Superior dilatation
     ii. Inferior dilatation
• Deviations of the oesophagus: On the superior part of the pectoral division, it deviates to the left side, and soon it deviates to the right again. At the level of 5th thoracic vertebra, it deviates to the left again, and at the level of 10th thoracic vertebra it penetrates the diaphragm and enters the abdominal cavity through the hiatus oesophagus. Finally, it connects with the stomach at its cardiac orifice.

F) Function:
• Conducting food from the oral cavity to the stomach

G) Holotopy:
• Cervical part: Cervical cavity
• Thoracic part: Pectoral cavity; posterior mediastinum; covered slightly by the pleura
• Abdominal part: Abdominal cavity; covered by the peritoneum

H) Skeletopy:
• 6th cervical – 11th thoracic vertebrae

J) Syntopy:
• Cervical part:
  i. Anterior: Trachea, left lobe of the thyroid gland and left recurrent nerve
  ii. Posterior: Vertebral column and prevertebral fascia
  iii. Superior: Pharynx
  iv. Bilateral: Common carotid artery, internal jugular vein, vagus nerve and recurrent laryngeal nerve

• Thoracic part (upper 1/3):
  i. Anterior: Left recurrent laryngeal nerve, left common carotid artery and trachea (right)
  ii. Posterior: Vertebral column
  iii. Bilateral: Mediastinal pleura (right), thoracic duct and left subclavian artery (left)

• Thoracic part (middle 1/3):
  i. Anterior: Aortic arch, bifurcation of trachea, left bronchus and tracheobronchial plexus
  ii. Posterior: Thoracic duct, prevertebral fatty tissue and azygos vein (right)
  iii. Bilateral: Descending aorta (left) and right vagus nerve (right)

• Thoracic part (lower 1/3):
  i. Anterior: Pericardium, heart and left vagus nerve with plexus
  ii. Posterior: Thoracic aorta (right), right vagus nerve and azygos vein
  iii. Bilateral: Left vagus nerve, left pleura (left) and right pleura (right)

• Abdominal part:
  i. Inferior: Stomach
  ii. Anterior: Peritoneum and left lobe of the liver
  iii. Posterior: Vertebral column
  iv. Bilateral: Upper pole of the spleen (left) and left lobe of the liver (right)

J) Arterial supply:
Cervical part: Inferior thyroid artery
- Thoracic part: Branches from the thoracic aorta
- Abdominal part: Inferior phrenic artery and left gastric artery

K) Venous drainage:
- Cervical part: Brachiocephalic vein
- Thoracic part: Azygos and hemiazygos vein
- Abdominal part: Portal vein

L) Lymphatic drainage:
- Cervical part: Paratracheal and inferior deep cervical nodes
- Thoracic part: Mediastinal lymph nodes
- Abdominal part: Left gastric and left inferior phrenic nodes

M) Nerve supply:
- Vagus nerve
- Sympathetic trunk
- Splanchnic nerve
- Oesophageal nerve

TOPOGRAPHY OF THE THYROID GLAND
A) English: Thyroid gland
B) Latin: Glandula thyroidea
C) Greek: Thyreos
D) Russian: Щитовидная железа

E) Morphology:
- Several structures are distinguished: right lobe (lobus dexter), left lobe (lobus sinister), isthmus and pyramidal lobe (lobus pyramidalis). The pyramidal lobe is an inconstant structure.

F) Function:
- Endocrine organ

G) Holotopy:
- Anterior part of the neck

H) Skeletopy:
- 5th cervical – 1st thoracic vertebrae

I) Syntopy:
- Anterior: Sternothyroid muscle, sternohyoid muscle, superior belly of the omohyoid muscle and external carotid artery
- Posterior: Pharynx, trachea, oesophagus and parathyroid glands
- Superior: Thyroid and cricoid cartilages
- Inferior: Trachea
- Medial: Cricothyroid muscle
- Lateral: Common carotid artery, internal jugular vein and vagus nerve
J) Arterial supply:
   - Superior thyroid artery (from the external carotid artery)
   - Inferior thyroid artery (from the thyrocervical artery)
   - Arteria thyroidea ima (from the brachiocephalic trunk)

K) Venous drainage:
   - Superior thyroid vein; then drained into the internal jugular vein
   - Inferior thyroid vein and vena thyroidea ima; then drained into the brachiocephalic vein

L) Lymphatic drainage:
   - Tracheal lymph nodes
   - Deep cervical lymph nodes
   - Mediastinal lymph nodes

M) Nerve supply:
   - Cervical ganglia of the sympathetic trunk
   - Middle and superior cervical parts of the vagus nerve
   - Superior laryngeal nerve
   - External laryngeal nerve
   - Recurrent laryngeal nerve

CONICOTOMY

- It is a transverse dissection of the cricothyroid ligament.
- The cricothyroid ligament is situated between the cricoid and thyroid cartilages.
- If a foreign body is found at the level of the cricoid cartilage closing the respiratory tract, conicotomy will not be useful; only tracheostomy is helpful.
- Conicotomy is easy to manipulate and does not cause damage to the thyroid cartilage.
TRACHEOSTOMY

Tracheotomy is an incision on the trachea, to gain access to the airway below a blockage by a foreign body or tumour.
This measure usually is made for emergency measure (after accident or operating patient).
Tracheotomy is an opening through the neck on the trachea with a tracheostomy tube inserted after tracheotomy.
It is usually done when long-term artificial ventilation of the lung is required.

A) Indications:
- Upper airway obstruction
- Lower airway protection against aspiration of saliva in comatose state
- Prolonged artificial respiration

B) Aims:
- To relieve the upper airway obstruction by tumour, foreign body, trauma or inflammatory swelling
- To clear the secretions and prevent the tracheobronchial tree obstruction
- To maintain prolonged artificial respiration
- To reduce the anatomical dead space

C) Procedures:
- A pillow is placed beneath the shoulders to assure hyperextension of the neck together with the chin being maintained in the midline.
- A 2 inch (5 cm) vertical midline incision on the skin is made, from the upper border of the cricoid cartilage to the sternal notch (heavy bleeding may occur due to the anastomosing veins located here in the superficial fascia).
- The incision of the deep fascia is continued in the midline opening the 2 sternohyoid muscles.
- Then, the endocervical fascia is incised transversely under the cricoid cartilage to expose the rings of the trachea.
- The trachea is then dissected by a small incision placed between the 2nd and 3rd or 3rd and 4th rings.
- The patient may cough violently due to entry of blood into the airway at this point.
- A tube is inserted by 1 moment as soon as possible, while the blood and secretion are sucked out.
- A metal tube is replaced once breathing has been restored.

D) Postoperative management:
- Constant supervision
- A well-ventilated warm room
- For cuffed tube: To release regularly the inflated pressure to reduce the ischemic necrosis of the tracheal wall
- For metal tube: To remove, clean, sterilize and replace the inner part as often as it becomes blocked
Aspiration of the secretions by a soft moist catheter

Physiotherapy

E) Advantages:
- Reduction of the anatomical dead space by approximately 50%
- Reduction of the work of breathing
- Increased level of alveolar ventilation
- Decreased level of sedation needed
- Patient's ability to talk and eat even if the tube is in place

F) Disadvantages:
- Formation of thick mucus which is able to block the tube
- Loss of ciliated cells causing the mucociliary stream to be arrested
- Aspiration of secretions

G) Complications:
- Haemorrhage
- Injury to the carotid artery
- Injury to the oesophagus
- Damage to the trachea
- Infection
- Swallowing dysfunction
- Tracheal stenosis
- Tracheoesophageal fistula

ACCESS TO THE OESOPHAGUS

A) Indications:
- Bullet or other wounds of the oesophagus
- Swallowing of the foreign body into the oesophagus
- Diverticulum

B) Procedures:
- The patient is placed in the supine position. A pillow is placed under the shoulder.
- The head is turned to the right side. The operative intervention is done on the left side of the neck.
- General anaesthesia or local anaesthesia is administered. The surgeon must avoid the anaesthesia of the recurrent laryngeal nerve. This procedure is performed under the control of the patient's voice.
- Dissection of skin, subcutaneous tissue, platysma and superficial fascia is made along the anterior margin of the left sternocleidomastoid muscle from the mastoid process to the superior margin of the thyroid cartilage. Then, the anterior covering of the sternocleidomastoid muscle is opened and retracted laterally.
- The posterior covering 3rd fascia of the neck and common sheath of the neurovascular bundles are dissected carefully; the common carotid artery, internal jugular vein and vagus nerve are retracted laterally.
A dissection is made between the anterior and posterior bellies of the omohyoid muscle on the superior border of the dissected tissue. The sternohyoid muscle, sternothyroid muscle, lateral lobe of thyroid gland and trachea are retracted. Then, the oesophagus which lies between trachea and vertebra is exposed. The soft tissue in front of the oesophagus is cleared with a blunt hook. The left inferior thyroid artery is ligated and dissected if necessary.

2. Ligature handles (ление держалка) are applied to the oesophagus; the oesophagus is opened longitudinally until the mucous membrane. The mucous membrane is held with a clamp and dissected with a scalpel. The wall of the oesophagus is dissected above the foreign body. The unaffected wall is dissected if the wall of the oesophagus above the foreign body is severely damaged. The foreign body is extracted by fingers or instrument through the opening.

The edges of the wound are retracted and processed. Interrupted catgut sutures are made through all layers of the oesophagus. Then, gauzes and gloves of the surgeon are changed. External interrupted silk sutures are applied to the muscular and adventitious layers.

Interrupted catgut sutures are applied to the anterior and posterior walls of the muscular coverings of the sternocleidomastoid muscle while the silk sutures are applied to the skin.

An oesophageal fistula is made in purulent inflammation of the perioesophageal tissue. A draining tube is inserted into the perioesophageal tissue. A nasogastric tube is inserted through the nose for feeding of the patient. A fistula of the stomach (gastrostomy) is made in severe patients.

NIKOLAEV’S SUBTOTAL AND SUBFASCIAL RESECTION OF THE THYROID GLAND

A) Indications:

- Diffuse toxic goitre
- Tumour of the thyroid gland

B) Procedures:

Patient is placed in the supine position with a pillow under the scapula. General anaesthesia or local anaesthesia is administered.

A collar-shaped incision on the skin fold 1 – 1.5 cm above the jugular notch and between the anterior margins of the sternocleidomastoid muscles (left and right).

Dissection of the skin, subcutaneous tissue, platysma and superficial fascia is made.

A superior flap (skin, subcutaneous tissue and muscle) is done until its base reaches the superior margin of the thyroid cartilage.

The anterior jugular vein which is located on the 2nd fascia or underneath it is ligated and sutured. The 2nd and 3rd fasciae are dissected longitudinally in the middle point between the sternohyoid and sternothyroid muscles. A transverse dissection of the sternohyoid muscle at the level of the skin dissection (dissection of the sternothyroid muscle in large goitre) and the Kocher’s probe (зонд Кохера) is introduced under the muscle; 2 clamps are applied and muscles are dissected. Then, the thyroid gland is exposed.

10 ml of 0.25 % Novocain solution is injected under the capsule of the thyroid gland. Resection of the thyroid gland with dissection of the isthmus of the thyroid gland is
performed with the help of the Kocher’s probe. If the pyramidal lobe is present, it is dissected at the beginning of the operation. The fascia of the capsule is retracted and the right lobe of the thyroid gland is dissected. The lower lobe is displaced first; then, the upper lobe is displaced and both of them are dissected. After the right lobe is dissected, haemostasis is performed with some clamps. Then, the fascia of the capsule is stitched by catgut sutures. The thyroid gland is processed with Novocain solution in order to clear away the toxic products. Then, the left lobe is removed as well.

The fascia of the capsule is sutured after being processed with Novocain solution. The sternohyoid muscle is stitched with a P-shaped catgut suture. An interrupted catgut suture is applied on the edge of the fascia; the skin is stitched by interrupted silk sutures.

A draining tube (bulbous end) is inserted into the wound for 1 day.
CHAPTER SIX
THE THORAX

DETAILS OF CONTENTS

Topography of the thorax, pleura, pericardium, diaphragm, mammary gland and lung

Intercostal spaces and their contents

Organs of the anterior mediastinum: heart, great vessels, thymus, phrenic nerve, thoracic part of the trachea, ascending aorta and aortic arch

Organs of the posterior mediastinum: thoracic part of the oesophagus, descending thoracic aorta, azygos and hemiazygos veins, thoracic duct, vagus nerve, splanchnic nerve and sympathetic trunk

Cardiopulmonary bypass system

Operations including pleural and pericardial punctures; operations for mastitis, non-malignant tumor and cancer of the breast; resection of the rib; preventive surgical processing of the penetrating and non-penetrating wounds; operations on the heart and great vessels; aortocoronary bypass; pulmonectomy, lobectomy, segmental resection of the lung; oesphagotomy, resection of the oesophagus; reconstructive operations on the oesophagus and surgical treatment of the oesophageal atresia
BORDERS OF THE THORAX

Anterior - Upper border of the manubrium sterni (incisura jugularis) and clavicle before acromion.
Posterior - Imaginary line between 7th cervical vertebra and acromion.

BORDERS AND ORIENTATION LINES OF THE THORAX

A) Borders:
- Superior aperture:
  i. Anterior: Upper border of the manubrium sterni
  ii. Posterior: Superior surface of the body of the 1st thoracic vertebra
  iii. Bilateral: 1st rib with its cartilage
- Inferior aperture:
  i. Anterior: Infrasternal angle between the 2 costal margins
  ii. Posterior: Inferior surface of the 12th thoracic vertebra
  iii. Bilateral:
    - Costal margin formed by cartilages of the 7th to 10th ribs
    - 11th and 12th ribs

B) Orientation lines:
- Anterior median line (linea mediana anterior) - Directed on the middle of the sternum
- Right and left sternal lines (linea sternalis dextra et sinistra) - Directed along the edge of the sternum
- Right and left parasternal lines (linea parasternalis dextra et sinistra) - Directed on the middle between the sternum and midclavicular line
- Right and left midclavicular lines (linea midclavicularis dextra et sinistra) - Directed on the middle of the clavicle and through the nipple
- Right and left anterior axillary lines (linea axillaris anterior dextra et sinistra) - Directed on the anterior edge of the axillary cavity
- Right and left midaxillary lines (linea axillaris media dextra et sinistra) - Directed through the middle of the axillary cavity
- Right and left posterior axillary lines (linea axillaris posterior dextra et sinistra) - Directed on posterior edge of the axillary cavity
- Right and left scapular lines (linea scapularis dextra et sinistra) - Directed through the scapular angle
- Right and left paravertebral lines (linea paravertebralis dextra et sinistra) - Directed between the scapular and posterior median lines
- Posterior median line (linea mediana posterior) - Directed along the vertebral spinal processes

LAYERS AND INTERCOSTAL SPACES OF THE THORACIC WALL

A) Skin
B) Subcutaneous tissue

C) Superficial fascia:
   - It forms the capsule for the mammary glands and *ligamentum suspensorium mammæ* (Cooper’s ligament).

D) Deep fascia:
   - Anterior wall: Pectoral, axillary, endothoracic and clavipectoral fasciae
   - Posterior wall: Nuchal and lumbar fasciae

E) Muscles:
   - The muscles of the thoracic wall may be divided into the extrinsic and intrinsic groups.
   - Extrinsic muscles – They have either their origins or insertions on the bony thorax.
     - Muscles of the upper limb: Pectoralis major, trapezius, serratus anterior, latissimus dorsi, levator scapulae, rhomboideus major, rhomboideus minor, serratus posterior superior, serratus posterior inferior muscles
     - Muscles of the abdomen: Rectus abdominis and external oblique muscles
     - Muscles of the back: Erector spinae muscle
   - In addition to the muscles listed above, a number of other muscles (of the abdomen and of the head and neck) are attached to the margins of the 2 apertures of the thorax.
   - Intrinsic muscles – They have both their origins and insertions on the thoracic wall and are innervated by the thoracic nerves.
     - External layer: External intercostal muscles
     - Middle layer: Internal intercostal muscles
     - Internal layer: Transverse thoracic and innermost intercostal muscles

F) Intercostal spaces and their contents:
   - There are 11 intercostal spaces.
   - They are wider above than below; anteriorly than posteriorly.
   - Each intercostal space contains the intrinsic thoracic muscles and intercostals veins, arteries and nerves.

**TOPOGRAPHY OF THE MAMMARY GLAND**

A) English: Mammary gland, breast

B) Latin: *Glandula mammae, mamma*

C) Greek: Mastos

D) Russian: Молочная железа

E) Morphology:
   - The nipple (*papilla mammæ*) is situated on the anterior surface of the gland. It is surrounded by the areola (*areola mammæ*). The areola contains the areolar (Montgomery’s) glands and sebaceous glands.
It is composed of acini, which make up lobules, whose aggregation will form the lobes of the gland.

- The lobes are partly separated from each other by irregular and incomplete fibrous septa, which are continuous with the gland stroma.
- These lobes are arranged in a radiating fashion and drained into lactiferous ducts (*ductus lactiferi*).
- 18 – 20 lobes drain through 18 – 20 ducts, which open on the nipple.
- There is a fascial capsule, which covers the whole gland.
- The organ is anchored to the overlying skin and the underlying pectoral fascia by bands of fibrous tissue, called the Cooper’s ligaments.
- These fibrous bands are accompanied by the lymphatic vessels, which, when invaded in breast cancer, will cause contraction and produce dimpling of the skin or attachment of the skin to the underlying growth.
- The cancer cells also grow along the fibrous processes to bind the breast tissue to the pectoral fascia.

F) Function:
- Lactation

G) Skeletopy:
- 3rd – 6th ribs

H) Syntopy:
- Posterior: Fatty tissue, pectoralis major and minor muscles, intercostal muscles and ribs

I) Arterial supply:
- Lateral thoracic artery
- Perforating cutaneous branches of the internal mammary artery
- Lateral branches of the 2nd, 3rd and 4th intercostal arteries

J) Venous drainage:
- Axillary vein
- Internal mammary vein
- Intercostal veins.

K) Lymphatic drainage:
- Superficial groups: Transmammar nodes, infraclavicular nodes, Grossman’s pathway to the superior axillary nodes and Gerota’s epigastric pathway
- Deep groups: Axillary (5 groups), pectoral, parasternal, substernal and inguinal lymph nodes
- The largest lymph node is called the Zorgius’ lymph node.

L) Nerve supply:
- 2nd to 5th intercostal nerves
- *Nervi pectorales medialis et lateralis* (from the brachial plexus)
- *Nervi supraclavicularares* (from the cervical plexus)
- Sympathetic nerves

**THORACIC CAVITY**
- It contains the right and left pleural cavities which are completely invaginated and occupied by the lungs.
- The right and left pleural cavities are separated by a thick median partition called the mediastinum.
- The heart lies in the mediastinum.

**PLEURAL CAVITY, PERICARDIAL CAVITY, INTERPLEURAL AREAS AND SINUSES**

A) Pleural cavity:
- The lungs are each encased in a serous sac, the pleura.
- The two sacs are separated by the mediastinum.
- The pleura consist of a parietal and a visceral layer, between which is a potential capillary space, the pleural cavity, containing a small amount of serous fluid.

B) Sinuses:
- Costodihaphragmatic triangle (the largest sinus)
- Mediastinodiaphragmatic triangle
- Anterior and posterior costomediastinal triangles

C) Interpleural areas:
- 2 triangular spaces in front and behind the sternum.

D) Pericardial cavity:
- The pericardial cavity is a potential space between the parietal pericardium and the visceral pericardium.
- It contains only a thin film of serous fluid which lubricates the apposed surfaces and allows the heart to move smoothly.

**TOPOGRAPHY OF THE DIAPHRAGM**

A) English: Diaphragm

B) Latin: Diaphragma

C) Greek: Diaphragma

D) Russian: Диафрагма

E) Morphology:
- The diaphragm is a dome-shaped muscle forming the partition between the thoracic and abdominal cavities.
It is the chief muscle of respiration.

The muscle fibres form the periphery of the partition.

They arise from the circumference of the thoracic outlet and are inserted into the central tendon (centrum tendineum).

3 parts (according to origin of the muscular fibres) are distinguished:
  i. Sternal part
  ii. Costal part
  iii. Lumbar part

Orifices:
  i. Foramen venae cavae – It transmits the inferior vena cava and right phrenic nerve.
  ii. Hiatus esophagus – It transmits the oesophagus, vagus nerve and lower oesophageal blood vessels.
  iii. Hiatus aorticus – It transmits the aorta, thoracic duct and azygos vein.
  iv. Sternocostal triangle (Morgagni’s foramen, trigonum sternocostale) – It transmits the superior epigastric vessels.

F) Functions:
  - Acting as a respiratory muscle
  - Assisting in moving lymph along the thoracic duct – “Passive lymphatic heart”

G) Weak places:
  - Lumbocostal triangle (Bochdalek’s foramen) lies just below the lateral lumbocostal arch. Owing to its poorly developed costal portion of the muscle, the diaphragm may be closed only by the connective tissue. On the left side, this area may be a site of the diaphragmatic (congenital) herniation.
  - Sternocostal triangle (Morgagni’s foramen) may also be a site of the diaphragmatic herniation.

H) Arterial supply:
  - Inferior phrenic artery
  - Superior phrenic artery
    - Branches from the superior epigastric artery
    - Lower intercostal arteries

I) Venous drainage:
  - Inferior phrenic vein

J) Lymphatic drainage:
  - Phrenic lymph nodes
  - Mediastinal lymph nodes
  - Parasternal lymph nodes

K) Nerve supply:
  - Phrenic nerve
7th to 12th intercostal nerves

MOTIVATION OF THE DISSECTION IN MASTITIS
The motivation of the dissection in mastitis is drainage of pus.
It is required in acute mastitis, when there is definite abscess formation.

OPERATIONS FOR MASTITIS, NON-MALIGNANT TUMOUR AND CANCER OF THE BREAST
A) Operation for mastitis:
In the cellullitic stage, antibiotic solution is administered and the breast is supported
with a firm poly-tailed bandage.
Local heat is applied to relieve pain.
When there is definite abscess formation, the treatment is drainage of pus.

B) Operations for non-malignant tumour and cancer of the breast:
Lumpectomy (partial mastectomy) is lymphadenectomy of the axillary lymph nodes.
Simple mastectomy includes surgical removal of the breast with an excision of the
axillary lymph nodes. It is indicated for large tumour and central tumour under the
nipple.
Halsted’s radical mastectomy is an excision of the breast with the axillary, subclavian
and subscapular lymph nodes, pectoralis major and pectoralis minor muscles. This
operation is no longer advocated as it causes considerable morbidity.
Patey’s modified radical mastectomy is more commonly performed. It is a wide
local excision or lumpectomy, which involves an excision of the tumour with a margin
of normal sufficient tissue to obtain macroscopic clearance. It results in a rather
higher incidence of local recurrence.
Quadrantectomy is a partial mastectomy in which a tumour is excised in 1 quadrant
of the breast and at least a 1-inch margin of the surrounding tissue along with the
pectoralis fascia. This operation is usually combined with axillary surgery via a
separate incision in the axilla to remove the lymph nodes.

a – Dissection lines for mastitis; 1, 2 – Radial dissection, 3 – Bardenheyer’s retromammary dissection; b –
Types of mastitis: 1 – Subareolar mastitis, 2 – Interstitial mastitis, 3 – Retromammary mastitis, 4 –
Galactophoritis; c – Tubes for drainage
TOPOGRAPHICO-ANATOMICAL MOTIVATION OF THE PLEURAL PUNCTURE

The motivation of the pleural puncture is to remove the purulent effusion or air within the pleural cavity in patients with pleural empyema, hydrothorax, haemothorax, chylothorax, or traumatic pneumothorax.

PLEURAL PUNCTURE

- It is also known as thoracocentesis or thoracentesis.

A) Aims: To aspirate fluid from the pleural cavity for diagnostic and therapeutic purposes

B) Procedures:

- The patient should be seated with his back facing the doctor and his face should look down to the floor.
- The site of puncture is infiltrate with 1% local anaesthetic solution.
- The pleural puncture should be made on the 8th or 9th intercostal space on the posterior axillary line.
- A large needle is introduced into the upper border of the rib to avoid damage to the vessels on the lower border. Then the fluid is aspirated as much as possible.
- After aspiration, antibiotic solution should be instilled.
- Some lipiodol is injected into the pleural cavity to determine the lower limit of the pleural cavity.

RESECTION OF THE RIB

A) Indications:

- Tumour of the rib
- Approach to the thoracic organs

B) Procedures:

- The patient is seated.
- General anaesthesia is introduced with an endotracheal tube for positive pressure respiration.
- The site of opening is decided.
- A vertical incision is preferred as it remains the choice of more than 1 rib for resection.
- Local anaesthesia is used along the line of the incision to the skin, muscles and intercostal spaces.
- The incision is made straight through the muscles up to the ribs.
- The intercostal nerves are infiltrated with local anaesthetic solution again.
- The periosteum is incised longitudinally for 5 – 7 cm and this section of the rib is cleared subperiosteally. For the periosteum, the Farabeuf’s raspatory is used.
- The upper and lower borders of the rib are thoroughly cleaned before introducing the Duane’s raspatory for stripping the periosteum from the inner surface of the rib.
The stripping of the periosteum from the borders are achieved by sweeping the Duane's raspatory from behind forwards for the upper border and from before backwards for the lower border of the rib to prevent laceration of the muscles. The intercostal vessels and nerves are thus protected from being injured. About 5-7 cm of the rib (devoid of periosteum), is thus resected by the rib shears. In case of bleeding, a catgut suture is made around the rib proximally for haemostatic purpose. The local anaesthetic is injected into the inner periosteum with the adherent parietal pleura to prevent pleural shock.

Resection of the rib and pleural puncture:
a - Separation of the periosteum from the external surface of the rib by a curved raspatory, b - Separation of the periosteum from the internal surface of the rib by the Duane's rib raspatory, c - Removing part of the rib by the rib scissors, d - Diagnostic puncture of the pleural cavity through the remained periosteum, e - Saturating of the wound after resection of the rib and drainage of the pleural cavity.

PREVENTIVE SURGICAL PROCESSING OF THE PENETRATING AND NON-PENETRATING THORACIC WOUNDS COMPLICATED WITH FRACTURES OF THE RIBS, PNEUMOTHORAX AND HAEMOTHORAX

A) Wounds complicated with fractures of the ribs:

- The patient must be hospitalized immediately.
- A relaxant drug is administered immediately, an endotracheal tube is introduced, intrapleural drains are given and positive pressure respiration is started.
- Bronchial cleaning may be required through the bronchoscopy.
- Modern plastic endotracheal tubes can be retained up to 5 days. But 10-14 days are required for the fractured ribs to unite. As a result of this, tracheostomy should be performed.
- This technique of 'internal pneumatic fixation' is capable of managing many patients with this injury.
But the main disadvantage of this process is that the patient is submitted to prolonged period of mechanical ventilation. For this reason, recently the old technique of operative fixation of the fractured ribs is becoming popular. A long curved incision is made over the affected side and the pleural space is entered by stripping the upper border of 1 of the ribs.

If there is any bleeding from the intercostal artery or internal mammary artery, it should be secured.

Additional fixation may be achieved by inserting sutures through the intercostal muscles.

Finally, thoracotomy is closed with a tube for drainage of the pleural cavity.

B) Wounds complicated with pneumothorax:

- Treatment of this condition is the closure of the wound in the chest wall as soon as possible.
- This may be done by pieces of gauze covered with Elastoplasts or with 1 or 2 skin stitches.
- After some time, proper exploration of the wound and debris should be carried out.
- If thoracotomy is required, it should not be done through the wound of the chest wall.

C) Wounds complicated with haemothorax:

- Treatment consists of transfusion to restore the blood volume, aspiration of the blood from the pleural cavity and sedation of the patient.
- Generally a draining tube is preferred, which is carried out through the 7th or 8th intercostal space on the mid-axillary line.
- A 2nd tube may be inserted through the 2nd intercostal space anteriorly if there is an associated pneumothorax. These tubes should be connected to an under-water-seal drainage.
- If the patient does not respond to this treatment, thoracotomy should be carried out.
- The indications of thoracotomy are:
  i. If bleeding continues as determined by signs of internal haemorrhage or if bleeding reaches 200 ml of blood per hour through the intercostal tube.
  ii. In presence of a large haemothorax, but unsuccessful clearing of the thorax by the intercostal tube due to constant blockage by fibrin clots.

CLASSIFICATION AND CONTENTS OF THE MEDIASTINUM

Mediastinum refers to a complex of organs situated between the mediastinal pleura.

The organs are surrounded by mediastinal fat, in which the neurovascular structure is located.

It is divided into the anterior and posterior departments by the frontal plane drawn posteriorly to the root of the lung.

A) Borders:

- Superior: Thoracic inlet
- Inferior: Diaphragm
Anterior: Sternum
Posterior: Vertebra column
Bilateral: Mediastinal pleura

B) Classification:
   - Anterior mediastinum
   - Posterior mediastinum

C) Anterior mediastinum (*mediastinum anterius*):
   - Skeletopy: 7th cervical – 6th thoracic vertebrae
   - Borders:
     a) Superior: Superior thoracic aperture
     b) Inferior: Thoracic surface of the diaphragm
     c) Anterior: Sternum and costal cartilages
     d) Posterior: Posterior part of the roots of the lungs
   - Contents:
     a) Superior: From the anterior to posterior, thymus (may be replaced by fatty tissue), superior vena cava and its root, ascending aorta, aortic arch with its branches, pulmonary veins, trachea, bronchi, phrenic nerve, bronchial arteries and veins, lymph nodes
     b) Inferior: Heart and pericardium

D) Contents of the posterior mediastinum (*mediastinum posterius*):
   - From the anterior to posterior, inferior vena cava, oesophagus, vagus nerve, thoracic (descending) aorta, thoracic duct, lymph nodes, azygos and hemiazygos veins, splanchic nerves

TOPOGRAPHY OF THE HEART

A) English: Heart

B) Latin: Cor

C) Greek: Kardia

D) Russian: Сердце

E) Morphology:
   - The heart has 4 chambers, which are the right atrium, right ventricle, left atrium, and left ventricle.
   - The right atrium is divided from the right ventricle by the bicuspid valve (mitral valve); the left atrium is divided from the left ventricle by the tricuspid valve.
   - The right ventricle is separated from the pulmonary trunk by the pulmonary valve; the left ventricle is separated from the aorta by the aortic valve.
   - All valves are stringed by the tendineal cord which is pulled by the papillary muscles.
   - Fossa ovale is located between right atrium and left atrium.
There is an auricle located on the right atrium.
- The superior vena cava and inferior vena cava are connected to the right atrium.
- The sinus atrium node is located in the right atrium while the atroventricular node is located in the interventricular septa.
- The atroventricular node gives out the His bundle which later divides into the Purkinje's fibres.
- There are 3 layers of the heart: epicardium, myocardium and endocardium.

