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Кафедра анатомии человека
с курсом оперативной хирургии и топографической анатомии

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КУРС ЛЕКЦИЙ ПО ТОПОГРАФИЧЕСКОЙ АНАТОМИИ И ОПЕРАТИВНОЙ ХИРУРГИИ

Учебно-методическое пособие на английском языке
к практическим занятиям для студентов 3 курса
факультета по подготовке специалистов для зарубежных стран
медицинских вузов, обучающихся по специальности
«Лечебное дело» и «Медико-диагностическое дело»

COURSE OF LECTURES ON TOPOGRAPHIC ANATOMY AND OPERATIVE SURGERY

Teaching workbook in English
to the practical lessons for the 3rd year students
faculty on preparation of experts for foreign countries
of medical higher educational institutions,
specialty of «General Medicine»

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С 30 Курс лекций по топографической анатомии и оперативной хирургии: учеб.-метод. пособие на английском языке к практическим занятиям для студентов 3 курса факультета по подготовке специалистов для зарубежных стран медицинских вузов, обучающихся по специальности «Лечебное дело» и «Медико-диагностическое дело» = Course of lectures on topographic anatomy and operative surgery: teaching workbook in English to the practical lessons for the 3rd year students faculty on preparation of experts for foreign countries of medical higher educational institutions, specialty of «General Medicine» / С. А. Семеняго, Е. Ю. Дорошкевич, С. В. Дорошкевич. — Гомель: ГомГМУ, 2012. — 56 с.

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Цель учебно-методического пособия — облегчить студентам факультета по подготовке специалистов для зарубежных стран с преподаванием на английском языке понимание наиболее сложных вопросов топографической анатомии и оперативной хирургии.

Предназначено для самостоятельной подготовки студентов 3 курса факультета по подготовке специалистов для зарубежных стран медицинских вузов при изучении топографической анатомии и оперативной хирургии.

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LIST OF ABBREVIATIONS

a. — artery
aa. — arteries
C I–VII — the 1st–the 7th cervical vertebra
CCA — common carotid artery
CTF — connective tissue fascicles
ECA — external carotid artery
etc. — et cetera
for ex. — for example
ICA — internal carotid artery
L I–V — the 1st–the 5th lumbar vertebra
n. — nerve
nn. — nerves
NVF — neurovascular fascicle
SCT — subcutaneous cellular tissue
Th I–XII — the 1st – the 12th thoracic vertebra
v. — vein
vv. — veins

LECTURE 1.
DISCIPLINE OF OPERATIVE SURGERY AND TOPOGRAPHIC ANATOMY. OPERATIONS ON BLOOD VESSELS AND NERVES OF EXTREMITIES

1. Discipline of operative surgery and topographic anatomy, its terminology; surgical operations and instruments.
2. Operations on blood vessels of extremities: methods of the bleeding arrest, operations on the vascular pathology, aneurysm and varicose veins.
3. Operations on nerves of extremities.

1. Discipline of operative surgery and topographic anatomy, its terminology; surgical operations and instruments.

Operative surgery and topographic anatomy — practical discipline, which studies mutual spatial location of organs and tissues in different regions of human body. Also this discipline studies methods and rules of performing different surgical operations.

Terminology

Topographic region — is a part of human body separated from surrounding regions by borders that have the structure that differs from surrounding regions.

Surface landmark — is an anatomic feature of specific region that can be seen or palpated. In different regions it will be a bone prominence (*spina iliaca anterior superior*), skin fold (*inguinal fold*, *umbilicus*), relief of muscle (*m. biceps brachii*), etc.

Projection — is a point, line or geometrical figure on the surface of human body that corresponds to the deep location of organs or neurovascular fascicles.

Holotopy — is location of an organ according to the whole human body (for ex.: *hand is a distal part of upper extremity*).

Syntopy — is location of an organ according to the surrounding organs and tissues (for ex.: *gall-bladder locates on the visceral surface of liver and covered with peritoneum in the mesoperitoneal way*).

Skeletopy — is location of an organ according to the parts of skeleton (vertebra, intercostals space, etc., for ex.: *kidney locates at the level of Th XII – L II*).

Neurovascular fascicle (NVF) — is a big main artery with escorting veins and big nerves that locates in common fascial sheath (for ex.: *NVF of anterior surface of thigh is femoral artery, femoral vein and n. saphenus*).

Cellular space (space) — is a space between leaves of fascia filled with areolar tissue and fat (cellular tissue).

In topographic anatomy human body is divided into topographic regions. Each topographic region is studied layer by layer structure, describing each layer from skin to the deep. So there is a common scheme of this structure:

• Skin (describing its thickness, mobility, skin folds, sweat glands, innervations, etc.).

• Subcutaneous cellular tissue (SCT) (describing its intensity, layers, blood vessels and nerves).

• Superficial fascia (describing its intensity, features of structure).

• Proper fascia (describing its features of structure, layers, fascial sheath, etc.).

• Muscles (describing groups, layers, spaces and channels between muscles).

• Bones and joints (describing features, joint structure, joint capsule and its weak places, etc.).

• NVF (structure, topography, projection).

If described topographic region locates on extremity, we'll stop describing on bones, joints and NVF. If it's a part of a trunk (head, neck, thorax, abdomen or pelvis) we'll going on:

• Deep parietal fascia.

• Parietal leaf of serous tunic.

• Spaces (borders, ways of communication).

• Organs (holotopy, syntopy, skeletopy, function, blood supplying, venous and lymphatic drainage, innervation).

As for NVF, it has common structural features, that were described by the Russian anatomist and surgeon Pirogov.

Pirogov's laws about relations of fascias and blood vessels:

1. The first law — all NVFs are located in fascial sheaths.

2. The second law — walls of fascial sheaths are formed by proper fascias which cover surrounding muscles.

3. The third law — fascial sheath in a cross-section has form of triangle which base directed at the outside and apex directed at the inside and fixed by fascia to the bone.

Surgical operations

Surgical operation — is a mechanical force on tissues and organs of a patient with the aim of diagnosis, treatment or function recover realized by incision and connection tissues in different forms.

Operative access — is an initial stage of operation when an organ or pathological nidus is uncovered.

Operative method — is a stage of operation when manipulations on organ or pathological nidus are carried out.

Classification

According to urgency:

• Emergency operation — is an operation which is carried out immediately according to vital indications (heart wound, perforated ulcer, asphyxia, etc.).

• Pressing operation — is an operation which may be delayed for a little time to prepare a patient and give more definition to the diagnosis.

• Elective operation — is an operation which is performed after sufficient patient's examination, exact statement of diagnosis and full preparation for the operation.

According to elimination of the cause of disease:

• Radical — an operation completely eliminates the cause of the disease (appendectomy).

• Palliative — an operation doesn't eliminate the cause of the disease but makes the patient's condition better (fistula of stomach at inoperable stomach cancer).

Operative terminology

• Tomia — is transection of organ wall (*choledochotomy*).

• Ectomia — is complete removal of organ (*appendectomy*).

• Resectio — is excision of organ or extremity saving peripheral part (*stomach resection*).

• Stomia — is fistulization (*enterostomy*).

• Rrhaphia — is putting on the stitch (*aneurysmorrhaphia*).

• Sectio — is section (*venesectio*).

• Punctio — is puncture (*venepunctio*).

Surgical instruments are divided into two groups: common and special.

Common surgical instruments are used on each operation and divided into four groups:

1. Instruments for dividing tissue: *scalpels, scissors.*
2. Instruments for connecting tissue: *needles, needle-holders, clips etc.*
3. Hemostatic instruments: *different clamps and forceps, ligature needles.*
4. Auxiliary instruments (dilating and fixating): *hooks, retractors, speculum, dressing forceps, probes, etc.*

Special surgical instruments are used in specific spheres of surgery such as traumatology, urology, neurosurgery etc.

2. Operations on blood vessels of extremities: methods of the bleeding arrest, operations on the vascular pathology, aneurysm and varicose veins.

Types of bleeding

According to its aetiology:

• arterial;

• venous;

• capillary (erosive);

• parenchymatous;

• mixed.

According to direction of bleeding:

• external;

• internal.

According to time of bleeding origin:

- primary;
- secondary.

Classification of methods of bleeding arrest

According to factor:

- mechanical (tourniquet, digital occlusion, applying a hemostatic clamp, etc.);
- physical (thermocoagulation, electrocoagulation, etc.);
- chemical (ε-aminocapronic acid, hydrogen peroxid, etc.);
- biological (tamponade with epiploon, hemostatic tubes, etc.).

According to time:

- temporary (elevated position of extremity, maximal flexion in joint, compressive bandage, tamponade, digital occlusion, applying a tourniquet or hemostatic clamp, using hemostatic tubes);
- final (ligating a blood vessel in wound or at a distance, vascular stitch).

Temporary bleeding arrest

1. Applying a tourniquet. The tourniquet is applied on the part of an extremity that has only one bone (for example: arm (humerus), thigh (femur)). The tourniquet compresses main arteries and their collaterals, so its use over a long period of time causes ischemia. The time limit for the tourniquet is one hour in winter and two hours in summer.

Complications:

- Necrosis of an extremity if the tourniquet stays for a long time.
- Nerve damage, that is caused by compression of a soft tissues under the tourniquet (some cloth must be put under the tourniquet to prevent this).
- Tourniquet shock that is caused by metabolic intoxication in case of ischemia.

Contraindications:

- Anaerobic infection;
- Arteriovenous aneurysm;
- Obliterating endoarteritis.

2. Digital occlusion. Occlusion of blood vessels by fingers to bone in special points. This method saves the collaterals but has some defects such as tiredness of hand, difficulties in transportation, etc.

3. Temporary prosthetics. This is the method of applying a synthetic hemostatic tubes that are put into damaged blood vessels. Shortcomings:

- Possibility to connect vessels only in case its diameter more than 6 mm.
- Time limit is 72 hours.
- Damaging of vessels intima (cause for trombosis).

Final bleeding arrest

1. Ligating a blood vessel in wound;
2. Ligating a blood vessel at a distance;
3. Vascular stitch.

Ligating a blood vessel in a wound

Ligating a blood vessel in a wound is putting a ligature in the place of injuring of the blood vessel.

Technique:

- wide operative access;
- separation of blood vessel from surrounding tissue;
- if the vessel is *artery* we'll put in two ligatures on proximal part (one of them with sewing) and one ligature on distal part (without sewing);
- if the vessel is *vein* we'll put in one ligature on the proximal and distal part (both without sewing).

Why do we put in ligature with sewing on arteries? Blood pressure is very high in arteries, so it may cause sliding of ligature and renewal of bleeding. Sewing protects ligature from sliding and further complications.

Ligating a blood vessel at a distance

Ligating a blood vessel at a distance is making an additional incision higher than the place of bleeding and putting a ligature in the blood vessel that gives bleeding branch. For ex.: if there is bleeding from the radial and ulnar arteries in case of bruising the hand we must put ligature in the brachial artery.

Indications:

- Repeat erosive bleeding, that is higher than the place of ligating.
- Bad accessibility to blood vessel (superior and inferior gluteal arteries).
- When pulsating aneurysm was detected (method of treatment).
- In case of high amputations and exarticulations.
- When amputations and exarticulations are performed in case of anaerobic infection or obliterating diseases and applying of tourniquet is contraindicated.
- Purulent wound (bleeding will repeat after disappearing purulent trombi).
- Bruising wound (very difficult to find bleeding arteries).

Technique:

- Operative access in projection line of NVF performed higher than the place of bleeding.
- Separation of blood vessel from surrounding tissue.
- Ligating (the same method as in case of ligating in wound).
- Section of blood vessel between proximal and distal ligature (deinnervation of distal part of vessel makes quick development of collaterals).

Collateral circulation is blood supplying of distal parts of region or extremity by small branches of arteries and its anastomoses after ligating main artery.

Types of collaterals:

According to anatomical location:

- Intersystem (long) — connects branches of different main arteries.
- Intrasystem (short) — connects branches of one main artery.

• Intraorgan — connects vessels in organ.

• Extraorgan — connects vessels before they enter the organ.

According to time of forming:

• Existing collaterals — are big branches, that supply blood to the distal part of region or extremity at once after the main artery has been ligated.

• New born collaterals — are formed by small intramuscular branches, vasa vasorum, vasa nervorum in case of ligating the main artery. It will get enough development only after 60–70 days after ligating.

Classification of collateral circulation:

• Sufficient — when blood supply is full.

• Functionally insufficient — when blood supply is enough for nutrition but not enough for function.

• Absolutely insufficient — when blood supply is not enough for nutrition and causes ischemia and necrosis.

Reduced circulation is an artificial decrease of blood flow intensity lower than the place of the main artery ligation by ligating the same vein. It's performed to prevent the ischemia increasing. It was proposed in 1906 by Oppel. After the artery was ligated blood inflow to tissue decreases but outflow remains on the same level. So it may enlarge ischemia. We can eliminate this threat by ligating the vein and decreasing blood outflow by this way.

Vascular stitch

Vascular stitch always performs to repair the damaged blood vessel.

Indications:

• Damage of big main arteries (femoral, subclavicular).

• Damage of small arteries with decompensated ischemia of tissues.

• Replantation of an extremity.

Contraindications:

• Purulent wounds.

• Plural damages of blood vessels.

• Vessels with small diameter.

Demands:

• Airtightness — blood must not flow through the line of stitch (we can reach this demand by using non-traumatic needles, make a small distance between stitches (1 mm), etc).

• Sewing intim (endothelium) to intim.

• Suture material must not be in the opening of vessel (very difficult demand, in a practice use intact material — supramid, polyamid).

• Stitch must not narrow the opening of vessel.

Classification of vascular stitch:

1. Manual.

2. Mechanical.

Manual sutures

1. Blanket suture:

Carrel suture: three traction sutures are put on blood vessel on equal distance from each other. Then sutures are stretched and blanket suture are put on between them.

Morozova suture: two traction sutures are put on blood vessel one against another. Then blanket suture are put on between them. Suture material is permanently stretched, so it performs function of third traction suture.

Traction suture — is a suture material that stretches the wall of blood vessel. It makes putting the stitches on easier.

2. Everting suture:

Sapozhnikov suture: 2mm incisions are made on excised margin of vessel. It let us to turn margins inside out. After turning out the uninterrupted suture is put on margins.

3. Invaginating suture:

Solovyov suture: suture is used for uniting vessels with different diameters. Central end of blood vessel is turned inside out and introduced into peripheral end. Then sutures are put on blood vessels.

Shortcomings of manual vascular stitch:

- It's laborious.
- It's difficult to control sewing intim to intim.
- Microsurgical hardware is necessary if small vessels are sutured.

Mechanical suture

Gudov vascular stapler is used. There are staple part (with tantal or titan staples) and thrust part (for bending the staples) in this apparatus. The vessel ends are put on these parts. Then they are stitched with staples like a stapler for paper.

Advantages:

- Full airtightness and sewing intim to intim.
- Quickness of operation.

Shortcomings:

- It's difficult to work in the depth of wound.
- It's necessary to separate vessel on a long length.
- It's impossible to work with pathologically changed vessels (calcinosis, atherosclerosis).

Sutureless methods

These are the methods of connection of blood vessels with laser, special glue, electrocoagulation and rings of Donetsky.

Rings of Donetsky — are rings with thorns. Central end of vessel is introduced into ring, turned inside out and put on thorns. Then central end is introduced into peripheral end and fixed with thorns.

Operations on vascular pathology

• Exovascular operations — operations that improve haemodynamics by forcing on vegetative nervous system or removing the external cause of artery compression (*sympathectomy*).

• Endovascular operations – operations that recover blood flow by manipulating in the opening of vessel (*tromboembolectomy*).

• Reconstructive operations – replacement of the damaged part with a transplant or prosthesis (*prosthetics of blood vessel, bypass surgery*).

Tromboembolectomy:

• Direct tromboembolectomy — trombus or embolus is removed from incision in the place of occlusion.

• Indirect tromboembolectomy — trombus or embolus is removed ante- or retrograde with special Fogarty catheter, which was introduced in aperture of blood vessel.

Reconstructive operations.

Types of blood vessels plasty:

• Bypass surgery — it's making the additional way for blood flow roundabout the obstacle (such as trombus) with transplant.

• Prosthetics of blood vessels — it's removing the place of occlusion and replacement the defect by transplant:

— Autoplasty — it's plasty with fragment of vein.

— Xenoplasty — it's plasty with synthetic material.

Operations on an aneurysm

An aneurysm is a local dilating of blood vessel opening restricted by even stretching of its wall.

Classification:

According to damaged vessel:

• Arterial.

• Venous.

• Arteriovenous.

Types:

• True — it's a stretching of vessel wall without damaging intima (for ex.: syphilitic damaging of aorta).

• False — it's formation of cavity encapsulated in adjoining tissue and communicated with vessel opening because of intima damaging (for ex.: after gunshot wound).

Surgical treatment.

Palliative operations:

• Asnelles method — it's ligating of afferent vessel at place of aneurysm formation.

• Hunter method — it's ligating of afferent vessel at a distance.

Radical operations:

• Antyllus method — all afferent and efferent vessels are ligated. Aneurysm is cut and tamponed, for the purpose of its collapse and sclerosis.

• Philagrius method — all afferent and efferent vessels are ligated. Aneurysm is excised. Both of these methods can be performed only on true aneurysms.

• Endoaneurismorrhaphia (Kikutsi-Matas method) — aneurysm is cut, then from its cavity defect of vessel wall is sutured. Performed on false aneurysms.

• Transvenous aneurismorrhaphia (Radushkevich-Petrovsky method) – it's used on arteriovenous aneurysm. From the opened vein defect of vessel wall is sutured, then the vein is sutured.

Operations on varicose veins of lower extremities

Varicose veins — is a pathological state with coarse irreversible changes of walls and valves of veins. It leads to dilation and prolongation of veins, makes it twisting, and forms painful varicose knots.

The pathogenesis of varicose veins is an increase of venous blood dumping from deep veins to superficial by connecting veins called communicants. As a result, the walls of superficial veins are under high haemodynamic pressure and stretch. The venous walls and valves change its structure. This leads to venous stasis and progress of disease.

Methods of treatment:

1. Conservative methods — use an elastic bandage which decreases blood dumping from deep veins.
2. Sclerosing methods — are injection of sclerosing medicines.
3. Surgical methods.
4. Combined methods.

Surgical methods are:

1. Ligature methods — are ligating of superficial veins to stop blood flow on it.

• Klapp-Sokolov method – is used on solitary varicose knot. The knot is ligated by silk material under skin.

2. Methods of excision:

• Madelung method — an operative access to *v. saphena magna* is made on whole length. Vein is completely removed. Shortcomings are the low cosmetics; collaterals remain that may cause a relapse.

• Babcock method — two accesses are made at place of confluence *v. saphena magna* to *v. femoralis* and near the medial condyle of femur. In these

places vein is cut. Then vein is removed with the probe which put into vein aperture. This method is cosmetic but has a shortcoming: it's a rupture of communicants, with bleeding and forming haematomas.

• Narath method — small accesses are made in the places of varicose veins. After separating the parts of veins are removed.

3. Methods of communicants ligation — is prevent blood dumping from deep veins.

• Cockett method — is ligating of communicants above proper fascia.

• Linton method — is ligating of communicants under proper fascia.

4. Method of vein plasty and forming the valves.

3. Operations on nerves of extremities

Peripheral nerves are formed by long neuron processes. Each neuron process (axon or long dendritis) unites in nerve fiber covered with *endoneuron*. Then nerve fibers unite in bundles of nerve fibers covered with *perineuron*. Then bundles unite in peripheral nerve. Each peripheral nerve covered with *epineuron*. Epineuron is connective-tissue nerve sheath that has blood vessels for nutrition, lymphatic vessels and adipocytes.

Classification of nerve damages:

1. Closed — if epineuron is safe:

• commotion;

• contusion;

• compression;

• dislocation;

• tension.

2. Open — if epineuron and continuity of nerve fibers are damaged (at slash and gunshot wound):

• Partial — it's marginal nerve damage without divergence of its ends.

• Full — it's damage with divergence of nerve ends and with loss of nerve function.

Pathomorphology of nerve damage.

At full open nerve damage the central end falls in shock with further retrograde degeneration. The peripheral end falls in primary and then secondary degeneration with destruction an lysis of neurofibrils (after 10 days) and replacing it by Schwann cells (*Waller degeneration*). After shock elimination in the central end regeneration begins. "Bulb of growth" appears and grows with speed 1–1.5mm per day. But nerve continuity doesn't recover because of divergence of nerve ends. So in this case neuroma is formed by the central nerve end. If neuroma traps into scar tissue it will be compressed by scar so phantom pain will appear (causalgia). Phantom pain — is feeling of pain in amputated extremity.

Types of nerve regeneration:

- True — if each axon traps in its own place. Function completely recovers.
- Heterotopic — if motor axons trap in place of motor ones, sensory axons trap in place of sensory ones, but each axon doesn't trap to its own place (for example: motor axon of extensor traps in place of flexor). Function recovers not completely.
- Heterogeneous — if motor axons trap in place of sensor one and vice versa. Function doesn't recover.

Operations on nerves:

1. Nerve suture.
2. Neurolysis.

Nerve suture (neurorrhaphy) — it's recovering of nerve continuity by putting the stitches on after full open damage.

Classification of nerve suture

1. Primary suture — is performed after primary surgical treatment of a wound. It must be performed not later on 12h from the moment of damage.

Indications:

- Absence of purulent infection in wound.
- Absence of bruising and plural ruptures of epineuron.
- Necessary neurological exploration must be performed (detection size of damage, etc.).
- It's proper qualification of surgeon and necessary hardware.

The most favorable term for primary suture is clean slash wound.

2. Delayed suture:

- Delayed early suture — is performed after 2–3 weeks. We perform the repeated injury and then suture the nerve. Its advantage is in the exact detection of damage borders.
- Delayed late suture — is performed from 4–6 weeks till a few years. The time of active regeneration is lost in this case.

Demands to the nerve suture:

- Exact confrontation on axis.
- It must be diastasis 1mm between the ends of the nerve to prevent nerve compression.
- It's necessary to "refresh" ends of nerve (central till granularity, peripheral till bleeding).
- Stitch must pass through the epineuron.
- An extremity must be immobilized after operation to prevent rupture of sutures.

Stages of performing nerve suture

- Separation of nerve from tissues.
- Mobilization of nerve and elimination of its tension.
- "Refreshing" the ends — it means resection of neuroma and damaged parts.
- Performing suture itself.

Neurolysis — is nerve liberation from scar tissue which compressed this nerve.

Indication: is compression of nerve with scar tissue at case of full viability and nerve conduction.

Stages:

- Operative access about 8–10 cm aside from line of nerve projection.
- Cutting of scar tissue.
- Checking the nerve for its conduction and liberating it from scar tissue. In case of injuring of nerve conduction nerve suture must be performed.
- Deleting of scar tissue and forming a new place for nerve between the muscles.
- Sewing up the wound.