F) Functions:
- Acting as a muscular pump sending blood to the arteries and receiving blood from the veins
- Production of atrial natriuretic hormone in the right atrium

G) Holotopy:
- Chest, anterior department

H) Skeletopy:
- Superoinferior: 3rd costal cartilage (or 3rd intercostal space) to 6th costal cartilage
- Right: 1 – 2.5 cm lateral to the right sternal line
- Left: 1 cm medial to the left midclavicular line

I) Syntopy:
- Superior: Superior vena cava, ascending aorta, pericardium, main vessels, pulmonary trunk, thymus, trachea, fatty tissue and anterior mediastinal lymph nodes
- Inferior: Pericardium, diaphragm and inferior vena cava
- Anterior: Pericardium, lungs, pleura, sternum, retrosternal fatty space, retrosternal and parasternal lymph nodes
- Posterior: Pericardium, descending aorta, oesophagus, vagus nerve, thoracic duct, azygos and hemazygos veins, sympathetic trunk, vertebral column, fatty tissue and posterior mediastinal lymph nodes
- Bilateral: Pericardium, lungs, pleura and phrenic nerves

J) Arterial supply:
- Right and left coronary arteries

K) Venous drainage:
- *Sinus coronarius cardis*
- *Veni cordis anteriores*
- *Veni cordis minimae*

L) Lymphatic drainage:
- Anterior mediastinal nodes
- Left tracheal nodes
- Tracheobronchial nodes
M) Nerve supply:
  - Superficial cardiac plexus (from the sympathetic trunk and vagus nerve)
  - Deep cardiac plexus (from the sympathetic trunk and vagus nerve)

TOPOGRAPHY OF THE PERICARDIUM

A) English: Pericardium

B) Latin: Pericardium

C) Greek: Perikardia

D) Russian: Околовсердечная сумка, перикард

E) Morphology:
   - It is closed serous sac which is composed of an outer fibrous layer (pericardium fibrosum) and an inner serous layer (pericardium serosum).
   - The serous layer is divided into the visceral and parietal layers.

F) Sinuses:
   - Transverse sinus of the pericardium (sinus transversus pericardii) – It is a passage behind the aorta and pulmonary trunk.
   - Oblique sinus of the pericardium (sinus obliquus pericardii) – It is a space bounded below and to the right by the inferior vena cava; above and to the left by the left pulmonary vein.

G) Function:
   - Producing fluid to reduce friction during the heart contraction

H) Holotopy:
   - Chest; anterior department

I) Skeletopy:
   - 4th – 9th thoracic vertebrae
   - 3rd – 5th intercostal spaces

J) Syntopy:
   - Superior: Main vessels
   - Inferior: Diaphragm
   - Anterior: Sternum
   - Posterior: Oesophagus and descending aorta
   - Lateral: Lung and pleura

K) Arterial supply:
   - Pericardiophrenic artery (from the internal thoracic artery)
   - Musculophrenic artery (from the internal thoracic artery)
- Pericardial branch of the bronchial artery
- Pericardial branch of the oesophageal artery
- Pericardial branch of the superior phrenic artery
- Coronary artery — It supplies the visceral layer of the pericardium serosum.

L) Nerve supply:
- Vagus nerve
- Phrenic nerve
- Sympathetic trunk

TOPOGRAPHY OF THE THORACIC AORTA
A) English: Thoracic aorta

B) Latin: Aorta thoracica

C) Greek: /

D) Russian: Грудная аорта

E) Holotopy:
- Chest; posterior department

F) Skeletopy:
- 4\textsuperscript{th} – 12\textsuperscript{th} thoracic vertebrae

G) Syntopy:
- Anterior: Root of the left lung, pericardium, oesophagus, bronchi and heart
- Posterior: Fat tissue, pectoralis major and pectoralis minor muscles, intercostal muscles and ribs
- Lateral: Thoracic duct, azygos vein, hemiazygos vein, sympathetic trunk and lungs
- Inferior: Aortic Arch

H) Branches:
- Visceral branches:
  i. Bronchial artery
  ii. Oesophageal artery
  iii. Pericardial artery
  iv. Mediastinal artery
- Parietal branches:
  i. Posterior intercostal artery
  ii. Subcostal artery
  iii. Superior phrenic artery

TOPOGRAPHY OF THE THYMUS
A) English: Thymus gland
B) Latin: Thymus

C) Greek: Thymos

D) Russian: Щитовидная железа, загрудинная железа, грудная железа

E) Morphology:
   It is divided into the cortical and medullary substances by the septa.

F) Function:
   Central organ of the immune system

G) Holotopy:
   Chest; anterior department

H) Skeletopy:
   In children: 1 – 1.5 cm over the manubrium sterni – 3rd (or 4th) rib
   In adults: Jugular notch (or 2nd thoracic vertebra) – 2nd intercostal space (or 3rd rib)

I) Syntopy:
   Superior: Fatty tissue and thyroid gland
   Inferior: Pericardium and heart
   Anterior: Sternum and pleura
   Posterior: Superior vena cava, ascending aorta, aortic arch, trachea and bronchial trunk
   Bilateral: Lung, pleura and phrenic nerves

J) Arterial supply:
   Internal thoracic artery
   Brachiocephalic trunk

K) Venous drainage:
   Left brachiocephalic vein
   Internal thoracic vein

L) Lymphatic drainage:
   Mediastinal nodes

M) Nerve supply:
   Sympathetic trunk
   Vagus nerve
   Cervical spinal nerves

TOPOGRAPHY OF THE TRACHEA
A) English: Trachea

B) Latin: Trachea
C) Greek: Tracheia

D) Russian: Трахея, дыхательное горло

E) Morphology:
   - The anterior 2/3 of the tracheal wall is made up of the C-shaped cartilaginous rings.
   - The posterior 1/3 is devoid of the cartilage and is made up of the trachealis muscle and fibrous tissue.

F) Function:
   - For air passage

G) Holotopy:
   - Neck, chest (in the midline)
   - Anterior department
   - Cervical, thoracic, pectoral and mediastinal cavities

H) Skeletotopy:
   - Lower border of the 6th cervical – Upper border of the 5th thoracic vertebrae

I) Syntopy (in the chest):
   - Anterior: Thymus and main vessels of the heart
   - Posterior: Oesophagus
   - Inferior: Bifurcation of the trachea
   - Bilateral: Lungs, pleura and aortic arch (in the left)

J) Arterial supply:
   - Inferior thyroid artery
   - Internal thoracic artery
   - Bronchial branches of the thoracic aorta

K) Venous drainage:
   - Inferior thyroid vein (drained into the left brachiocephalic vein)

L) Lymphatic drainage:
   - Tracheal nodes
   - Prelaryngeal nodes
   - Superior deep cervical nodes
   - Subclavian nodes
   - Anterior mediastinal nodes

M) Nerve supply:
   - Sympathetic trunk
   - Vagus nerve
   - Inferior laryngeal nerve (vagal branch)
TOPOGRAPHY OF THE ASCENDING AORTA
A) English: Ascending aorta

B) Latin: Aorta ascendens

C) Greek: /

D) Russian: Восходящая аорта

E) Holotopy:
   - Chest; anterior department

F) Skeletopy:
   - 2nd rib

G) Syntopy:
   - Anterior: Thymus and pleural
   - Posterior: Trachea, oesophagus and right pulmonary artery
   - Superior: Aortic arch
   - Inferior: Heart
   - Lateral: Pleural and lungs

TOPOGRAPHY OF THE AORTIC ARCH
A) English: Aortic arch

B) Latin: Arcus aortica

C) Greek: /

D) Russian: Дуга аорты

E) Holotopy:
   - Chest; anterior department

F) Skeletopy:
   - 1st intercostal space

G) Syntopy:
   - Anterior: Pleural and thymus
   - Posterior: Trachea, oesophagus and right pulmonary artery
   - Inferior: Heart
   - Lateral: Pleural and lungs

H) Branches:
   - Brachiocephalic trunk
Left common carotid artery
Left subclavian artery

**ACCESS TO THE ORGANS OF THE THORACIC CAVITY**

All surgical approaches to the organs of the thoracic cavity are called thoracotomy. The commonly used thoracotomies are the following: anterior or anterolateral thoracotomy; posterior or posterolateral thoracotomy and lateral one. Sternotomy is also used. It is subdivided into the transverse sternotomy and median (midline) sternotomy.

Surgical access to the thorax:
a – Anterolateral intercostal approach without intersection with the costal cartilages. b – Superior posterolateral approach to the lung. c – Lateral intercostal approach. d – Incision line on the skin by the median sternotomy

**Anterior or anterolateral thoracotomy:**
- The patient is placed in the lateral or dorsal decubitus position.
- A skin incision starts at the level of the 3rd rib along the parasternal line and runs down laterally to the nipple. The incision surrounds the nipple inferiorly and continues along the 4th intercostal space to the medial or posterior axillary line.
- The incision penetrates the subcutaneous tissue into the muscular layer (pectoralis major, pectoralis minor, anterior serratus, external and internal intercostal muscles), endothoracic fascia and parietal pleura. It is dangerous to injure the internal thoracic artery in the medial angle of the operative wound.

**Posterior or posterolateral thoracotomy:**
- The patient is placed in the lateral or ventral decubitus position.
- A skin incision starts between the medial border of the scapula and thoracic vertebral spines (paravertebral line) at the level of 3rd or 4th thoracic vertebra and runs vertically down, midway between the medial border of the scapula and spines of the vertebral column. Below the inferior angle of the scapula, the incision curves anteriously and continues along the 6th or 7th intercostal space to the medial or anterior axillary line.
- The incision penetrates the subcutaneous tissue into the muscular layer.
- Rib resection may be performed if it is necessary.
Lateral thoracotomy:

The patient is placed in the lateral decubitus position.

This is the most frequently used incision for operations on the lungs and organs of the anterior mediastinum. A skin incision starts at a level of 3rd or 4th intercostal space along the medioclavicular line. The incision continues along the intercostal space to the posterior axillary line.

Median sternotomy:

This is the most frequently used incision for open heart surgery. In thoracic surgery the median sternotomy may be the incision of choice for procedures requiring access to both hemi-thoraces such as bilateral pleurectomy, simultaneous resection of the metastatic lesions in both lungs and for excision of the thymic or anterior mediastinal tumours.

The patient is placed in the dorsal decubitus position. The skin, subcutaneous tissue, fasciae and periosteum are cut. The tunnel is made behind the sternum with the aid of the dressing forceps. The sternum is split by the sternotom, wire saw, gouge or electric saw.

The transverse sternotomy gives wider access to the organs of the thoracic cavity but is more traumatic because this incision is performed through both pleural cavities.

PERICARDIAL PUNCTURE

Puncture of the pericardial cavity is carried out, for example, in acute suppurative pericarditis, in order to aspirate fluid from the pericardial cavity.

A needle is introduced upwards and to the left through the costoxiphoid angle or through the 5th intercostal space.

After aspiration of the effusion, penicillin is administered.

Operative drainage is only indicated if aspiration and penicillin administration do not cure the patient rapidly.

OPERATIONS ON THE HEART AND GREAT VESSELS

When the heart has beating, it can be stimulated or massaged in order to restore its function and the life of the patient. Penetrating wounds of its walls can be sutured and foreign bodies are removed.

Obstruction of the valvular openings can be relieved, and fistulous communications between the 2 sides of the heart, or between chambers and vessels, can be closed. Furthermore, diseased heart valves can be repaired or replaced with the prosthetic valves under vision, with the support of cardipulmonary bypass, and the surgical operation on the coronary arteries is similarly performed.

GENERAL PRINCIPLES OF THE OPERATIONS ON THE CONGENITAL AND ACQUIRED DISEASES OF THE HEART

A) Congenital cardiac anomalies:

Patent ductus arteriosus:

i. It is an abnormal opening between the pulmonary artery and aorta caused by failure of the fetal ductus arteriosus to close after birth.

ii. Surgical closure is the treatment of choice whenever the diagnosis is confirmed.
Coarctation of aorta:
   i. It is a localized narrowing of the aorta mostly at a site just beyond the origin of the subclavian artery in close relationship to the ductus arteriosus.
   ii. The treatment is surgical excision of the stenosed segment and end-to-end anastomosis. Instead, a graft is sometimes required to bridge the wide defect which may result in excision of the stenotic segment.
   iii. Teflon and Dacron grafts are mostly used in these cases.

Atrial septal defect:
   i. It is an abnormal opening between the atria.
   ii. Persistence of the defect in the atrial septum allows the blood flow from the left atrium to the right atrium and from there to the pulmonary circulation.
   iii. These defects may be classified into ostium primum defect, ostium secundum defect and sinus venosus defect.
   iv. In case of ostium secundum defect, under hypothermia, the closure of the defect is performed with fine silk sutures. In case of ostium primum defect, which is a greater one and often associated with ventricular septal defect, extracorporeal circulation should be used to close the defect.

Ventricular septal defect:
   i. It is a defect characterized by 1 or more abnormal openings in the septum separating the ventricles.
   ii. The defect usually lies in the fibrous part of the septum.
   iii. The operation is always performed with the help of the extracorporeal circulation.
   iv. The defect is closed by suturing a patch of Dacron or pericardium.

Fallot’s tetralogy:
   i. The 4 defects which constitute this tetralogy are: pulmonary stenosis, ventricular septal defect, dextro-position of the aorta (which receives blood from both ventricles) and right ventricular hypertrophy.
   ii. The treatment is surgical. Palliative treatment in form of Blalock’s operation, which consists of an anastomosis between the side of the pulmonary artery and the proximal end of the subclavian artery, should be carried out without delay.
   iii. Alternative anastomosis procedures, when a Blalock’s operation cannot be done as in case of infants, are Pott’s operation in which descending aorta is anastomosed to the left pulmonary artery and Waterston’s operation in which ascending aorta is anastomosed to the right pulmonary artery.
   iv. Actual operation of complete correction is carried out with help of the extracorporeal circulation with additional hypothermia.
   v. The ventricular septal defect is closed by a Dacron patch.
   vi. The pulmonary valvular and infundibular obstruction is relieved and a Dacron patch is inserted to enlarge the tract.

B) Acquired heart diseases:
   Mitral stenosis:
i. It is an obstructive lesion in the mitral valve caused by adhesions on the leaflets of the valve.
ii. This condition is a common sequela to rheumatic heart disease.
iii. Whatever may be the cause of this mitral stenosis, this is 1 of the conditions in which operation (mitral valvotomy) gives a very satisfactory result and is often practiced even in not equipped operation theatres.

Mitrus insufficiency:

i. It is also known as mitral regurgitation. It is a backflow of blood from the left ventricle into the left atrium in systole across a diseased mitral valve.
ii. This condition requires a greater operation of valve replacement. This should be done under cardiopulmonary bypass.

Aortic valve diseases:

i. Aortic valve diseases include aortic stenosis and aortic insufficiency.
ii. The operation for this condition is the valve replacement either by a prosthetic valve or by a homograft valve. This operation is always performed under the cardiopulmonary bypass.

Atherosclerosis:

i. It is a form of arteriosclerosis in which atheromas containing cholesterol, lipoid material and lipophages are formed within the intima and inner media of the large and medium-sized arteries.
ii. Bypass grafting is the treatment of choice for atherosclerosis. This operation is pathologically based on the fact that atherosclerosis affects only a limited portion of proximal coronary arteries and does not involve distal vessels of 2 mm or less in diameter.
iii. This operation is routinely performed with extracorporeal circulation.

MITRAL COMMISSUROTOMY

It is a closed heart surgical operation which the mitral valve is divided at the junction of its cusps for treatment of mitral valve stenosis.

A) Indication:

Mitral valve stenosis

B) Aim: To widen the left atrioventricular orifice after the cicatricial process

C) Procedures:

The patient lies on the right side or is placed in the supine position.
The 1st incision is from the left parasternal line to the anterior axillary line on the 4th left intercostal space. The internal thoracic artery is ligated. The 3rd and 4th costal cartilages are intersected.
The wound is widened and separated from the anterolateral surface of the pericardium. The position of the phrenic nerve is determined on the pericardium.
The pericardium is dissected at the level of the left atrium, from the anterior or posterior margin of the phrenic nerve to the initial part of the pulmonary trunk.
The cut edge of the pericardium is fixed.

— 179 ——
In mitral stenosis, the enlarged left atrium has a pink colour; while the left ventricle (whose size is decreased) has a blue colour. This is known as the Kudan’s symptom. After separation of the auricle, a purse-string suture is applied 1 cm above its base. A special clamp is applied under the purse-string suture. The tip of the auricle is dissected with scissors. The cavity of the auricle is processed with heparin solution. The special clamp from the base is removed. The surgeon’s index finger is inserted into the left atrium and the purse-string is pulled by an assistant to prevent bleeding. The index finger is inserted to widen the atroventricular orifice. A comissurotome is placed on the tip of the index finger to widen the atroventricular orifice if the orifice is extremely dense and thick. Its diameter is widened up to 3.5 – 4 cm. The index finger is then removed from the atrium and an elastic clamp is applied to the base of the atrium simultaneously.

The purse-string suture is removed after the opening of the left atrium is stitched by a blanket silk suture.

The pericardial cavity is processed with warm physiological solution. The pericardium is stitched by interrupted catgut sutures.

The wound is stitched layer by layer. A plastic tube is inserted into the pleural cavity through the thoracic wall for 24 – 48 hours. Puncture on the 6th or 8th intercostal space is made to remove the pleural fluid if there is excess fluid in the pleural cavity.

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**Mitral comissurotomy:**

a – Insertion of the index finger into the left atrium to separate the anterior cusp. b – Separation of the posterior cusp; the arrows indicate the movement of the distal phalanx.

**OPERATIVE ACCESS TO THE HEART**

The left thoracotomy is used for closed operations on the heart, closure of the patent ductus arteriosus, resection of the aortic coarctation and urgent exposure of the heart. With the patient partly on his side, an incision is made on the 4th or 5th intercostal space extending from the left margin of the sternum to the posterior axillary line. In urgent cases – for example, cardiac arrest or wounds, the incision is deepened directly through the intercostal space, and the pleural cavity is opened on the same line. A better approach associated with less bleeding, is through the deep periosteum of the rib above the incision (but without rib resection).

For wider access, the incision can be extended transversely (trans-sternal thoracotomy) by dividing the sternum with Gigli’s saw and ligation of the 2 internal mammary arteries.
The median sternotomy gives the best approach to all other operations on the heart, particularly those with the cardiopulmonary bypass. The vertical incision extends from the sternal notch to the xiphoid process. The sternum is split with a sternal gouge or pneumatic or electrical saw. A very careful closure using heavy wire sutures to fix the sternum is needed.

**STITCHES OF THE HEART WOUNDS**

A) Atrial wounds:
- Atrial wounds are immediately controlled by a finger pressure and then an appropriate clamp (Brock's mitral or Craaford's arterial clamp) is applied. The wound is then stitched with vascular sutures.

B) Ventricular wounds:
- Ventricular wounds are also similarly controlled by a finger pressure and then vascular sutures are applied, while the finger pressure is gradually released. A pad of Dacron may be used to reinforce the closure if the muscle is friable. The internal mammary artery is secured. The pericardium is left unsutured, so that the bleeding will take place in the pleural cavity rather than in the pericardial cavity, which may give rise to cardiac tamponade again. Drainage of the pleural cavity is required.

**CARDIOPULMONARY BYPASS SYSTEM**

It is an extracorporeal system used in heart surgery in which the blood is diverted from the heart and lungs by means of a pump oxygenator and returned directly to the aorta. The components of this system include a heat exchanger, venous reservoir, filter and oxygenator. It permits the performance of cardiac surgery for coronary artery diseases, repair of the interatrial and interventricular septal defects, replacement of the aortic, mitral, and tricuspid valves, correction of the aortic defects and Fallot's tetralogy, and heart transplant.
AORTOCORONARY BYPASS

- It is a surgical procedure for treatment of ischemic heart diseases, in which a saphenous vein or other blood vessel or a synthetic graft is used to build a shunt from the aorta to one of the coronary arteries in order to bypass a circulatory obstruction.

A) Indication:
- Ischemic heart disease (e.g., angina pectoris, myocardial infarction)

B) Procedures:
- Coronary angiography is a requisite before any bypass is contemplated, for it is the only diagnostic procedure that can anatomically orient the surgeon to the location and extent of obstruction.
- The surgical approach is the median sternotomy.
- The grafts used may be venous or arterial.
- The most popular venous homograft is the great saphenous vein, although the cephalic vein may also be used.
- The arterial graft is the internal mammary artery related to the ventral wall of the thorax after arising from the 1st portion of the subclavian artery.
- The proximal end of the venous graft is anastomosed to the ascending aorta and the distal end of the obstructed site.
- It is most important that the veins be in the reversed anatomical position because of their valvular arrangement.
- With the internal mammary graft, the vessel's origin is kept intact from the subclavian artery and, after being freed from the anterior thoracic wall, its distal end is also anastomosed into the coronary artery distal to the obstruction.
- It is imperative that the distal anastomosis in both types of grafts be made in an area devoid of arteriosclerotic changes in the adjacent myocardium.

Aortocoronary bypass:
a - Scheme of reconstruction of the anterior interventricular artery. b - Scheme of reconstruction by 2 aortocoronary shunts
TOPOGRAPHY OF THE OESOPHAGUS

A) English: Oesophagus, gullet

B) Latin: Oesophagus

C) Greek: Oisophagus

D) Russian: Пищевод

E) Morphology:
   - 3 parts are distinguished, which are the cervical (pars cervicalis), thoracic (pars thoracica) and abdominal (pars abdominalis) parts.
   - Layers:
     i. Serous layer:
        - It is covered by the serous layer when it pierces the diaphragm
     ii. Adventitious layer (tunica adventitia)
     iii. Muscular layer:
        - External layer consists of longitudinal fibres
        - Internal layer consists of circular fibres
     iv. Submucous layer
     v. Mucous layer

F) Function:
   - Conducting food from the oral cavity to the stomach

G) Holotopy:
   - Left midline of the neck, thorax and projected on the left hypochondriac region

H) Skeletopy:
   - 6th cervical ~ 11th thoracic vertebrae

I) Syntopy:
   - Thoracic part (upper 1/3):
     iv. Anterior: Left recurrent laryngeal nerve, left common carotid artery and trachea (right)
     v. Posterior: Vertebral column
     vi. Bilateral: Mediastinal pleura (right), thoracic duct and left subclavian artery (left)
   - Thoracic part (middle 1/3):
     iv. Anterior: Aortic arch, bifurcation of trachea, left bronchus and tracheobronchial plexus
     v. Posterior: Thoracic duct, prevertebral fatty tissue and azygos vein (right)
     vi. Bilateral: Descending aorta (left) and right vagus nerve (right)
   - Thoracic part (lower 1/3):
     iv. Anterior: Pericardium, heart and left vagus nerve with plexus
     v. Posterior: Thoracic aorta (right), right vagus nerve and azygos vein
vi. Bilateral: Left vagus nerve, left pleura (left) and right pleura (right)
   Abdominal part:
   v. Inferior: Stomach
   vi. Anterior: Peritoneum and left lobe of the liver
   vii. Posterior: Vertebral column
   viii. Bilateral: Upper pole of the spleen (left) and left lobe of the liver (right)

J) Arterial supply:
   Oesophageal artery (from the inferior thyroid artery, inferior phrenic artery and left
   gastric artery)

K) Venous drainage:
   Oesophageal vein

L) Lymphatic drainage:
   Deep cervical nodes
   Tracheal nodes
   Tracheobronchial nodes
   Posterior mediastinal nodes
   Abdominal nodes

M) Nerve supply:
   Vagus nerve
   Sympathetic trunk

TOPOGRAPHY OF THE DESCENDING THORACIC AORTA
A) English: Thoracic aorta

B) Latin: Aorta thoracica

C) Greek: Α""ρτή ""θορακική

D) Russian: Грудная аорта

E) Skeletopy:
   4th – 12th thoracic vertebrae

F) Syntopy:
   Anterior: Root of left lung, pericardium, oesophagus, bronchi and heart
   Posterior: Fatty tissue, pectoralis major and minor muscles, intercostal muscles and
   ribs
   Lateral: Thoracic duct, azygos vein, hemiazygos vein, sympathetic trunk and lungs
   Inferior: Aortic arch
G) Branches:
   i. Bronchial artery
   ii. Oesophageal artery
   iii. Pericardial artery
   iv. Mediastinal artery
   Parietal branches:
   i. Posterior intercostal artery
   ii. Subcostal artery
   iii. Superior phrenic artery

TOPOGRAPHY OF THE AZYGOS AND HEMIazygos Veins
A) English: Azygos and hemiazygos veins
B) Latin: Vena azygos et vena hemiazygos
C) Greek:
D) Russian: Непарная и полунепарная вены
E) Azygos vein (unpaired vein): It consists of the veins on each side of the vertebra column that drain blood from the posterior wall of the thorax and abdomen. It connects with the superior vena cava. It receives blood from the mediastinal, oesophageal and bronchial veins.
F) Hemiazygos vein (half unpaired): It arises from the left side by joining the left subcostal and ascending lumbar veins. It receives blood from 3 inferior posterior intercostal, inferior esophageal, and small mediastinal veins.

TOPOGRAPHY OF THE THORACIC DUCT
A) English: Thoracic duct
B) Latin: Ductus thoracicus
C) Greek:
D) Russian: Грудной проток
E) Functions:
   • Receiver of 75% of total lymph from the body, including the left part of the head, neck, thorax, left upper limb, both lower limbs, abdominal and pelvic parts
F) Holotopy:
G) Skeletopy:
- 2nd lumbar – 7th cervical vertebrae

H) Syntopy:
- Anterior: Pericardium, oesophagus, bronchi, heart, main vessels and diaphragm
- Posterior: Vertebral column and posterior intercostal vessels
- Lateral: Azygos vein, hemiazygos vein, sympathetic trunk and lungs
- Inferior: Cisterna chyli (of Picquet)

I) Main tributaries:
- Right and left lumbar lymph trunks
- Intestinal lymph trunk
- Left jugular trunk
- Left subclavian trunk

TOPOGRAPHY OF THE VAGUS NERVE (NERVUS VAGUS)
In the thoracic part, the main branches of the vagus nerve include:

Recrrent laryngeal nerve:
- i. The right branch lies in front of the subclavian artery, and then it curves below
  and behind it.
- ii. The left branch lies in front of the aortic arch, and then it curves below and
  behind it.
- iii. They then ascend between the oesophagus and trachea, giving out the tracheal
  branches and esophageal branches.
- iv. The end of the nerve is named the inferior laryngeal nerve, innervating some
  laryngeal muscles, mucosa below vocal cords, root of the tongue near the
  epiglottis, trachea, throat, esophagus, thyroid gland, thymus, cervical lymph nodes,
  heart and mediastinum.
- v. It connects with the neighbouring nerves, sympathetic ganglia and perivascular
  plexus.

Lower cardiac branches:
- i. It consists of 2 branches from the recurrent laryngeal nerve and thoracic portion
  of the vagus nerve.
- ii. They pass to the cardiac plexus.

Pulmonary and tracheal branches:
- i. They form the pulmonary plexus together with the branches of the sympathetic
  trunk.
- ii. The plexus innervates the smooth muscles and glands of the trachea and bronchi.
- iii. It also contains sensory fibers for the trachea, bronchi and lung.

Thoracic branches
- Oesophageal branches
- Small branches to the thoracic duct
TOPOGRAPHY OF THE SYMPATHETIC TRUNK
(TRUNCUS SYMPATHICUS)

The thoracic part of the sympathetic trunk lies in front of the neck of the ribs and is covered anteriorly by the pleura.

It consists of 10 to 12 ganglia.

It is characterized by presence of the white communicating branches (rami communicantes albae) connecting the anterior roots of the spinal nerves with the sympathetic trunk.

It has the following branches:

i. Cardiac branches: They arise from the superior thoracic ganglia and form the cardiac plexus.

ii. Grey communicating branches: They are non-medullated fibers supplied to the intercostals nerves (somatic part of the sympathetic system).

iii. Pulmonary branches: They form the pulmonary plexus.

iv. Aortic branches: They form the thoracic aortic plexus, part of the esophageal plexus, and plexus of the thoracic duct.

v. Greater and lesser splanchnic nerves

TOPOGRAPHY OF THE SPLANCHNICUS NERVE

The greater splanchnic nerve is formed by the 5th to 9th thoracic ganglia. It passes medial to the level of the 9th thoracic vertebra, fuses into 1 common trunk and then passes through the space between the muscular bundles of the diaphragmatic crura into the abdominal cavity and forms part of the coeliac plexus.

The lesser splanchnic nerve is formed by the 10th to 11th thoracic ganglia. Then it penetrates into the abdominal cavity together with the greater splanchnic nerve or separately to form the coeliac plexus too.

They include vasoconstriction fibers, fibers inhibiting motor activity of the stomach and intestine, and sensory fibers from the viscera.

TOPOGRAPHY OF THE LUNG

A) English: Lung

B) Latin: Pulmo

C) Greek: Pneumon

D) Russian: Лёгкие

E) Morphology:

a) 3 surfaces:
   - Diaphragmatic surface (facies diaphragmatica)
   - Costal surface (facies costalis)
   - Medial surface (facies medialis)

b) Lobes and segments:
   - Right:
i. Upper lobe (lobus superior):
   - Apical segment (segmentum apicale)
   - Posterior segment (segmentum posterius)
   - Anterior segment (segmentum anterius)

ii. Middle lobe (lobus medius):
   - Lateral segment (segmentum laterale)
   - Medial segment (segmentum mediale)

iii. Lower lobe (lobus inferior):
   - Apical segment (segmentum apicale)
   - Medial / cardiac basal segment (segmentum basale mediale s. cardiacum)
   - Anterior basal segment (segmentum basale anterius)
   - Posterior basal segment (segmentum basale posterius)
   - Lateral basal segment (segmentum basale laterale)
   - Subapical segment (segmentum subapicale s. subsuperius) – inconstant

Left:

i. Upper lobe (lobus superior):
   - Apicoposterior segment (segmentum apicoposterius)
   - Anterior segment (segmentum anterius)
   - Superior lingular segment (segmentum lingulare superius)
   - Inferior lingular segment (segmentum lingulare inferior)

ii. Lower lobe (lobus inferior):
   - Apical segment (segmentum apicale)
   - Medial / cardiac basal segment (segmentum basale mediale s. cardiacum)
   - Posterior basal segment (segmentum basale posterius)
   - Lateral basal segment (segmentum basale laterale)
   - Subapical segment (segmentum subapicale s. subsuperius) – inconstant

F) Functions:
   - Respiratory function: Gaseous exchange
   - Non-respiratory functions:
     - Participating in metabolism (water, lipid and salt with regulation of chlorine balance)
     - Excretion of waste products
     - Maintaining acid-base balance in the organism
     - Participating in phagocytosis by alveolar macrophages (dust cells)
     - Conversion of the angiotensinogen into the angiotensin I

G) Holotopy:
   - Chest; anterior department; thoracic, pleural and pectoral cavities; covered by the pleura

H) Skeletopy:
   - Superior: 3 – 4 cm above the 1st rib (or 2 – 3 cm above the clavicle or 7th cervical vertebra)
Inferior: 5th intercostal space (right), 6th rib (left)

I) Syntopy:
- Superior: Pleura, subclavian artery and vein
- Inferior: Pleura, diaphragm, liver (right) and stomach (left)
- Anterior: Pleura, ribs, intercostal muscles, internal thoracic arteries and veins
- Posterior: Pleura, ribs and posterior thoracic wall
- Medial: Pleura, root of the lung, pericardium, heart, mediastinum, thymus, trachea, oesophagus, azygos and hemiazygos veins, phrenic nerve, thoracic duct, superior vena cava, ascending aorta, aortic arch, descending aorta, pericardiocophrenic artery and vein
- Lateral: Pleura, ribs and lateral thoracic wall

J) Arterial supply:
- Bronchial branches of the aorta
- Bronchial branches of the posterior intercostal arteries
- Bronchial branches of the subclavian artery

K) Venous drainage:
- Right: Right bronchial veins; then drained into the azygos vein
- Left: Left bronchial veins; then drained into the left superior intercostals vein or hemiazygos vein
- Pulmonary veins

L) Lymphatic drainage:
- Right:
  - i. Upper: Right tracheal nodes
  - ii. Middle: Tracheal and tracheobronchial nodes
  - iii. Lower: Tracheobronchial nodes
- Left:
  - i. Upper: Left tracheal and anterior mediastinal nodes
  - ii. Lower: Tracheobronchial nodes

M) Nerve supply:
- Pulmonary plexus (branches of the vagus nerve and sympathetic trunk)

TOPOGRAPHY OF THE ROOT OF THE LUNG

A) English: Root of the lung

B) Latin: Radix pulmonis

C) Greek: /

D) Russian: Корень легкого

E) Skeletopy:
- 5th thoracic vertebra
F) Syntopy:
- Superior: Pulmonary artery
- Inferior: Pulmonary vein
- Middle: Bronchus

G) Contents:
- Bronchi, pulmonary artery and nerves enter the lungs through this root.
- 2 pulmonary veins and lymphatic vessels leave the lungs through this root.