LECTURE 2
OPERATIONS ON THE LOCOMOTOR SYSTEM

1. Operations on joints: joint puncture, arthrotomy, arthrodesis, arthrorisis, tenodesis, joint resection, arthroplasty, endoprosthesis replacement.
2. Operations on bones: osteotomy, bone resection, osteosynthesis.
3. Operations on tendons: tenorrhaphia, tendon elongation.

1. Operations on joints: joint puncture, arthrotomy, arthrodesis, arthrorisis, tenodesis, joint resection, arthroplasty, endoprosthesis replacement

Operations on joints:
- joint puncture;
- arthrotomy;
- arthrodesis;
- arthrorisis;
- joint resection;
- arthroplasty;
- endoprosthesis replacement.

Joint puncture — is a puncture of synovial capsule for the purpose of diagnostics (research of synovial liquid, arthroscopy) or treatment (removal of exudates, introduction of remedies).

Demands:
- Compliance with the asepsis and antisepsis.
- Anesthesia of puncture place.
- Carrying out puncture in strictly definite points.
- It's necessary to move the skin in place of puncture. After puncture skin will move back at its place and close puncture channel that prevents flowing the synovial liquid out.
- The needle is introduced slowly and pulled out quickly to prevent trapping the synovial liquid in puncture channel.
- When remedy is introduced its volume must not be more than volume of removed synovial liquid.
- It's necessary to immobilize the extremity after puncture for a one day.

Some points of joint puncture:

1. Shoulder joint:
- Anterior point — is under the *processus coracoideus* of *scapula*;
- Posterior point — is lower from *acromion* between *m. deltoideus* and *m. supraspinatus*.

2. Elbow joint: point is located between lateral margin of *olecranon* and inferior margin of *epicondylus lateralis humeri*.

3. Wrist joint: is in the point of cross two lines — first line unites *processus styloideus* of radia and ulna, second line is a prolongation of second metacarpal bone.

4. Hip joint:

- Anterior point — is in the middle of the line that build from the *trochanter major* to the middle of inguinal ligament;
- Lateral point — is above the *trochanter major*.

5. Knee joint: point is located at the lateral margin of *patella* basis.

6. Ankle joint:

- Lateral point is between the lateral ankle and *m. extensor digitorum longus*;
- Medial point is between the medial ankle and *m. extensor hallucis longus*.

Arthrotomy — is an operation of joint transection by cutting synovial capsule.

Indications:

- Operative access at the operations on joints (joint resection, arthroplasty).
- Separate operation for the removal of foreign bodies and drainage joint cavity.

Joint resection — is an operation of complete or partial removal of damaged articular surfaces with cartilage and synovial capsule.

Classification:

- Complete — is removal of both articular surfaces.
- Unicompartmental — is removal of one articular surface.
- Partial — is removal of part of articular surface.
- Economical — is removal of articular surfaces with saving metaepiphysial zones. It makes it possible to save bone growth (carry out at the children).

Resection of shoulder joint: firstly carries out arthrotomy, then in operative wound takes out tuberculum major and minor of humerus. They are removed with a chisel together with tendons of muscles that attached to them. Then head of humerus is dislocated to operative wound and cut away with saw. Pathologically changed parts of synovial capsule and cavitas glenoidalis of scapula are removed, remaining parts of joint are joined together, wound is sutured, extremity is fixed in bandage.

Resection of knee joint:

Textor method: the bow-shaped incision is carried out from the level of femoral epicondyles to the level that below from tuberositas tibiae at 1cm. Ligaments and synovial capsule are cut, articular surfaces are removed. After that wound is sutured and extremity is fixed in bandage.

Kornev method: it's an extraarticular economical resection so articular cavity isn't cut. Incision is carried out like at the Textor method, but horizontal line is located at the level of articular space. Ligament of patella is cut and patella is sawn at the frontal plane. Then articular surfaces are sawn by the epicondyle curvature with saving metaepiphysial zones without cutting synovial capsule.

Articular surfaces are removed with synovial capsule as a single unit. Wound is sutured, extremity is fixed in bandage.

Arthroplasty — is an operation of recovery of mobility in immobile joint.

Indications: ankylosis, marked contracture, recover of mobility after joint resection.

Stages:

- Operative access (arthrotomy).
- Separation of conjoined articular ends.
- Processing of articular ends and modeling new articular surfaces.
- Placing the special insert from the fascia or alloplastic material that prevents articular surfaces from growing together.

Endoprosthesis replacement — is an operation of recovering of joint mobility with artificial articular surfaces from synthetic material.

Indications: recover of joint mobility when it's impossible to carry out other operations.

Arthrodesis (artificial ankylosis) — is an operation of full joint immobilization in position that most comfortable for the function.

Indications: pathological mobility in deformed joint.

Types:

- Intraarticular — it is when articular cavity is cut, articular cartilage is removed and articular surfaces are fixed tightly for growing its together.
- Extraarticular — it is when articular cavity isn't cut and joint is immobilized with osseus transplants that applied paraarticular.

Arthrorisis — is an operation of limitation of joint mobility.

Indications: pathological joint mobility in case of paralysis of certain muscle groups. More frequent is artrorisis of ankle joint.

Principles: creating an osseus insert that limits motions in joint.

Tenodesis — is an operation of limitation of joint mobility with tendons of paralyzed muscles, which introduced in artificial apertures in bones.

2. Operations on bones: osteotomy, bone resection, osteosynthesis

Osteotomy — is an operation of bone transection.

Indications:

- contracture and ankylosis of joint with incorrect position of extremity;
- fractures that healed in incorrect position;
- deformation of long bones;
- elongation of extremities.

Classification:

1. Correcting osteotomy — is carried out for correction of bone deformation:

• *Subtrochanteric osteotomy of femur by Kochev* — after uncovering femur at the level of trochanter minor reach-through hole are drilled under the trochanter. Then its margins are sawn, after that saddle-shaped surfaces are formed. Then thigh is placed in correct position and fixed in a plaster bandage.

• *Subtrochanteric osteotomy of femur by Kozlovsky* — femur is sawn at inferior margin of trochanter major. Then extremity is placed in correct position and fixed with osseus joint pins.

• *Supracondylar angular osteotomy of femur by Repke* — femur is sawn in angular way, then extremity is placed in correct position and fixed.

2. Lengthening osteotomy — is carried out for elongation of extremities. Bone is sawn and formed the "steps". Bone is elongated on the length of its "steps."

3. Combined osteotomy — is carried out for elongation of extremities and correction of bone deformation.

Combined osteotomy by Bogoraz — multiple oblique saw cuts are made and bone segments are formed. These segments are lined and fixed by intraosseous joint pin or skeletal traction takes place.

Bone resection — is a removal of bone.

Indications:

• bone tumour;
• osteomyelitis;
• false joint (pseudoarthrosis);
• forming an autotransplant.

Classification:

1. According to the bone shortening:

• *partial* — without changing bone length;
• *enlarged* — with changing of bone length but saving its part;
• *complete* — removal of whole bone.

2. According with processing of periosteum:

• *subperiosteal* — bone is sawn after periosteum have been cut and moved to side of healthy tissue;

• *transperiosteal* — bone is removed together with periosteum.

Bone fractures

Classification of fractures:

1. According with the aetiology:

• congenital;
• acquired:
— traumatic;
— because of bone pathology (osteoblastoclastoma).

2. According with an injuring of soft tissue:
- open (compound);
- closed (subcutaneous).

3.According with the place of fracture:
- diaphysial;
- metaphysial;
- epiphysial;
- apophysial.

4. According with the line of fracture (longitudinal, transversal, oblique, spiral, etc.).

5. According with the presence of splinters:
- comminuted (splintered) fracture;
- uncomminuted fracture.

6. According with the involving a joint:
- intraarticular;
- extraarticular.

7. According with the displacement of bone fragments:
- displaced fracture;
- undisplaced fracture.

Fracture treatment:
- conservative — plaster bandage, skeletal traction;
- operative.

Indications for operative treatment of fractures:
- open fracture;
- avulsion fracture;
- intraarticular fracture with rotation of bone fragments;
- fracture with injuring of main arteries and nerves;
- fracture with interposition of soft tissue;
- femoral neck fracture of elderly patients.

Stages of primary surgical treatment of a wound at open fracture:
- excision of unviable soft tissue;
- removal of small osseous splinters without periosteum;
- processing of sharp margins of bone fragments;
- reposition and fixation of bone fragments;
- arrest of the bleeding;
- immobilization of extremity.

Osteosynthesis — is an operation of joining of bone fragments.

Classification:

1. *Bone suture*:
- without modelling of bone fragments — bone suture of olecranon or patella;

• with modelling of bone fragments — "russian lock" method (it shorten an extremity on a length of lock, used for transplant fixation).

2. *«Bandage»* — is fixation of bone fragments by winding wire round the bone. It's carried out on oblique and spiral fractures.

3. *Osteosynthesis with metal* — is joining of bone fragments with metal plates, sprigs and joint pins:

• Extramedullary – joining metal plate is fixed to the bone with screws in fracture place (*plate by Len*).

• Intramedullary — joining metal sprig is located inside the bone in medullary canal:

✓ Open method — with uncovering of fracture place.

✓ Closed method — without uncovering of fracture place. It's carried out under X-ray control.

— Antegrade method — sprig is introduced in medullary canal through the bone epiphysis.

— Retrograde method — sprig is introduced through the fracture line to the proximal bone fragment. After reposition sprig is introduced into the distal bone fragment.

4. *Osteosynthesis with bone* — is joining of bone fragments with bone plates or joint pins:

• Extramedullary — with external bone plate (*method of sliding transplant by Khakhutov*).

• Intramedullary — with bone joint pin into medullary canal.

5. *Hardware-based osteosynthesis* — is joining of bone fragments with compressive-distractive apparatus (*Ilizarov apparatus*):

Advantages:

• Joint immobilization isn't required.

• Extremity is functionally active.

• There is a possibility of extremity elongation.

• There is a possibility of bone fragments compression in case of pseudoarthrosis.

Shortcomings: there is a possibility of osteomyelitis because of wires being introduced through the bone.

3. Operations on tendons: tenorrhaphia, tendon elongation

Tendon suture (tenorrhaphia).

Indication — is a tendon wound with the damage of its structure.

Classification:

1. According with the time of carrying out:

• Primary suture: is carried out at primary surgical treatment of wound. Indication is a clean slash wound.

• Secondary suture:

— Early — is carried out after wound has been healed by primary intension (2–3 weeks after wounding).

— Late — is carried out after wound has been healed by secondary intension.

2. According with the way of sutures: with straight suture way; with forming of loops.

Demands:

- Strength.
- Suture must not divide tendon into fibers.
- There must be minimal damaging of tendon blood supplying.
- Smooth sliding surface of tendon must be saved.
- Vaginal synovial membrane must be recovered.

Cuneo tendon suture – is applied with two straight needles that have been put on one filament of suture material. Tendon is sutured first at transversal direction and then in oblique. Filaments are tied up between the tendon ends.

Advantages: filaments are located inside the tendon that saves its smooth surface.

Shortcomings:

- It's traumatical.
- It damages tendon blood supplying.

Operations of tendon elongation

Tendon elongation may be carried out with different materials:

- Using the tendons of less important muscles (m. palmaris longus, m. plantaris longus).
- Using the part of fascia.
- Using the tendons of corpse. Own connective tissue is formed on its place.