OPERATIONS ON THE LUNG AND MEDIASTINUM
- The removal of the entire lung, lobe, or a bronchopulmonary segment or segments depends on the location and the extent of the disease.
- The lesser the resection, the greater the demand for knowledge for bronchopulmonary and vascular anatomy. It is because in removing a diseased segment, the bronchial supply and blood supply of the adjacent lung segments must be preserved.
- The main technical problem in segmental resection is identification of bronchial, arterial, and venous elements supplying the segment, and dissection in the intersegmental planes without injury to the adjacent segments.
- This identification must be done by isolating several or all of the arteries entering the lobe.
- If doubt still exists, temporary occlusion of the bronchus with the use of alternate expansion and collapse of the surrounding lung is helpful in fixing the boundaries of the segment.
- When the proper bronchus has been identified and sectioned, traction on its distal end with simultaneous dissection peripherally permits the isolation of the segmental arteries and veins as they become evident.
- A great number of variations in vascular patterns, particularly in the left upper lobe, make this approach the only reliable one.
- The main indications of operations on the lung and pleura are bronchiectasis, benign and malignant tumours of the lung, chronic lung abscess, fibrocavernous tuberculosis and chronic pleural empyema.
- Resection of the lung – removing part of the lung
- Pneumonecetomy – removing the whole lung
- Lobectomy – removing a lobe of the lung
- Bilobectomy – removing 2 lobes of the lung
- Segmentectomy – removing segment of the lung
- For complete removal of the chronic empyema of the pleura, pleurectomy with decortication of the lung is performed to remove the suppurative (purulent) sac completely. Decortication of the lung – removing the fibrous surface.

PULMONECTOMY, LOBECTOMY AND SEGMENTAL RESECTION
A) Pneumonecetomy:
- Indications:
  i. Lung cancer
ii. Multiple abscesses
iii. Spreading of the bronchiectasis
iv. Tuberculosis of the lung

Procedures:

i. The pleura are divided at the hilum of the lung.
ii. The structures are separated.
iii. The vein is isolated and divided by double ligatures to prevent the tumor emboli from spreading through the vein.
iv. The pulmonary artery is divided by double ligatures.
v. The bronchus is divided close to the bifurcation of the trachea, so that no blind end remains.
vi. Closure of the bronchus is done as usual.

B) Lobectomy:

Indications:

i. Chronic suppurative process (abscess and bronchiectasis) and tumour limited in 1 lobe
ii. Cavernous tuberculosis

Procedures:

i. Generally lobes are well demarcated by fissures.
ii. But sometimes in affected lungs, there may be adhesions between the lobes.
iii. The lobe, which is upon resection, is held with forceps and the surrounding adhesions are divided by sharp dissection.
iv. In case of lower lobes, pulmonary ligaments have to be divided.
v. The visceral pleura around the hilus are incised and the lobar bronchus should be isolated.
vi. This bronchus is clamped and the corresponding vessels are divided between ligatures.
vii. The bronchus is divided proximal to the clamp and close to its origin from the main stem.
viii. The bronchus is closed by interrupted non-absorbable suture material.
ix. The bronchial stump may then be over-sewn by the mediastinal pleura.

C) Segmental resection:

Indications:

i. Cavernous tuberculosis
ii. Echinococcosis
iii. Bronchiogenic cyst

Procedures:

i. Broncho-pulmonary segments are independent segments of the lung so far as the arterial supply and bronchus are concerned although the venous drainage is shared with other segments.
ii. The access is usually obtained by posterolateral thoracotomy through the level of the 5th, 6th or 7th rib, depending on the position of the tumour.

iii. At first the segmental bronchus and its accompanying artery are isolated.

iv. The bronchus is clamped and the lung is inflated by the anaesthetist. This will delineate the segment (upon resection) as this segment will remain collapsed, whereas the rest of the lung will be inflated.

v. The segment is now gradually separated from its neighbours and the visceral pleura is divided.

vi. The vessels are secured carefully.

vii. The bronchus is now divided proximal to the clamp and the whole segment of the lung is removed.

viii. The bronchus is divided close to its parent’s stem, without leaving a blind end.

ix. The bronchial stump is sutured carefully with interrupted non-absorbable sutures.

x. The bronchial stump is never clamped and the bronchus is always divided close to its parent’s stem.

**OESOPHAGOTOMY AND RESECTION OF THE OESOPHAGUS**

A) Oesophagotomy (opening or dissection of the oesophagus):
   
   Indications:
   
   i. Foreign body of the oesophagus
   
   ii. Haemorrhage of the oesophagus

B) Resection of the oesophagus:
   
   Indications:
   
   i. Tumour of the oesophagus
   
   ii. Constriction of the oesophagus

   Procedures:
   
   i. The mediastinum is dissected along the anterior margin of the left sternocleidomastoid muscle.
   
   ii. The cervical part of the oesophagus is retracted superiorly till the tumour is seen. The tumour is then removed.

**RECONSTRUCTIVE (RESTORATIVE) OPERATIONS ON THE OESOPHAGUS**

A) Indications:
   
   - Cicatrical narrowing of the oesophagus
   
   - Extirpation of the oesophagus
   
   - Ineffective widening of the oesophagus with the aid of bougieurage

B) The stomach, small and large bowels are usually used as grafts (transplants) for oesophagoplasty. Nowadays, the greater curvature is predominantly used as a tubular graft for oesophagoplasty.

C) Depending on the localization of the grafts, they are divided into the antethoracic, retrosternal, retrocostal and posteromediastinal ones.
SUGICAL TREATMENT OF THE OESOPHAGEAL ATRESIA

A) Indication:
   - Oesophageal atresia – congenital absence or closure of the oesophagus

B) Procedures:
   - The operation is performed mostly through the right-sided thoracotomy at the level of the 5th intercostal space.
   - The pleura is gradually separated from the thoracic wall till the mediastinum is exposed.
   - The azygos vein is divided by ligatures.
   - A catheter is pushed into the upper segment of the esophagus by the anaesthetist to facilitate the isolation of this segment of the esophagus.
   - The lower segment of the esophagus is transected below the tracheo-esophageal fistula and the lower segment is mobilized.
   - End-to-end anastomosis is made between the two ends of the esophagus with interrupted silk sutures through all layers.
   - A tube is passed through the anastomosis for feeding.
   - An extrapleural drain is inserted.
   - It may so happen that the end of the esophagus may not be brought together.
   - In this case the upper end should be brought to the surface on the left side of the neck above the clavicle and a gastrostomy is performed for feeding.
CHAPTER
SEVEN
THE
ABDOMEN

DETAILS OF CONTENTS

Divisions of the abdominal wall and projection of the abdominal organs

Topography of the umbilical region, white line and inguinal region

Abdominal hernias

Peritoneum and peritoneal formation; connections between the abdominal and pelvic cavities; spreading of purulent processes in the abdominal cavity

Topography of the hollow organs: stomach, gall bladder, small and large intestines

Topography of the parenchymatous organs: liver, spleen and pancreas

Operations including laparotomy, laparocentesis, laparoscopy and laparostomy; herniotomy and hernioplasty; gastrotomy, gastrostomy, resection of the stomach, vagotomy, drainage and reconstructive operations on the stomach; haemostatic methods in liver haemorrhage; splenectomy; principles of operations on the pancreas; cholecystectomy, cholecystostomy and choledochostomy; resection of the small intestine, enterostomy, appendectomy, colotomy, colostomy, formation of the artificial anus
ANTEROLATERAL ABDOMINAL WALL

- Anterolateral abdominal wall is the muscular aponeurotic formation limited by the abdominal wall from the anterior and lateral sides.

A) Borders:
- Superior: Costal arches of both sides and xiphoid process
- Inferior: Iliac crest, anterior superior iliac spines of both sides, inguinal ligaments or inguinal folds of both sides, pubic symphysis and pubic tubercle
- Lateral: Continuation of the midaxillary lines (Lesgaft's lines) of both sides

B) Orientation Lines:
- Horizontal orientation lines:
  i. Superior horizontal line (linea costarum, linea bicostalis):
     - It joins the lowest points of the costal arches.
     - Area superior to this line is the epigastrium.
  i. Inferior horizontal line (linea spinarum, linea bispinalis):
     - It joins the anterior superior iliac spines of both sides.
     - Area inferior to this line is the hypogastrium.
     - Area between these 2 lines is the mesogastrium.
- Vertical orientation lines:
  1. Right midclavicular line (linea clavicularis media, linea mamillaris dextra):
     - It joins the middle point of the right clavicle to the middle point of the right inguinal ligament.
  2. Left midclavicular line (linea clavicularis media, linea mamillaris sinistra):
     - It joins the middle point of the left clavicle to the middle point of the left inguinal ligament.

Orientation lines of the anterior wall:
- a - Left and right midclavicular lines
- b - Left and right semilunar lines (lateral rectus plane)
- c - Transpyloric plane
- d - Subcostal plane
- e - Intertubercular plane
- f - Interspinous plane
C) Regions:

The abdomen is divided into 9 regions by the orientation lines:

i. Right hypochondriac region (regio hypochondriaca dextra)
ii. Proper epigastric region (regio epigastrica propria)
iii. Left hypochondriac region (regio hypochondriaca sinistra)
iv. Right lateral abdominal region (regio abdominalis lateralis dextra)
v. Umbilical region (regio umbilicalis)
vi. Left lateral abdominal region (regio abdominalis lateralis sinistra)
vii. Right inguinal (ilioinguinal) region (regio ilioinguinalis dextra)
viii. Hypogastric (suprapubic) region (regio suprapublicalis)
ix. Left inguinal (ilioinguinal) region (regio ilioinguinalis sinistra)

D) Quadrants:

The abdomen is divided into 4 quadrants by the sternal line (linea sternalis) corresponding to the white line (linea alba abdominis) and transumbilical line (linea transumbilicalis) crossing the umbilicus:

i. Right upper quadrant
ii. Left upper quadrant
iii. Right lower quadrant
iv. Left lower quadrant

E) Projection of organs on the abdomen (holotopy of the abdominal organs):

Right hypochondriac region:

i. Right lobe of the liver, gall bladder, superior pole of the right kidney, right suprarenal gland and right colic flexure of the large intestine

Proper epigastric region:

i. Left lobe of the liver, stomach, body of the pancreas, superior part of the duodenum, inferior vena cava, abdominal aorta, coeliac trunk, coeliac plexus and lesser omentum

Left hypochondriac region:

i. Part of the stomach, left colic flexure of the large intestine, spleen, superior pole of the left kidney, left suprarenal gland, tail of the pancreas

Right lateral abdominal region:

i. Ascending colon, right kidney (except the superior pole), right ureter and loops of the small intestine

Umbilical region:

i. Duodenum (except the superior part), head of the pancreas, transverse colon, loops of the small intestine and inferior vena cava

Left lateral abdominal region:

i. Descending colon, left kidney (except the superior pole), left ureter and loops of the small intestine

Right inguinal region:

i. Caecum, vermiform appendix, right ureter, right external iliac artery and vein
Hypogastric region:
\[ \text{i. Distal part of the sigmoid colon, supraampular part of the rectum, abdominal part of the ureter, distended urinary bladder and uterus after the 1st trimester} \]

\[\text{Left inguinal region:} \]
\[ \text{i. Sigmoid colon, left ureter, left external iliac artery and vein} \]

E) Layers:

Skin:
\[ \text{i. It is thick skin with numerous hair follicles especially in the hypogastric region (especially in males).} \]

Subcutaneous tissue:
\[ \text{i. It is a thick layer of fatty tissue which is the primary site of adipose depot for the body, especially in males.} \]
\[ \text{ii. The thoracoepigastric vein and tributaries of the paraumbilical veins are found in this layer.} \]
\[ \text{iii. The thoracoepigastric and great saphenous veins form the cavocaval anastomosis.} \]
\[ \text{iv. The paraumbilical veins, superior and inferior epigastric veins form the portocaval anastomosis.} \]

Superficial fascia:
\[ \text{i. It is a continuation of the superficial fascia of the thorax.} \]
\[ \text{ii. It is divided into 2 laminae:} \]
- \[ \text{Superficial lamina (Camper's fascia):} \]
  1. It is a fatty layer.
  2. It continues with the thigh as the fascia lata.
  3. It is not attached to the inguinal ligament.
- \[ \text{Deep lamina (Thompson's fascia: Scarpà's fascia):} \]
  1. It is a membranous layer.
  2. It continues to form a superficial fascia of the penis and scrotum in males or perineal fascia in females.
  3. It is attached to the inguinal ligament.

Muscles (from the superficial to deep):
\[ \text{i. Pyramidalis muscle (musculus pyramidalis)} \]
\[ \text{ii. Rectus abdominis muscle (musculus rectus abdominis)} \]
\[ \text{iii. External oblique muscle (musculus obliquus externus abdominis)} \]
\[ \text{iv. Internal oblique muscle (musculus obliquus internus abdominis)} \]
\[ \text{v. Transversus abdominis muscle (musculus transversus abdominis)} \]

Deep fascia:
\[ \text{i. Above the arcuate line, aponeurosis of the external oblique muscle and half of the aponeurosis of the internal oblique muscle form the anterior layer of the rectus sheath; the other half of the aponeurosis of the internal oblique muscle} \]
and aponeurosis of the transversus abdominis muscle form the posterior layer of the rectus sheath.

ii. Below the arcuate line, aponeurosis of the external oblique, internal oblique and transversus abdominis muscles form the anterior layer of the rectus sheath.

Transversalis fascia (fascia transversalis, fascia endoabdominalis):

i. It is a continuation of the endothoracic fascia (fascia endoThoracica).
ii. It continues into the pelvic cavity as the endopelvic fascia (fascia endopelvina).
iii. It is attached to the iliac crest and lateral half of the inguinal ligament and continues as the iliac fascia (fascia iliaca).
iv. It is attached to the pubic tubercle, pubic crest and Cooper's pectineal line medially.
v. It forms the anterior wall of the femoral sheath.

Preperitoneal fatty space:

i. It is thinner above the arcuate line compared with that of below it.
ii. The superior epigastric vessels and deep circumflex iliac vessels are lodged here.

Peritoneum

G) Weak places:

They are places where the tendons are not closely fused together and the foramina or fissures are thus formed. Hernias tend to occur in these places. The common hernias of the anterolateral abdominal wall are as follows:

i. White line (linea alba, Hunter's line)
ii. Umbilical region (regio umbilicalis)
iii. Inguinal region (regio inguinalis)
iv. Semilunar line (linea semilunaris, Spigelli's line)
v. Arcuate line (linea arcuata, linea semicircularis, Douglas' line)

Semilunar line:

i. It is seen as a shallow groove when the rectus abdominis muscle is tensed.
ii. It is regarded as the lateral border of this muscle.

Arcuate line:

i. It is a curved tendinous band in the sheath of the rectus abdominis muscle 4 – 5 cm below the navel.
ii. It is derived from the aponeurosis of the transversus abdominis muscle or of the internal oblique muscle.
iii. It is inserted into the white line.

H) Blood vessels:

Superior epigastric artery from the internal thoracic artery and the same vein
Inferior epigastric and deep circumflex iliac arteries from the external iliac artery and the same veins
Superficial circumflex iliac and superficial epigastric arteries and the same veins
Anterior and collateral branches of the posterior intercostals vessels of the 10th and 11th intercostals spaces, and from the anterior branches of the subcostal arteries and the same veins.

I) Innervation:
   - Thoracoabdominal (formerly known as the inferior intercostals) nerves – anterior abdominal (cutaneous) branches of the anterior primary rami of the inferior 6 thoracic nerves (T₇ to T₁₁).
   - Subcostal nerves (T₁₂)
   - Iliohypogastric and ilioinguinal nerves (T₁₂)
   - T₇ to T₁₂ supply the skin superior to the umbilicus.
   - T₁₂ innervates the skin around the umbilicus.
   - Cutaneous branches of the subcostal nerves (T₁₂), iliohypogastric and ilioinguinal (L₁) supply the skin inferior to the umbilicus.

TOPOGRAPHY OF THE UMBILICAL REGION AND WHITE LINE
   - The umbilical ring (anulus umbilicalis) is located in the umbilical region. It is a weak place because it consists of 3 layers only: the skin, endoabdominal fascia and peritoneum. The muscle is absent in this region, which contributes to the common occurrence of umbilical hernias.
   - The white line (linea alba) is formed by the fusion of the aponeurosis of the broad muscles of the abdominal wall. The muscle is absent here. The white line is wider in the upper part of the abdomen; narrower in the lower part of it. If the loops of aponeurotic fibres are wide in this region, herniation may occur.

TOPOGRAPHY OF THE INGUINAL REGION (REGIO INGUINALIS)
A) Inguinal triangle (trigonum inguinale, Hesselbach’s triangle):
   - Borders:
     - Superior: Horizontal line drawn between the lateral and middle 1/3 of the inguinal ligament
     - Medial: Lateral margin of the rectus abdominis muscle

B) Inguinal canal (canalis inguinalis):
   - Walls:
     - Anterior: Aponeurosis of the external oblique muscle
     - Posterior: Transversalis fascia
     - Superior / Roof: Inferior border of the internal oblique and transversus abdominis muscles
     - Inferior / Floor: Inguinal (Poupart’s) ligament
   - Contents:
     - In males: Spermatic cord (funiculus spermaticus) and ilioinguinal nerve (nervus ilioinguinalis)
     - In females: Round ligament of the uterus (ligamentum teres uteri), ilioinguinal nerve and genital branch of the genitofemoral nerve
   - Rings:
Hernial contents may be loops of the small intestine, sigmoid colon or other organs such as liver, spleen and etc.

B) Classifications of hernias:

External and internal hernias:
  i. External hernia is the herniation outside the abdominal or pelvic cavity, such as umbilical hernia.
  ii. Internal hernia is the herniation inside the abdominal or thoracic cavity, such as diaphragmatic hernia.

Anatomical classification (according to anatomical localization of the hernia):
  i. Inguinal hernia, umbilical hernia, hernia of the white line and etc.

Etiological classification:
  i. Congenital hernia – Hernia which is present at birth regardless of its causation
  ii. Acquired hernia – Hernia which occurs as a result of its causative or predisposing factors during life
    - Postoperative hernia: Hernia which occurs in the area of post-operative cicatrix as a result of surgical faults
    - Traumatic hernia: Hernia which occurs after some traumas
    - Neuropathic hernia: Hernia which occurs due to some neurological diseases, such as poliomyelitis

Clinical classification:
  i. Reducible (free) hernia – Hernia in which the hernial contents can move freely from the abdominal cavity to the hernial sac
  ii. Irreducible hernia – Hernia in which the hernial contents cannot move freely owing to the formation of adhesive process in the abdominal cavity
  iii. Strangulated hernia – Irreducible hernia in which compression of the vessels of the hernial contents occurs, leading to gangrene of the hernial sac and its contents

  According to size of the hernia:
  i. Small hernia
  ii. Medium hernia
  iii. Large hernia
  iv. Giant hernia

  According to presence of complication:
  i. Uncomplicated hernia – Hernia which occurs without any complications
  ii. Complicated hernia – Hernia which occurs with complications, such as strangulation, inflammation and skin destruction

C) Types of strangulated hernias:
  i. Parietal (Richter’s) hernia – Hernia in which a portion of the bowel is strangulated
  ii. Retrograde (Maidl’s) hernia – Hernia in which some loops of the bowel are strangulated (W-shaped hernia)
  iii. Litter’s hernia – Hernia of the Meckel’s diverticulum
  iv. Elastic strangulation – Hernia which occurs due to external pressure of the vessels
  v. Faecal strangulation – Hernia which occurs due to internal pressure exerted by fecal mass.
Types of hernias:
a – Parietal (Richeter's) strangulated hernia, b – Retrograde (Maidl's) strangulated hernia, c – Periperitoneal sliding hernia of the appendix

D) Types of inguinal hernias:
   Direct inguinal hernia:
   i. The herniated organ passes through the medial inguinal fossa and never enters the scrotum.
   ii. It is located separately from the spermatic cord.

Topography of the direct inguinal hernia:
1 – Iliouinguinal nerve, 2 – Internal oblique muscle, 3 – Transversalis fascia, 4 – Fatty tissue of the peritoneum, 5 – Hernial sac, 6 – Small intestine, 7 – Funiculus spermaticus, 8 – Inferior epigastric artery and vein, 9 – Aponeurosis of the external oblique muscle
Indirect (oblique) inguinal hernia:

i. Hernia passes through the lateral inguinal fossa and inguinal canal, and then enters the scrotum.

ii. It is located with the spermatic cord.

iii. Depending on the origin of the hernial sac, oblique inguinal hernias may be congenital or acquired.

iv. Congenital inguinal hernia is the hernia in which the hernial sac is composed of patent (or partially obliterated) vaginal process of the peritoneum.

E) Sliding hernia:

It is a hernia in which the visceral peritoneum forms a portion of the hernial sac. Mesoperitoneal organs are involved, such as caecum and urinary bladder.

OPERATIVE ACCESS TO THE ABDOMINAL ORGANS

LAPAROTOMY:

It is an incision through any part of the abdominal wall.

All surgical approaches to the organs of the abdominal cavity may be divided into:

i. Longitudinal approach

ii. Transverse approach

iii. Oblique approach

iv. Angular approach

v. Combined approach

Types of longitudinal, transverse and oblique laparotomies:
A) Longitudinal approach:

Longitudinal approach may be midline, paramedian, transrectal, and pararectal.

Midline approach:

i. The midline laparotomy is subdivided into the superior midline laparotomy, middle midline laparotomy, inferior and total ones. For all types of the midline laparotomy, the following layers are cut: skin, subcutaneous fatty tissue, superficial and deep layers of the superficial fascia, aponeurosis of the abdominal muscles, transverse fascia, preperitoneal fatty tissue and parietal peritoneum.

ii. The superior midline laparotomy is performed along the white line of the abdomen from the xiphoid process to the umbilicus. It is the universal access to the organs of the upper floor of the peritoneal cavity.

iii. The middle midline laparotomy is performed along the white line of the abdomen from the middle of the distance between the xiphoid process and umbilicus to the middle distance between the umbilicus and pubic symphysis. It is the approach to the organs of the upper and lower floors of the abdominal cavity. This operative access is performed for inspection of the peritoneal cavity.

iv. The inferior midline laparotomy is performed from the umbilicus to the pubic symphysis and used for surgery of the organs of the lower floors of the peritoneal and pelvic cavities.

v. The total midline laparotomy is used in extensive process in the peritoneal cavity.

vi. The advantages of these approaches are less trauma, easier access to the pathological focus and satisfactory cosmetic effect.

vii. The disadvantages are delayed formation of the postoperative scars and frequent occurrence of postoperative hernias.

Paramedian approach:

i. The paramedian laparotomy is performed along the medial edge of the rectus abdominis muscle or about 2 cm lateral to the white line of abdomen. The skin, subcutaneous fatty tissue, superficial and deep layers of the superficial fascia,
anterior layer of the rectus sheath are cut. The rectus abdominis muscle is drawn aside by a blunt hook. The posterior layer of the rectus sheath, transverse fascia, preperitoneal fatty tissue and parietal peritoneum are cut then.

ii. The advantages of this approach are easier access to the pathological focus and formation of valued postoperative scars.

iii. The disadvantages are high traumatic rate and insufficient time for haemostasis.

Transrectal approach:

i. The transrectal laparotomy is performed with the cutting of the rectus abdominis muscle. The tissues are dissected in the middle of the rectus abdominis muscle. The rectus abdominis muscle is not cut but the muscular fibers are separated by blunt way with the help of scissors or haemostatic forceps.

ii. The advantages of this approach are easier access to the pathological focus and formation of valued postoperative scars.

iii. The disadvantages are high traumatic rate and insufficient time for haemostasis.

Pararectal approach:

i. The pararectal laparotomy is performed along the lateral edge of the rectus abdominis muscle like the paramedian laparotomy. But the rectus abdominis muscle is drawn medially by a blunt hook. For example, this approach is used in acute appendicitis and called the Lenander’s access. It is performed when diagnosis is not confirmed before the operation.

ii. The advantages of this approach are easier access to the pathological focus and formation of valued postoperative scars.

iii. The disadvantages are high traumatic rate and insufficient time for haemostasis.

B) Transverse approach:

Transverse approach is represented by the superior and inferior ones.

Superior approach:

i. The superior transverse laparotomy is performed at the level of the superior horizontal line. All tissues of the anterior abdominal wall are cut in the transverse direction.

ii. Such approach gives wide access to the organs of the upper floor of the abdominal cavity, easier access to the pathological focus and maximal convenience for surgery.

iii. The disadvantages of this method are high traumatic rate and frequent occurrence of postoperative hernias.

Inferior approach:

i. The lower transverse approach is performed below the inferior horizontal line. The skin, subcutaneous fatty tissue, superficial and deep layers of the superficial fascia and aponeurosis of the rectus abdominis muscle are cut transversely. All deep tissue layers are cut longitudinally.

ii. The advantages are less trauma, good cosmetic effect and formation of valued postoperative scars.

C) Oblique approach:

Upper approach:
i. The upper oblique laparotomy is performed parallel to the costal arch and all tissues are cut in the same direction.

ii. The disadvantages are high traumatic rate and frequent occurrence of postoperative hernias.

D) Lower approach:

The lower oblique laparotomy is performed parallel to the inguinal ligament. For example, this approach is used in acute appendicitis and called the Volkovich-Dyakonov's access. The skin, subcutaneous fatty tissue, superficial and deep layers of the superficial fascia are cut parallel to the inguinal ligament. The aponeurosis of the external oblique, internal oblique and transversus abdominis muscles is cut.

LAPAROSCOPY:

It is visualization of the abdominal cavity with a laparoscope through an incision (laparocentensis).

A) Indications:

- Diagnostic laparoscopy
- Laparoscopic appendectomy
- Laparoscopic cholecystectomy

B) Contraindications:

- Patients not bearing general anaesthesia
- Patients with irreducible hernia
- Patients with acute ileus
- Pregnant patients
- Patients with hiatal hernia
- Obese patients

LAPAROSTOMY:

It is creation of an opening or communication between the abdominal cavity and external environment.

LAPAROCENTESIS:

It is puncture (incision) of the anterolateral abdominal wall with the aim of aspiration of fluid (exudation) or for future laparoscopy.

GENERAL PRINCIPLES AND STAGES OF THE OPERATIONS FOR ABDOMINAL HERNIAS

A) Principles:

- Herniotomy: Incision of the hernia or removal of the hernia canal or place, in which the hernia takes place
- Hernioplasty: Surgical repair of the hernia

Depending on materials used for plastic repair, they are divided into autoplasic, alloplastic and combined ones.

i. Autoplasic materials are materials taken from the tissues of the organism.

ii. Alloplastic materials are foreign tissues. They may be xenogenic (tissues of other organisms) and explants (non-biological tissues).
Techniques of hernioplasty may be musculoaponeurotic, musculofascial and aponeurotic hernioplasties.

B) Stages:
- Surgical approach to the hernia by incision of the tissues of the abdomen
- Excision of the hernial ring
- Extraction of the hernial sac
- Opening of the hernial sac and inspection of its contents
- Closure of the inguinal opening up to the normal size
- Plastic repair of the hernial ring

Stages of herniotomy:
- a – Opening of the hernial sac
- b – Invagination of the hernial content into the abdominal wall
- c – Suturing of the hernial neck
- d – Removal of the peripheral part of the hernial sac

SURGICAL TREATMENT OF THE INGUINAL HERNIA
- It is performed under local anaesthesia.
- General anaesthesia is only applied to children of 1 year old, patients not bearing Novocain and patients insisting on general anaesthesia.

Incision line on the skin of the inguinal hernia
A) Bassini’s method:
- It is used to build up the posterior wall of the inguinal canal. After extraction of the hernial sac, the spermatic cord is clamped and held. Between the borders of the transversus abdominis muscle, internal oblique muscle, transversalis fascia and inguinal ligament, interrupted sutures are placed. Besides, a few sutures are also placed between the borders of the rectus sheath and pubic bone periosteum.
- The inguinal space is closed and posterior wall strengthened. The spermatic cord is placed on the newly formed posterior wall of the inguinal canal. Over the spermatic cord, the aponeurosis is restored by interrupted sutures.

Bassini’s method: Suturing of the internal oblique, transversus abdominis and rectus abdominis muscles to the inguinal ligament posterior to the *funiculus spermaticus*

B) Martyanov’s method:
- After opening the inguinal canal by dissecting the aponeurosis of the external oblique muscle and removing the hernial sac, the superior flap of the aponeurosis of the external oblique muscle is sutured to the inguinal hernia by interrupted sutures; the inferior flap is sutured up to the surface of the aponeurosis. It will be duplication of the aponeurosis of the external oblique muscle.

Martyanov’s method: Suturing of the internal flap of the aponeurosis of the external oblique muscle to the inguinal ligament
C) Girar’s method:

It is done by stitching the superior flap of the aponeurosis of the external oblique muscle with the inferior margin of the internal oblique and transversus abdominis muscles.

Stages of stitching:

i. 1st stage: Access to the muscle and inguinal ligament
ii. 2nd stage: Access to the aponeurosis
iii. 3rd stage: Same as the Martyanov’s method (duplication)

![Image of Girar’s method: Suturing of the internal oblique muscle and transversus abdominis muscle to the inguinal ligament.]

D) Spasokukotsky’s method:

- It is performed by stitching the aponeurosis and muscles together.
- After penetrating the aponeurosis and the muscles with a needle, it reaches the inguinal ligament.

![Image of Spasokukotsky’s method: Suturing of the internal flap of the aponeurosis of the external oblique, internal oblique and transversus abdominis muscles to the inguinal ligament.]

E) Kimbarovsky’s method:

- The margins of the internal oblique and transversus muscles are covered by the superior flap of the aponeurosis of the external oblique muscle.
- The needle passes through the aponeurosis, muscles and returns to the aponeurosis. Then it reaches the inguinal ligament.
F) Postempsky’s method:

- It is performed to close the inguinal canal by moving the spermatic cord laterally. The plastic narrowing of the inguinal ring up to 0.8 cm is the important stage of this modification.
- On occasion, when superficial and deep inguinal rings are in one plane, the spermatic cord is displaced in the lateral direction by a transverse incision of the internal oblique and transversus abdominis muscles. Then the aponeurosis of the internal oblique and transversus abdominis muscles is fixed to the pectineal ligament.

G) Shouldice’s method:

- The lateral border of the transversalis fascia is stitched to the lower surface of the rectus sheath by an uninterrupted suture. This suture is tied at the pubic tubercle, and the other end of the thread is left long. The suture is continued, connecting both parts of the transversalis fascia up to the deep inguinal ring. Then the suture is
turned in the opposite direction to suture the medial border of the transversalis fascia to the inguinal ligament.

H) Kukudzhanov’s method:

- This method is to restore the posterior wall of the inguinal canal. Sutures are placed between the pectineal ligament, rectus sheath and aponeurosis of the transversus abdominis muscle.

Kukudzhanov’s method: Suturing of the transversalis fascia by 2 mattress sutures (left picture), Suturing of the sheath of the rectus abdominis muscle and aponeurosis of the internal oblique muscle and transversus abdominis muscle to the inguinal ligament (right picture)

I) Lichtenstein’s method:

- For the direct hernia, the transversalis fascia is dissected above the hernial sac and reduced. Then the transversalis fascia is sutured by uninterrupted sutures.
- For the oblique hernia, after the excision of the hernial sac, the deep inguinal ring is restored. Then the transversalis fascia is sutured.
- A polypropylene mesh is used for plastic repair of the hernial ring. It is implanted in the spermatic cord and fixed by interrupted sutures to the inguinal ligament. The
superior edge of the mesh is stitched by interrupted sutures to the internal oblique muscle. The deep inguinal ring is then formed. The inferior edge of the mesh is fixed with 2 – 3 stitches to the pubic tubercle together with the superior pubic ligament to prevent the formation of the femoral hernia.

**Surgical Treatment of the Femoral Hernia**

According to surgical approach, there are femoral, inguinal and intra-abdominal ones.

A) Rudzhi-Parlaveccio’s method:
   - Incision of the hernial sac is performed through the inguinal canal.
   - After the excision of the hernial sac, the hernial ring is restored by suturing of the inguinal and pectineal ligaments.

B) Bassini’s method:
   - This approach is performed by a vertical incision on the thigh.
   - After the excision of the hernial sac, the hernial ring is restored by suturing of the inguinal and pectineal ligaments.

**Surgical Treatment of the Umbilical Hernia**

A) Sapezhko’s method:
   - This method is used to cut the umbilical ring in the longitudinal direction and the duplication of the aponeurosis is made longitudinally.
B) Mayo's method:
- This method is used to cut the umbilical ring in the transverse direction and the duplication of the aponeurosis is made longitudinally.

C) Lexer's method.
- A purse-string suture is applied around the umbilicus.

SURGICAL TREATMENT OF THE HERNIA OF THE WHITE LINE

Procedures:
- Herniotomy is performed by traditional method.
- The edge of the aponeurosis is sutured transversely or by Sapezhko-Dyakonov's method.
According to Sapezhko-Dyakonov's method, creation of the duplicature is performed in the vertical direction. The aponeurosis of the white line is stitched to the anterior layer of the rectus sheath.

SURGICAL TREATMENT OF THE STRANGULATED HERNIA

A) Stages:
- Surgical approach to the hernia by incision of the tissues of the abdomen
- Excision of the hernial ring
- Extraction of the hernial sac
- Opening of the hernial sac and examination of viability of the organ
- Closure of the inguinal opening up to the normal size
- Plastic repair of the hernial ring

B) Criteria for estimation of viability of the small intestine:
- Restoration of the bowel to normal pink colour
- Absence of marks of constriction and dark spots
- Presence of pulsation
- Presence of intestinal peristalsis

SURGICAL TREATMENT OF THE SLIDING HERNIA

It is performed like the previous operations. But the surgeon must carefully examine all sides of the hernial sac before its opening because the wall of the slid organ may be cut accidentally.

HERNIOTOMY IN CHILDREN

Procedures:
- General anaesthesia is applied.
- Sutures are made through the aponeurosis of the external oblique muscle without its dissection. The opening of the inguinal canal is also forbidden.
ABDOMINAL CAVITY (CAVITAS ABDOMINIS)

It is the space in the trunk below the diaphragm.

It is divided into the abdominal cavity proper and pelvic cavity.

A) Borders:

Anterolateral: Rectus abdominis, external oblique, internal oblique and transversus abdominis muscles

Posterior: Lumbar segment of the spine, psoas major and quadratus lumborum muscles

Superior: Diaphragm

Inferior: Iliac bones and pelvic diaphragm

B) Division:

The abdominal cavity is divided into 3 storeys.

i. Upper storey:

- Borders:
  1. Superior: Inferior surface of the diaphragm
  2. Inferior: Transverse mesocolon

- Contents:
  1. Hepatic bursa
2. Pregastric bursa
3. Omental bursa
4. Liver, stomach, gall bladder, spleen, superior poles of the kidneys, adrenal glands, superior part of the duodenum, abdominal aorta and inferior vena cava

ii. Middle storey:
- Borders:
  1. Superior: Transverse mesocolon
  2. Inferior: Inlet of the lesser pelvis
- Contents:
  1. Right and left paracolic canals (gutters)
  2. Right and left mesenteric sinuses
  3. Mesentery
  4. Sigmoid mesocolon
  5. Duodenojejunal recess
  6. Superior and inferior ileocaecal recesses
  7. Large and small intestines

iii. Lower storey:
- Borders
  1. Superior: Inlet of the lesser pelvis
  2. Inferior: Pelvic cavity
- Contents:
  1. Rectovesical pouch in males
  2. Rectouterine and uterovesical pouches in females
  3. Pelvic organs

PERITONEUM

It is a serous membrane lining the abdominal and pelvic cavities.
In males, the peritoneum is closed; in females, the peritoneum communicates with the external environment by means of the uterine tubes.
It consists of 2 layers, which are the parietal (*peritoneum parietale*) and visceral (*peritoneum viscerale*). Between these layers, the peritoneal cavity (*cavum peritonei*) is located. The peritoneal cavity contains peritoneal fluid (*liquor peritoneale*).
The extraperitoneal tissue (*tela subserosa*) containing a large amount of fatty tissue is lodged between the peritoneum and abdominal wall. This layer is richly developed on the posterior abdominal wall and poorly developed on the anterior abdominal wall.

A) Parietal peritoneum:
- It is composed of fibrous tissue.
- It lines the inner surface of the abdominal and pelvic cavities and forms the outer limit of the peritoneal cavity.
- It receives the same arterial and nerve supplies as the wall it lines.
- It is more sensitive to pain because it is innervated by the somatic innervation.
- The parietal peritoneum of the pelvis is devoid of somatic innervation.
5) Visceral peritoneum:
   - It is composed of mesothelial cells.
   - It covers the outer surface of the abdominal visceral organs.
   - It receives the same arterial and nerve supplies as the organ it covers.
   - It is innervated by the autonomic innervation.
   - Pain is only felt when the organ is distended or ischemic.

C) Functions:
   - Movement – It reduces friction from the movements, peristalsis and respiration.
   - Protection – It contains various phagocytic cells and lymphocytes which participate in immune reaction. The greater omentum can move towards sites of infection to prevent perforation.
   - Absorption – Mesothelium cells act as semipermeable membrane that permits water and electrolytes to diffuse straight into blood vessels.
   - Healing and adhesion – Fibroblasts promote fast healing of wounds.
   - Storage of fat – Fat is richly developed in the peritoneal folds.

D) Relations of visceral organs to the peritoneum:
   - Intrapерitoneal organs:
     i. They are completely (4 sides) covered by the peritoneum.
     ii. They are generally mobile. They can thus be moved away to access deeper organs in surgery and prone to herniation.
     iii. They are stomach, bulbus duodeni of the superior part of the duodenum, jejunum, ileum, appendix, transverse colon, sigmoid colon, supraampullar part of the rectum, spleen and ovaries.
   - Mesoperitoneal organs:
     i. They are covered by the peritoneum by 3 sides.
     ii. Degree of mobility is between the intraperitoneal and extraperitoneal organs.
     iii. They are liver, gall bladder, ascending part of the duodenum, caecum, ascending colon, descending colon, ampullar part of the rectum, urinary bladder (when distended) and uterus.
   - Extraperitoneal (retroperitoneal) organs:
     i. They are covered by the peritoneum by only 1 side.
     ii. They are located in the retroperitoneal space (spatium retroperitoneale).
     iii. They are not moveable at all.
     iv. They are descending and horizontal parts of the duodenum, anal canal, pancreas, kidneys, adrenal glands, ureters, urinary bladder (when empty), major vessels like the abdominal aorta and the inferior vena cava.

PERITONEAL FORMATION
A) Mesentery (mesenterium):
   - It is a double layer peritoneum that occurs as a result of invagination of the peritoneum by the small intestine.
   - It connects the small intestine to the posterior abdominal wall.
   - It contains the neurovascular bundles that supply and drain the small intestine.
It forms the root of the mesentery (*radix mesenterium*) that divides the mesenteric sinus into right and left mesenteric sinuses.

The root of the mesentery starts from the 2nd lumbar vertebra and ends at the right iliob fossa.

**B) Mesocolon:**

It is the mesentery of the large intestine.

It contains the neurovascular bundles that supply and drain the parts of the large intestine where they are connected to the posterior abdominal wall by mesocolon.

Types of mesocolon:

i. *Mesocolon transversum* – It connects the transverse colon to the posterior abdominal wall.

ii. *Mesocolon sigmoideum* – It connects the sigmoid colon to the posterior abdominal wall.

iii. *Mesoappendix (mesenteriolum appendicis vermiformis)* – It connects the appendix to the posterior abdominal wall.

**C) Omentum:**

It is a duplicature of the mesentery which contains a large amount of fatty tissue.

i. Lesser omentum (*omentum minus*):
   - It stretches from the portal triad to the lesser curvature of the stomach and proximal part of the duodenum.
   - It is formed by the hepatogastric and hepatoduodenal ligaments.

ii. Greater omentum (*omentum majus*):
   - It stretches from the greater curvature of the stomach to the transverse colon and covers loops of the small intestine.
   - It is formed by 4 peritoneal layers, which are fused to form 2 laminae.
   - The anterior lamina starts from the greater curvature of the stomach and descends anterior to the transverse colon. It descends almost up to the pubic bones and ascends to form the posterior lamina. The ligament which connects the stomach to the transverse colon is called the gastrocolic ligament (*ligamentum gastrocolicum*).
   - The posterior lamina blends with the transverse colon and ascends up to the anterior border of the pancreas where it is separated into 2 layers. 1 of these layers covers the anterior part of the pancreas and goes up to the diaphragm; another layer covers the inferior part of the pancreas and is continuous with the *mesocolon transversum*.

**D) Ligaments:**

They connect the adjacent organs (for eg, hepatogastric ligament) or connect the organ to the abdominal wall (for eg, falciform ligament).

Nomenclature of the ligament reflects the organs that it connects.

i. Falciform ligament (*ligamentum falciforme*) – Connects the liver to the abdominal wall.
ii. Coronary ligament (*ligamentum coronarium hepatis*) – Connects the liver to the diaphragm
iii. Triangular ligament of the liver (*ligamentum triangulare*)
iv. Hepatogastric ligament (*ligamentum hepatogastricum*) – Connects the liver to the lesser curvature of the stomach
v. Hepatoduodenal ligament (*ligamentum hepatoduodenale*) – Connects the liver to the duodenum
vi. Hepatocolic ligament (*ligamentum hepatocolicum*) – Connects the liver to the large intestine
vii. Hepatorenal ligament (*ligamentum hepatorenale*) – Connects the liver to the right kidney
viii. Gastrophrenic ligament (*ligamentum gastrophrenicum*) – Connects the stomach to the diaphragm
ix. Gastrolienal (gastroplenic) ligament (*ligamentum gastrolinale*) – Connects the stomach to the spleen
x. Gastrocolic ligament (*ligamentum gastrocolicum*) – Connects the stomach to the transverse colon
xi. Gastropancreatic ligament (*ligamentum gastropancreaticum*) – Connects the stomach to the pancreas
xii. Phrenicoesophageal ligament (*ligamentum phrenicoesophageale*) – Connects the diaphragm to the oesophagus
xiii. Phrenicocolic ligament (*ligamentum phrenicocolicum*) – Connects the diaphragm to the large intestine
xiv. Phrenicorenal ligament (*ligamentum phrenicorenale*) – Connects the diaphragm to the kidney
xv. Phrenicolienal ligament (*ligamentum phrenicolienale*) – Connects the diaphragm to the spleen
xvi. Pancreaticocolienal ligament (*ligamentum pancreaticolicienale*) – Connects the pancreas to the spleen
xvii. Lienorenal ligament (*ligamentum lienorenale*) – Connects the spleen to the left kidney
xviii. Pyloropancreatic ligament (*ligamentum pyloropancreaticum*) – Connects the pylorus to the pancreas
xix. Duodenorenal ligament (*ligamentum duodenorenale*) – Connects the duodenum to the right kidney

**E) Recesses:** They are pouches that are formed by the peritoneal folds. They are practically important because they are places of retroperitoneal herniation.

i. Duodenojejunal recess (*recessus duodenojejunalis*)
ii. Superior ileocaecal recess (*recessus ileocecalis superior*)
iii. Inferior ileocaecal recess (*recessus ileocecalis inferior*)
iv. Retrocaecal recess (*recessus retrocecalis*)
v. Intersigmoid recess (*recessus intersigmoideus*)
F) Folds:
- They are the reflection of the peritoneum that rises from the abdominal wall by the underlying structures.
  i. Gastropancreatic fold (*plica gastropancreatrica*)
  ii. Ileocaecal fold (*plica ileocecalis*)
  iii. Superior duodenal fold (*plica duodenalis superior*)
  iv. Inferior duodenal fold (*plica duodenalis inferior*)
  v. Median umbilical fold (*plica umbilicalis mediana*)
  vi. Medial umbilical fold (*plica umbilicalis medialis*)
  vii. Lateral umbilical fold (*plica umbilicalis lateralis*)

G) Sinuses:
- There are 2 sinuses, which are the right and left mesenteric sinuses.
  i. Right mesenteric sinus (*sinus mesentericus dexter*):
      - It is a closed sinus.
      - Borders:
        1. Medial: Root of the mesentery
        2. Lateral: Ascending colon
        3. Superior: Transverse colon
  ii. Left mesenteric sinus (*sinus mesentericus sinister*):
      - It communicates with the lesser pelvis.
      - Borders:
        1. Medial: Descending colon
        2. Lateral: Root of the mesentery
        3. Inferior: Sigmoid colon

H) Paracolic canals (paracolic gutters, lateral abdominal canals):
- They consist of 2 paracolic canals, which are the right and left paracolic canals.
  i. Right paracolic canal:
      - It communicates with the right hepatic bursa.
      - Borders:
        1. Medial: Ascending colon
        2. Lateral: Parietal peritoneum
        3. Inferior: Caecum
  ii. Left paracolic canal:
      - It communicates with the lesser pelvis.
      - Borders:
        1. Medial: Descending colon
        2. Lateral: Parietal peritoneum
        3. Superior: Phrenicocolic ligament

**BURSAE OF THE ABDOMINAL CAVITY**

A) Hepatic bursa (*bursa hepatica*):
  - Borders:
    - Superior: Diaphragm
- Inferior: Transverse mesocolon
- Anterior: Anterior abdominal wall
- Medial: Falciform ligament

Pathology: Abscess from the middle storey of the abdominal cavity may spread here and cause subphrenic abscess through the right paracolic canal.

B) Pregastric bursa (bursa pregastrica):
- Borders:
  - Anterior: Left lobe of the liver and anterior abdominal wall
  - Posterior: Lesser omentum
- Pathology: Abscess from this bursa may spread to the omental bursa.

C) Omental bursa (bursa omentalis):
- It is also called the lesser sac of the peritoneum.
- It has 2 recesses, which are the superior and inferior recesses.
- Borders:
  - Superior: Caudate lobe of the liver
  - Inferior: Transverse mesocolon
  - Anterior: Stomach and lesser omentum
  - Posterior: Parietal peritoneum
- Pathology: Inflammation from this bursa may spread to the general peritoneal cavity through the epiploic (Winslow's) foramen. For example, perforation of the gastric ulcer may cause generalized peritonitis.
- Epiploic foramen:
  - Superior: Caudate lobe of the liver
  - Inferior: Superior part of the duodenum
  - Anterior: Hepatoduodenal ligament
  - Posterior: Inferior vena cava and hepatorenal ligament

TOPOGRAPHY OF THE STOMACH
A) English: Stomach

B) Latin: Ventriculus

C) Greek: Gaster

D) Russian: Желудок

E) Morphology:
- Several parts are distinguished: fundus, cardiac part (pars cardiaca), body (corpus), lesser curvature (curvature ventriculi minor), greater curvature (curvature ventriculi major), pyloric antrum (antrum pyloricum) and pyloric canal (canalis pyloricus).
- 2 notches are distinguished: cardiac notch (incisura cardiaca) and angular notch (incisura angularis).
Layers:
  i. Serous layer (tunica serosa, peritoneum)
  ii. Muscular layer (tunica muscularis):
      - External layer consists of longitudinal fibres.
      - Middle layer consists of circular fibres.
      - Internal layer consists of oblique fibres.
  iii. Submucous layer (tunica submucosa)
  iv. Mucous layer (tunica mucosa)

F) Functions:
  - Reservoir of food
  - Processing ingesting food into chyme
  - Production of mucus by the mucous neck cells and surface lining cells
  - Production of hydrochloric acid and gastric intrinsic factor by the parietal cells
  - Production of pepsinogen, rennin and gastric lipase by the chief cells
  - Production of hormones such as gastrin and glicentin by the diffuse neuroendocrine system (DNES) cells

G) Holotopy:
  - Projected on the left hypochondriac and proper epigastric regions

H) Skeletopy:
  - Cardiac part: 10th or 11th thoracic vertebrae
  - Fundus: 11th thoracic vertebra
  - Greater curvature: Above the costal arch
  - Pyloric part: 12th thoracic – 1st lumbar vertebrae

I) Syntopy:
  - Anterior: Pregastric bursa
  - Posterior: Left kidney, adrenal gland and pancreas
  - Superior: Liver, oesophagus and diaphragm
  - Inferior: Transverse colon
  - Medial: Liver, duodenum, gall bladder, aorta, inferior vena cava and portal triad
  - Lateral: Spleen

J) Arterial supply:
  - Left gastric artery (branch of the coelica trunk)
  - Right gastric artery (branch of the common hepatic or right proper hepatic artery)
  - Left gastroepiploic artery (branch of the splenic artery)
  - Right gastroepiploic artery (branch of the gastroduodenal artery)
  - Short gastric arteries (branch of the splenic artery)

K) Venous drainage:
  - Right and left gastric veins, right and left gastroepiploic veins; then drained into the portal vein
  - Veins of the cardiac part of the stomach are drained into the oesophageal plexus.
L) Lymphatic drainage:
- Paraorganic lymphatic nodes along the gastric and gastroepiploic arteries
- Nodes along the splenic artery and common hepatic artery
- Drainage to other organs, such as the spleen and liver in the hilus of these organs
- Coeliac lymph nodes

M) Nerve supply:
- Sympathetic: T6 – T9
- Parasympathetic: Vagus nerve
- Afferent: Phrenic nerve, hepatic and coeliac plexuses, thoracic and lumbar spinal nerves, vagus nerve (anterior trunk), greater and lesser splanchnic nerves

LIGAMENTS OF THE STOMACH
- There are superficial and deep ligaments.
- Superficial ligaments include hepatoduodenal ligament (ligamentum hepatoduodenale), hepatogastric ligament (ligamentum hepatogastricum), phrenicogastric ligament (ligamentum phrenicogastricum), gastrolienal ligament (ligamentum gastrolienal) and gastrocolic ligament (ligamentum gastrocolicum).
- Deep ligaments include gastropancreatic ligament (ligamentum gastropancreaticum) and pyloropancreatic ligament (ligamentum pyloropancreaticum).

TOPOGRAPHY OF THE DUODENUM
A) English: Duodenum

B) Latin: Duodenum

C) Greek: Duodenum

D) Russian: Двенадцатиперстная кишка

E) Morphology:
- 4 parts are distinguished: superior part (pars superior), descending part (pars descendens), horizontal part (pars horizontalis) and ascending part (pars ascendens).
- Layers:
  iv. Serous layer
  v. Muscular layer:
    - External layer consists of longitudinal fibres.
    - Internal layer consists of circular fibres.
    - Auerbach’s myenteric plexus is located between these 2 layers.
  vi. Submucous layer:
    - Meissner’s submucosal plexus is located here.
  vii. Mucous layer
F) Functions:
- Initial digestion of chyme
- Receiver of pancreatic juice and bile

G) Holotopy:
- Projected on the proper epigastric and umbilical regions

H) Skeletopy:
- 1st – 3rd lumbar vertebrae

I) Syntopy:
- Superior: Liver and gall bladder
- Inferior: Jejunum
- Posterior: Inferior vena cava
- Lateral: Pancreas

J) Arterial supply:
- Supraduodenal artery
- Anterior and posterior branches of the inferior pancreaticoduodenal artery (branch of the superior mesenteric artery)
- Anterior superior pancreaticoduodenal artery (branch of the gastroduodenal artery)
- Posterior superior pancreaticoduodenal artery (branch of the gastroduodenal artery)

K) Venous drainage:
- Splenic and superior mesenteric veins; then drained into the portal vein

L) Lymphatic drainage:
- Superior and inferior pancreaticoduodenal lymph nodes; then drained into the hepatic nodes; then drained into the coeliac and superior mesenteric lymph nodes

M) Nerve supply:
- Sympathetic: T5 – L2
- Parasympathetic: Vagus nerve
- Afferent: Phrenic nerve, greater and lesser splanchnic nerves, thoracic and lumbar spinal nerves, hypogastric, hepatic, superior and inferior mesenteric plexuses

**OPERATIONS ON THE STOMACH**
- They are classified into the palliative and radical ones.
- Palliative operations include gastrostomy and gastroenterostomy.
- Radical operations include gastrostomy, vagotomy, resection of the stomach, reconstructive operation, gastrectomy and surgical closure of the perforative opening or wound.
GASTROTOMY
A) Indications:
- Removal of the foreign substance, tumour, papilloma and bleeding
- Inspection of the stomach for diagnostic purpose

B) Procedures:
- The surgical approach is superior midline laparotomy or transrectal one through the rectus abdominis muscle.
- The stomach is incised longitudinally and sutured transversely.

GASTROSTOMY
A) Indications:
- Inoperable cancer of the oesophagus and cardiac part of the stomach
- Trauma, burn and narrowing of the oesophagus
- Craniocerebral trauma
- Coma

B) Types:
- Temporary gastrostomy:
  i. Minimal gastrostomy
  ii. Vitzel’s gastrostomy
  iii. Stamm-Senn-Kader’s gastrostomy
- Permanent gastrostomy:
  i. Toprover’s gastrostomy
  ii. Beck Jian’s gastrostomy

C) Anaesthesia: Endotracheal narcosis

D) Witzel’s gastrostomy:
- The patient lies on the back.
- The approach is transrectal left-sided laparotomy. An incision is made 10 cm from the subcostal arch.
- In the middle of the lesser and greater curvatures of the stomach, a rubber tube is inserted. At the end of the operation, the rubber tube has to be in the pyloric part of the stomach.
- 6 – 8 seromuscular silk sutures are stitched over the rubber tube. In the pyloric part, a purse-string suture is made. But at present time, it is replaced by Ho Dak Di’s modification by putting a tube into the fundal part.
- The tube is fixed to the skin of the abdomen.
- The gastric wall is fixed to the parietal peritoneum with 4 – 5 knot sutures, 1 – 1.5 cm from the peritoneal incision (gastropexy).
- At last, the wound of the abdominal wall is sutured.
Stages of Witzel's gastrostomy:

a – Applying a rubber tube to the gastric wall and stitching the tube’s end with a purse-string suture.
b – Dissection of the gastric wall on the centre of the suture.
c – Burying the tube's end into the stomach.
d – Applying interrupted seromuscular sutures.
e – Clamping with the aid of a thread-holder for removal of the stitches.
f – Removal of the tube through an incision.

E) Stamm-Senn-Kader's gastrostomy:

The patient lies on the back.

- The surgical approach is superior paramedian incision.
- The tube is not fixed to the anterior wall of the stomach. 3 purse-string sutures are made surrounding the incision on the fundal part of the stomach for fixation of the tube with invagination of the wall of the stomach.

F) Toprover's gastrostomy:

- The beginning of this method is the same as the Stamm-Senn-Kader's operation.
- The only difference is that no invagination of the wall of the stomach is performed.
- A gastrostomic canal external to the cavity of the stomach is made instead.

RESECTION OF THE STOMACH

A) Absolute indications:

- Complications of the peptic ulcer, such as haemorrhage, perforation, malignization and pyloric stenosis
- Cancer of the stomach

B) Relative indications:
Penetration of the ulcer
Ineffectiveness of conservative treatment
Recurrent ulcerous haemorrhage
Benign tumour of the stomach, such as polyp and adenoma

C) Classifications:
According to size of the removed part:
  i. Minimal – 1/3 of the stomach is removed.
  ii. Subtotal – 2/3 of the stomach is removed.
  iii. Vast – 4/5 of the stomach is removed.
  iv. Gastrectomy – The whole stomach is removed.
According to region:
  i. Pyloric
  ii. Antral
  iii. Cardiac
  iv. Fundal
According to form:
  i. Circular
  ii. Segmental

D) Anaesthesia: Endotracheal narcosis

PARTIAL RESECTION ON THE STOMACH:
A) Billroth I:
   The stump of the stomach is anastomosed with that of the duodenum.

B) Billroth II:
   The stump of the stomach is anastomosed with the initial portion of the ileum.

C) Modifications of Billroth II:
   Polya-Reichel's resection:
   i. The stump of the stomach is anastomosed with the initial portion of the jejunum.
      This is done through the opening of the mesentery of the colon.
   Roux's resection:
   i. The stump of the duodenum is closed. The stump of the stomach is connected to
      the transected end of the jejunum; while another end of the jejunum is connected
      by a Y-shaped anastomosis.
Balfur’s resection:
i. Gastroenterostomy is performed on the long loop of the jejunum.

Hofmeister-Finsterer’s resection:
i. The distal portion of the stomach is removed with the closure of the stump of the duodenum.

ii. The stump of the stomach is anastomosed with the short loop of the jejunum.

This is done through the opening of the mesentery of the colon.

Stages of Hofmeister-Finsterer’s resection:
a – Dissection of the removed part of the stomach, b – Suturing of the gastric stump in the reverse direction, c – Burying the stump with seromuscular sutures, 1 – Haemostatic suture of the stump, 2 – Seromuscular suture, 3 – Sutures on part of the lesser curvature, 4 – Anterior wall of the stomach, d – Joining the gastric stump with intestinal loops, e – Opening of the gastric lumen, 1 – Posterior wall of the stomach, 2 – Mucous layer of the posterior wall, 3 – Mucous layer of the jejunum, f – Suturing of the anterior wall of the anastomosis, 1 – Jejunal lumen, 2 – Anterior wall of the stomach, 3 – Gastric lumen, 4 – Suture of the posterior wall of the anastomosis, g – Applying the 2nd layer of sutures on the anterior wall of the anastomosis, 1 – Anterior wall of the stomach, 2 – Suture of the 2nd layer, 3 – Jejunum

D) Gastrectomy:

Exophytic cancer of the body of the stomach and infiltrating tumour of the stomach at any location are indications of this operation.

The stomach is mobilised. All vessels and nerves around the gastric region are crossed and ligated.

The peritoneum is incised above the oesophagus; the oesophagus and crurals of the diaphragm are exposed near the oesophageal opening.
The Fyodorov’s forceps is applied on the oesophagus 5 cm above the tumour. The oesophagus is transected between the forceps.
The stomach is pushed to the right and removed.

E) Combined gastrectomy:
It is removal of the stomach with partial or total removal of the adjacent organ in extension of the metastatic growth into this organ.
For example, combined removal of the stomach and transverse colon; combined removal of the stomach and pancreas; combined resection of the stomach and spleen.

VAGOTOMY
A) Indication:
  Duodenal ulcer

B) Methods:
This operation is excision of certain branches of the vagus nerve to reduce excess secretion of hydrochloric acid and lessen the chance of recurrence of an ulcer.
A pyloroplasty or gastroenterostomy has to be carried out at the end of vagotomy.
There are 3 kinds of vagotomy, namely truncal vagotomy, selective vagotomy and proximal selective vagotomy (parietal cell vagotomy).
Truncal vagotomy is the cutting of the vagal trunks, which pass along the stomach and other abdominal organs.
Selective vagotomy is the excision of all gastric branches of the anterior and posterior vagal trunks with preservation of other branches to abdominal organs.
Proximal selective vagotomy is the cutting of the short branches which innervate the body and fundus of the stomach, where most of the parietal cells are found.

Types of vagotomy:
1 – Truncal vagotomy, 2 – Selective vagotomy, 3 – Proximal selective vagotomy

PYLOROPLASTY
A) Indications:
  – Uncomplicated duodenal ulcer (performed together with vagotomy)
  – Gastric ulcer (performed together with vagotomy)
  – Perforation of the peptic ulcer (performed together with vagotomy)
B) Contraindication:
- Pyloric stenosis

C) Methods:
It is the plastic surgery of the pylorus.
There are 2 main kinds of pyloroplasty, which are Finney’s and Heineke-Mikulicz’s ones.
- Finney’s pyloroplasty is the enlargement of the pyloric canal by inserting an inverted U-shaped anastomosis between the stomach and duodenum following a longitudinal incision.
- Heineke-Mikulicz’s pyloroplasty is the enlargement of the pyloric stricture by cutting the pylorus longitudinally and suturing the incision transversely.

D) Finney’s pyloroplasty:
- The surgical approach is midline laparotomy.
- An incision is made through all layers of the anterior wall of the pyloric canal midway between the greater and lesser curvatures 3 cm proximal to the pylorus up to 2 cm distal to the pylorus on the anterior wall of the abdomen. If the ulcer is located near the incision, it should be encircled and excised along with the incision.
- 2 pairs of tissue forceps are applied to the upper and lower edges of the incision. Then they are pulled apart to allow the widening of the pyloric canal.
- The wound is closed by through sutures, leaving a vertical suture line.

E) Heineke-Mikulicz’s pyloroplasty:
- Kocher’s method is applied to mobilise the descending part of the duodenum, so that it will lie against the greater curvature of the stomach.
- A seromuscular Lembert’s suture is used to connect the greater curvature and the descending part of the duodenum. The anterior walls of the stomach and duodenum are dissected 5 mm away from the suture line along an inverted horse-shoe shaped line. If the ulcer is located near the incision, it should be encircled and excised along with the incision.
- A through suture is applied to connect the greater curvature to the left edge of the duodenal wall. It is continued around the corner to unite the right edge of the duodenum to the left edge of the stomach.
- The wound is closed by a seromuscular suture.
RECONSTRUCTIVE OPERATIONS ON THE STOMACH
They are plastic operations of the stomach after gastrectomy by using fragments of the small or large intestine as grafts (transplants).