Elongation of Achilles tendon:

- *Baier method*: tendon is cut as Z-shape in the sagittal plane. Then it's sutured. Tendon elongates on the length of formed "step".
- *Vulpius method*: is the same like Baier method, but incision is made in the frontal plate.

LECTURE 3
AMPUTATIONS AND EXARTICULATIONS OF EXTREMITIES

1. Definition of amputation, classification and indications.
2. Stages of amputation.
3. Different types of amputations.

1. Definition of amputation, classification and indications

Amputation — is an operation of removing a part of extremity at the level of bone diaphysis.

Exarticulation (disarticulation) — is an operation of removing a part of extremity at the level of joint space.

Amputation level — is a place of bone saw cut. The length and functionality of the stump depends on it.

Stump — is the part of extremity that remains after amputation.

Classification:

1. According with the time of carrying out:

- Primary — is the amputation that carries out in 24 hours after extremity damage before the beginning of inflammation.
- Secondary — is the amputation that carries out in case of developing inflammation or pathological process.
- Reamputation — is a repeated amputation on the stump of extremity.

2. According with the type of tissue covering bone saw cut:

- fascioplastic;
- myoplastic;
- periosteoplastic;
- osteoplastic.

3. According with the way of soft tissue incision:

- Flapping — the flaps are formed by incision of soft tissue. These flaps cover the bone saw cut. This type of amputation may be one- and two-flapping, equal- and non-equal-flapping.
- Ellipsoid — line of incision passes obliquely to the extremity axis.
- Circular — line of incision passes perpendicularly to the extremity axis:

Single-stage — skin, subcutaneous cellular tissue (SCT), fascias and muscles are cut by one incision. Then soft tissue is pulled off and bone is sawn at line of contracted muscles;

Double-stage — skin, SCT and fascias are cut by the first incision, muscles are cut by the second incision at the level of pulled skin, and then bone is sawn at line of contracted muscles.

Three-stage — skin, SCT and fascias are cut by the first incision, superficial layer of muscles is cut by the second incision, then muscles are pulled off

and deep layer of muscles is revealed. It is cut by the third incision. After that bone is sawn at line of contracted muscles.

There is a certain type of circular amputations called guillotine amputations (open amputations). These are amputations when all soft tissue and bone are cut at one level without contraction of soft tissue. As a result conic stump is formed. This type of amputation takes place at anaerobic infection because it supplies tissue with good aeration.

At the present time flapping amputations have preference, because circular amputations lead the scar forming at the supporting surface of the stump. So it may bring difficulties to prosthetics.

Indications for amputations

Indications for the primary amputations:

1. Relative:

- Traumatic tearing away of the extremity.
- Extremity is on the soft tissue flap.
- Bruising of an extremity.
- Rupture of a big main arteries and nerves.
- Extensive soft tissue damages more than two thirds of the extremity circumference.

2. Absolute: forth-degree burns and frostbites of the extremity.

Indications for the secondary amputations:

- Necrosis in a result of obliterating diseases of extremity blood vessels.
- Extensive wounds with anaerobic infection.
- Malignant tumors.

Indications for the reamputation:

- Faulty stump (defective stump) — when trophic ulcers, osteophytes or phantom pain are in the place of stump.
- Mistakes of choice of amputation level, which bring difficulties to prosthetics or not eliminate spreading of pathological process.
- Improvement of stump functionality (physiological reamputations) – it is an operation of the I metacarpal bone phalangisation *by Albrecht*, dividing of forearm bones *by Krukenberg*.

2. Stages of amputation

Stages of amputation:

- Choice of the amputation level.
- Anaesthesia.
- Applying a tourniquet. A tourniquet doesn't apply in case of anaerobic infection or obliterating diseases of extremity blood vessels. In these cases ligating blood vessels at a distance takes place.

• Division of soft tissue.
• Periosteum processing and bone sawing.
• Stump processing — it is the processing of blood vessels, nerves and soft tissue of stump.

It's necessary to cut and move out periosteum before bone sawing. If bone is sawn through the periosteum it may causes the inflammation of periosteum with pathological growth and forming sharp osseous thorns called osteophytes.

Methods of periosteum processing:
• Aperiosteal: periosteum is cut by scalpel at the amputation level, then it is moved with raspatory to the distal end from the amputation level. After that uncovered bone is sawn. This way prevents of forming osteophytes but it is possible necrosis of uncovered bone margin.
• Subperiosteal: periosteum is moved to the proximal end, then bone is sawn and after that periosteum replaced to the bone saw cut.
• Transperiosteal: periosteum is moved to the distal end and bone is sawn at the line of periosteum incision.

Stump processing:
•Ligating of blood vessels: big main blood vessels are ligated with catgut, arteries may be additionally sewed. It is important that each vessel must be ligated separately. After that the tourniquet is taken off and small blood vessels begin to bleed. They are ligated by sewing surrounding tissue.
• Transection of nerves: solution of novocaine is introduced into epineuron and nerve is transected by one movement of sharp blade. It's necessary to transect nerves above 2–3 cm from the amputation level. It prevents neuroma trapping into postoperational scar tissue and causing phantom pain.
• Processing of muscles — muscles-antagonists are joined together by sewing, it improves stump functionality.
• Operative wound closure.

3. Different types of amputations

Three-stage conical-circular amputation by Pirogov

It carries out in three stages and allows covering bone saw cut with soft tissues. Shortcoming is forming of the scar at the supporting surface of the stump that brings difficulties to prosthetics.

Osteoplastic amputations of thigh

• *Gritti-Shimanovsky method* — bone saw cut is covered with patella. Shortcoming is m. quadriceps femoris can move patella away.

• *Albrecht method* — is like previous method but has one difference: there is a bone protuberance that is formed by sawing on the posterior surface of patella. This protuberance is put into medullar canal of femur and fixes patella firmly to the bone saw cut.

• *Sabaneev method* — bone saw cut is covered with tuberositas tibiae. Its advantages that patella ligament isn't cut and tuberositas is more proper for supporting function.

Tendoplastic amputations of thigh

Callender method — bone saw cut is covered with tendinous-aponeurotic flap, from which patella is removed. Flap is joined together with periosteum and posterior muscles of femur by sewing.

Osteoplastic amputations of leg

• *Beer method:* there is a bone plate that is cut out from the tibia and covers both bone saw cuts.

• *Pirogov method:* two incisions are carried out. First incision is from one ankle bone to other through the dorsal part of the foot which transects the ankle-joint. Second incision is a stirrup-shaped from the ends of the first incision through the sole of foot. Tibia, fibula and heel bone are cut with saw but calcaneal tuber remains. Damaged foot is removed and calcaneal tuber joined with saw cut of tibia and fibula. Advantages are the extremity is shortening insignificantly and stump has a good supporting surface. Shortcoming is the difficulty of the operation. Also necrosis of calcaneal tuber can take place because of cutting calcaneal blood vessels.

Exarticulations of hand fingers

The main term at the exarticulation of hand fingers is the postoperative scar must not locate on the effective area of the finger. For this term flap of soft tissue is formed long enough. It is formed from side of effective area and covers the wound.

Methods:

• *Malgenue method* — is the exarticulation of the I finger. It's necessary to save points of attachment of thenar muscles. It significantly improves stump functionality.

• *Farabeuf method* — is the exarticulation of the II or the V fingers. At this operation the lateral flaps of soft tissue are formed.

• *Luppi method* — is the exarticulation of the IV finger.

• *The racket incision method* — is the exarticulation of the III finger.

Amputations and exarticulations of foot at different levels.

Methods:

- *Exarticulation of all foot fingers by Garangeo* — only foot fingers are removed. Wound is covered by a sole soft tissue flap.
- *Amputation by Sharpe* — the saw cut is carrying out at the level of diaphyses of metatarseal bones. Then sole soft tissue flap is formed. The operative wound is covered by this flap.
- *Exarticulation of foot by Lisfranc* — is exarticulation in tarso-metatarseal joint (Lisfranc joint). This operation saves attachment points of extensor muscles of foot and stump doesn't get in the defective position.
- *Exarticulation of foot by Chopard* — is exarticulation in the transversal joint of tarsus (talonavicular and calcaneocuboid joints — Chopard joint). This operation doesn't save attachment points of extensor muscles of foot and as a result stump gets in the defective plantar flexion.

LECTURE 4
TOPOGRAPHIC ANATOMY OF A HEAD. OPERATIONS ON A HEAD

1. Topographic anatomy of a cranial vault. The scheme of craniocerebral topography by Krenlein and Briusova.
2. Operations on a head: trepanations, operative treatment of head wounds.
3. Topographic features of some regions of a face. Demands to the incisions on a face. Operations on purulent parotitis and parapharyngeal abscess.

1. Topographic anatomy of a cranial vault. The scheme of craniocerebral topography by Krenlein and Briusova.

There are two topographic regions in a head: facial region and cranial vault. The border between these regions is the line that passes through the supra-orbital margin, zygomatic arch and external acoustic meatus.

Regions of the cranial vault:
- frontal-parietal-occipital region;
- temporal region (left and right);
- mastoid region (left and right).

Frontal-parietal-occipital region

Borders:
- anterior — is a supra-orbital margin;
- posterior — is superior nuchal line;
- lateral — are superior temporal lines.

Layers:
- Skin — is thick.
- Subcutaneous cellular tissue — it contains connective tissue fascicles (CTF) which bind skin and aponeurosis. Also it contains blood vessels and nerves. Blood vessels have ascending radial direction and good anastomoses between each other. Walls of blood vessels connect with CTF. It makes vessels not closed and gape in case of injury. So open wounds of this region are very dangerous because of voluminous bleeding. In case of closed wounds local haematomas have a form of bump.
- Epicranial aponeurosis — it binds to skin by CTF and makes a scalp with it.
- Subaponeurotic cellular tissue — in case of injuring haematomas may spreads around.
- Periosteum — is firmly bind only with the interosseous sutures.
- Subperiostal cellular tissue — in case of injuring haematoma bordered by interosseous sutures and repeats the form of the bone.
- Bone, that consists of three layers:

— external lamina (thickness about 1mm);
— diploe — spongy substance that contains diploic and emissary veins;
— internal lamina (lamina vitrea — thickness about 0.5 mm).

• Under calvaria the brain with maters locates:

— Epidural space — it locates between dura mater and bones and contains meningeal arteries.

— Dura mater — it forms venous sinuses that realize venous outflow from the brain. Sinuses connect with superficial veins by emissary veins.

— Subdural space.
— Arachnoid mater.
— Subarachnoid mater — it contains liquor and connect with brain ventricles.
— Pia mater.
— Brain (cerebral cortex).

Temporal region

Borders:

• anterior — frontal-zygomatic line;
• posterior-superior — superior temporal line;
• inferior — zygomatic arch.

Layers:

• Skin — is thin.
• Subcutaneous cellular tissue — is friable and narrow, contains ear muscles, superficial blood vessels and nerves.
• Superficial fascia.
• Temporal aponeurosis — it consists of superficial and deep leafs that attached to zygomatic arch. There is interaponeurotic cellular space between it.
• Subaponeurotic cellular space.
• Temporal muscle.
• Submuscular cellular space.
• Periosteum firmly binds with bone in this region. Subperiostal cellular tissue is absent.
• Squama of temporal bone — is thin and fragile without diploe.

Mastoid region

Borders:

• superior — relative line that is continuation of zygomatic arch;
• anterior, posterior, inferior — are proper to shape of mastoid process.

Layers:

• Skin — is mobile.
• Subcutaneous cellular tissue — is narrow and contains blood vessels and nerves.

• Aponeurosis — is formed by tendon of m. sternocleidomastoidus.