TOPOGRAPHY OF THE LIVER
A) English: Liver
B) Latin: Hepar
C) Greek: Hepar
D) Russian: Печень
E) Morphology:
   - Several lobes are distinguished: right lobe (lobus hepatis dexter), left lobe (lobus hepatis sinister), caudate lobe (lobus caudatus) and quadrate lobe (lobus quadratus).
   - On the right lobe, colic impression (impressio colica), renal impression (impressio renalis), suprarenal impression (impressio suprarenalis) and duodenal impression (impressio duodenalis) are distinguished.
   - On the left lobe, gastric impression (impressio gastrica) and oesophageal impression (impressio esophagealis) are distinguished.
F) Functions:
   - Participating in metabolism of fats, proteins and carbohydrates
   - Detoxification of drugs and toxins
   - Storage of glycogen, iron, vitamins and others
   - Protecting the body by Kupffer cells, immunoglobulins, complement proteins and others
   - Synthesis of bile, plasma proteins, clotting proteins, lipoproteins and others
   - Degradation of hormones, such as aldosterone
   - Maintaining osmotic pressure by synthesis of albumin
   - Destruction of erythrocytes
G) Holotopy:

- Projected on the right hypochondriac and proper epigastric regions

H) Skeletopy:

- 10th–11th thoracic vertebrae
- Superior margin: 5th rib
- Inferior margin: 7th–8th ribs (near the xiphoid process)
- Left lobe: 5th–7th ribs

I) Syntopy:

- Anterior: Diaphragm and anterior abdominal wall
- Posterior: Inferior vena cava, abdominal aorta and esophagus
- Superior: Diaphragm

- Inferior: Pylorus, transverse colon, stomach, duodenum, gall bladder, right colic flexure, right kidney and suprarenal gland

J) Arterial supply:

- Proper hepatic artery

K) Venous drainage:

- Central vein; drained into the sublobular vein; drained into the hepatic vein; then into the inferior vena cava

L) Lymphatic drainage:

- Hepatic lymph nodes (at the hilus)
- Hepatic lymph nodes (along the proper hepatic artery)
- Coeliac lymph nodes
- Cisterna chyli

M) Nerve supply:

- Sympathetic: T7 – T10
- Parasympathetic: Vagus nerve

- Afferent: Right and left anterior phrenic plexuses, coelica plexus and common trunk of vagus nerve

LIGAMENTS OF THE LIVER

- Falciform ligament (ligamentum falciforme)
- Coronary ligament (ligamentum coronarium)
- Round ligament (ligamentum teres hepatis)
- Hepatogastric ligament (ligamentum hepatogastricum)
- Hepatoduodenal ligament (ligamentum hepatoduodenale)
- Venous ligament (ligamentum venosum)
- Right and left triangular ligaments (ligamentum triangulare dextrum et sinistrum)
TOPOGRAPHY OF THE PANCREAS

A) English: Pancreas

B) Latin: Pancreas

C) Greek: Pankreas

D) Russian: Поджелудочная железа

E) Morphology:
   - Several parts are distinguished: head (caput pancreatis), neck (collum pancreatis), body (corpus pancreatis) and tail (cauda pancreatis)
   - Wirsung's pancreatic duct (ductus pancreaticus) joins the common bile duct (ductus choledochus) and open into the Vater's major duodenal papilla.
   - Santorini's accessory pancreatic duct (ductus pancreaticus accessorius) opens into the minor duodenal papilla.

F) Functions:
   - Exocrine function – Production of lipase, trypsinogen, chymotrypsinogen, carboxypeptidase and amylase
   - Endocrine function – Production of glucagon, insulin, somatostatin and pancreatic polypeptide
   - Providing alkaline environment for the duodenum by production of bicarbonate ions

G) Holotopy:
   - Projected on the umbilical and left hypochondriac regions

H) Skeletopy:
   - Head: 2nd lumbar vertebra
   - Body: 1st lumbar vertebra
   - Tail: 12th thoracic vertebra

I) Syntopy:
   - Anterior: Transverse mesocolon, lesser sac and stomach
   - Posterior: Common bile duct, portal vein, splenic vein, inferior vena cava, aorta, superior mesentery artery and left psoas major muscle
   - Inferior: Transverse colon

J) Arterial supply:
   - Superior pancreaticoduodenal artery
   - Inferior pancreaticoduodenal artery

K) Venous drainage:
   - Superior mesenteric vein
L) Lymphatic drainage:
   - Pancreaticosplenic lymph nodes
   - Pyloric lymph nodes

M) Nerve supply:
   - Sympathetic: T₁₂ – T₆
   - Parasympathetic: Vagus nerve
   - Afferent: Left renal, superior mesenteric, splenic, hepatic and coeliac plexuses

TOPOGRAPHY OF THE SPLEEN

A) English: Spleen

B) Latin: Lien

C) Greek: Splen

D) Russian: Селезёнка

E) Morphology:
   - 2 ends are distinguished: anterior and posterior ends.
   - 3 borders are distinguished: superior, inferior and intermediate borders.
   - 2 surfaces are distinguished: diaphragmatic (facies diaphragmatica) and visceral surfaces (facies visceralis).

F) Functions:
   - Participating in reticuloendothelial system
   - Participating in lymphopoiesis
   - Participating in haemopoiesis during fetal life
   - Reservoir and destruction of erythrocytes

G) Holotopy:
   - Projected on the left hypochondriac region

H) Skeletopy:
   - 10th – 12th vertebrae (or 9th – 10th ribs)

I) Syntopy:
   - Anteromedial: Fundus of the stomach
   - Posterior: Left kidney
   - Lateral: Diaphragm
   - Inferior: Left angle of the intestine

J) Arterial supply:
   - Splenic artery
K) Venous drainage:
- Splenic vein; then drained into the portal vein

L) Lymphatic drainage:
- Intraorganic nodes
- Splenic nodes located in the hilus of spleen
- Lymphatic nodes along the splenic vein
- Coeliac nodes

M) Nerve supply:
- Splenic plexus (from the coeliac plexus)

TOPOGRAPHY OF THE GALL BLADDER

A) English: Gall bladder

B) Latin: Vesica fellea, vesica biliaris, cystic fellea

C) Greek: Cholekystis

D) Russian: Желчный пузырь

E) Morphology:
  Several parts are distinguished: fundus (fundus vesicae felleae), neck (collum vesicae felleae), body (corpus vesicae felleae) and infundibulum (Hartmann’s pouch).

F) Functions:
- Storage of bile and its release into the duodenum
- Making the bile more concentrated by absorption of water and secretion of mucus
- Regulation of pressure in the biliary system by appropriate dilation and contraction

G) Holotopy:
- Projected on the point between the right costal arch and margin of the rectus abdominis muscle

H) Skeletopy:
- 9th rib

I) Syntopy:
- Anterior: Anterior abdominal wall
- Posterior: Left quadrate lobe of the liver
- Superior: Inferior surface of the liver
- Inferior: Duodenum and transverse colon

J) Arterial supply:
- Cystic artery
- Right hepatic artery
- Branches of the superior pancreaticoduodenal artery
K) Venous drainage:
- Superior part: Drained into the hepatic vein
- Others: Drained into the cystic vein; then into the portal vein

L) Lymphatic drainage:
- Cystic nodes
- Lower hepatic and upper pancreaticosplenical nodes

M) Nerve supply:
- Sympathetic: T<sub>7</sub> – T<sub>10</sub>
- Parasympathetic: Vagus nerve
- Afferent: Right and left anterior phrenic plexuses, coeliac plexus and common trunk of vagus nerve

**TOPOGRAPHY OF THE COMMON BILE DUCT**

The common bile duct (*ductus choledochus*) is formed by the cystic duct and common hepatic duct.

A) Morphology:
- The common bile duct has 4 portions: supraduodenal, retroduodenal, pancreatic and intraduodenal portions.
  - Supraduodenal: Located superior to the duodenum
  - Retroduodenal: Located behind the superior part of the duodenum
  - Pancreatic: Located between the duodenum and head of the pancreas
  - Intraduodenal: Located inside the duodenum

B) Topography:
- This duct is lodged in the hepatoduodenal ligament, with the portal vein behind it and the common hepatic artery to the left of it. The common bile duct, portal vein and common hepatic artery form the portal triad.
- It descends posterior to the duodenum and joins the Wirsung’s pancreatic duct to open into the Vater’s major duodenal papilla.
- The cystic duct, common hepatic duct and cystic artery form the Carlo’s triangle.

C) Layers:
- Serous layer (*tunica serosa*)
- Muscular layer (*tunica muscularis*)
- Mucous layer (*tunica mucosa*)

**TEMPORARY AND PERMANENT HAEMOSTATIC METHODS IN LIVER HAEMORRHAGE**

A) Temporary haemostatic methods:
- Finger compression of the liver
- Applying elastic clamps to the liver
- Temporal compression of the hepatoduodenal ligament by fingers or special clamps for not more than 15 minutes. This method is used in necrosis of the liver and venous stasis with haemorrhage of the organs of the gastrointestinal tract.
B) Permanent haemostatic methods:

- Mechanical methods:
  i. Applying hepatic sutures
  ii. Ligature of the vessels on the wound
  iii. Tamponade of the wound

- Physical methods:
  i. Hot compress
  ii. Electrocoagulation

- Biological methods:
  i. Temponade with the aid of the omentum

- Special haemostatic preparations:
  i. Calcium preparations, such as calcium chloride
  ii. Vicasol
  iii. ε-aminocaproic acid
  iv. Gelatinol
  v. Etamsylate

**KUZNETZOV-PENSKY'S SUTURE**

A) Indication:
- It is a specialised mechanical method used to stop liver haemorrhage.

B) Procedures:
- During the suturing of the hepatic tissue with a double ligature (one half of the thread is coloured), the ligature is withdrawn on the superior and inferior surfaces of the liver. The ligature is not tightened.
- One of the threads from the surface is intersected, and the end of other threads is tightened up.
- This method ensures that the hepatic tissue is pulled together by the stitches.
GENERAL PRINCIPLES OF THE OPERATIONS ON THE PANCREAS

There are 3 methods of surgical approach to the pancreas: through the gastrocolic ligament, through the mesentery of the transverse colon and approach to the greater omentum from the transverse colon.

Access to the pancreas:
- Through the gastrocolic ligament, b - Through the mesentery of the transverse colon, c - Approach to the greater omentum from the transverse colon

Operations for tumour of the pancreas:

There are 2 kinds of operations: radical and palliative ones.

Radical operations include pancreaticoduodenal resection. Its indications are cancer of the head of the pancreas, cancer of the intraduodenal part of the common bile duct and cancer of the major duodenal papilla.

Palliative operations include anastomosis between the intrahepatic bile ducts, anastomosis between the gall bladder and duodenum, anastomosis between the gall bladder and jejunum, anastomosis between the gall bladder and stomach.

Stages of the pancreaticoduodenal resection:

i. Mobilisation of the duodenum, head of the pancreas and distal part of the stomach
ii. Intersecting the common bile duct and duodenum
iii. Removal of the head of the pancreas, part of the stomach and superior part of the duodenum
iv. Applying anastomosis between the common bile duct, stump of the pancreas and jejunum; remaining part of the stomach and jejunum.
Left-sided resection of the pancreas in acute destructive pancreatitis:

a. Mobilization of the body and tail of the pancreas. b – Ligature of the splenic artery. c – Final stage

**Operation for acute pancreatitis:**

A) Indication: Acute destructive pancreatitis with signs of peritonitis

B) Aims:
   - To cease self-activation of the pancreatic enzymes and autodigestion (self-destruction of the pancreatic tissue)
   - To form a canal for outflow of the pancreatic juice
   - To eliminate the inflammatory process in the hepatobiliary tract
     i. The patient lies on the back.
     ii. Endotracheal narcosis is administered.
     iii. The surgical approach is superior midline laparotomy.
     iv. This operation includes the drainage of the omental bursa and catheterization of the right gastro-omental (gastroepiploic) artery.

Drainage of the omental bursa:
   - Transperitoneal approach:
     i. The gastrocolic ligament is dissected so that the stomach can be moved upwards and the transverse colon downwards.
     ii. At the beginning, 0.25% Novocain solution is administered to the transverse mesocolon and hepatoduodenal ligament.
     iii. The pancreatic capsule is not cut to prevent additional trauma of the pancreas and generalized process.
     iv. 5 – 6 gauze tampons and draining tube are put in the omental bursa.
     v. The gastrocolic ligament is then sutured and lined on the parietal peritoneum.
   - Extraperitoneal approach:
     i. An incision is made at the inferior border of the left 12th rib.
     ii. The soft tissue of the lumbar region is dissected layer by layer. Then the retroperitoneal fatty tissue is stratified till the inflammatory focus. A draining tube is inserted here.
     iii. The advantages of this approach are minimal infection in the abdominal cavity and prevention of the formation of postoperative adhesions.
Opening of abscess with drainage:

- Dissection of the gastrocolic ligament, b – Fixation of the gastrocolic ligament and greater omentum, c – Final stage

Catheterization of the right gastro-omental artery:

- The right gastro-omental artery is isolated in the greater omentum near the pylorus.
- In the middle of this artery, a catheter with a diameter of 1 mm is inserted. Then the artery is tightened at the level of its outflow from the hepatic artery. The correct position of the catheter is controlled by administering 2 – 3 ml indigocarmine (a colour indicator which has the same colour as the pancreas) to the catheter. The distal part of the catheter is brought out through the skin.
- Different drugs like Contrycal, Octreotide can then be administered through this catheter.

Splenectomy

A) Indications:
- Traumatic injury (wound, rupture)
- Echinococcosis
- Haemolytic (suprahepatic) jaundice
- Wielhoffs’s disease (idiopathic thrombocytopenic purpura)
- Splenomegaly accompanied with portal hypertension
- Congenital anomaly of the spleen

B) Procedures:
- The patient lies on the back or on the right side with a roller (валик) placed under the waist.
- Endotracheal narcosis is administered.
- Either upper oblique laparotomy parallel to the left costal arch or superior midline laparotomy is performed.
- The costal arch is drawn out superiorly; the transverse colon and stomach are drawn out to the right and inferiorly.
The phrenicolienal ligament is found and dissected. In case of bleeding in the abdominal cavity due to rupture of the spleen, haemostatic forceps is applied. Then the gastrolienal ligament is dissected in parts, stitched and ligated.

To prevent bleeding, the splenic artery is ligated. But owing to the fact that the short gastric arteries are also branches of this artery, it is forbidden to ligate its trunk. Only the branches to the spleen (which are located near to the hilus) are ligated. After the ligation of the splenic artery, the splenic vein is also ligated.

The spleen is then removed. A puncture is made on the left hypochondrium for drainage.

**CHOLECYSTECTOMY**

A) Indications:
- Chronic residual cholecystitis (calculous and acalculous)
- Phlegmon, gangrene, perforation and cancer of the gall bladder

B) Procedures:
- The patient lies down on the back with a roller placed under it.
- Endotracheal narcosis is administered.
- The surgical approach is upper oblique laparotomy (Fyodorov’s or Kocher’s method) parallel to the right costal arch.
- There are 2 kinds of cholecystectomy, namely the cholecystectomy from the neck and cholecystectomy from the fundus.

**Cholecystectomy from the neck:**

A) Indication:
- It is carried out in the absence of inflammation.

B) Procedures:
- The gall bladder is identified and the small intestine is placed downwards to expose the hepatobilary tract. An assistant’s left hand maintains the exposure. The liver is retracted with the Daever’s retractor held in the assistant’s right hand.
- The peritoneum overlying the neck of the gall bladder is carefully incised and the junction of the cystic duct with the common bile duct is exposed. The cystic artery is exposed close to the cystic duct by the same method. It is then ligated at 2 sites and divided between the ligatures. Now the gall bladder is attached to the common bile duct by the cystic duct only.
- At this stage, cholangiography is carried out either by passing a catheter into the common bile duct via the cystic duct or by the direct puncture technique. Take 2 films after injecting 2 – 4 ml of contrast. If this excludes stones and shows good outflow into the duodenum, the cystic duct will then be ligated.
- The gall bladder is removed by dividing its peritoneal attachment to the liver.
Cholecystectomy from the neck

**Cholecystectomy from the fundus:**

A) Indication:
   - It is performed in case of inflammation of the gall bladder.

B) Procedures:
   - It is almost the same as the previous operation. The only difference is that the cystic artery and duct are ligated after the removal of the gall bladder from the liver.

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**CHOLECYSTOSTOMY**

A) Indications:
   - Acute cholecystitis
   - In patients with severe cardiovascular and respiratory diseases
   - Obstructive (subhepatic) jaundice

B) Procedures:
   - The patient lies down on the back with a roller placed under it at the level of the 12th rib.
Endotracheal narcosis is administered.

The surgical approach is upper oblique laparotomy.

Through the operative wound, a wide (1 cm in diameter) seroserous purse-string silk suture is applied on the fundus of the gall bladder. A puncture is made on the bladder with a thick needle.

After discharge of the contents of the bladder through the place of puncture, the bladder is opened with a scalpel. The calculi are then removed from it.

A draining tube is inserted into the bladder through the opening. The tube is strengthened and fixed to the bladder after applying the wound with a purse-string suture.

The serous layer of the bladder is fixed with interrupted sutures to the peritoneum; later to the aponeurosis.

It is forbidden to fix it to the skin because a fistula may be formed.

CHOLEDOSTOMY

A) Indications:

Choledocholitis (inflammation of the common bile duct)
Choledocholithiasis (biliary calculus)
Performed before or after cholecystectomy

B) Types:

This operation may be subdivided into external and internal ones.

External drainage: The tube is brought out to the external environment.
Internal drainage: The tube is brought to the duodenum.

C) Procedures:

The surgical approach is carried out as that of the operations on the gall bladder or superior median laparotomy.

After the dissection of the hepatoduodenal ligament and longitudinal dissection of the common bile duct, a tube is inserted into it in the direction to the hepatic bile duct.

The distal end of the tube is drawn out below the incision of the anterior abdominal wall.

TOPOGRAPHY OF THE JEJUNUM AND ILEUM

A) English: Jejunum and ileum

B) Latin: Jejunum and ileum (under the common name intestinum tenue mesenteriale)

C) Greek: Jejunum and ileum

D) Russian: Тощая и подвздошная кишки

E) Morphology:
Layers:
  i. Serous layer *(tunica serosa, peritoneum)*
  ii. Muscular layer *(tunica muscularis)*:
      - External layer consists of longitudinal fibres.
      - Internal layer consists of circular fibres.
  iii. Submucous layer *(tunica submucosa)*
  iv. Mucous layer *(tunica mucosa)*

F) Function:
  - Digestion and absorption of nutrients

G) Holotopy:
  - Projected on the umbilical region

H) Skeletopy:
  - 2nd lumbar vertebra – terminal line of the pelvis
  - Root of the mesentery: Left side of the 2nd lumbar vertebra – right sacroiliac joint

I) Syntopy:
  - Anterior: Greater omentum
  - Posterior: Aorta, ureter and duodenum
  - Superior: Transverse colon
  - Inferior: Pelvic organs
  - Lateral: Descending and ascending colon

J) Arterial supply:
  - Marginal arteries (branches of 20 jejunal and ileal arteries)
    - Ileal branch of the ileocolic artery

K) Venous drainage:
  - Superior mesenteric vein; then drained into the portal vein

L) Lymphatic drainage:
  - Lymph nodes along the superior mesenteric artery; then drained into the preaortic lymph nodes

M) Nerve supply:
  - Sympathetic: T₃ – L₂
  - Parasympathetic: Vagus nerve
  - Subserosal, Auerbach’s myenteric and Meissner’s submucosal plexuses
  - Afferent: Phrenic nerve, greater and lesser splanchnic nerves, thoracic and lumbar spinal nerves, hypogastric plexus, hepatic plexus, superior and inferior mesenteric plexuses
### Differences Between the Jejunum and Ileum

<table>
<thead>
<tr>
<th>Features</th>
<th>Jejunum</th>
<th>Ileum</th>
</tr>
</thead>
<tbody>
<tr>
<td>Location</td>
<td>Occupies upper and left parts of the intestine</td>
<td>Occupies lower and right parts of the intestine</td>
</tr>
<tr>
<td>Wall</td>
<td>Thicker and more vascular</td>
<td>Thinner and less vascular</td>
</tr>
<tr>
<td>Lumen</td>
<td>Wider and often empty</td>
<td>Narrower and often loaded</td>
</tr>
<tr>
<td>Mesentery</td>
<td>A. Windows present</td>
<td>A. No windows</td>
</tr>
<tr>
<td></td>
<td>B. Less abundant fat</td>
<td>B. More abundant fat</td>
</tr>
<tr>
<td></td>
<td>C. 1 or 2 arterial arcades</td>
<td>C. 3 or 6 arterial arcades</td>
</tr>
<tr>
<td></td>
<td>D. Longer and fewer vasa recta</td>
<td>D. Shorter and more vasa recta</td>
</tr>
<tr>
<td>Circular mucosal folds</td>
<td>Larger and dense</td>
<td>Smaller and sparse</td>
</tr>
<tr>
<td>Villi</td>
<td>Large, thick (leaf-like) and more abundant</td>
<td>Shorter, thinner (finger-like) and less abundant</td>
</tr>
<tr>
<td>Peyer’s patches</td>
<td>Absent</td>
<td>Present</td>
</tr>
<tr>
<td>Solitary lymphatic follicles</td>
<td>Fewer</td>
<td>More</td>
</tr>
<tr>
<td>Length</td>
<td>2/5 of the small intestine with the exception of the duodenum</td>
<td>3/5 of the small intestine with the exception of the duodenum</td>
</tr>
<tr>
<td>Diameter</td>
<td>More than 4.5 cm</td>
<td>Less than 3 cm</td>
</tr>
<tr>
<td>Colour</td>
<td>Red</td>
<td>Gray</td>
</tr>
<tr>
<td>Cross section</td>
<td>Oval-shaped</td>
<td>Round-shaped</td>
</tr>
<tr>
<td>Lymphatic nodes</td>
<td>Solitary</td>
<td>Aggregate (Peyer’s patches)</td>
</tr>
</tbody>
</table>

### Topography of the Appendix

A) English: Appendix, vermiform process

B) Latin: Appendix vermiformis

C) Greek: Appendix

D) Russian: Червеобразный отросток

E) Morphology:

1. Layers:
   - Serous layer
   - Muscular layer:
     - External layer consists of longitudinal fibres.
     - Internal layer consists of circular fibres.
   - Submucous layer
   - Mucous layer

F) Function
Participating in lymphopoiesis with the help of its white tissues

G) Holotopy:
- Projected on the right inguinal region

H) Skeletopy:
- 5th lumbar vertebra

I) Syntopy:
- Anterior: Anterior abdominal wall and greater omentum
- Posterior: External iliac vessels
- Superior: Terminal part of the ileum, ascending colon, inferior part of the pelvic bone and right oviduct
- Lateral: Caecum and ascending colon

J) Arterial supply:
- Appendicular artery

K) Venous drainage:
- Appendicular vein; drained into the ileocolic vein; drained into the superior mesenteric vein; then drained into the portal vein

L) Lymph drainage:
- Inguinal lymph nodes

M) Nerve supply:
- Inferior mesenteric plexus

**VARIATIONS IN POSITION OF THE APPENDIX**
- Medial:
  - Ascending
  - Descending
- Lateral:
  - Ascending
  - Descending
  - Mesocaecal (at the level of the caecum)
  - Antecaecal (in front of the caecum)
  - Retrocaecal (behind the caecum)
  - Subhepatic (below the liver)

**TOPOGRAPPHY OF THE ILEOCAECAL ANGLE**
- It is located in the inferior floor of the peritoneal cavity and projected on the right inguinal region of the abdominal wall.
- It is formed between the terminal part of the ileum and caecum. The mesentery of the ileum, superior and inferior ileocaecal recesses (*recessus ileocaecalis superior et inferior*) are located between them.
Posterior to the caecum, the retrocaecal recess (recessus retrocaecalis) is located.

**TOPOGRAPHY OF THE LARGE INTESTINE**

A) English: Large intestine

B) Latin: *Intestinum crassum*

C) Greek: Colon

D) Russian: Толстая кишка

E) Morphology:
   - The large intestine is divided into the caecum, appendix, ascending colon (*colon ascendens*), transverse colon (*colon transversum*), descending colon (*colon descendens*), sigmoid (pelvic) colon (*colon sigmoideum*) and rectum.
   - Junctions (flexures):
     i. Ileocaecal angle
     ii. Right colic (hepatic) flexure
     iii. Left colic (splenic) flexure
     iv. Rectosigmoid junction
     v. Sacral flexure of the rectum
     vi. Perineal flexure of the rectum
   - Layers:
     i. Serous layer
     ii. Muscular layer:
       - External layer consists of longitudinal fibres. The longitudinal layers form the taeniae.
       - Internal layer consists of circular fibres.
     iii. Submucous layer
     iv. Mucous layer
   - 3 main characteristic structures:
     i. Teniae coli consisting of free taenia (*tenia libera*), omental taenia (*tenia omentalis*) and mesocolic taenia (*tenia mesocolica*)
     ii. *Haustra coli*
     iii. Omental (epiploic) appendices (*appendices epiploicae*)

F) Functions:
   - Absorption of water, electrolytes and gases
   - Compaction and elimination of faeces
   - Production of vitamins B and K by the microflora
   - Conversion of bilirubin into stercobilin

G) Holotopy:
   - Caecum: Projected on the right inguinal region
   - Ascending colon: Projected on the lateral abdominal region
Right (hepatic) flexure of the colon: Projected on the right hypochondriac region
Transverse colon: Projected on the umbilical region
Left (splenic) flexure of the colon: Projected on the hypochondriac region
Descending colon: Projected on the right lateral abdominal region
Sigmoid colon: Projected on the left inguinal region
Rectum: Projected on the suprapubic region
Serous covering:
i. Caecum: Intra- or mesoperitoneal
ii. Ascending colon: Mesoperitoneal
iii. Transverse colon: Intraperitoneal (It has transverse mesocolon.)
iv. Descending colon: Mesoperitoneal
v. Sigmoid colon: Intraperitoneal (It has its own mesentery called the sigmoid mesocolon.)
vi. Rectum: Supraampular (intraperitoneal), ampular (mesoperitoneal), anal canal (extraperitoneal)

H) Skelotopy:
12th thoracic vertebra – sacrum
Transverse mesocolon: Lies horizontally at the level of the 12th thoracic vertebra

I) Syntopy:
Superior: Stomach, pancreas, liver, gall bladder, duodenum and spleen
Inferior: Urinary bladder, uterus (in females) and prostate gland (in males)
Medial: Small intestine
Lateral: Left and right paracolic canals, lateral abdominal wall
Anterior: Anterior abdominal wall
Posterior: Posterior abdominal wall, great vessels and kidneys

J) Arterial supply:
Caecum: Supplied by the anterior and posterior caecal arteries
Appendix: Supplied by the appendicular artery
Ascending colon: Supplied by the right colic artery
Transverse colon: Supplied by the middle colic artery
Descending colon: Supplied by the left colic artery
Sigmoid colon: Supplied by the sigmoid artery or rectosigmoid artery
Rectum: Supplied by the superior rectal, middle rectal and inferior rectal arteries
Middle colic and left colic arteries form the arc of Riolan.

K) Venous drainage:
Caecum: Drained into the anterior and posterior caecal veins; then into the superior mesenteric vein
Ascending colon: Drained into the right colic vein; then into the superior mesenteric vein
Proximal half of the transverse colon: Drained into the middle colic vein; then into the superior mesenteric vein

248
Distal half of the transverse colon: Drained into the middle colic vein; then into the inferior mesenteric vein
Descending colon: Drained into the left colic vein; then into the inferior mesenteric vein
Sigmoid colon: Drained into the sigmoid vein; then into the inferior mesenteric vein
Rectum:
- i. Supraampullary: Drained into the superior rectal vein; then into the portal vein
- ii. Ampullary: Drained into the middle rectal vein; then into the inferior vena cava
- iii. Anal canal: Drained into the inferior rectal vein; then into the inferior vena cava
Portocaval anastomoses are formed by the portal vein and inferior vena cava.

I.) Lymphatic drainage:
- Intraorganic lymph nodes
- Paracolic and epicolic lymph nodes; preaecal nodes (for caecum)
- Lymph nodes along the vessels
- Superior and inferior mesenteric lymph nodes
- Para-aortic and coeliac lymph nodes

M.) Nerve supply:
- Sympathetic: T₅ – L₂
- Parasympathetic: Vagus nerve
- Afferent: Phrenic nerve, greater and lesser splanchnic nerves, thoracic and lumbar spinal nerves, hypogastric and hepatic plexuses, superior and inferior mesenteric plexuses

DIFFERENCES BETWEEN THE SMALL AND LARGE INTESTINE

<table>
<thead>
<tr>
<th>Features</th>
<th>Small intestine</th>
<th>Large intestine</th>
</tr>
</thead>
<tbody>
<tr>
<td>Appendices epiploicae</td>
<td>Absent</td>
<td>Present</td>
</tr>
<tr>
<td>Teniae coli</td>
<td>Absent</td>
<td>Present</td>
</tr>
<tr>
<td>Haustra coli</td>
<td>Absent</td>
<td>Present</td>
</tr>
<tr>
<td>Distensibility</td>
<td>Less</td>
<td>More</td>
</tr>
<tr>
<td>Fixation</td>
<td>Greater part is freely mobile</td>
<td>Greater part is fixed</td>
</tr>
<tr>
<td>Villi</td>
<td>Present</td>
<td>Absent</td>
</tr>
<tr>
<td>Transverse mucosal folds</td>
<td>Permanent</td>
<td>Obliterated when longitudinal muscle coat relaxes</td>
</tr>
<tr>
<td>Peyer’s patches</td>
<td>Present in ileum</td>
<td>Absent</td>
</tr>
<tr>
<td>Length</td>
<td>6.5 – 7 m</td>
<td>1 – 1.5 m</td>
</tr>
<tr>
<td>Diameter</td>
<td>Small</td>
<td>Large</td>
</tr>
<tr>
<td>Thickness of the wall</td>
<td>Thicker</td>
<td>Thinner</td>
</tr>
<tr>
<td>Colour</td>
<td>Rosy</td>
<td>Blue + gray</td>
</tr>
</tbody>
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INTESTINAL SUTURES

The term "intestinal suture" implies all kinds of sutures, which are put on the wall of
a hollow organ of the alimentary tract (for eg, esophagus, stomach, intestine), as
well as on other hollow organs, having peritoneal integument, muscular layer, submucous layer and mucous membrane.

General requirements for putting the intestinal sutures are: 1) observance of asepsis, accurate haemostasis and minimal damage to tissue, especially those of mucous membrane and submucous layer; 2) safe impermeability by means of securing a wide contact of serous surfaces and adaptation of the rest layers of the wall, especially during performing operations on the large intestine and biliferous ducts; 3) application of absorbable material (catgut sutures) while putting through and buried sutures on the borders of the wound, directed into the lumen of the gastrointestinal tract, and application of non-absorbable material while putting seromuscular sutures; 4) in connection with the intestinal peristalsis, sutures from the absorbable material should be put as continuous, and from non-absorbable material – interrupted ones; 5) intestinal suture is placed with the aid of the round needles (straight or circle).

Dirty sutures:
These sutures reach the intestinal lumen.

Clean sutures:
These sutures only reach the serous and muscular layers.

Through (сквозной) sutures:
Contintous catgut suture: The thread is laid through the borders of sutured walls by
the principle, mucous membrane – serous membrane – serous membrane, serous
membrane – mucous membrane and so on, which is from the internal to external or
from the external to internal.

Schmieden’s suture: The thread goes from the external to internal or from the internal
to external, which is mucous membrane – serous membrane and serous membrane
– mucous membrane. The thread is tightened after each stitch. As a result of this,
the walls turn out and adjoin their serous surfaces.

Interrupted sutures: It is through all layers of the wall inside the lumen.

Aseptic sutures:
Seromuscular suture: Pricking in and out of the needle in every stitch is performed
through serous and muscular stitches.

Purse-string suture: It is a seromuscular suture performed by stitches with a circle.
It is used to bury the stump of the appendix, duodenum, jejunum or ileum, as well as
for suturing small stab wounds of the stomach and intestine. After the suturing, the
ends of the needle are tightened and tied up, and the stump or wound is buried inside
the wall of the organ.
Z-shaped suture: It is an additional suture to the purse-string suture and is placed above it.

Haemostatic sutures:
- There are applied with the purpose of creating a reliable haemostasis of the vessels of the crossed wall of the alimentary tract.
- Haemostasis is achieved by putting the edge of the catgut suture and Shmieden's suture together. There are also special haemostatic sutures, such as Reverden-Multanovsky's suture and stitch suture.
  - Reverden-Multanovsky's buttonhole (петельный) suture: After putting the edge of the suture, the needle is passed into the loop and laced.
  - Stitch (строечный) suture: It is more frequently used in suturing stump of the stomach during resection.

Mechanical sutures:
- At present, this method of suture is widely used in operations on the gastrointestinal tract: resection of the stomach and intestine, gastroenteroanastomosis and etc.
- The suture is often performed with the help of suturing apparatuses and tantal-containing staplers. More often, УКЖА-60 (apparatus for gastrointestinal anastomosis) and КЦ (apparatus for round suture on the large intestine) are used in operations on the gastrointestinal tract.
- The advantages of this method are fast application of the sutures, reliability of sterilization, and absence of hygroscopicity of the suture material.
Intestinal sutures:
a - Lembert's suture. 1 - Serous layer, 2 - Muscular layer, 3 - Mucous layer, b - Through suture, c - Albert's two-layer suture

INTESTINAL ANASTOMOSES

Intestinal anastomoses may be end to end, side to side, end to side and side to end.

A) End to end anastomosis:
   - It is direct connection of the ends of organs with double- or triple-layer sutures.
   - This anastomosis is more physiological and can thus be applied in different operations.
   - The disadvantage of this method is possible constriction of the intestinal lumen.
   - This method is not recommended to be applied to intestinal ends with different diameters (for example, between the small and large intestines).
   - Zholli's suture and Schmieden's suture are typical examples of this anastomosis.
   - Zholli's suture is anastomosis of the posterior wall of the intestine. It is a continuous and dirty suture.
   - Schmieden's suture is a shoe-like suture. This suture penetrates all time from internal-external-internal surfaces of the intestine.

B) Side to side anastomosis:
   - The stumps are located isoperistaltically by suturing both sides of the intestine or stomach with the intestine.
   - The advantages of this method are absence of constriction at the site of anastomosis and allowable anastomosis between intestinal ends with different diameters.
   - Its disadvantage is development of necrosis at the site of anastomosis due to poor blood supply in this area.
C) End to side anastomosis:
- This method is used to connect sections of the gastrointestinal tract with different diameters.
- It is used in resection of the stomach, where the stump of the stomach is sutured to the side of the small intestine.
- It is also a palliative method to relieve condition of patients suffering from cancer.

D) Side to end anastomosis:
- It is a rarely used method which connects the proximal side of an organ with the distal end of another organ. For example, Ru’s gastroenteroanastomosis and ileotransversoanastomosis.

Intestinal anastomosis:
 a – End to end anastomosis, b – Side to side anastomosis, c – End to side anastomosis

OPERATIONS ON THE SMALL INTESTINE
- They are divided into palliative and radical operations.

A) Palliative operations:
- They include different kinds of stomas. According to location, they are divided into jejunostomy and ileostomy. According to structure, they may be tubular (temporary) or lip-shaped (permanent).
- Jejunostomy is creation of an opening between the jejunum and the surface of the abdominal wall. It is used for feeding of the patients. It is performed in any pathology of the oesophagus or stomach.
- Ileostomy is creation of an opening between the ileum and the surface of the abdominal wall. It is performed to remove intestinal contents.

B) Radical operations:
- They include duodenotomy, jejunotomy, ileotomy and resection of the small intestine.
RESECTION OF THE SMALL INTESTINE

A) Indications:
- Tumour of the small intestine or its mesentery
- Necrosis of the small intestine in acute ileus, strangulated hernia, thrombosis of the arteries of the small intestine

B) Procedures:
- The patient lies on the back.
- Endotracheal narcosis is administered.
- The surgical approach is midline laparotomy.
- Separation of the mesentery from the intestine may be of 2 ways: parallel separation of the intestine at the level of the arteries or wedge-shaped separation with preliminary ligature of the vessels near the root of the mesentery. The latter approach is applied in extensive resection and tumour of the intestine.
- A stiff haemostatic clamp is applied in the proximal and distal ends of the removed part of the intestine in the oblique direction at 45°. This is done so to provide better blood supply for the free margin (margo liberalis) of the intestine at the region of anastomosis. The intestinal lumen can also be widened at the region of anastomosis by this method.
- Soft intestinal clamps are applied 1 – 1.5 cm superior and external to the place of resection. The removed part of the intestine is dissected in the oblique direction parallel to the stiff clamp. After the removal, the intestinal ends are drawn together by anastomosis.

Mobilization of part of the small intestine:
a – Parallel separation of the mesentery, b – Wedge-shaped separation of the mesentery

OPERATIONS ON THE DUODENUM
- They include resection and puncture of the duodenum.

A) Resection:
i) Kocher’s method:
- It is mobilization of the duodenum.
An anastomosis between the oesophagus and duodenum is performed after gastrectomy.

ii) Nakayama’s method:

The diaphragm and pancreas are sutured together and anastomosis is carried out between the oesophagus and duodenum.

B) Puncture:

A purse-string suture is made on the intestinal wall. Then a puncture is performed. The opening is closed by pulling the suture.

WITZEL’S JEJUNOSTOMY

A) Indications:

- Metastatic spreading of the cancer of the stomach
- Chemical burn of the stomach
- Inapplicable performance of gastrostomy

B) Procedures:

The patient lies on the back.

Endotracheal narcosis is administered.

The surgical approach is either superior midline laparotomy or superior left-sided transrectal incision.

Loops of jejunum 40 – 50 cm in length from the duodenojejunal flexure are identified and drawn out. An intestinal anastomosis is performed between the adducting and abducting ends. A jejunostomy tube is inserted in the abducting loop of the jejunum and later buried by the interrupted silk sutures.

The opening of the intestine above the tube is stitched with a purse-string and interrupted sutures. The tube is fixed to the intestinal wall with catgut sutures to prevent its formation of sliding hernia. The tube is thus located in the canal, forming the intestinal wall with its serous covering.

An incision is made to draw out the tube through the anterior abdominal wall. The intestine around the tube and the formed canal is fixed to the internal surface of the abdominal wall with seromuscular sutures.

The operative wound around the stoma is stitched and the tube is fixed to the edge of the skin wound.

ILEOSTOMY

A) Indications:

- Paralytic ileus
- Inoperable tumour (located in the distal part of the ileum, for example, tumour of the caecum)

B) Procedures:

The abdominal cavity is approached by an oblique incision 6 cm in length in the inguinal region, 4 cm above the inguinal ligament.
Loops of the ileum are stitched to the dissected edge of the parietal peritoneum with continuous sutures. The intestinal wall is cut longitudinally. The dissected edges of the intestine are stitched to the edges of the skin with interrupted sutures. A lip-shaped stoma is thus formed.

An operation is required in case of removal of this stoma.

OPERATIONS ON THE LARGE INTESTINE

- They are divided into palliative and radical operations.

A) Palliative operations:

• They include different kinds of stomas. According to location, they are divided into caecostomy, transverse colostomy and sigmoidostomy. According to structure, they may be tubular (temporary) or lip-shaped (permanent).

B) Radical operations:

• They include one-stage resection of the transverse colon, one-stage resection of the sigmoid colon, right-sided and left-sided hemicolecctomies.

  Right hemicolecctomy includes removal of the caecum together with the terminal part of the ileum, ascending colon, right colic flexure and right half of the transverse colon. The operative stages include mobilization of the right half large intestine together with the terminal part of the ileum, ligature of the main arterial trunks, removal of the right half of the large intestine together with the appendix and section of the ileum 10 cm in length. End to side or side to side anastomosis is carried out between the stump of the large intestine and transverse colon.

  Left hemicolecctomy includes removal of the sigmoid colon, descending colon, left colic flexure and left half of the transverse colon. The operative stages are almost the same as those of right hemicolecctomy. End to end anastomosis is performed between the transverse colon and stump of the sigmoid colon or beginning part of the rectum.
RESECTION OF THE LARGE INTESTINE
A) Indications:
- Cancer, volvulus and intussusception of the colon accompanied with its necrosis
- Extensive trauma of the colon
- Fistula of the colon
- Ulcerative colitis

B) Procedures:
- The patient lies on the back.
- Endotracheal narcosis is administered.
- The surgical approach may be para-rectal, midline, trans-rectal or combined.

One-stage primary resection of the sigmoid colon
- The abdominal cavity is opened by inferior midline laparotomy.
- The vessels are ligated at the root of the mesentery. The mesentery is dissected like a wedge shape from its root till the place where resection takes place. It is done so to preserve the marginal arteries at the proximal part of the section.
- The stiff intestinal clamps are applied to the ends of the removed section and the soft intestinal clamps are applied to the remaining part of the colon.
- The colon is intersected and removed together with its part of mesentery.
- End to end anastomosis is applied in this case. Triple-layer suture is applied: 1st layer – continuous catgut suture on the posterior edge of anastomosis and screwing (вворачивающий) suture on the anterior edge; 2nd layer – interrupted silk seromuscular suture; 3rd layer – interrupted seromuscular suture. The opening of the mesentery is stitched by interrupted sutures.

CAECOSTOMY
A) Indications:
- Acute ileus
- Temporal faecal fistula in case of operation on the large intestine
- Ulcerative colitis
- Wound of the large intestine

B) Procedures:
- The patient lies on the back.
- Endotracheal narcosis is administered.
- The surgical approach is oblique laparotomy on the right ilioinguinal region.
- The caecum is drawn out through the surgical wound. A seromuscular purse-string suture with a diameter of 1 cm is applied to it. Its wall is cut at the centre of the suture along the taenia coli. A rubber tube is inserted into its lumen.
- The end of the tube is laid down along the taenia coli and buried by interrupted seromuscular sutures.
- The edge of the parietal peritoneum is stitched to the serous covering of the caecum around the absorbed tube. The abdominal wall is sutured around the caecostoma (fixation of the caecum).
In case of removal of the fistula, the rubber tube is removed and the fistula closes on its own.

TRANSVERSE COLOSTOMY
A) Indication:
- Tumour or diverticulitis of the distal half of the colon

B) Procedures:
- An incision is made longitudinally along the rectus abdominis muscle.
- The place for colostomy is at the proximal half of the transverse colon to the right of the middle colic artery. The greater omentum is separated from the bowel for 4 – 6 inches and returned to the abdomen. A rubber tube is inserted through an avascular area in the mesocolon near to the bowel at the level where colostomy is placed.
- The tube is drawn out from the previous incision. Sutures are placed around the skin wound.

APPENDECTOMY
A) Indications:
- Acute or chronic inflammation of the appendix
- Tumour of the appendix

B) Kinds of operations:
- Open – Laparotomy
  i. Anterograde appendectomy
  ii. Retrograde appendectomy
- Closed – Laparoscopy

C) Procedures:
- Laparotomy:
  i. The patient lies on the back.
  ii. Endotracheal narcosis or local anaesthesia is administered.
  iii. There are 3 kinds of surgical approach, which are lower oblique laparotomy (Volkovich-Dyakonov’s access), pararectal laparotomy (Lenander’s access) and inferior midline laparotomy.
iv. Volkovich-Dyakonov's approach is applied in acute appendicitis with pain in the right iliac fossa. Lenander's approach is used when the diagnosis is not confirmed before the operation. Inferior midline laparotomy is applied in the presence of signs of peritonitis.

v. Points of incisions include McBurney's and Lanz's points. McBurney's point is located at the lateral 1/3 of the right spinoumbilical line. Lanz's point is found at the middle of the bispinal line on the right.

**Anterograde appendectomy:**
- It is performed in the absence of inflammation.
- The appendix is identified by finding the free taenia. It is because the free taenia almost connects with the appendix.
- The appendicular artery is found, clamped and ligated. Near the base of the appendix, there is a structure called the Ognev's window. It is devoid of vessels and ligature of mesenterium can thus be performed here.
- With the aid of Kocher's forceps, the base of the appendix is pressed, ligated, cut and removed.
- The stump of the appendix is ligated with a purse-string suture. An invagination is then made to pull down the stump. At the end, it is closed by a Z-shaped suture.

**Retrograde appendectomy:**
- It is performed in inflammation of the appendix.
- It is almost the same as the previous operation. The only difference is that the appendicular artery is ligated after the removal of the appendix.

![Stages of appendectomy](image-url)

Stages of appendectomy:

a, b – Ligature of the vessels and dissection of the mesoappendix. c, d, e, f – Removal of the appendix by means of ligature and invagination
MAIDL'S FORMATION OF THE ARTIFICIAL ANUS
(ANUS PRAETERNATURALIS)

A) Indications:
- Wound of the rectum
- Inoperable tumour of the rectum
- Cicatrical narrowing of the rectum

B) Procedures:
- The patient lies on the back.
- Local infiltrative anaesthesia is administered.
- The abdominal wall is approached by an oblique incision on the left ilioinguinal region.
- The edges of the skin are connected with the edges of the parietal peritoneum with continuous catgut sutures. Through the wound, loops of the sigmoid colon together with the mesocolon are drawn out. The mesenteric margins of both the abducting and adducting ends are connected to each other with interrupted silk sutures. Then both ends lie parallel to each other, forming the "bishaft" (двустволки). Their walls are separated by a septum called the "spur" (шпора).
- The serous covering for the intestinal loops is stitched to the parietal peritoneum with close interrupted silk sutures.
- The artificial anus may be "unishaft" (одностволка). It is done in case of removal of the whole peripheral part of the affected intestine. The abdominal wall is sutured, remaining only the central end of the intestine.

Formation of the bishaft artificial anus:
a – Formation of the bishaft, b – Openings of the adducting and abducting ends. 1 – Separation by the “spur”
CHAPTER
EIGHT
THE LUMBAR
REGION

DETAILS OF CONTENTS

Retroperitoneal space

Vertebral column

Topography of the kidney, ureter, adrenal gland, abdominal aorta, inferior vena cava, lumbar nerve plexus and epidural venous plexus

Vishnevsky's paranephral blockade, epidural and subdural anaesthesia

Operations including lumbar puncture; laminectomy; resection of the kidney and nephrectomy; principles of operations on the ureter and stitches of the ureter
TOPOGRAPHY OF THE LUMBAR REGION (REGIO LUMBARIS)

A) Borders:
- Superior: 12th rib
- Inferior: Iliac crest
- Lateral: Lesgaft's line (vertical line passing through the end of the 11th rib from the midaxillary line)
- According to the erector spinae muscle, the lumbar region is divided into the medial and lateral departments.

B) Layers:
- The skin is thick.
- Subcutaneous tissue:
  i. It contains the superficial fascia which divides the fatty tissue into 2 to 3 layers.
  ii. The fat tissue continued in the gluteal region is called massa adiposa lumboglutealis (deep fat).
- Proper fascia:
  i. It forms a sheath for the erector spinae muscle and is called the fascia thoracolumbalis.
  ii. It is divided into superficial and deep layers.
  iii. Superficial layer: It is fixed to the spinous process.
  iv. Deep layer: It is fixed to the transverse process.
- Muscles:
  i. They are divided into the superficial and deep groups.
  ii. Superficial: Latissimus dorsi muscle
  iii. Deep muscles are divided into the medial and lateral groups according to margin of the erector spinae muscle.
  iv. Medial: Psoas major, psoas minor and quadratus lumborum muscles
  v. Lateral: External oblique, internal oblique, transversus abdominis and serratus posterior inferior muscles.

C) Weak places:
- Petit's lumbar triangle:
  i. Borders:
    - Medial: Margin of the latissimus dorsi muscle
    - Lateral: Margin of the external oblique muscle
    - Inferior: Iliac crest
    - Floor: Internal oblique muscle
  ii. Clinical importance:
- Herniation
- This place contains fat, where abscesses and phlegmons tend to occur.

Lesgalt-Grinfield's rhombus:
  i. Borders:
    - Superomedial: Serratus posterior inferior muscle
    - Superolateral: 12th rib
    - Inferomedial: Erector spinae muscle
    - Inferolateral: Internal oblique muscle
  ii. Clinical importance:
    - Herniation
    - This place contains fat, where abscesses and phlegmons tend to occur.

D) Arterial supply:
  - Lumbar arteries (branches of the abdominal aorta)

E) Venous drainage:
  - Lumbar veins, then drained into the inferior vena cava

F) Nerve supply:
  - Subcostal nerve
  - Posterior branches of the spinal nerve

FASCIAE AND FATTY LAYERS OF THE RETROPERITONEAL SPACE

A) Renal fascia:
  - It is divided into the prerenal and retrorenal fasciae.
  - Between these 2 fasciae, paranephron or adipose capsule of the kidney is located.
  - Inferior to the kidney, paranephron continues into the paraureteron. This is a fatty layer surrounding the ureter.
  - Toft's fascia separates the retroperitoneal fat from the paracolon.

B) Retroperitoneal fatty space:
  - Borders:
    i. Anterior: Parietal peritoneum
    ii. Posterior: Endoabdominal fascia

C) Paraneiphron:
  - Borders:
    i. Anterior: Prerenal fascia
    ii. Posterior: Retrorenal fascia
    iii. Inferior: Paraureteron

D) Paraureteron:
Borders:
  i. Anterior: Preureteric fascia
  ii. Posterior: Repousseretic fascia

E) Paracolon:
  Borders:
    i. Anterior: Retrocolic fascia
    ii. Posterior: Reproperitoneal fascia
    iii. Superior: Transverse mesocolon

Topography of the fasciae and fatty layers of the retroperitoneal space; sagittal section:
TOPOGRAPHY OF THE VERTEBRAL COLUMN

A) English: Spinal column, spine, backbone

B) Latin: Columna vertebralis

C) Greek: Rhachis

D) Russian: Позвоночник

E) Morphology:
It is made up of 7 cervical, 12 thoracic, 5 lumbar, 5 sacral and 2 – 3 coccygeal vertebrae.

There are 2 curvatures, which are the lordosis (anteriorly convex in cervical and lumbar parts) and kyphosis (posteriorly convex in thoracic and sacral parts).

F) Functions:
- Supporting the body weight
- Protecting the spinal cord

G) Ligaments:
- Ligamentum longitudinale anterius:
  i. It stretches along the anterior part of the vertebral bodies.

- Ligamentum longitudinale posterius:
  i. It stretches along the posterior part of the vertebral bodies.

- Ligamentum flavum:
  i. It is found in spaces between the arches.

- Ligamentum interspinalium:
  i. It passes between the spinous process of 2 adjacent vertebrae.

- Ligamentum supraspinale:
  i. It stretches over the tips of the spinous processes in the lumbar and thoracic vertebrae.

- Ligamentum nuchae:
  i. It continues from the ligamentum supraspinale along the spinous processes of the cervical vertebra.
  ii. It is attached to the external occipital crest and external occipital protuberances

- Ligamentum intertransversarium:
  i. It connects the apices of the transverse processes of the adjacent vertebrae.

TOPOGRAPHY OF THE SPINAL CORD

A) English: Spinal cord

B) Latin: Medulla spinalis

C) Greek: Myelon
D) Russian: Спинной мозг

E) Morphology:
   - It consists of 8 cervical, 12 thoracic, 5 lumbar, 5 sacral and 1 – 3 coccygeal segments.

F) Functions:
   - Conducting sensory and motor impulses
   - Participating in reflex function

G) Meninges:
   - There are 3 meninges, which are the dura mater (*pachymeninx, dura mater spinalis*), arachnoid mater (*arachnoidea spinalis*) and pia mater (*pia mater spinalis*). Both arachnoid mater and pia mater are called the leptomeninges. The dura mater is composed of 2 thick and inelastic dense membranes, which are outer endosteal and inner meningeal membranes.

H) Intermeningeal spaces:
   - Epidural space (*cavum epidurale*) – Between the dura mater and vertebra
   - Subdural space (*cavum subdurale*) – Between the dura mater and arachnoid mater
   - Subarachnoid space (*cavum subarachnoidale*) – Between the arachnoid mater and pia mater, consisting of cerebrospinal fluid (*liquor cerebrospinalis*)

**Epidural Venous Plexus**

- The venous plexuses are located in the vertebral canal between the 2 layers of the dura mater in the epidural space.
- They are connected with the vertebral plexuses with the lumbar veins and other tributaries of the inferior vena cava and also those of the superior vena cava. That is why the epidural venous plexuses play a role of cava-caval anastomosis.

**A. V. Vishnevsky's Paraneurphal Blockade**

A) Indications:
   - Hepatic and renal colics
   - Occlusion in the vessels of the lower extremity
   - Dynamic intestinal ileus

B) Mechanisms:
   - The renal plexuses are located in the renal hilum.
   - Along the pathway of the vessels and nerves, the Novocain solution will reach the vegetative plexuses of the abdominal cavity (for example, the coeliac plexus) and block the pathologic impulses from the plexuses.

C) Procedures:
   - The patient lies on the sound side with some clothes placed under him. The leg of the sound side is flexed at the knee joints; the affected side is straightened. 60 – 80
ml of 0.25% Novocain solution is administered at the point between the erector spinae muscle and 12th rib and moved to the paranephron. The correct criterion of this procedure is that, if the needle is in the paranephron, it will move upwards and downwards corresponding to the movement of the diaphragm during respiration. The Novocain can pass through the syringe easily. In case of blockade in the syringe, the solution will drop out.

**LUMBAR PUNCTURE**

A) Indications:
- Meningitis
- Stroke

B) Contraindication:
- Raised intracranial pressure

C) Purposes:
- To take cerebrospinal fluid (CSF) for diagnostic and therapeutic purposes

D) Procedures:
- It is carried out inferior to the end of the spinal cord (conus medullaris) between the 3rd and 4th lumbar vertebrae.
- The patient lies on 1 side and a needle is inserted between the spinal processes of the 3rd and 4th lumbar vertebrae in the upper direction.
- If the needle is in the proper place, clear, straw-coloured CSF will begin to drop out through the needle.

**EPIDURAL AND SUBDURAL ANAESTHESIA**

- Procedures:
  - An anaesthetic solution is injected into the epidural space and spread along the loose (alveolar) connective tissue of the epidural space. The afferent impulses will be blocked because the spinal nerves pass through this space.
  - For the subdural anaesthesia, the anaesthetic is injected much deeper.

**LAMINECTOMY**

- It is surgical removal of the bony arches of 1 or more vertebrae.

A) Indications:
- Pott's disease (tuberculous spondylitis, spinal caries)
- Prolapse of the intervertebral disc
- Removal of the foreign body, eg bullet
- Fracture or dislocation of the spine which requires reduction and internal fixation

B) Procedures:
- The patient is placed either in the prone position or lateral position. The former position is more preferred. The head is lowered to minimize the flowing of the
cerebrospinal fluid. The centre of the table is raised and through this, the lumbar region is made convex. Pillows placed under the abdomen are not allowed as this will cause congestion of the spinal veins.

General anaesthesia is administered with tracheal intubation.

A vertical incision is made on the midline of the back with its centre at the level of the incision. The length of the incision depends on the number of laminae to be excised. The incision is made deep to the spinous processes. The knife is kept close to the bone and the muscle fibres are removed from the spinous processes as well as the laminae. A broad-bladed osteotome is used to detach the musculoaponeurotic fibres from the laminae. Hot moist gauze is packed into the gutter between the spinous processes and the muscle. These gauze pieces are kept for a while to stop bleeding.

After some moments, packs of hot moist gauze are removed and retractors are applied. This procedure is repeated on the other side of the spinous processes.

The spinous processes, supraspinous and interspinous ligaments are divided. At first, the lowest lamina is removed by the bone-cutting forceps. A hole must be made first to facilitate the cutting of the bone.

After the laminae are properly excised, the extradural fatty tissue will be exposed. This is moved aside to reveal the dura mater. With a fine hook, the dura mater is elevated and is carefully nicked with scissors. Sometimes, the spinal cord may remain adhered to the dura mater at the site of lesion. So, if the dura mater is opened at this region, it may cause injury to the underlying adhered spinal cord.

A grooved elevator is inserted through the opening of the dura mater and the opening is enlarged. Generally the arachnoid is incised along with the dura mater.

Surgical set of bone cutting forceps for operation on the vertebral column:
1 – Liston’s forceps, 2 – Borchard’s forceps, 3 – Laminectomy, 4 – Yansen’s forceps, 5 – Gorski’s forceps with 2 locks, 6 – Becon’s forceps, 7 – Luer’s forceps
Stages of laminectomy:
a – Dissection of the ligamentum supraspinale. b – Removal of the spinous processes together with the ligaments, c – Removal of the laminae with the aid of the Borchard’s forceps, d – Dissection of the dura mater with the scissors, e – Applying continuous sutures to the dura mater.

TOPOGRAPHY OF THE KIDNEY
A) English: Kidney
B) Latin: Ren
C) Greek: Nephros
D) Russian: Почка

E) Morphology:
- 2 histological parts are distinguished, namely the cortex (cortex renis) and medulla (medulla renis).
- 2 poles are distinguished, namely the superior and inferior poles.
- 2 margins are distinguished, namely the medial and lateral margins.

F) Functions:
- Filtration
- Reabsorption
- Excretion
- Production of erythropoietin for erythropoiesis
Participating in renin-angiotensin-aldosterone system by producing renin in the juxtaglomerular apparatus

G) Holotopy:
- Superior poles: Projected on the right and left hypochondriac regions
- Inferior poles: Projected on the right and left lateral abdominal regions

H) Skeletopy:
- 12th thoracic vertebra – 2nd lumbar vertebra
- 12th rib divides the right kidney into superior 1/3 and inferior 2/3; the left kidney is divided into 2 halves.

I) Syntopy:
- Right kidney:
  i. Superior: Right adrenal gland and liver
  ii. Inferior: Loops of the small intestine and right colic (hepatic) flexure below the hilus
  iii. Anterior: Transverse mesocolon near the hilus
  iv. Posterior: Psoas major muscle, quadratus lumborum muscle, transversus abdominis muscle, medial and lateral arcuate ligaments and diaphragm
  v. Medial: Descending part of the duodenum
- Left kidney:
  i. Superior: Left adrenal gland, stomach and spleen
  ii. Inferior: Loops of the small intestine
  iii. Anterior: Transverse mesocolon, pancreas, left colic (splenic) flexure and loops of the small intestine
  iv. Posterior: Psoas major muscle, quadratus lumborum muscle, transversus abdominis muscle, medial and lateral arcuate ligaments, and diaphragm
  v. Lateral: Spleen and descending colon

J) Arterial supply:
- Renal artery

K) Venous drainage:
- Renal vein; then drained into the inferior vena cava

L) Lymphatic drainage:
- Para-aortic nodes and coeliac lymph nodes

M) Nerve supply:
- Renal plexus (branch of the coeliac plexus)
- Sympathetic fibres: T10 – L1
- Parasympathetic fibres: Vagus nerve
CAPSULES AND FIXATION OF THE KIDNEY
A) Capsules of the kidney:
   - Fibrous capsule (*capsula fibrosa*)
   - Adipose tissue
   - Renal fascia:
     - Prerenal fascia
     - Retrorenal fascia

B) Fixation of the kidney:
   - Renal fascia
   - Psoas major and quadratum lumborum muscles
   - Renal vessels
   - Hepatorenal ligament, phrenicocolic ligament (left kidney only) and duodenorenal ligament
   - Intra-abdominal pressure

TOPOGRAPHY OF THE ADRENAL GLAND
A) English: Adrenal gland, suprarenal gland

B) Latin: *Glandula adrenalisis s. suprarenalis*

C) Greek: /

D) Russian: Надпочечная железа

E) Morphology:
   - 2 histological parts are distinguished: cortex and medulla.

F) Functions:
   - Secretion of glucocorticoids, mineralocorticoids and androgens in the cortex
   - Secretion of adrenaline (epinephrine) and noradrenaline (norepinephrine) in the medulla

G) Holotopy:
   - Projected on the right and left hypochondriac regions

H) Skeletony:
   - 11th or 12th thoracic vertebra

I) Syntopy:
   - Right adrenal gland:
     i. Superior pole of the right kidney, liver, inferior vena cava and diaphragm
   - Left adrenal gland:
     ii. Superior pole of the left kidney, stomach and diaphragm
J) Arterial supply:
   - Superior suprarenal artery (branch of the inferior phrenic artery)
   - Middle suprarenal artery (branch of the abdominal aorta)
   - Inferior suprarenal artery (branch of the renal artery)

K) Venous drainage:
   - Right suprarenal gland – Drained into the inferior vena cava
   - Left suprarenal gland – Drained into the left renal vein; then into the inferior vena cava

L) Lymphatic drainage:
   - Lateral aortic node

M) Nerve supply:
   - Suprarenal nervous plexus

TOPOGRAPHY OF THE ABDOMINAL AORTA
   - The abdominal aorta is located below the aortic hiatus (hiiatus aorticus) and divided into the right and left common iliac arteries at the level of the 4th lumbar vertebra.
   - It carries oxygenated blood from the heart to the abdominal organs

A) English: Abdominal aorta

B) Latin: Aorta abdominalis

C) Greek: /

D) Russian: Брюшная аорта

E) Holotopy:
   - Projected on the proper epigastric and umbilical regions

F) Skeletopy:
   - 1st – 4th lumbar vertebrae

G) Syntopy:
   - Anterior: Coeliac and aortic plexuses, body of the pancreas, horizontal part of the duodenum, parietal peritoneum and root of the mesentery
   - Posterior: Vertebral column
   - Right: Inferior vena cava, thoracic duct and cisterna chyli
   - Left: Ascending part of the duodenum, sympathetic trunk and azygos vein
   - Superior: Left renal vein

H) Branches:
   - Parietal (All are paired)
i) Inferior phrenic arteries
ii) Lumbar arteries
iii) Medial sacral arteries
iv) Right and left common iliac arteries

Visceral:
i) Paired:
   - Middle suprarenal artery (arteria suprarenalis media)
   - Renal artery (arteria renalis)
   - Testicular artery (arteria testicularis) – In males
   - Ovarian artery (arteria ovarica) – In females

ii) Unpaired:
   - Coeliac trunk (truncus coeliacus):
     1. Left gastric artery (arteria gastrica sinistra)
     2. Common hepatic artery (arteria hepatica communis)
     3. Splenic artery (arteria lienalis s. splenica)
   - Superior mesenteric artery (arteria mesenterica superior):
     1. Inferior pancreaticoduodenal artery (arteria pancreaticoduodenalis inferior)
     2. Intestinal arteries (arteriae intestinales)
     3. Ileocolic artery (arteria ileocolica)
     4. Right colic artery (arteria colica dextra)
     5. Middle colic artery (arteria colica media)
   - Inferior mesenteric artery (arteria mesenterica inferior):
     1. Left colic artery (arteria colica sinistra)
     2. Sigmoid arteries (arteriae sigmoideae)
     3. Superior rectal artery (arteria rectalis superior)

TOPOGRAPHY OF THE INFERIOR VENA CAVA
Inferior vena cava is formed by right and left common iliac veins at the level of the 4th vertebra.
It carries deoxygenated blood from the lower part of the body to the heart.
It passes through the caval opening (foramen venae cavae) and enters the right atrium.

A) English: Inferior vena cava
B) Latin: Vena cava inferior
C) Greek: /
D) Russian: Нижняя полая вена
E) Holotopy:
   Projected on the proper epigastric and umbilical regions
F) Skeletopy:
- Veins are drained into the inferior vena cava at the 4th lumbar vertebra.