• Periosteum — is firmly bound with bone except *Chipault triangle*.

Mastoid process contains many cells and the biggest one called antrum (cavity). Antrum connects with tympanic cavity. In case of chronic otitis purulent process can spread to the antrum and it is the indication for *antrotomy* — operation of opening antrum.

Antrotomy carries out in the *Chipault triangle* because in this place periosteum bind with bone not firmly.

Borders of *Chipault triangle*:

• superior — relative line that is continuation of zygomatic arch;

• anterior — posterior margin of external acoustic meatus;

• posterior — crista mastoidea.

Technique of antrotomy:

• Arched incision of soft tissue behind the ear.

• In the Chipault triangle periosteum is removed by raspatory.

• Bone is gouged and mastoid process is opened with chisel.

• Pathological contents and pus are removed from antrum with sharp small spoon.

• Applying the drainage and sewing up the wound.

Complications:

• When chisel deflects upwards it may traps into middle cranial fossa.

• When chisel deflects backwards sigmoid sinus can be damaged.

• When chisel deflects downwards and forward facial nerve can be damaged.

• Damage of semicircular ducts.

The scheme of craniocerebral topography by Krenlein and Briusova

This scheme allows to project brain fissures and convolutions and also trunk and branches of *a. meningea media* on the skull surface.

Lines of the scheme:

• Basic — inferior horizontal line — it passes through the infra-orbital margin and superior margin of external acoustic meatus.

• Superior horizontal line — it passes through the supra-orbital margin and parallel to the basic line.

• Anterior vertical line — is perpendicular to the horizontal lines and passes to the middle of zygomatic arch.

• Middle vertical line — it passes to the middle of articular process of mandibula.

• Posterior vertical line — it passes to the posterior border of mastoid process.

• Sagittal midline — it passes through glabella and protuberantia occipitalis externa.

Projections:

• *Sulcus centralis (Roland)* — is the line from the point of crossing posterior vertical line with sagittal midline to the point of crossing anterior vertical line with superior horizontal line.

• *Sulcus lateralis (Sylvius)* — is a bisector of the angle between projection line of sulcus centralis and superior horizontal line.

• *Trunk of a. meningea media* — is a point of crossing anterior vertical line and inferior horizontal line. *Frontal branch* projects at the point of crossing anterior vertical line with superior horizontal line. *Parietal branch* projects at the point of crossing posterior vertical line with superior horizontal line.

2. Operations on a head: trepanations, operative treatment of head wounds

Operative treatment of head wounds

Bleeding arrest:

1. Arrest of the bleeding from the scalp:

• Applying a tourniquet.

• Digital occlusion.

• Applying a hemostatic clamp with fixation on the epicranial aponeurosis.

• Hemostatic stitch of Heidenhein — is sewing of head soft tissue with blood vessels that pass through it.

2. Arrest of the bleeding from the diploic veins:

• Introducing special wax into the diploe.

• Compression of external and internal laminas with forceps.

• Applying a hot saline to accelerate the coagulation.

• Tamponade with piece of muscle.

3. Arrest of the bleeding from the venous sinuses:

• Vascular stitch in case of small line wound.

• Plasty of sinus by Burdenko with dura mater flap.

• Sinus tamponade.

• Ligating of sinus in case of rupture. This method is very dangerous because of possibility of venous encephalopathy and can be performed only in anterior third of sinus.

Trepanation — is an operation of opening of the skull cavity.

Classification:

• Osteoplastic trepanation — at this operation osseous flap is formed. This flap closes skull defect after operation.

• Decompressive-resection trepanation — at this operation part of bone is removed and skull defect remains open.

Osteoplastic trepanation:

• Wagner-Wolf method — skin-aponeurotic and osseous flaps have the single narrow basis that cause blood supply malfunction.

• Olivecron method — skin-aponeurotic and osseous flaps have different basis.

Indications: operative access at the brain tumors, intracranial haematomas and also for arresting the bleeding from damaged *a. meningea media*.

Technique:

• Horseshoe-shaped skin-aponeurotic flap is formed and periosteum is revealed.

• Periosteum is a cut at 1cm from margin of skin incision.

• Five-six openings are drilled. Lancet-shaped cutter is used at first. When sawdust painted with the blood it means that cutter enters the diploe. Than lancet-shaped cutter is changed to the circular-shaped one and drilling is gone on very carefully. When internal lamina was revealed drilling is stopped. Openings are made wider with a sharp spoon.

• In the openings wire chain saw by Gigli is introduced with Polenov guide. Then bone is sawn.

Decompressive-resection trepanation by Kushing

Indications: it's palliative operation at high intracranial pressure in case of inoperable brain tumor or rapid increasing of brain edema. By this operation open skull defect is formed and as a result intracranial pressure decreases.

Technique:

• Horseshoe-shaped skin-aponeurotic flap is formed with basis directing down.

• Temporal aponeurosis is a cut and temporal muscle is divided. Afterwards muscle will close trepanation opening and prevent intracranial contents from prolapse.

• Periosteum is a cut and removed with raspatory at area with the size of 6x6 cm.

• The only opening is drilled and made more wide with Luer's forceps.

• Lumbar puncture is carried out to decrease an intracranial pressure. Then dura mater is cut in a crosswise way.

• Wound is sutured but dura mater remains unsutured.

Skull defects plasty:

• Autoplasty with bone transplants taken from patient: plasty with bone transplant with pedicle *by Polenov*, plasty with rib plate *by Dobrotvorsky*. It's ineffective because of significant scars forming in the wound.

• Alloplasty with synthetic material: plexiglass, polyethylene and others.

3. Topographic features of some regions of a face. Demands to the incisions on a face. Operations on purulent parotitis and parapharyngeal abscess

Some regions of a face.

Parotideomasseteric region.

Borders:

• anterior — is anterior margin of m. masseter;
• posterior — is external acoustic meatus;
• inferior — is inferior margin of mandibula;
• superior — is zygomatic arch.

Layers:

1. Skin — is thin and mobile.
2. Subcutaneous cellular tissue — is good marked and contains branches of facial artery, vein and nerve.
3. Superficial fascia.
4. Fascia parotideomasseterica — it has two leaves and covers m. masseter and forms capsule for parotid gland.
5. Parotid gland — is divided with fascial septum into the lobules. A. carotica externa, v. retromandibularis and facial nerve pass through in the mass of gland. Facial nerve divides here into the branches that's why purulent parotitis may cause its paralysis. Gland capsule has two "weak places":

• in place of external acoustic meatus lymphatic vessels passes through capsule, so purulent infection at the parotitis may spreads here.
• pharyngeal process of parotid gland locates between styloid process and m. pterygoideus medialis. In this place capsule is absent and infection may spreads to the parapharyngeal cellular space.

Deep facial region

It locates between ramus of mandibula and tuber of maxilla. There are some interspaces in it:

• *Temporal-pterygoid interspace* — it locates between temporal muscle and m. pterygoideus lateralis and contains venous plexus pterygoideus.
• *Interpterygoid interspace* — it locates between mm. pterygoideus lateralis and medialis and contains remains of plexus pterygoideus, n. mandibularis, and a. maxillaris, that gives here a. alveolaris inferior, a. meningea media, a. alveolaris superior, a. palatine descendens.
• *Fossa pterygopalatina* — is the deepest interspace that contains ganglion pterygopalatinum.

Venous system of a face and its connections with venous sinuses

The main blood vessel that performes venous outflow from tissues of a face is *v. facialis.* This vein connects with *v. retromandibularis* and goes to the *v. jugularis interna.* At the same time facial vein connected with sinus cavernosus that locates within the head. So facial vein receives the part of venous outflow from the brain. There are two systems of this connection:

• *Superficial*: venous outflow goes from sinus cavernosus through v. ophtalmica superior to v.nasofrontalis and then through v. angularis to v. facialis.
• *Deep*: venous outflow goes from sinus cavernosus through plexus pterygoideus to v. facialis profunda and then to v. facialis.

The practical meaning of this connection reveals in case of facial furuncle. When furuncles appeared in the nasolabial triangle *v. facialis* can be squeezed by edema. As a result retrograde blood flow takes place and purulent infection spreads to the sinus cavernosus that causes its trombosis and death.

Demands to the incisions on a face

- It must be cosmetic — it means that incisions must pass at natural skin folds or be "backstage" (hidden). Also it's necessary sewing up subcutaneous cellular tissue, using non-traumatic needles, applying cosmetic intradermal stitch.
- Incisions must not damage branches of facial nerve.

Purulent parotitis

Purulent parotitis — is the inflammation of the tissue of parotid gland. It's necessary to cut the gland tissue and delete all of pus in case of this disease. Technique of operation:

- Incision carries out behind the mandibula.
- Gland capsule is cut.
- Blood vessels and nerves are move upwards with blunt retractors.
- Surgeon enters the wound with blunt instrument or finger, divides connective tissue fascicles and removes the pus.
- Applying drainage and sewing up the wound.

Complications:

- Damage of facial nerve that passes here.
- Damage of v. retromandibularis.
- Damage of a. carotica externa and its branch superficial temporal artery.

Removing of parapharyngeal abscess

Parapharyngeal cellular space bordered by pharynx in front and prevertebral fascia backwards and divides into the right and left parts. So in case of purulent infection abscess can be removed through the posterior wall of pharynx.

Technique:

- A patient sits.
- Operative access is performed through the patient's mouth.
- The gag is introduced to the mouth to make it wider.
- Anaesthesia is performed in the place of the abscess.
- Puncture is performed with a scalpel. The patient is bending forward so pus of abscess traps into mouth and then can be spat out by the patient himself.

LECTURE 5
TOPOGRAPHIC FEATURES OF A NECK. OPERATIONS ON A NECK

1. Topography of a neck: regions, triangles, fascias and cellular spaces.
2. Operations on a neck: vagosympathetic block, ligating of CCA and ECA.
3. Tracheostomy: indications, classification, technique, complications.
4. Strumectomy: indications, classification, technique, complications.

1. Topography of a neck: regions, triangles, fascias and cellular spaces

Borders:

- Superior: inferior margin of mandibula, apex of mastoid process, superior nuchal line, external occipital protuberance.
- Inferior: jugular incisure, superior margins of clavicles, line that connects acromion with spinous process of C VII vertebra.

Regions:

- Anterior region — it contains organs and neurovascular fascicles (NVF).
- Posterior region — contains m. trapezoideus and some other muscles.

Border between these regions is artificial plane that pass through transversal processes of cervical vertebrae.

Anterior region:

1. Lateral triangle of a neck — NVF is *a. et v. subclavia* and *nervous brachial plexus*. Borders:
   - anterior — is a posterior margin of sternocleidomastoid muscle;
   - posterior — is m. trapezoideus;
   - inferior — is a clavicle.
2. Medial triangle of a neck — NVF is *a. carotis communis*, *v. jugularis interna* and *n. vagus*. Borders:
   - anterior — is a midline of a neck;
   - posterior — is an anterior margin of sternocleidomastoid muscle;
   - superior — is an inferior margin of mandibula.
3. Sternocleidomastoid region — borders are the shape of the same name muscle.

Each triangle divides into smaller triangles.

Lateral triangle contains:

- Trigonum omotrapezoideus.
- Trigonum omoclavicularis (operative access to NVF).

Medial triangle contains:

- Suprahyoid region with the paired trigonum submandibularis and unpaired trigonum submentalis.

• Infrahyoid region with the paired trigonum caroticum (operative access to the NVF) and trigonum omotracheale.

There is *Pirogov triangle* in the trigonum submandibularis. It's operative access to the *a. lingualis*.

Borders of the Pirogov triangle:

• superior — is n. hypoglossus;

• posterior — is m. digastricus;

• anterior — is a margin of m. milohyoideus;

• bottom — is m. hyoglossus.

There are two slit-like spaces in the sternocleidomastoid region:

• *spatium antescalenum* — it locates between m. scalenus anterior from behind, mm. sternohyoideus et sternothyreoideus in front and inside, m. sternocleidomastoideus in front and outside. It contains angulus venosus (place of connection of v. subclavia and v. jugularis interna), initial part of a. carotis communis, n. vagus and n. phrenicus.

• *trigonum scalenovertebrale* — it locates between m. scalenus anterior at lateral part and m. longus colli at medial part, its base is a cervical pleura, its apex is tuberculum caroticum on the transversal process of the VI cervical vertebra. It contains the initial part of a. subclavia, thoracic duct and inferior and intermediate sympathetic ganglions.

Fascias of a neck

Fascias cover the muscles and organs of a neck and form fascial capsules for it. There are many classifications of fascias.

Schevkunenko classification:

1. *Superficial fascia* — it locates under the skin and forms capsule for m. platysma.

2. *Proper fascia* — covers the whole neck and forms capsules for mm. sternocleidomastoideus and trapezoideus. Also it forms capsule for submandibular gland. It gives spurs to the transversal processes of vertebrae and divides neck into anterior and posterior regions.

3. *Fascia omoclavicularis (Richet sail)* — is attached to the hyoid bone on the tope, to the posterior surface of sternum and clavicle at the bottom and to the m. omohyoideus at the lateral part. It forms capsules for infrahyoid muscles and grows together with the 2^{d} fascia at the midline forming white line of a neck.

4. *Fascia endocervicalis* — consist of two leaves:

• Parietal lamina — it goes around all organs of a neck and forms capsule for NVF of a medial triangle. It grows together with the 2nd and the 3rd fascias at the midline.

• Visceral lamina — it forms fascial capsules for thyroid gland and other organs of a neck.

5. *Fascia prevertebralis* — is the deepest fascia. It forms capsules for mm. longus cervicis and capitis, mm. scalenii, and also for NVF of the lateral triangle.

Bobrov classification:

1. Lamina superficialis — is the 2nd fascia according with Schevkunenko;
2. Lamina pretrachealis — is the 3rd fascia;
3. Lamina prevertebralis — is the 5th fascia.

International classification (PNA):

There are three fascias the same as in the Bobrov classification and capsule for NVF of a medial triangle.

Cellular spaces of the neck

1. Closed:

• *Suprasternal interaponeurotic space* – it locates between the 2rd and the 3nd fascias and connects with saccus caecus of Gruber which locates on the posterior surface of sternocleidomastoid muscle. It contains arcus venosus juguli which connects anterior jugular veins.

• *Capsule of the submandibular gland* — is formed by the 2rd fascia and connect by its duct with cellular tissue of oral cavity bottom.

• *Fascial capsule of the sternocleidomastoid muscle* — is formed by the 2rd fascia.

• *Cellular space of the thyroid gland* — it locates between fibrous capsule of the gland and its fascial capsule formed by the visceral lamina of the 4th fascia. It contains blood vessels, nerves and parathyroid glands.

• *Prevertebral cellular space* — it locates behind the 5th fascia and contains mm. longus colli and capitis and trunk of a sympathetic nerve.

2. Open:

• *Spatium previscerale (pretracheale)* — it locates between parietal and visceral laminas of the 4th fascia and contains thyroid venous plexus and truncus brachiocephalicus. It connects with cellular space of anterior mediastinum.

• *Spatium retroviscerale* — it locates between the 4th and the 5th fascias and connects with posterior mediastinum.

• *Cellular space of the capsule of NVF of medial triangle* — it connects with the face and anterior mediastinum.

• *Cellular space of a lateral triangle* — it locates between the 2nd and the 5th fascias and connects with a scapular region (fossa supraspinata).

• *Cellular space of a capsule of NVF of lateral triangle* — it connects with armpit (fossa axillaris).

Reflexogenic zones of a neck

Reflexogenic zones — are zones of gathering of great number of nerves. Influence on it zone may cause shock and also reflex cardiac arrest. It's neces-

sary of additional anaesthesia of these zones in case of operations. Components of reflexogenic zones of a neck:

1. *NVF of the medial triangle* — the place of projection is from the middle of the line between apex of mastoid process and angle of the mandibula to the sternal part of sternocleidomastoid muscle.

2. *Carotid sinus* — is a place of bifurcation of a. carotis communis with great number of baro- and chemoceptors. It locates at the level of superior margin of thyroid cartilage or hyoid bone.

3. Places of going out of cervical and brachial nervous plexus: *cervical plexus* — is at the middle of posterior margin of sternocleidomastoid muscle, *brachial plexus* – is between middle and lower thirds of the same muscle.

4. *Trunk of sympathetic nerve* — it has four ganglions that locate at the level of transversal processes of vertebrae from C II to Th I.

5. *Projection of a. subclavia* — it locates at the middle of clavicle. Nn. vagus and phrenicus cross this artery here.

2. Operations on a neck: vagosympathetic block, ligating of CCA and ECA

Operations on a neck

Demands to the incisions of a neck:

- It must be cosmetic and pass at the natural skin folds or be "backstage" (hidden).
- Non-traumatic and blunt instruments are used.
- It's necessary to take into account location of big blood vessels and nerves.
- Cervical veins are cut only after applying a clamp because their injuring threatens with air embolism. The threat is real because of the veins tightly bind with fascia and not close after injuring. Also there are no valves inside cervical veins and blood pressure is lower than atmospheric one.

Vagosympathetic block according with Vishnevsky

Indications: closed and open pneumothorax.

Principle: Nn. phrenicus, vagus and sympathicus are blocked with Novocain to prevent shock in case of pneumothorax.

Technique: the patient's head is turned to the other side. Sternocleidomastoid muscle is moved to the medial side and needle is introduced at the posterior margin of muscle above the external jugular vein (at the level of hyoid bone). Then needle is moved to the vertebral column. Then it's pulled back from the vertebral column at a distance of 0.5 cm and 40–50ml of 0.25 % solution of Novocain is introduced.

Criteria of successful block are hyperaemia of a face on the side of block and *Claude Bernard-Horner syndrome* — ptosis, miosis, endophthalm.

Ligating of common carotid artery (CCA) and external carotid artery (ECA)

Indications: wounds, aneurysm, tumours of facial region, resection of mandibula.

Technique of CCA ligating — arteria is divided from surrounding tissue and two ligatures are applied on it at a distance of 1–1.5cm from the bifurcation. Blood supply restores by anastomoses between:

- Right and left ECA (aa. facialis, occipitalis).
- ECA and a. subclavia (aa. thyroidea superior et inferior).
- ECA and internal carotid artery (ICA) (rami of a. ophtalmica).
- Right and left ICA and a. subclavia (circle of Willis).

Technique of ECA ligating — it's necessary to ligate artery after place of giving a. thyroidea superior. Blood supply restore by anastomoses between:

- Right and left ECA.
- ECA and a. subclavia.
- ECA and ICA.

3. Tracheostomy: indications, classification, technique, complications

Tracheostomy — is the operation of trachea opening with introducing the tube into it.

Classification:

- Upper — is an opening of trachea above the isthmus of thyroid.
- Middle — is an opening of trachea at the level of isthmus after its transaction.
- Lower — is an opening of trachea below the isthmus.

Indications: asphyxia of different aetiology (in case of trauma, inflammation, tumours, obturation with foreign bodies of upper air passages).

Instruments: there in addition to common instruments are single-toothed sharp tracheal hook by *Shassaignac*, tracheostomy tube (*Luer's* cannula), tracheal dilator of *Trousseau*.

Technique:

- Incision with size 6–8cm is passed down from the middle of the thyroid cartilage strictly at the neck midline. Skins, SCT, the 1st, the 2nd, the 3rd and parietal lamina of the 4th fascia are cut. Muscles move away with blunt retractors.
- Ligaments of isthmus are cut, isthmus moved away and trachea is revealed.
- Trachea is cut and opened. It's necessary to hold scalpel with blade upwards and limiting 1cm of blade length to prevent trachea pierced through.
- At first tracheal dilator and then tube are introduced into trachea.
- Wound is sutured; tube is fixed to patient's neck with cheesecloth.

Complications:

- Bleeding: in case of damage of NVF of medial triangle it leads to death. If small vessels bleed blood can trap into patient's lungs, so why we must arrest bleeding well.

• Tracheoesophageal fistula forming when trachea was pierced through.

• Subcutaneous emphysema can forms in case of fascias were sutured not airtight. It leads to jugular veins are squeezed and blood outflow from the brain sinuses are broken.

• Asphyxia takes place in case of cutting not all layers of trachea. In that case tube is introduced under the mucous layer and it closed the trachea aperture.

• Necrosis of trachea cartilages if the incision was less than diameter of the tube.

4. Strumectomy: indications, classification, technique, complications

Strumectomy — is the operation of removal the part or the whole thyroid gland.

Indications: thyrotoxicosis (goiter), tumours of thyroid gland.

Technique of subtotal subfascial resection of thyroid gland *according with Nicolaev*:

• Transversal collar-shaped incision is carried out between sternocleido-mastoid muscles at 2–3 cm above the jugular incisure. Skin, SCT and fascias are cut.

• According with the volume of goiter infrahyoid muscles may be cut or move away with blunt retractors.

• Novocain is introduced under the parietal lamina of the 4^{th} fascia. It will make moving out of gland capsule easier.

• Parietal lamina is cut, and then isthmus of gland is cut too.

• One of the gland lobes moving to the wound. It is divided from the fascial capsule. Gland tissue is removed and posterior part remains (part which locates closely to trachea). It prevents from mistaken removing of parathyroid glands and damaging of recurrent laryngeal nerve.

• Arrest of the bleeding carries out well. Capsule is sutured. Operative wound is washed with Novocain to remove toxic colloid with hormones of the gland.

• Other lobe is removed by the same way.

• Wound is sutured. Drainage is applied for a one day.

Complications:

• Bleeding.

• Thyreotoxic crisis — it takes place if colloid with the gland hormones trapped into the blood.

• Damage of recurrent laryngeal nerves — hoarseness of a voice in case of nerve damage at one side and aphonia in case of nerve damage at the both sides.

•There may be asphyxia in case of huge goiter, which causes the atrophy of tracheal cartilages.

•Myxedema takes place in case of excessive removing of gland tissue.

•Tetany takes place in case of removing parathyroid glands.

LECTURE 6
TOPOGRAPHIC ANATOMY AND OPERATIONS ON A THORAX AND ORGANS OF A THORACIC CAVITY

1. Topographic anatomy of a thoracic wall. Structure of intercostal space. Pleural cavity puncture.
2. Topographic anatomy of mammary gland. Operations on mammary gland.
3. Topographic anatomy of mediastinum and pericardium. Puncture of pericardium.
4. Pneumothorax: classification and treatment.
5. Operations on a thorax and organs of a thoracic cavity.

1. Topographic anatomy of a thoracic wall. Structure of intercostal space. Pleural cavity puncture

Borders:

- Superior: jugular incisure of sternum, clavicle, line connecting acromion with spinous process of C VII.
- Inferior: xiphoid process of sternum, costal margin, spinous process of Th XII.