G) Syntopy:
- Anterior: Posterior surface of liver, horizontal part of the duodenum, portal vein, head of the pancreas, right testicular (ovarian) artery, parietal peritoneum, root of the mesentery and hepatorenal ligament
- Posterior-superior: Right crus of the diaphragm, right renal artery, middle suprarenal artery, inferior phrenic artery and right coeliac ganglion
- Posterior: Vertebral column
- Right: Right adrenal gland
- Left: Thoracic duct

H) Tributaries:
- Parietal:
  i) Right and left lumbar veins (venae lumbales dextrae et sinistrae)
  ii) Inferior phrenic vein (vena phrenica inferior)
- Visceral:
  i) Testicular vein (vena testicularis) – In males
  ii) Ovarian vein (vena ovarica) – In females
  iii) Renal vein (vena renalis)
  iv) Right suprarenal vein (vena suprarenalis dextra)
  v) Hepatic vein (vena hepatica)

TOPOGRAPHY OF THE LUMBAR PLEXUS
- Lumbar plexus (plexus lumbalis) is formed from T₁₂ to L₄.
- It lies anterior to the transverse processes of the lumbar vertebrae and lodges in the psoas major muscle.
- Branches:
  i) Muscular branches (rami musculares) supply the psoas major and minor muscles, quadratus lumborum muscle, lateral intertransversarius muscle (musculus intertransversarius lateralis lumborum) and iliopsoas muscle of Hyrtl (musculus iliopsoas).
  ii) Iliohypogastric nerve (nervus iliohypogastricus) starts from the lateral edge of the psoas major muscle and reaches the anterior surface of the quadratus lumborum muscle.
    - Muscular branches: Supply the external and internal oblique muscles, transversus abdominis muscle, pyramidal muscle and inferior portion of the rectus abdominis muscle
    - Anterior cutaneous branches (rami cutanei anteriores): Supply the skin above the pubis symphysis
    - Lateral cutaneous branches (rami cutanei laterales): Supply the skin of the superior lateral surface of the thigh
iii) Ilioinguinal nerve (*nervus ilioinguinalis*) starts from the lateral edge of the psoas major muscle, passes down to the inguinal canal and exits through the superficial inguinal ring.

- Muscular branches: Supply the transversus abdominis muscle, external and internal oblique muscle
- Cutaneous branches (*rami cutanei*): Supply the skin of the pubis symphysis, skin of the superior medial surface of the thigh and skin of the inguinal region
- Anterior scrotal nerves (*nervis scrotalis anteriores*): Supply the skin of the root of penis and anterior part of the scrotum
- Anterior labial nerves (*nervis labialis anteriores*): Supply the skin of the upper part of the labia majora

iv) Genitofemoral nerve (*nervus genitofemoralis*) pierces the psoas major muscle and is divided into 2 branches.

- Femoral branch (*ramus femoralis*): Supplies the skin below the inguinal ligament of Poupart
- Genital branch (*ramus genitalis*): Supplies the skin of the upper medial surface of the thigh and superficial inguinal ring in males and females; cremaster muscle and membrane of the testicle in males; round ligament and labia majora in females.

v) Lateral cutaneous of the thigh (*nervus cutaneus femoris lateralis*) passes from the lateral edge of the psoas major muscle and over the surface of the iliacus muscle and laterally to anterior superior iliac spine. It innervates the skin of the external surface of the thigh.

vi) Femoral nerve (*nervus femoralis*) appears through the lacuna musculorum and travels lateral to the femoral artery.

- Muscular branches: Supply the quadriceps femoris, sartorius, pectineus and tensor fasciae latae muscles.
- Anterior cutaneous branches: Supply the skin of the anterior medial surface of the thigh
- Saphenous nerve (*nervus saphenus*) travels in the adductor canal (*canalis adductorius*) and gives rise to:
  1. Infrapatellar branch (*ramus infrapatellaris*): Supplies the skin below the patella, medial surface of the knee above the tibia
  2. Medial cutaneous nerve of the thigh (*ramus cutaneus cruris medialis*):
     Supplies the skin of the anterior and posterior surfaces of the leg till the foot angle

vii) Obturator nerve (*nervus obturatorius*) passes through the obturator canal (*canalis obturatorius*) and gives rise to:

- Posterior branch (*ramus posterior*): Supplies the adductor magnus muscle, adductor minimus muscle, capsule of the hip joint and periosteum of the posterior surface of the femur
- Anterior cutaneous branch: Supplies the adductor longus, adductor brevis, adductor minimus, gracilis, pectineus and obturator externus muscles, and skin of the lower half of the medial surface of the thigh

— 275 —
OPERATIONS ON THE KIDNEY AND URETER

Fyodorov’s and Bergmann’s methods are frequently used to gain access to the kidney; while Pirogov’s and Bergmann’s methods are applied for the section of the ureter.

A) Fyodorov’s approach:

- An incision is made posteriorly at the angle between the erector spinae muscle and 12th rib. This incision is carried out anteriorly and inferiorly towards the anterior superior iliac spine, as far as the anterior axillary line.

B) Bergmann-Israel’s approach:

- The exact length of the incision depends on the individual case, type of the operation, degree of adiposity and breadth of the space between the last rib and iliac crest. The incision may be required to be above and parallel to the iliac crest and inguinal ligament as far as the abdominal inguinal ring.

NEPHRECTOMY

A) Indications:

- Malignant tumour of the kidney
- Pyogenic infection of the kidney
- Renal hypertension
- Renal tuberculosis
- Hydronephrosis
- Urolithiasis
- Hemorrhage of the kidney

B) Procedures:

- The patient lies on the abdomen.
- Endotracheal narcosis is administered.
- The surgical approach is oblique lumbar incision by Fyodorov’s or Bergmann’s approach.
- The fatty tissue is separated from the kidney and its adhesions and cicatrices are dissected. The kidney is taken out from the wound by removing the fatty tissue from its pole. The renal vein, artery, posterior wall of the pelvis and ureter are isolated consecutively.
- With the aid of the Deschamp’s ligature needle, 2 firm silk ligatures are placed under the renal vessels with the distance of 1 cm from each other. The 1st ligature is tightened up and placed near the vertebral column; the 2nd one is also tightened up and the Fyodorov’s renal clamp is applied between the ligature threads and renal hilus. The vessels are intersected between the clamp and renal hilus. The artery is intersected first, and then followed by the vein.
- A clamp is placed 2 – 3 cm below the outflow of the ureter. A catgut suture is applied below the clamp. The ureter is intersected and the kidney is removed between the clamp and suture. Iodine solution is applied to the stump of the ureter and later it is plunged into the soft tissue.
A rubber draining tube is placed at the bed of the kidney after carrying out haemostatic procedures. The wound is sutured layer by layer.

**NEPHROTOMY**

A) **Indications:**
- Hydronephrosis
- Pyelonephrosis
- Calculi in the kidney

B) **Methods:**
- Nephrolithotomy – Opening of the renal parenchyma and removal of calculi
- Nephroscopy – Incision of the kidney

There are 2 kinds of nephrotomy, which are complete (major) and partial (minor) ones.
- Partial nephrotomy is widely used and of more important significance.
- During the partial nephrotomy, only a small area of the renal tissue is cut and haemorrhage from the wound is less. The complications and relapses of urolithiasis after this operation are also unlikely to happen.

C) **Procedures:**
- An incision is made on the renal parenchyma 1 cm from the middle of the convex margin of the kidney. The wound is stitched by catgut sutures.

**NEPHROSTOMY**

This operation is performed for persistent drainage of the kidney and improving its functions.

A) **Indications:**
- Renal failure
- Pyelonephritis
- Severe course of the calculous pyelonephrosis

B) **Procedures:**
- An incision is made on the renal pelvis.
- From the incision, a finger is inserted to the calyx.
- Later, a small incision is made on the cortex. A probe is introduced to make contact with the finger and guided out through the pelvic incision.
- The external end of the catheter is cut to form a bevel and attached to a silk stitch to the probe.
- Then the probe is drawn out through the cortical incision.
- Pelvic incision is closed by sutures.

**NEPHROPEXY**

This operation is carried out in nephroptosis.
A) Indications:
- Significant displacement of the kidney
- Haemorrhage
- Pyelonephritis
- Renal hypertension

B) Procedures:
- The pelvis and ureter are examined to exclude any organic obstruction to the urinary outflow.
- The kidney is stitched against the quadratus lumborum muscle. Then it is placed as high as possible and covered by the 12th rib.
- The kidney is then placed to the lateral part of the muscle with 3 stitches.
- A sheet of polyvinyl alcohol sponge is placed between the kidney and muscle to promote adhesion.

EXPOSURE OF THE URETER
In general, it can be divided into exposure of the upper end of the ureter or exposure of the iliac portion.

Exposure of the upper end of the ureter:
- The upper abdominal portion of the ureter is exposed by the same incision as used in exposure of the kidney.
- It is frequently necessary, especially in stout patients, to prolong the incision forward and downward.

Exposure of the iliac portion by the extraperitoneal route:
- The patient lies on the back with the head slightly lowered. A roller is placed below the pelvis on the affected side.
- An incision is made on the line of the fibres of the external oblique muscle with 3–5 cm medial to the anterior superior iliac spine. The external oblique muscle and aponeurosis are split along the line of the fibres; the internal oblique and transversus abdominis muscles are split along the line of their fibres.
- Branches of the deep circumflex iliac artery require ligation. The transversalis fascia is divided and the peritoneum is carefully divided from the fascia covering the iliacus and psoas muscles.
- The ureter is elevated from the great vessels along the peritoneum. It is easily recognized and isolated, especially when it is thickened by some pathologic processes. If a stone is located in the pelvic portion, the ureter should be displaced upwards to be more accessible to facilitate the stitching of the wound in the ureter. The incision in the ureter should be in the longitudinal axis, and the subsequent drainage of the wound is required.

Exposure of the lowest 10 cm from the ureter:
- Extraperitoneal method is also applied in this case.
The access may be gained through an oblique incision. It is also necessary to prolong the incision medially by partly dividing the rectus sheath and retracting the rectus abdominis muscle medially.

With the patient placed in the Trendelenburg's position, the access may be gained through a medial hypogastric incision. The bladder is exposed and retracted, and the peritoneum is divided from the wall of the pelvis. This operation must be conducted carefully in females to avoid injury to the uterine vessels.

**Sutures of the Ureter**

The wound in the ureter is closed with fine catgut sutures. Though the wound of the ureter can be closed by the sutures efficiently, it is advisable to provide drainage for the external wound.
CHAPTER
NINE
THE PELVIS
AND PERINEUM

DETAILS OF CONTENTS

Pelvis and its divisions

Connections of fatty spaces of the pelvis and other areas

Pelvic diaphragm

Topography of the male and female perineum

Internal iliac artery, vein, nerve plexuses and lymphatic outflow of the pelvis

Topography of the urinary bladder, urethra, scrotum, testis, prostate, seminal vesicle,
dererent duct, uterus, uterine tube, ovary and rectum

Blockade of the pelvic nerves

Operations including drainage of the pelvic fatty spaces; operations for phimosis,
paraphimosis, cryptorchidism and hydrocele; prostatectomy; puncture, opening and
drainage of the urinary bladder; operation for ectopic pregnancy; puncture of the
Douglas's space; rectopexy, surgical treatment of the haemorrhoids, paraproctitis
and tumor of the rectum

— 280 —
PELVIS AND ITS BORDERS

The pelvis connects the lower part of the trunk and the lower extremities.

A) Borders:
   - Anterior: 2 hip bones
     * Hip bone (coxa, os coxae, innominate bone, os innominatum)
   - Posterior: Sacrum and coccyx
   - Lateral: 2 hip bones

B) Division:
   - It is divided into the greater and lesser pelvis by the pelvic brim (terminal line, linea terminalis).
   - The pelvic brim is formed by the sacral promontory (promontorium ossis sacrí), arcuate lines of the ilia, pectineal lines of the pubic bones and superior margin of the pubic symphysis (symphysis pubica).

C) Greater pelvis (false pelvis, pelvis mayor):
   - Borders:
     i) Superior: Inferior floor of the abdominal cavity
     ii) Inferior: Pelvic brim
     iii) Lateral: Wings of the ilia
     iv) Posterior: Lumbar vertebrae

D) Lesser pelvis (true pelvis, pelvis minor):
   - Borders:
     i) Anterior: Pubis
     ii) Posterior: Sacrum and coccyx
     iii) Lateral: Ischial bones
     iv) Superior: Pelvic brim
      - It is then subdivided into the pelvic inlet, cavity and outlet.

E) Pelvic inlet (superior aperture, apertura pelvis superior):
   - Borders:
     i) Anterior: Pubic tubercles and superior margin of the pubic symphysis
     ii) Posterior: Sacral promontory
     iii) Lateral: Arcuate and pectineal lines

F) Pelvic cavity (cavum pelvis):
Bones of the pelvis
The pelvis consists of the hip bones, sacrum and coccyx. The hip bone consists of 3 bones which are ilium (os ilium), ishium (os ischii) and pubis (os pubis).

Joints of the pelvis
A) Sacroiliac joint (articulatio sacroiliaca):
   - It is a synovial joint covered by a fibrous cartilage.
   - It is strengthened by the following ligaments:
     i) Interosseous sacroiliac ligaments (ligamenta sacroiliaca interossea):
        - It stretches between the iliac tuberosity (tuberositas iliaca) and sacrum.
     ii) Iliolumbar ligament (ligamentum iliolumbale):
        - It stretches between the transverse process of the 5th lumbar vertebra and iliac crest.
     iii) Anterior sacroiliac ligaments (ligamenta sacroiliaca ventralia):
        - It is fused tightly with the capsule.
     iv) Posterior sacroiliac ligaments (ligamenta sacroiliaca dorsalia):
        - It connects the anterior and posterior superior iliac spines to the sacrum.

B) Pubic symphysis:
   - It is a fibrocartilage interpubic disk uniting the pubic bones.
   - It is strengthened by the following ligaments:
     i) Superior pubic ligament (ligamentum pubicum superius)
     ii) Inferior pubic ligament (ligamentum pubicum inferior, arcuate pubic ligament, ligamentum arcuatum pubis)

C) Obturator membrane (membrana obturatoria):
   - It is a fibrous plate covering the obturator foramen (foramen obturatorium).
   - It is attached to the obturator groove (sulcus obturatorius) and converts it into the obturator canal (canalis obturatorius).
   - The obturator artery (arteria obturatoria), obturator vein (vena obturatoria) and obturator nerve (nervus obturatorius) pass through this canal.

D) Sacrotuberous ligament (ligamentum sacrotuberale):
It connects the ischial tuberosity to the lateral surface of the sacrum and coccyx. It forms the greater and lesser sciatic foramina together with the sacrospinous ligament.

E) Sacrospinous ligament (ligamentum sacrospinale):
- It connects the ischial spine to the lateral surface of the sacrum and coccyx.
- It forms the greater and lesser sciatic foramina together with the sacrotuberous ligament.

MUSCLES OF THE PELVIS
- The muscles are divided into the parietal and visceral muscles.

A) Parietal muscles:
- Iliacus muscle (musculus iliacus)
- Psoas major muscle (musculus psoas major)
- Iliopsoas muscle (musculus iliopsoas)
- Obturator internus muscle (musculus obturatorius internus)
- Obturator externus muscle (musculus obturatorius externus)
- Piriformis muscle (musculus piriformis)
- Superior gemellus muscle (musculus gemellus superior)
- Inferior gemellus muscle (musculus gemellus inferior)

B) Visceral muscles:
- Levator ani muscle (musculus levator ani) consisting of puborectalis muscle (musculus puborectalis), pubococcygeus muscle (musculus pubococygeus) and iliococcygeus muscle (musculus iliococygeus)
- Coccygeus muscle (musculus coccygeus)
- External anal sphincter muscle (musculus sphincter ani externus)
- Visceral muscles (Pelvic diaphragm, diaphragma pelvis) form the floor of the pelvic cavity.

FASCIAE AND FATTY SPACES OF THE PELVIS
- There are 2 fasciae, which are the parietal and visceral layers.
- The parietal layer covers the wall; while the visceral layer surrounds the pelvic organs and forms 2 septa which pass in the sagittal direction beside the pelvic organs. The visceral fascia separates the fatty spaces located around the organs of the lesser pelvis. The peritoneoperineal fascia (Denonvilliers' fascia) stretches in the transverse direction between 2 septa of the visceral fascia and separates the fatty spaces of the lesser pelvis into 2 compartments: Pirogov-Retzius' and Amusat's capsules.
- The fatty spaces are prevesical (retropubic), paravesical and retrovesical spaces; parametrium (around the cervix); pararectal (paraproctal) and retrorectal spaces; and paraprostatic space.
Fasciae and fatty spaces of the male (a) and female (b) pelvis:

DIVISION OF THE PELVIS INTO FLOORS

The lesser pelvis is divided into 3 floors:

A) Cavum pelvis peritoneale:
   Superior: Imaginary plane of the inlet of the lesser pelvis
   Inferior: Lowest part of the peritoneum
   It contains the peritoneal organs of the lesser pelvis: upper part of the urinary bladder, uterus, supra-ampullar and ampullar parts of the rectum.

B) Cavum pelvis supraperitoneale:
   Superior: Peritoneum
   Inferior: Muscles and fasciae of the pelvic diaphragm
   It contains the extraperitoneal organs of the lesser pelvis.

C) Cavum pelvis subcutaneum:
   Superior: Pelvic diaphragm
   Inferior: Skin of the perineum
   It contains the soft tissue of the perineum and part of some pelvic organs.

Floors of the pelvic cavity:
a – Cavum pelvis peritoneale, b – Cavum pelvis supraperitoneale, c – Cavum pelvis subcutaneum, 1 – Peritoneum, 2 – Uterus, 3 – Levator ani muscle, 4 – Vagina
RELATIONS OF PERITONEUM IN THE MALE AND FEMALE PELVES

In males:
- Rectovesical pouch (excavatio rectovesicalis) – Pouch between the rectum and urinary bladder

In females:
- Rectouterine pouch (excavatio rectouterina, cul-de-sac of Douglas) – Pouch between the rectum and uterus. It is the lowest point of the abdominal cavity, where pathology tends to collect.
- Vescouterine pouch (excavatio vescouterina) – Pouch between the urinary bladder and uterus

INTERNAL ILIAC ARTERY AND ITS BRANCHES
- It begins from the sacroiliac joint; runs down to the lesser pelvis; and reaches the superior part of the greater sciatic foramen. It gives rise to 2 branches of arteries, namely the parietal and visceral branches.

A) Parietal branches:
- Iliolumbar artery (arteria iliolumbalis)
- Lateral sacral artery (arteria sacralis lateralis)
- Obturator artery
- Superior gluteal artery (arteria glutea superior)
- Inferior gluteal artery (arteria glutea inferior)

B) Visceral branches:
- Umbilical artery (arteria umbilicalis)
- Ureteric branches (rami ureterici)
- Uterine artery (arteria uterina)
- Artery of vas deferens (arteria ductus deferentis)
- Middle rectal artery (arteria rectalis media)
- Internal pudendal artery
- Superior vesical artery (arteria vesicalis superior)
- Inferior vesical artery (arteria vesicalis inferior)

VENOUS AND NERVE PLEXUSES, LYMPHATIC OUTFLOW OF THE PELVIS
- Venous plexuses are present around all organs of the lesser pelvis. For example in the rectum, there are subserous, subfascial and subcutaneous plexuses. They communicate with one another and play a role in the porta-caval anastomosis. There are also venous plexuses around the vagina and urinary bladder.
- Nerve plexuses of the pelvis are represented by the hypogastric and pelvic plexuses. They are formed by the autonomic nervous ganglia and give rise to the secondary plexuses. These secondary plexuses are located around the organs, for example the uterovaginal plexus.
The lymphatic drainage from the organs of the lesser pelvis passes to the external and internal iliac lymph nodes. Then they pass to the common iliac and lumbar lymph nodes. From there, they pass to the lumbar trunks and reach the thoracic lymph ducts.

PERINEUM

- It is the pelvic floor with associated structures occupying the pelvic outlet.

A) Borders:
   - Anterior: Pubic symphysis
   - Posterior: Tip of the coccyx
   - Lateral: Ischial tuberosities

B) It is made up of 2 triangles, which are the urogenital diaphragm and pelvic diaphragm.

C) Urogenital diaphragm (Diaphragma urogenitale):
   - It transmits the urethra in males; urethra and vagina in females.
   - It is filled with 2 groups of muscles, namely the superficial and deep muscles.
     - Superficial muscles:
       i) Superficial transverse perineal muscle (musculus transversus perinei superficialis)
       ii) Bulbospongious muscle (musculus bulbospongiosus)
       iii) Ischiocavernosus muscle (musculus ischiocavernosus)
     - Deep muscles:
       i) Deep transverse perineal muscle (musculus transversus perinei profundus)
       ii) Sphincter urethrae muscle (musculus sphincter urethrae)

D) Pelvic diaphragm (Diaphragma pelvicum, anal diahragm):
   - It transmits the anus both in males and females.
     - Muscles of the pelvic diaphragm:
       i) Levator ani muscle
       ii) Coccygeus muscle
       iii) External anal sphincter muscle
TOPOGRAPHY OF THE MALE PERINEUM

Layers:

- Skin
- Subcutaneous tissue – Camper’s fascia
- Superficial membranous fascia:
  i) Scarpa’s fascia (abdominal superficial membranous fascia)
  ii) Colle’s fascia:
    - It is continuous with the Scarpa’s fascia in the region posterior to the scrotum.
  iii) Darto’s Fascia (superficial membranous fascia of the penis)
- Superficial perineal space:
  i) Investing fascia (deep fascia, Gallerudt’s fascia):
    - It is the inferior border of the bulbospongiosus muscle.
  ii) Buck’s fascia:
    - It is the superior border of the bulbospongiosus muscle.
  iii) Suspensory ligament of the penis (ligamentum suspensorium penis):
    - It is continuous with the transverse fascia (fascia transversalis) of the anterior abdominal wall.
  iv) Muscles attached to the perineal body:
    - Superficial transverse perineal muscle
    - Bulbospongiosus muscle
    - Ischiocavernosus muscle
  v) Perineal nerves
  Perineal membrane
  Deep perineal space:
  i) Muscles:
    - Deep transverse perineal muscle
    - Sphincter urethrae muscle
  ii) Dorsal artery and deep dorsal vein of the penis
  iii) Dorsal nerve of the penis
  iv) Bulbourethral glands (Cowper’s glands, glandulae bulbourethrales s. Cowperi)
  v) Male urethra (urethra masculina)
- Superior membrane of the urogenital diaphragm

TOPOGRAPHY OF THE FEMALE PERINEUM

Layers:

- Skin
- Subcutaneous tissue – Camper’s fascia
- Superficial membranous fascia:
  i) Scarpa’s fascia (abdominal superficial membranous fascia)
  ii) Colle’s Fascia:
    - It is continuous with the Scarpa’s fascia in the region posterior to the vagina.
- Superficial perineal space:
  i) Investing fascia (deep fascia, Gallaudet’s fascia):
    - It is the inferior border of the bulbospongiosus muscle.
ii) Suspensory ligament of the clitoris (ligamentum suspensorium clitoridis):
   - It is continuous with the transverse fascia of the anterior abdominal wall.
 iii) Muscles attached to the perineal body:
   - Superficial transverse perineal muscle
   - Bulbospongiosus muscle
   - Ischiocavernosus muscle
   - Greater vestibular glands (Bartolin’s glands, glandulae vestibulares majores s. Bartolini)
   - Perineal nerves
   - Perineal membrane
   - Deep perineal space:
     i) Muscles:
        - Deep transverse perineal muscle
        - Sphincter urethrae muscle
        - Compressor urethrae muscle (musculus compressor urethrae)
        - Sphincter urethrovaginalis muscle (musculus sphinter urethrovaginalis)
     ii) Dorsal artery and deep dorsal vein of the clitoris
     iii) Dorsal nerve of the clitoris
     iv) Female urethra (urethra feminina)

PUDENDAL CANAL (ALCOCK’S CANAL, CANALIS PUĐENDALIS)
A) Borders:  
   - It is formed by the sheath of the obturator internus muscle.
B) Contents:  
   - Internal pudendal artery (arteria pudenda interna), internal pudendal vein (vena pudenda interna) and pudendal nerve (nervus pudendus)
C) Topography:  
   - It goes out from the greater sciatic foramen; then runs laterally along the ischial spine and sacrospinous ligament; then enters through the lesser sciatic foramen and runs along the medial aspect of the ischiopubic rami.

ISCHIORECTAL FOSSA (ISCHIOANAL FOSSA, FOSSA ISCHIORECTALIS)
- It is the space surrounding the anal canal (pars analis recti s. canalis analis) located between the skin of the anal region and pelvic diaphragm.

A) Borders:
   - Superior: Levator ani muscles
   - Inferior: Perianal skin
   - Medial: Anal canal
   - Lateral: Obturator internus muscles
   - Posterior: Sacrotuberous ligaments and gluteus maximus muscles
B) Contents:
   - Fatty tissue

C) Clinical importance:
   - Inflammation of this tissue is called paraproctitis.

TOPOGRAPAPHY OF THE SCROTUM

Layers:
   - Skin of the scrotum:
     i) It is thin and dark, covered with sebaceous glands.
   - Superficial fascia (dartos fascia, tunica dartos):
     i) It is continuous with the inguinal and perineal connective tissue.
   - External spermatic fascia (fascia spermatica externa):
     i) It is continuous with the superficial fascia of the abdomen.
   - Cremasteric fascia (fascia cremasterica):
     i) It is continuous with the intercrural fascia; covering the cremasteric muscle
        
        (musculus cremaster).
   - Cremaster muscle (musculus cremaster)
   - Internal spermatic fascia (fascia spermatica interna):
     i) It is continuous with the transversalis fascia.
   - Tunica vaginalis:
     i) It is derived from the peritoneal vaginal process (process vaginalis peritoni).
     ii) It consists of 2 layers, which are the parietal and visceral layers.
     iii) Cavum vaginale is cavity between the parietal and visceral layers. Accumulation
         of fluid in this cavity is called hydrocele.

TOPOGRAPAPHY OF THE TESTIS

A) English: Testis

B) Latin: Testis

C) Greek: Orchis

D) Russian: Яичко

E) Morphology:
   - The testis is coated by the tunica albuginea.
   - The parenchyma of the testis is divided into lobes (lobuli testis) and separated by
     septa (septula testis).
   - The parenchyma is composed of seminiferous tubules. There are 2 parts of them,
     namely the convoluted seminiferous tubules (tubuli seminiferi contorti) and straight
     seminiferous tubules (tubuli seminiferi recti). The latter tubules form rete testis in
     the mediastinum testis.
The rete testis give rise to the efferent ductules (ductuli efferentes), which are continuous with the epididymis. The epididymis is divided into the head, body and tail.

F) Functions:
- Production of spermatozoa by the seminiferous epithelium of the seminiferous tubules
- Production of testosterone by the Leydig's interstitial cells

G) Arterial supply:
- Testicular artery (arteria testicularis)
- Artery of the ductus deferens
- Cremasteric artery (arteria cremasterica)

H) Venous drainage:
- Pampiniform plexus (plexus pampiniformis); then drained into the testicular vein (vena testicularis)

I) Lymphatic drainage:
- Inguinal lymph nodes; then drained into the lumbar lymph nodes

J) Nerve supply:
- Testicular nervous plexus (composed of the sympathetic and parasympathetic fibres)

MC WORTER'S DRAINAGE OF THE PELVIC FATTY SPACE

Procedures:
- The patient lies on the back with legs flexed in the knee and hip joints.
- An incision about 8 – 9 cm is made along the inner surface of the thigh over the gracilis and adductor longus muscles. The adductor brevis muscle is cut out and reached to the obturator externus muscle. It is dissected together with the obturator membrane and obturator internus muscle along the inferior border of the pubic bone.
- By using long instruments (for example hemostatic forceps or dressing forceps), a drainage tube is inserted into the paravesical space. The tube is drawn out through the incision.
- The wound is closed by sutures.

P. A. KUPIRIYANOVS DRAINAGE OF THE PELVIC FATTY SPACE

Procedures:
- The operative approach is the inferior midline laparotomy.
- With the dressing forceps inserted between the lateral wall of the urinary bladder and medial margin of the levator ani muscle through the urogenital diaphragm, the skin and perineum are elevated by the end of the dressing forceps. The skin is dissected over this elevation, and a tube inserted by the dressing forceps.
The drainage of the prevesical space depends on the severity of the injury. It may be one-sided or two-sided.

**PRESACRAL BLOCKADE WITH NOVOCAIN**

**Procedures:**
- A little amount of Novocain is injected intracutaneously 1.5 – 2.0 cm from the anus with the help of a thin needle.
- The thin needle is then replaced by a longer one (8 – 10 cm long). It is passed through the retroanal space and reaches the retrorectal space.
- This procedure is better controlled by the index finger introduced into the rectum.
- 70 – 120 ml of 0.25 % Novocain solution is then injected.

**SHKOLNIKOV-SELIYANOV’S PELVIC BLOCKADE**

**A) Indication:**
- Fracture of the pelvic bone

**B) Procedures:**
- A long needle (15 cm long) is inserted near the anterior superior iliac spine and along the wing of the ilium to the lateral pelvic space.
- 80 – 100 ml of 0.25 % Novocain solution is then injected.

**CIRCULAR EXCISION OF THE PREPUCE OF THE PENIS (CIRCUMCISION)**

**A) Indication:**
- Phymosis – Constriction of the prepuce that prevents its retraction over the glans penis

**B) Procedures:**
- After the local anaesthesia, the prepuce is drawn anteriorly and cut off.
- The edges of the internal and external tissues are stitched with silk sutures.

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Stages of circumcision:

a – Drawing out the prepuce, b – Dissection of the dorsal surface of the prepuce, c – Circular excision of the prepuce, d – Applying interrupted sutures to the prepuce, e – Applying gauze between ends of the threads

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291
EXCISION OF THE PREPUCE
A) Indication:
- Paraphimosis – Incarceration of the glans penis by the preputial prepuce

B) Procedures:
- After the local anaesthesia, the incarcerated ring is cut through all layers.
- Then the prepuce is moved back to the glans penis.
- After the surgical operation, anti-inflammatory therapy is administered.

TOREK-KITLA-GERCEN’S OPERATION FOR CRYPTORCHIDISM AND MONORCHIDISM (ORCHIDOPEXY)
A) Indications:
- Cryptorchidism – A developmental anomaly in which both testes fail to descend into the scrotum and remain either in the abdominal cavity or inguinal canal
- Monorchidism – A developmental anomaly in which one testis fails to descend into the scrotum and remains either into the abdominal cavity or inguinal canal

B) Purposes:
- To bring the testis (testes) down to the normal anatomical position;
- To fix it (them) to the new position.