Layers:

- Skin — at the back is thicker than in the front and aside.
- SCT — is variable, it contains superficial blood vessels and nerves, veins make network of anastomoses.
- Superficial fascia — it makes capsule for mammary gland and *lig. suspensorium mammae*.
- Proper fascia — it makes capsule for *m. pectoralis major* in front, for *m. trapezoideus*, *m. latissimus dorsi* at the back and covers *m. serratus anterior* aside.
- Superficial subpectoral space — it locates under capsule of *m. pectoralis major* and contains NVF (*a.* et *v. subclavia*, *plexus brachialis*).
- Fascia clavipectoralis — it makes capsule for *m. pectoralis minor*.
- Deep subpectoral space — it contains initial parts of *a.* and *v. axillaris* and *brachial plexus*.
- Ribs and intercostals spaces.
- Fascia endothoracica.
- Antepleural cellular tissue.
- Parietal pleura.

Structure of intercostal space:

- External intercostal muscles.
- Intercostal blood vessels and nerves — top-down location: *v. intercostalis*, *a. intercostalis*, *n. intercostalis*. Arteries are branches of aorta descendens and

truncus costocervicalis of a. subclavia. From costal angles till linea axillaris media blood vessels locate at the inferior costal margin in the sulcus costalis. There are no nerves in this sulcus. After linea axillaris media arteries go out from the sulcus and divides into branches that locates at the middle of intercostal space. Some of these branches make anastomoses with anterior intercostals branches from a. thoracica interna.

•Internal intercostal muscles.

Pleural cavity puncture

Indications: exudative pleuritis, pleural empyema, hemo-, hydro-, pneumothorax.

Technique: a patient sits. Anesthesia is carried out in the place of puncture. Skin is moved down before the puncture to prevent appearing of perforating wound. Puncture is carried out perpendicularly to the skin with a long needle to the depth of 3–4 cm. Needle is connected with a syringe by a rubber tube to prevent trapping of the air to the pleural cavity. Pathological contents are removed.

For removing the fluid puncture is carried out in the 7–8 intercostal space between the linea scapularis and linea axillaris media at the superior margin of the rib. It prevents damaging of intercostals blood vessels and nerves. Borders of the fluid are revealed by percussion, auscultation and X-ray examination.

For removing the air puncture is carried out in the 2–3 intercostal space at the midclavicular line.

Complications:

• Damage of NVF. It leads to the huge bleeding because intercostals arteries go from the aorta and make anastomoses with a. thoracica interna so both ends of vessel bleed in case of injuring.

• Damage of lung, diaphragm, liver or stomach when puncture is carried out in a wrong way.

• Shock as a result of moving of mediastinal organs. It takes place at the fast removing of big volume of the fluid, that's why fluid is removed by a small portions no more than 1.5 l.

• Trapping the air to the pleural cavity. To prevent this complication clamp is applied on the rubber tube when syringe was disconnected.

2. Topographic anatomy of mammary gland. Operations on mammary gland

Mammary gland

Gland locates between leaves of superficial fascia that forms the capsule and divides gland into 15–20 lobules. Each lobule has excretory duct which goes to the lactiferous sinus. Sinuses open on the nipple. There is a retromammary cellular space behind the gland between it and proper fascia.

Holo- and skeletopy: III rib from above, VI rib from below, medial border — parasternal line, lateral border — linea axillaris anterior.

Blood supplying: branches of *a. thoracica interna*, *a. thoracica lateralis*, *aa. intercostales*. Venous outflow is by the same-named veins.

Lymph outflow: there are lymphatic vessels of skin and gland tissue. They join together at the areola of nipple. Further outflow goes in different ways:

- Axillar way — to the axillar lymphatic nodes. There is the Zorgius node which is marker at the cancer of mammary gland because it's damaged first.
- Subclavicular way.
- Transpectoral way — to the nodes of the retromammary space and further through m. pectoralis major to the subpectoral space.
- Parasternal way — by the passage of a. thoracica interna through the intercostal spaces to the supraclavicular and cervical nodes.
- To the nodes of the opposite side.

Innervation: intercostal nerves, supraclavicular nerves (cervical plexus), anterior thoracic nerves (brachial plexus), sympathetic and parasympathetic nerves by the passages of the blood vessels.

Operations on mastitis

Mastitis — is a purulent inflammatory disease of a mammary gland.

Surgical treatment is an opening and draining of a suppurative focus. There are different incisions according with the type of mastitis:

- *Subcutaneous* — linear radial incision is carried out at the place of abscess. It's necessary not to damage the areola of the nipple because of the threat of malignization.
- *Subareolar* (under the areola) — circular incision is carried out around the areola.
- *Intramammary* (abscess locates in the gland tissue) — we may carry out deep linear radial incision but it has low cosmetics. It's much better to carry out bow-shaped incision at the skin fold under mammary gland.
- *Retromammary* (abscess is in the retromammary space) — is opened by the bow-shaped incision under mammary gland.

Operations on the cancer of mammary gland:

- *Radical mastectomy according with Halsted-Meyer* — wide operative access is carried out. It goes around the mammary gland. Gland, mm. pectoralis major and minor, cellular tissue, axillar and subclavicular lymphatic nodes are removed as a single unit.
- *Super-radical mastectomy according with Urban* — radical mastectomy is carried out. Then operative access to the a. thoracica interna is carried out by the cutting of costal cartilages. After that parasternal lymphatic nodes are removed. This operation is very traumatic and not carries out at the present time.

• *Mastectomy according with Patey* — is carried out at the small tumors. Only gland is removed and muscles are saved. If suspicion of metastases takes place axillar nodes are additionally removed.

• *Sector resection* — is carried out at the benign tumors, operative access is carried out at the place of tumor and it's removed.

3. Topographic anatomy of mediastinum and pericardium. Puncture of pericardium

Mediastinum — is a complex of organs, blood vessels and nerves, that locates between sternum in front, thoracic part of spine from behind, mediastinal pleura aside and diaphragm from below. From above mediastinum connects with cellular spaces of a neck. According with the clinical classification mediastinum divides into *superior, anterior, middle* and *posterior* parts. *Superior mediastinum* is separated from the other parts by a relative plane which passes through the sternal angle and the junction of Th IV–V. *Middle mediastinum* is the pericardium and its contents, so *anterior mediastinum* is in the front of pericardium and *posterior* is behind it.

Organs, blood vessels and nerves of mediastinum:

• *Superior mediastinum* contains thymus (at the children) or its remains (at the adult); v. cava superior, vv. brachiocephalicae; arch of aorta and its branches: truncus brachiocephalicus, a. carotica communis sinistra, a. subclavia sinistra; trachea; esophagus with nn. vagus that passes aside; thoracic duct; nn. phrenici; sympathetic nerves.

• *Anterior mediastinum* contains a. and v. thoracica interna, cellular tissue and lymphatic nodes.

• *Middle mediastinum* contains pericardium and its contents – heart, initial part of aorta, terminal parts of vv. cavae superior and inferior, pulmonary trunk and pulmonary veins, bifurcation of trachea and principal bronchi, nn. phrenici and also cellular tissue and lymphatic nodes.

• *Posterior mediastinum* contains aorta descendens; vv. azygos and hemiazygos; sympathetic nerves; nn. splanchnici; thoracic duct; esophagus with nn. vagus that passes aside and also cellular tissue and lymphatic nodes.

Pericardium

Pericardium — is a fibrous-serous cover, that's surrounding heart and blood vessels that goes from it. External fibrous layer joins together with diaphragm. Internal serous layer makes two leaves: parietal that adjoins to the external layer and visceral (epicardium) that covers the heart. There is a cavity between leaves that contains small volume of fluid. At the disease the volume of fluid enlarges and causes heart compression.

Pericardium sinuses — are places of passage the parietal leaf to the visceral one:

• *Sinus transversus pericardii* — it locates between aorta and pulmonary trunk in front and auricles and v. cava superior from behind. In this place aorta may be clamped in case of operations on the heart.

• *Sinus obliquus pericardii* — it locates between posterior surface of the left auricle in front and pericardium from behind. In this place exudates accumulate and it's hard to drain them.

• *Sinus anterior inferior pericardii* — it locates in the place of passage anterior part of the parietal leaf to its lower part. It adjoins to the anterior thoracic wall and diaphragm. The puncture of pericardium carries out here.

Puncture of pericardium.

Indications — exudative pericarditis, hydropericardium, hemopericardium.

Technique: puncture of pericardium performed in definite points:

• *Larrey method* — point of puncture locates under VII costal cartilage at the left side from xiphoid process.

• *Marfan method* — point of puncture locates strictly on the midline at the apex of the xiphoid process.

4. Pneumothorax: classification and treatment

Pneumothorax — is a trapping of air into the pleural cavity.

Classification:

• Closed — air traps into pleural cavity one time at the moment of the trauma.

• Open — there is a permanent connection between the pleural cavity and the atmospheric air in case of wound of thoracic wall. Air traps into pleural cavity at the inhalation and goes out at the exhalation.

• Valvular — air traps into the pleural cavity at the inhalation but not goes out. As a result volume of air in the pleural cavity rapidly increases.

Open and valvular pneumothoraxes are very dangerous for patient's life because of pleuropulmonar shock and demand an emergency treatment.

Treatment of closed pneumothorax:

• Small volume of air disappears without assistance in 2–3 weeks.

• In case of a big volume of air pleural cavity puncture must be carry out.

Treatment of open pneumothorax:

• First aid — is an occlusive dressing. Upper layer must not pass the air (rubber, cellophane).

• Medical treatment — is a checking of dressing effectiveness, prevention of pleuropulmonar shock (injection of painkillers, vagosympathetic block according with Vishnevsky).

• Surgical treatment — is sewing up the wound of lung, pleura and other tissues.

Treatment of valvular pneumothorax:

• First aid — is a puncture of thoracic wall with thick needle to change valvular pneumothorax into open and let the air out.

• Medical treatment — is the same as at the open pneumothorax.

• Surgical treatment — is sewing up the wound of a lung or bronchus through which air traps into the pleural cavity. Other way of treatment is a special drainage for removing the air from a pleural cavity.

5. Operations on a thorax and organs of a thoracic cavity

Operative accesses to the organs of a thoracic cavity

1. Transpleural — is a thoracotomy (with opening of pleural cavity):

• Anterolateral — it passes by IV or V intercostals space from the parasternal line to the posterior axillar line.

• Posterolateral — it begins at the level of spinous process of Th III and passes down by paravertebral line to the angle of scapula. Then angle is rounded and incision passes by VI rib to the anterior axillar line.

• Lateral — it passes by V or VI ribs from the paravertebral line to the midclavicular line.

2. Extrapleural (transsternal):

• Sternotomy — is a transection of sternum that allows revealing the organs of anterior mediastinum without opening of a pleural cavity.

Rib resection

Rib resection — is an operation of rib removing.

Indications:

• As operative access to the pleural cavity.

• Thoracoplasty.

• Tumors or osteomielitis of ribs.

• With the aim of draining the pleural empyema.

Types:

• Subperiostal — when the periosteum of rib remains.

• Transperiostal — when the rib is removed with periosteum.

Thoracoplasty

Thoracoplasty — is the operation of removing bone part of thoracic wall with the aim of decreasing the volume of thoracic cavity. As a result thoracic wall comes soft and complaisant. It allows compressing caverns of lungs or cavities of empyema.

Indications:

• Single tuberculous cavern.

• Residual cavities in a case of chronic pleural empyema.

Classification:

1. Extrapleural — it's carried out at the tuberculous caverns. A few ribs are removed partial or completely at the side of affected lung. Parietal pleura remains uncut. Lung tissue is compressed in the place of cavern location and wound sewing up.