C) Procedures:
- An incision is made on the line of the inguinal canal about a finger’s breadth above the inguinal ligament, exposing the superficial inguinal ring.
- The aponeurosis of the external oblique muscle is slit, and the testis is exposed as it lies in the canal. The coverings of the spermatic cord are freely divided, and the relations of the testis to the vaginal process are determined. It is usually found that after the vaginal process is divided, the testis can be brought down to the bottom of the scrotum. If it is not possible, the vas deferens with its accompanying artery must be separated from the other constituents of the cord and held aside. The spermatic vessels are dissected upwards in the extraperitoneal tissues for several inches. In some cases, the testis cannot be brought down with the division of the spermatic vessels, which gravely prejudices the further development and functions of the testis.
- With a finger, a bed for the testis is made in the scrotum. A chromic gut suture is now passed through the inferior pole of the testes, including the tunica albuginea, and the 2 ends of the suture are brought out separately through the lowest part of the scrotum about 1 – 5 cm apart. They are then tied over a small piece of rubber tube to avoid strangulation of the intervening portion of the skin. Fixation of the scrotum and testis to the skin of the thigh is unnecessary.
- In case of incomplete descent of the testis complicated by hernia, the vaginal process, which has been divided in the course of the operation, must be obliterated at the highest accessible point in the canal.
Stages of Torek-Kitla-Gercen's operation:
- a – Isolation of the testicle and spermatic cord.
- b – Formation of a base for the testicle.
- c – Insertion of the dressing forceps into the inferior part of the wound and incision of the skin of the scrotum.
- d – Bringing down the testis.

\[\text{VINKELMANN'S OPERATION FOR HYDROCELE}\]

A) Indication:
- Hydrocele – Accumulation of fluid in the cavum vaginale

B) Procedures:
- The patient lies on the back.
- Local anaesthesia is administered.
- An incision about 8 cm is made above the inguinal fold till the base of the scrotum.
- The skin, subcutaneous tissue, cremaster muscle, internal spermatic fascia are incised.
- The fluid-filled mass is taken out through the wound by pressing its inferior pole through the scrotum.
- The contents of the tunica vaginalis are removed by puncture with the help of a trocar.
- The serous layer is cut longitudinally and turned out around the testis and spermatic cord. Its edge is stitched with catgut sutures.
- A thorough hemostatic therapy is administered.
- The wound is stitched tightly layer by layer.

\[\text{BERGMANN'S OPERATION FOR HYDROCELE}\]

A) Indication:
- Hydrocele with thickening of the testicular layers

B) Procedures:
After the puncture and incision of the tunica vaginalis, the remaining layer is stitched with continuous catgut sutures. The wound is stitched tightly layer by layer.

Bergmann’s operation for hydrocele

**TOPOGRAPHY OF THE URINARY BLADDER**

A) English: Urinary bladder

B) Latin: *Vesica urinaria*

C) Greek: /

D) Russian: Мочевой пузырь

E) Morphology:

Several parts are distinguished: base (*fundus vesicae*), apex (*apex vesicae*), body (*corpus vesicae*), trigone (*trigonum vesicae*), neck (*cervix vesicae*) and uvula (*uvula vesicae*).

Layers:

i) Serous layer (*tunica serosa*, peritoneum):
   - When the urinary bladder is full, it is covered mesoperitoneally.
   - When it is empty, it is covered extraperitoneally.

ii) Muscular layer (*tunica muscularis*):
   - External layer consists of longitudinal fibres.
   - Middle layer consists of transverse or circular fibres.
   - Internal layer consists of longitudinal and transverse fibres.
   - These 3 layers of muscle fibres form the pubovesical muscle (*musculus detrusor urinae*).

iii) Submucous layer (*tunica submucosa*)

iv) Mucous layer (*tunica mucosa*)

F) Function:

- Reservoir for urine
G) Holotopy:
  Projected on the suprapubic region

H) Skeletopy:
  At the level of the pubic symphysis

I) Syntopy:
  Posterior: Seminal vesicles (vesiculae seminales), terminal parts of the deferent duct (ductus deferens) and rectum in males; uterus and vagina in females

J) Arterial supply:
  Superior vesical artery
  Inferior vesical artery
  Middle rectal artery

K) Venous drainage:
  Vesical venous plexus (plexus vesicalis)
  Internal iliac vein (vena iliaca interna)

L) Lymphatic drainage:
  Internal iliac lymph nodes

M) Nerve supply:
  Nerve plexus of the urinary bladder (derivate of the inferior mesenteric, hypogastric and sacral plexuses)

TOPOGRAPHY OF THE URETER
A) English: Ureter

B) Latin: Ureter

C) Greek:

D) Russian: Мочеточник

E) Morphology:
  2 parts are distinguished, namely the abdominal part (pars abdominalis) and pelvic part (pars pelvina).
  Layers:
  i) Adventitious layer (tunica adventitia)
  ii) Muscular layer:
       - Outer layer consists of longitudinal fibres.
       - Inner layer consists of circular fibres.
  iii) Mucous layer
F) Function:
- Delivering urine from the kidneys to the urinary bladder

G) Holotopy:
- Projected along the margin of the rectus abdominis muscle

H) Skeletopy:
- Initial part: 1st – 2nd lumbar vertebrae

I) Syntopy:
- Anterior: Parietal peritoneum and vasa tecticularia (ovaria)
- Posterior: Genitofemoral nerve and psoas muscle; external iliac artery (right); common iliac artery (left)
- Medial: Inferior vena cava (right); abdominal aorta (left)
- Lateral: Ascending colon and caecum (right); descending colon (left)

J) Arterial supply:
- Renal artery (arteria renalis)
- Testicular artery or ovarian artery (arteria ovarica)
- Ureteric branches of the internal iliac artery
- Middle rectal artery
- Inferior vesical artery

K) Venous drainage:
- Testicular vein or ovarian vein (vena ovarica)
- Internal iliac vein

L) Lymphatic drainage:
- Sacral and internal iliac lymph nodes

M) Nerve supply:
- Ureteric, renal, hypogastric and testicular (ovarian) plexuses

TOPOGRAPHY OF THE PROSTATE
A) English: Prostate
B) Latin: Prostata
C) Greek: Prostates
D) Russian: Предстательная железа
E) Morphology:
Several parts are distinguished, namely the base (basis prostatae), apex (apex prostatae) and median lobe (isthmus, lobus medius s. isthmus prostatae).

F) Functions:
- Secretion of proteolytic enzymes, acid phosphatase, fibrinolysin and citric acid
- Acting as a sphincter of the urethra to prevent the flow of urine during ejaculation

G) Holotopy:
- Projected on the suprapubic region

H) Skeletopy:
- Behind the pubic symphysis

I) Syntopy:
- Anterior: Pubic symphysis
- Posterior: Rectum
- Superior: Urinary bladder
- Inferior: Bulbourethral glands
- Lateral: Seminal vesicle

J) Arterial supply:
- Inferior vesical artery
- Middle rectal artery

K) Venous drainage:
- Vesical plexus (plexus vesicalis) and prostatic plexus; then drained into the inferior vesical vein (vena vesicalis inferior)

L) Lymphatic drainage:
- Sacral, iliac and internal iliac lymph nodes

M) Nerve supply:
- Hypogastric plexus

TOPOGRAPHY OF THE SEMINAL VESICLE
A) English: Seminal vesicle
B) Latin: Vesicula seminalis
C) Greek: 
D) Russian: Семенной пузыrek
E) Morphology:
The duct of seminal vesicle (*ductus excretorius*) unites with the deferent duct to form the ejaculatory duct (*ductus ejaculatorius*).

F) Function:
- Secretion of fructose into the ejaculate

G) Holotopy:
- Projected on the suprapubic region

H) Skeletopy:
- At the level of the pubic symphysis

I) Syntopy:
- Anterior: Fundus of the urinary bladder
- Posterior: Rectum
- Medial: Ampulla of the deferent duct

J) Arterial supply:
- Inferior vesical artery
- Artery of deferent duct
- Middle rectal artery

K) Venous drainage:
- Vein of the deferent duct (*vena deferentialis*); then drained into the internal iliac vein

L) Lymphatic drainage:
- Internal iliac lymph nodes

M) Nerve supply:
- Hypogastric plexus

**TOPOGRAPHY OF THE DEFERENT DUCT**

A) English: Deferent duct

B) Latin: *Ductus deferens*

C) Greek: /

D) Russian: Семявыносящий проток

E) Morphology:
- It is a component of the spermatic cord.
- The distal part is called the ampulla (*ampulla ductus deferentis*).
It unites with the seminal vesicle to form the ejaculatory duct.

F) Function:
- Conveying the spermatozoa from the epididymis to the ejaculatory duct

G) Holotopy:
- Projected on the suprapubic and inguinal regions

H) Syntopy:
- In the pelvis, it crosses the external iliac vessels; then it is situated between the urinary bladder and ureter; then it joins up with the duct of the seminal vesicle.

I) Arterial supply:
- Artery of the deferent duct

J) Venous drainage:
- Vein of the deferent duct; then drained into the internal iliac vein

K) Lymphatic drainage:
- Internal iliac lymph nodes

L) Nerve supply:
- Hypogastric plexus

TOPOGRAPPHY OF THE UTERUS
A) English: Uterus, womb
B) Latin: Uterus
C) Greek: Metra, hysterα
D) Russian: Матка
E) Morphology:
- Several parts are distinguished: fundus (fundus uteri), body (corpus uteri), isthmus (isthmus uteri), neck (cervix uteri), internal os (internal orifice, ostium internum uteri) and external os (external orifice, ostium externum uteri).
- Layers:
  i) Perimetrium – Serous layer (peritoneum):
     - The uterus is covered mesoperitoneally. The lateral surfaces and neck of it is not covered by the peritoneum.
  ii) Parametrium – Fatty tissue layer
  iii) Myometrium – Muscular layer
  iv) Endometrium – Mucous layer
F) Functions:
- Place for implantation and growth of fetus
- Place for menstruation

G) Holotopy:
- Projected on the suprapubic region

H) Skeletopy:
- At the level of the pubic symphysis

I) Syntopy:
- Anterior: Urinary bladder
- Posterior: Rectum

J) Arterial supply:
- Uterine artery
- Ovarian artery

K) Venous drainage:
- Uterine plexus (plexus uterina); then drained partly into the ovarian vein (vena ovarica); uterine vein (vena uterina) and internal iliac vein (vena iliaca interna)

L) Lymphatic drainage:
- Sacral, iliac and internal iliac lymph nodes

M) Nerve supply:
- Nerve plexus of the uterus, uterovaginal and hypogastric plexuses

TOPOGRAPHY OF THE UTERINE TUBE
A) English: Uterine tube, fallopian tube, oviduct

B) Latin: Tuba uterina, tuba Fallopii

C) Greek: Salpinx

D) Russian: Маточная труба

E) Morphology:
- Several parts are distinguished: fimbriae (fimbriae tubae), infundibulum (infundibulum tubae), ampulla (ampulla tubae), isthmus (isthmus tubae), uterine part (pars uterine) and uterine ostium (uterine opening, ostium uterinum tubae).
- Layers:
  i) Serous layer (peritoneum)
  ii) Subserous layer
iii) Muscular layer
  - Outer layer consists of longitudinal fibres.
  - Inner layer consists of circular fibres.

iv) Mucous layer

F) Functions:
  - Passage for spermatozoa to reach the primary oocyte
  - Place for fertilization (in the ampulla of the uterine tube)
  - Conveying the fertilized egg to the uterus

G) Skeletopy:
  - At the level of the pubic symphysis

H) Syntopy:
  - Situated in the broad ligaments of the uterus (mesosalpinx) near the ovary

I) Arterial supply:
  - Tubal branches (rami tubales) of the uterine artery
  - Tubal branches (rami tubales) of the ovarian artery

J) Venous drainage:
  - Uterine plexus; then drained into the ovarian vein

K) Lymphatic drainage:
  - Sacral and iliac lymph nodes

L) Nerve supply:
  - Uterine nerve plexus

TOPOGRAPPHY OF THE OVARY
A) English: Ovary

B) Latin: Ovarium

C) Greek: Oophoron

D) Russian: Яичник

E) Morphology:
  - 2 ends are distinguished: tubal end (extremitas tubaria) and uterine end (extremitas uterina).
  - 2 margins are distinguished: anterior mesovarian border (margo mesovaricus) and posterior free border (margo liber).
2. Histological parts: ovarian cortex consisting of stroma, which is filled with ovarian follicles (folliculi ovarici) and ovarian medulla consisting of connective tissue.

F) Functions:
- Production of oocytes
- Production of estrogens, progesterone, inhibin, folliostatin and activin

G) Holotopy:
- Projected on the suprapubic region

H) Skeletopy:
- At the level of the pubic symphysis

I) Syntopy:
- Situated in the broad ligaments of the uterus (mesoovarium), near the fimbria of the uterine tube

J) Arterial supply:
- Ovarian artery
- Ovarian branches of the uterine artery

K) Venous drainage:
- Right: Right ovarian vein; drained into the inferior vena cava
- Left: Left ovarian vein; drained into the left renal vein

L) Lymphatic drainage:
- Sacral and iliac lymph nodes

M) Nerve supply:
- Uterine and hypogastric plexuses

**LIGAMENTS OF THE INTERNAL GENITALIA (INTERNAL REPRODUCTIVE ORGANS)**

A) Broad ligament of the uterus (ligamentum latum uteri):
- It is the peritoneum which connects the uterus to the lateral wall of the pelvis.
- 3 parts are distinguished:
  i) Mesosalpinx (mesentery of the uterine tube)
  ii) Mesovarium (mesentery of the ovary)
  iii) Mesometrium (mesentery of the uterus)

B) Round ligament of the uterus (ligamentum rotundum uteri, ligamentum teres uteri):
- It connects the superior angle of the uterus to the deep inguinal ring (anulus inguinalis profundus).
- It terminates at the connective tissue of the mons pubis and labium majus.
C) Uterosacral ligament (*ligamentum sacrouterinum*): It connects the posterior part of the uterus to the anterior part of the sacrum.

D) Cardinal ligament (transverse ligament, Mackenrodt's ligament, *ligamentum cardinale*): It connects the inferior part of the uterus to the lateral wall of the pelvis.

E) Ligament of the ovary (*ligamentum proprium ovari*): It connects the uterine end of the ovary to the fundus of the uterus.

F) Suspensory ligament of the ovary (*ligamentum suspensorium ovari*): It connects the ovary to the pelvic brim.

**TOPOGRAPHY OF THE RECTUM**

A) English: Rectum

B) Latin: *Rectum*

C) Greek: Proktos

D) Russian: Прямая кишка

E) Morphology:

- 5 parts are distinguished: supra-ampullar (*rectosigmoid, pars supra-ampullaris*), superampullar (*pars superampullaris*), midampullar (*pars midampullaris*), inferoampullar (*pars inferoampullaris*) and perineal (*pars perinealis*).
- 2 flexures are distinguished: sacral flexure (upper flexure convex posterior to the sacrum) and perineal flexure (lower flexure convex anterior to the coccyx).

Layers:

i) Serous layer (peritoneum):
   - The superior part is covered intraperitoneally.
   - The middle part is covered mesoperitoneally.
   - The lower part is covered extraperitoneally.

ii) Muscular layer:
   - Outer layer consists of longitudinal layers.
   - Inner layer consists of circular fibres. This layer is thickened in the region of the pectinate line to form the internal anal sphincter muscle (*musculus sphincter ani internus*).

iii) Submucous layer:
   - It contains the internal rectal venous plexus (internal haemorrhoidal plexus, *plexus hemorrhoidalis internus*).
   - Dilation and prolapse of this plexus is called the internal haemorrhoids (piles).
   - Thrombosis of the external rectal venous plexus (external haemorrhoidal plexus, *plexus hemorrhoidalis externus*) located in the perianal space is called the external haemorrhoids (piles).
iv) Mucous layer:
  - It contains the anal columns (columnae anales) and anal sinuses (sinus anales).
  - The anal sinuses and anal crypts are the commonest site for pathogenic microorganisms. The infection of these structures will spread to the paraproctium and cause the paraproctitis.

F) Function:
   - Retention and evacuation of the faeces

G) Holotopy:
   - Projected on the suprapubic region

H) Skeletopy:
   - Superior part: 3\textsuperscript{rd} sacral vertebra

I) Syntopy:
   - Anterior: Seminal vesicles, deferent duct and urinary bladder (in males); uterus and vagina (in females)
   - Posterior: Sacrum and coccyx
   - Superior: Sigmoid colon (pelvic colon, colon sigmoideum)

J) Arterial supply:
   - Superior rectal artery
   - Middle rectal artery
   - Inferior rectal artery

K) Venous drainage:
   - Superior rectal vein; drained into the inferior mesenteric vein, then drained into the portal vein
   - Middle and inferior rectal veins; drained into the inferior vena cava
   - Portocaval anastomosis forms in the rectum

L) Lymphatic drainage:
   - Sacral, inguinal and iliac lymph nodes

M) Nerve supply:
   - Inferior hypogastric and aortic plexuses
   - Pudendal nerve

OPERATIVE ACCESS TO THE PELVIC ORGANS
   - Inferior median laparotomy
   - Pfannenstiel's horizontal inferior laparotomy
   - Oblique dissection in the inguinal region
CAPILLARY PUNCTURE OF THE URINARY BLADDER

A) Indication:
- Retention of urine and failure to evacuate it with catheterization

B) Procedures:
- The patient lies on the back with the pelvis slightly raised.
- The puncture is performed in the middle 2 cm above the pubic symphysis.
- A needle with a small diameter is used in order to avoid the leakage of urine into the prevesical fat space.
- The needle is inserted with 6 – 8 cm in depth, perpendicular to the patient’s body.
- If the urine does not flow out after the puncture, a suction pump is used.

OPENING OF THE URINARY BLADDER (CYSTOTOMY)
- Suprapubic cystotomy is called the sectio alta.

A) Indications:
- Urolithiasis
- Foreign body of the urinary bladder
- Electrocoagulation of the polyps in the urinary bladder
- Surgical approach to the prostate

B) Procedures:
- The patient lies on the back.
- The local infiltrative anaesthesia is administered.
- Prior to the operation, the urinary bladder is processed through a rubber tube. In some cases, physiological solution is added to the tube. The Kocher’s forceps is applied to the external end of this tube.
- An incision is made 3 – 4 cm from the umbilicus to the pubic symphysis.
- The skin, subcutaneous tissue and aponeurosis of the white line are dissected. The pyramidalis and rectus abdominis muscles are moved apart by means of the laminar surgical retractor (пластинчатый крючок). The transversalis fascia is cut horizontally above the pubic symphysis to gain access to the prevesical fatty space. Then the transversalis fascia, prevesical fatty tissue and prevesical fascia are moved upwards by blunt way to expose the wall of the urinary bladder.
- The muscular and mucous layers of the bladder are dissected. At this moment, the Kocher’s forceps is removed from the tube and the fluid from the bladder is freed. After opening of the bladder, surgical intervention may be performed (for eg. extraction of the stones and electrocoagulation and etc.).
- Continuous catgut sutures are applied to the muscular layer of the wall of the bladder. A draining tube is inserted into the prevesical space. The abdominal wall is sutured layer by layer: edges of the rectus abdominis muscles are joined by interrupted catgut sutures; edges of the aponeurosis are connected by silk sutures; the skin is stitched by interrupted silk sutures; a tension suture (провизорный шов) is applied above the drainage.
The drainage tube is usually removed in 4–5 days’ time.

**DRAINAGE OF THE PRESHESICAL SPACE**

The drainage of this space is usually carried out by dissecting the anterior abdominal wall.

But in neglected cases (with presence of the signs of phlegmon), the drainage is performed through the obturator foramen. This operation is called the Buliansky–Mc Yorter’s technique.

**A) Indication:**

Swelling or phlegmon of the preshesical space

**B) Procedures:**

The patient lies on the back with abduction of the lower extremity.

- Local or general anaesthesia is administered.
- A transverse incision is made on the internal surface of the thigh.
- The skin, subcutaneous tissue and proper fascia of the thigh are dissected. The adductor longus and adductor brevis muscles are moved apart by blunt way to penetrate the adductor minimus muscle.
- The preshesical fatty tissue is penetrated through the obturator externus muscle, obturator membrane and obturator internus muscle at the anterior margin of the obturator foramen. Through this opening, a draining tube is inserted for the outflow of the pus and administration of antibiotics.

**OPERATION FOR EXTRAUTERINE (ECTOPIC) PREGNANCY**

**A) Indication:**

Extrauterine pregnancy – Pregnancy occurring outside the uterus

**B) Procedures:**

The patient lies on the back.

- General anaesthesia is administered.
- Lower middle laparotomy or Pfannenstiel’s incision is performed.
  - Through the fundus of the uterus, catgut ligatures are performed. The uterus can also be reached with the help of the Miuso’s forceps.
  - The uterus, the indicated tube and ovary are taken out through the wound.
  - A clamp is applied to the uterine part of the tube; another one to the suspensory ligament of the ovary parallel to the tube.
  - According to size of the excision of the tube, 2–3 hemostatic clamps are applied to the mesosalpinx.
  - The end of the tube near the uterine angle is excised in V-shape not more than 5 mm in depth. The whole tube is then removed.
  - 2–3 catgut sutures are applied to the injured uterine angle.
  - Peritonization is performed on the injured surface with stitching of the continuous catgut sutures. For the uterine angle covered by the peritoneum, a seroserosa suture is applied to the anterior and posterior surfaces of the mesosalpinx.
The round ligament can be used for peritonealization of the uterine angle. After removal of the blood clots and observation of the appendages of the uterus, the abdominal wound is stitched.

Operation for ectopic pregnancy:
- a - Applying 2 clamps to the uterine part of the tube and mesosalpinx.
- b - Clamping of the whole mesosalpinx.
- c - Applying a clamp to the middle part of the mesosalpinx, resection of the uterine tube.
- d - Suturing of the round ligament to the uterus and covering the stump with a rubber tube.
- e - Fixing the round ligament to the remaining part of the mesosalpinx with continuous catgut sutures

**PUNCTURE OF THE RECTOUTERINE POUCH**

A) Indication:
- Aspiration of fluid from this region for analysis

B) Procedure:
- This is done at the posterior fornix of the vagina.

**ADENOMECTOMY (PROSTATEECTOMY)**
- There are mainly 4 methods to approach the prostate, namely the transvesical, perineal, transurethral and retropubic.
- For excision of the prostatic capsule, perianal or transrectal method is used.
- For tumour of the prostate, suprapubic or perineal method is used.
Surgical access to the prostate:
a – transvesical, b – perineal, c – transurethral, d – retropubic

A) Indications:
- Suppurative (purulent) disease of the prostate (for eg prostatatic abscess, acute parenchymatous prostatitis with formation of abscess)
- Prostatic adenoma

B) Procedures:
The patient is placed in the Trendelenburg's position.
Local spinal anaesthesia or general anaesthesia is administered.
A rubber tube is inserted into the urinary bladder and suprapubic cystotomy is carried out.
An incision is made on the mucous layer of the bladder 0.5 – 1 cm from the internal urethral orifice (meatus). Through this incision, the index finger is inserted into the mucous layer and got into the space between the adenoma and prostatic capsule. When the space is reached, the surgeon will attempt to make a round exfoliation (круговое отслаивание) of the adenoma. For removal, a transverse incision of the urethra at the level of the anterior margin of the prostate is made.
In cystitis, a two-stage operation is performed: a urinary fistula is applied for urine outflow; and when the inflammatory process ceases, adenomectomy will be carried out.

ZERENIN – KIUMMEL – GERCEN'S FIXATION OF THE RECTUM TO THE SACRUM
Procedures:
The patient is placed in the Trendelenburg's position.
After the lower middle laparotomy, the small intestine is moved up, and the large intestine is moved to the left.
The peritoneum is cut on the right from the sacral promontory till the 3rd sacral vertebra. After reaching the suprasacral region, 4 firm silk sutures are applied to the anterior longitudinal ligament of the vertebra.

- The rectum is then pulled up.
- The posterolateral surface of the rectal wall is stitched with the left ends of the ligature.
- The right border of the free margin of the peritoneum is stitched to the anterolateral surface of the fixed rectum.

Through the anus, a rubber tube is inserted into the rectum. The upper end of this tube has to be higher than the sacral promontory.

- The abdominal cavity is stitched layer by layer.
- The rubber tube is removed on the 2nd or 3rd day.

**LIGATURE OF THE HAEMORRHIOIDS (PILEs)**

**A) Indications:**
- Haemorrhage from the haemorrhoids leading to anaemia
- Frequent prolapse of the enlarged haemorrhoids
- Complicated haemorrhoids with inflammation and strangulation

**B) Contraindications:**
- Acute inflammation and strangulation of the haemorrhoids

**C) Procedures:**
- Local anaesthesia of the skin and the subcutaneous space around the anus is administered to the serous layer of the rectum. Then with the control of the index finger into the anus, the Novocain solution is injected into the sphincter of the rectum and ishioanal fossa nearly 7 cm in depth.
- The external anal sphincter is stretched with 2 hands. The ends of the clamps reach the haemorrhoids. Its mucous layer is cut off.
- The base of the haemorrhoids is stitched with a thick silk suture and has to be tightly tied.
- The clamps are then removed with the ligating suture cut off.
- On the 6th or 7th day, the haemorrhoids will tear off.

**WHITEHEAD'S PLASTIC (RECONSTRUCTIVE) OPERATION FOR HAEMORRHIOIDS**

**A) Indication:**
- Chronic haemorrhoids with relapse

**B) Procedure:**
- The haemorrhoids are excised together with the cylinder of mobilized mucous membrane of the anus.
OPERATIONS FOR PARAPROCTITIS

A) Indication:
- Paraproctitis – Inflammation of the paraproctum (tissues around the rectum and anus)

B) Procedures:
- The basic principles of this operation are drainage of the abscess and elimination of its internal opening.
- Drainage of the abscess is carried out by making a semilunar incision. Pus is drained out. A grooved probe is delivered from the wound through the opening of the rectum.
- The sinus tract is dissected through the probe. The perineal skin is excised in the form of triangle with its apex directed to the anus (by Gabriel).

C) Types:
- There are several types of paraproctitis, which are subcutaneous, submucous, ischiorectal (ischioanal), pelviorectal and retrorectal.
- In subcutaneous paraproctitis, the excision is performed radically above the focus of infection.
- In submucous one, the treatment involves the dissection of the abscess from the opening of the rectum. The direction of the excision is longitudinal. To dress the wound, hydrogen peroxide and 2 – 4 % potassium permanganate solution are administered. Then, the tampon is introduced into the rectum with the Vishnevsky’s ointment.
- In ischiorectal one, the excision is at the height of the infiltrate, 4 cm away from the anus. If the infiltrate becomes diffuse, the excision has to be extensive. The purulent area must be processed by hydrogen peroxide or 2 – 4 % potassium permanganate solution. The tampon is introduced into the rectum with an ointment.
- In pelviorectal one, the anus is widened with a rectal speculum. The abscess is punctured with a thick needle, through which the pus is received from the rectal wall. In the cavity of the opened abscess, a draining tube is introduced. For women, the abscess is dissected through the posterior vaginal fornix.

Types of paraproctitis:
1 – Pelviorectal, 2 – Submucous, 3 – Ischiorectal, 4 – Subcutaneous, 5 – Retrorectal, a – Levator ani muscle, b – External anal sphincter muscle, c – Internal anal sphincter muscle

— 310 —
OPERATIONS FOR RECTAL CANCER

These operations may be palliative or radical. Palliative operations are performed with formation of the faecal fistula or *anus praeternaturalis*.

The basis of the radical operations is to remove part of the rectum, together with the regional lymph nodes, fascia and cellular space.

There are 3 main types of the radical operations, namely resection, extirpation and amputation.

According to ways of approach to the rectum, the radical operations may be perineosacral, abdominal and combined.

There are also some subtypes of the radical operations: one-stage of the abdominoperineal extirpation of the rectum (operation by Kenu-Mailles), intra-abdominal resection of the rectosigmoid section (anterior resection of the rectum), abdomoanal resection of the rectum with the preservation of the sphincter (operation with bringing down), intra-abdominal resection of the rectum and sigmoid colon (Hartmann's operation) and perineal amputation of the rectum.

Resection of the rectum:

There are 2 types of resection, which are intraperitoneal and extraperitoneal.

This operation is aimed at excising part of the rectum to some extent with the restoration of the continuity, or excising the whole rectum with the preservation of the sphincter.

There is also another type of operation, in which the removal of part of the rectum without the restoration of the continuity, but with the preservation of the distal excision of the rectum.

Extirpation of the rectum:

The rectum is excised without the restoration of the continuity. It has one-stage and two-stage of the removal of the lower part of the large intestine, including the whole rectum with its external anal sphincter.

Amputation of the rectum:

The distal part of the rectum is removed by bringing down the central stump down to the level of the perineosacral wound.

ONE-STAGE PERITONEOPERINEAL EXTIRPATION OF THE RECTUM

Rectum is removed together with the anus, anal sphincter and fatty tissue with lymph nodes. The artificial anus will be formed from the sigmoid colon.

Peritoneal stage:

The approach is inferior midline laparotomy. The sigmoid and descending colons are pushed laterally. The peritoneum is cut 4 cm above the sacral promontorium at the level of 4th lumbar vertebra. This incision is continued downwards along the right border of the rectum. At the level of the rectovesical pouch (in males) or
rectouterine pouch (in females), the incision is continued in the transverse direction then upwards to the level of the beginning of the incision (like a U-shape).

The mobilization of the sigmoid colon is performed by ligature of the vessels in the mesocolon sigmoideum. The rectum is separated from the sacrum by blunt way together with the proper fascia, fatty tissue and lymph nodes up to the apex of the coccyx.

The rectum is separated from the lateral walls of the pelvis, partly by blunt way and partly by the scalpels. The surgeon must be very careful to prevent the penetration of the uterus and vagina in females and urinary bladder in males during separation of the anterior part of the rectum.

The sigmoid colon is cut. Both ends are ligated and applied by iodine (to prevent infection). The distal end of the sigmoid colon has to be put down to the floor of the pelvis and the peritoneum will be stitched over these ends. The proximal end of the sigmoid colon is drawn out to the anterior abdominal wall forming the colostomy. The peritoneum is stitched to the mesocolon sigmoideum. The wound of the anterior abdominal wall is closed.

Perineal stage:

The anus will be stitched by a purse-string suture. 2 oval incisions are performed around the anus. The margins of the removed skin are stitched by silk sutures. The fibres of the levator ani muscle are cut. Then the rectum is removed together with the lymph vessels and fatty tissue of the ischiorectal fossa.

After ligature of the vessels, the closure of the perineal incision is performed by silk sutures.

ONE-STAGE PERITONEOANAL RESECTION OF THE RECTUM WITH PRESERVATION OF THE ANAL SPHINCTER

The rectum is removed together with part of the sigmoid colon, but the sphincter ani externus muscle is preserved. The rectum is replaced by the sigmoid colon. The sphincter will preserve its function.

Peritoneal stage:

The beginning of this operation including the mobilization of the sigmoid colon is the same as the previous operation. The length of the sigmoid colon must be enough to be pulled down to the plane of the rectum. If it is necessary, the length can be increased by additional incisions of the peritoneum and mobilization of the left colic flexure.

After the mobilization, the sigmoid colon is pulled down to the lesser pelvis as much as possible but without any tension. The pelvic peritoneum is then restored.

Anal stage:

The anus has to be stretched and mucus layer of the rectum is cut at the boundary of the skin around the anus. It is then separated from the muscles approximately 4 cm from the anus. The margins of the mucosa are taken by forceps to close the
lumen of the rectum. A transverse incision about 4–5 cm is made anterior to the coccyx.

The anal-coccygeal ligament is cut to access the lesser pelvis. The muscular layer of the rectum is cut above the sphincter ani internus muscle by the Cooper’s scissors. The rectum is separated from the vagina in females and prostate in males by blunt and sharp ways. The rectum is pulled down through the anus. The sigmoid colon is stitched to the margins of the anal wound. Part of the rectum with the tumour is removed.

The tampon of the wound in the coccygeal region is applied. Then the anterior abdominal wall is closed.
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