2. Intrapleural — it's carried out at the pleural empyema:

- *Schede method* — ribs are removed in the transperiostal way. Intercostal muscles and parietal pleura are removed too. Cavity of empyema is covered with muscle-skin flap.
- *Linberg method* — ribs are removed in the subperiostal way. It allows saving intercostals muscles and making flaps for wound covering.

Operations on lungs

Pneumotomy — is the operation of transection the lung with aim of draining the abscess (not carries out at the present time).

Pneumonectomy — is an operation of completely removing of the lung.

Lung resection — is an operation of removing the part of the lung.

Sewing up the heart wounds

Operative access: thoracotomy.

Technique:

- Wound of pericardium is made more wide and fixed with the clamps.
- Heart wound is temporary closed with a finger and surgeon makes revision of a posterior surface of the heart by carefully moving it out from pericardium. Revision is necessary because perforate wound can take place.
- Stitches are put on in 0.5 cm from each other and not penetrate into endocardium. As a suture material a silk is used. Not allowed to use catgut or other resorbable suture material.
- It's necessary to prevent trapping the coronary blood vessels into the stitch. If these vessels were damaged vascular stitch is used.
- The blood clots are removed from the pericardium after sewing up the heart wound. Incision of a pericardium is sutured with catgut. Operative wound is sewing up in layers.

LECTURE 7
TOPOGRAPHY OF ABDOMINAL WALL. OPERATIONS ON THE HERNIAS OF ABDOMINAL WALL

1. Topography of abdominal wall. Operative accesses to the organs of abdominal cavity.
2. Weak places of abdominal wall.
3. Hernias. Surgical treatment of inguinal hernias.
4. Umbilical, midline and femoral hernias, its surgical treatment.
5. Strangulated hernias and features of its surgical treatment.

1. Topography of abdominal wall. Operative accesses to the organs of abdominal cavity

Borders:

- superior — is a xyphoid process of sternum, costal margins;
- inferior — is iliac crests, inguinal folds, pubic symphysis;
- lateral — is the Lesgaft line that connects ends of the XI ribs and iliac crests.

Relative lines divide abdominal wall into 9 regions.

Lines:

- *Horizontal* — it divides abdominal wall into epigastrium, mesogastrium and hypogastrium:
- *Linea bicostarum* — it connects inferior margins of the X ribs.
- *Linea bispinarum* — it connects both of spina iliaca anterior superior.
- *Vertical* — it passes at margins of m. rectus abdominis.

Regions:

- *epigastrium* — is divided into epigastrium itself and right and left subcostal area;
- *mesogastrium* — is divided into right and left flancs and umbilical region;
- *hypogastrium* — is divided into right and left inguinal regions (iliac fossae) and suprapubic region.

Layers:

- skin — is thin and elastic;
- SCT — its thickness depends on human's meals;
- superficial fascia — consists of two leaves and layer of cellular tissue with blood vessels and nerves between it. Superficial leaf passes on the thigh and deep leaf (the Thomson leaf) attaches to the inguinal ligament;
- proper fascia — tightly attaches to the lower muscles and inguinal ligament;
- muscles — there is a *m. rectus abdominis* in front and three layers of muscles aside: *mm. obliquus externus*, *obliquus internus* and *transversus abdominis*;

• transversal abdominal fascia — is a part of fascia endoabdominalis;
• preperitoneal cellular tissue;
• parietal peritoneum.

Blood supplying:

• superficial blood vessels — locates in the SCT between leaves of superficial fascia: *a. epigastrica superficialis*, branches of *aa. intercostales*;
• deep blood vessels — locates behind the m. rectus abdominis: *aa. epigastrica superior et inferior*.

Innervation: *nn. intercostals VIII–XII*, *ileohypogastricus*, *ileoinguinalis*.

Operative accesses to the organs of abdominal cavity:

• longitudinal — are midline laparotomy, transrectal (through the m. rectus abdominis) and pararectal (at the margin of m. rectus abdominis) accesses;
• transversal — are superior and inferior transversal laparotomy;
• oblique — are accesses by Kocher (to the liver), Volkovich-Diakonov (to the appendix), etc;
•combined — is angular access by Rio-Branco (to the liver), etc.

2. Weak places of abdominal wall

Weak places of abdominal wall — are places of hernia's going out:

• inguinal canal;
• femoral canal;
• umbilical ring;
• white line of abdomen — it locates between the bellies of m. rectus abdominis and formed by aponeuroses of mm. obliquus externus, obliquus internus and transversus abdominis;
• linea semilunaris — is a place of the passage of the muscular part of m. transversus abdominis to the tendinous part.

Inguinal canal

It's muscular-tendinous interspace through which spermatic cord passes in the men and round ligament of uterus passes in the women.

Walls:

• inferior — is the inguinal ligament;
• anterior — is aponeurosis of m. obliquus externus abdominis.;
• posterior — is the transversal abdominal fascia;
• superior — is margins of mm. obliquus internus and transversus abdominis.

Openings:

• entrance to the canal — *anulus inguinalis profundus* — is infundibular recess in the transversal abdominal fascia through which spermatic cord passes;

• exit from the canal — *anulus inguinalis superficialis* — is formed by crus of aponeurosis of m. obliquus externus abdominis: superior (medial) crus attaches to the pubic symphysis, inferior (lateral) crus attaches to the pubic tubercle, posterior (lig. reflexum) locates between them.

Femoral canal

This canal is absent in the healthy people (there is only annulus femoralis) and appears in case of femoral hernia.

Walls:

• anterior — is the margo falciformis (it's thickening of anterior leaf of the fascia lata femoris);

• posterior — is the fascia pectinea (it's posterior leaf of the fascia lata femoris);

• lateral — is v. femoralis.

Openings:

• Entrance to the canal — *anulus femoralis* — is bordered by inguinal ligament in front, lig. lacunare at the medial part, lig. pectineum from behind and v. femoralis at the lateral part.

• Exit from the canal — *hiatus saphenus* — it locates in the place of flowing v. saphena magna into v. femoralis.

Umbilical ring

The layers of umbilical ring are:

• skin;

• scar tissue;

• umbilical fascia;

• peritoneum.

There is no cellular tissue in this place. Umbilical scar tightly attaches with middle and lateral umbilical ligaments at the lower semicircular of a ring. That's why umbilical hernias pass through the upper semicircular more often.

3. Hernias. Surgical treatment of inguinal hernias

Hernia abdominalis — is a passing of internal organs with parietal peritoneum through the weak places or defects of abdominal wall.

Hernia structure:

• Hernial orifice (gates) — is a place of hernia's going out.

• Hernial saccus — is a part of parietal peritoneum that goes out through the hernial orifice.

• Hernial contents — are intestinal loops, organs etc.

Surgical treatment of hernias

Stages:

- operative access to the hernial orifice and saccus;
- cutting of the hernial orifice;
- revealing and cutting of the hernial saccus;
- revision of the hernial contents;
- reposition of the organs;
- sewing and removing the hernial saccus;
- plasty of the hernial orifice.

Inguinal hernias

Classification:

- direct — is going out through the *fossa inguinalis medialis* (posterior wall of inguinal canal must be strengthened);
- Indirect — is going out through the *fossa inguinalis lateralis* (anterior wall of inguinal canal must be strengthened).

Methods of plasty of anterior wall of the inguinal canal:

- Girard method — mm. obliquus internus and transversus abdominis are sewed to the inguinal ligament by the first line of stitches. Then upper flap of the aponeurosis of m. obliquus externus abdominis is sewed to the inguinal ligament by the second line of stitches. Then lower flap of aponeurosis is sewed to the upper flap and forming the duplication.

Shortcomings: the suture is frail because of sewing together the heterogeneous tissues (muscles, ligaments) and dividing into fibers the inguinal ligament.

- Girard-Spasokukotcki method – upper flap of aponeurosis and abdominal muscles are sewed to the inguinal ligament by the one line of stitches. Then lower flap of aponeurosis is sewed to the upper flap and forming the duplication.

Shortcomings: muscular tissue could be strangulated between flaps of aponeurosis and inguinal ligament.

- Kimbarovski method — upper flap of aponeurosis and abdominal muscles are sewed through and then upper flap sewed one more time from the inside by the same suture. After that all tissues joined together are sewed to the inguinal ligament by the same suture. It allows us to sew the homogeneous tissues. Then lower flap of aponeurosis is sewed to the upper flap and forming the duplication.

Methods of plasty of posterior wall of the inguinal canal:

- Bassini method — mm. obliquus internus and transversus abdominis are sewed to the inguinal ligament behind the spermatic cord. Then flaps of aponeurosis are sewed together without forming the duplication.

Congenital inguinal hernias

Congenital inguinal hernias are formed at the testicle descending, if the vaginal process of peritoneum didn't obliterate. Essence of operation is disconnecting the vaginal process from the abdominal cavity and cut it to prevent the hydrocele.

Sliding inguinal hernias

Sliding hernia — is a hernia in which the part of hernial saccus is formed by hernial contents. At these hernias hernial contents are the mesoperitoneal organs such as colon caecum, colon ascendens, urinary bladder etc. Operations on sliding hernias must be performed very carefully to prevent the damage of organs when cutting the hernial saccus.

4. Umbilical, midline and femoral hernias, its surgical treatment

Umbilical hernias.

Methods of plasty:

• Mayo method — an umbilical ring is cut at the transversal direction and lower flap of aponeurosis sewed to the upper flap forming the duplication.

• Sapezhko method — an umbilical ring is cut at the longitudinal direction. Right margin of aponeurosis is sewed to the posterior wall of the capsule of left m. rectus abdominis and left margin sewed to anterior wall of the right one.

• Lexer method — is carried out at the small hernias. Purse-string suture is applied around the inguinal ring, then it closed and strengthened with interrupted sutures.

Midline hernias — at the small hernias margins of aponeurosis are connected with interrupted sutures. At the big hernias plasty with anterior wall of capsule of m. rectus abdominis is performed.

Femoral hernias

Methods of plasty:

• Femoral method according with Bassini — vertical operative access is on the medial surface of the thigh. Inguinal ligament is sewed to the lig. pectineum (annulus femoralis is closed). Then margo falciformis is sewed to the fascia pectinea (hiatus saphenus is strengthened).

Shortcomings are widening of inguinal interspace and risk of the inguinal hernia.

• Inguinal method according with Ruggi — operative access is through the anterior an posterior walls of inguinal canal. The hernial saccus is sewed and removed in the preperitoneal cellular tissue. Inguinal ligament is sewed to the lig. pectineum from the inguinal canal.

Shortcomings: the inguinal ligament moves down and makes inguinal interspace wider.

• Inguinal method according with Parlavecchio — inguinal ligament and mm. obliquus internus and transversus abdominis are sewed to the lig. pectineum, so inguinal interspace closed.

5. Strangulated hernias and features of its surgical treatment

At strangulated hernias the hernial contents is strangulated by the hernial orifice. It leads to the ischemia and necrosis of the hernial contents and demands the emergency operation.

Differences from the operations at the not complicated hernias:

• The hernial saccus is cut at first.

• Then hernial orifice is cut. It's necessary to fix the hernial contents before this stage, because contents may go back to the abdominal cavity by itself and it brings difficulties to its revision.

• Revision of the hernial contents is performed. Viable contents are move back to the abdominal cavity; nonviable contents are removed with applying the anastomoses.

• Plasty of the hernial orifice.

Criteria of strangulated intestinal loop viability:

Criterion:	Viable intestinal loop:	Nonviable intestinal loop:
Color	*grayish pink*	*crimson*
Edema	*decreased*	*not decreased*
Peristalsis	*yes*	*no*
Pulsation of mesentery vessels	*yes*	*no*

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