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## TOPOGRAPHIC ANATOMY OF THE CHEST

Study guide



Ministry of Education and Science of Ukraine  
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Sumy State University

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Навчальний посібник рекомендований для студентів медичних закладів вищої освіти IV рівня акредитації, які вивчають анатомію людини англійською мовою.

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## TOPOGRAPHIC ANATOMY

### CHEST (pectus)

Chest comprises surface layers, thoracic cage (thorax) and chest cavity (cavum thoracis) where organs are located. The upper border of the chest passes through jugular notch of sternum, then – along the clavicle to acromioclavicular joint. Therefrom – backwards to spinous process of vertebra prominens, or C7 (vertebrae prominens).

Chest is separated from upper limb with the line, which passes from clavicle through deltopectoral groove and then – along the rear edge of deltoid muscle.

The lower border passes along the edge of the rib arch to 10th rib, and then – through the anterior ends of the 11th – 12th ribs, along the inferior border of the 12th rib until spinous process of thoracic vertebra.

In order to determine projection of lungs, heart and abdomen organs we can draw few conditional lines on the chest.

1. Linea mediana anterior – goes through the middle of the sternum.
2. Linea sternalis – goes through the sternum edge.
3. Linea parasternalis – goes to the middle between sternal line and midclavicular line.
4. Linea medioclavicularis – goes through the middle of the clavicle.
5. Linea axillaris anterior.
6. Linea axillaris media.
7. Linea axillaris posterior.

These three lines (5, 6, 7) go through the lateral surface of the chest – from anterior wall, middle and posterior wall of axilla accordingly.

1. Linea scapularis – goes through the scapula bottom corner.

2. Linea paravertebralis – passes between scapula and vertebral line.

3. Linea vertebralis – goes through vertebra transverse processes.

4. Linea mediana posterior – goes through vertebra spinous processes.

Chest is divided into several segments:

1. Anterior superior segment – complies with pectoralis major muscle. This segment comprises subclavian and breast area.

2. Anterior inferior segment – from bottom edge of pectoralis major muscle to costal margin.

3. Sternal segment – complies with sternum contours.

4. Scapular segment.

5. Subclavian segment.

6. Spinal segment.

**INFRACLAVICULAR SEGMENT (regio infraclavicularis)** is determined: by clavicle – from above; by the 3rd rib – from below; in the middle – by linea sternalis; sidewise – by anterior edge of deltoid muscle.

The skin of the segment is thin and flexible. Subcutaneous layer has nn. supraclaviculares, rr. cutanei anteriores et rr. cutanei laterales (these are branches of the intercostal nerves). The superficial fascia lies deeper which encases platysma muscle (m. platysma).

The fascia pectoralis is located, under the superficial fascia. It forms a fascial sheath for m. pectoralis major.

The sulcus deltoideopectoralis passes, between anterior edge of deltoid muscle and upper external edge of pectoralis

major muscle, where v. cephalica is located. V. cephalica penetrates fascia clavipectoralis and goes into v. axillaris. Sulcus deltoideopectoralis goes up to trigonum deltoideopectoralis (or fossa deltoideopectoralis, Mohrenheim's fossa).

Between the deep lamina of fascia pectoralis and deeper is located fascia clavipectoralis. There is superficial subpectoral space, filled with adipose tissue, where we see branches of a. thoracoacromialis, nn. pectorales medialis et lateralis and Rotter's lymph nodes (nodi lymphoidei interpectoriales).

Fascia clavipectoralis is located between scapula coracoid process, clavicle and the 3rd – 5th ribs. It forms the sheath for m. pectoralis minor, m. subclavius, a. et v. axillaris and plexus brachialis.

Between the posterior surface of m. pectoralis minor and thoracic wall is located a deep subpectoral space, where axilla neurovascular fascicle passes (Fig. A. 1).

Superficial and deep subpectoral spaces join together via cellular tissue, which surrounds the neurovascular fascicle, with axilla, cellular tissue of lateral cervical region and subdeltoid cellular space.

Subpectoral phlegmons should be cut through the line which goes along the posterior edge of pectoralis major muscle.

Two triangles can be considered in this segment:

1. Trigonum clavipectoralis – between the clavicle and upper edge of m. pectoralis minor.

2. Trigonum pectorale – complies with the position of m. pectoralis minor.

These triangles have neurovascular fascicle: a. et v. axillaris and plexus brachialis, which come here from the lateral cervical segment while passing between the clavicle and the

1st rib, and move to axilla.

V. axillaris passes in trigonum clavipectorale downward, up to the middle and forward from a. axillaris. It is bedded to fascia clavipectorale and attaches to it. That is why air epiboly occurs (frequent and dangerous complication of clavicle fracture).

The axillary vein (v. axillaris) is followed by a group of lymph nodes, which are amputated in mastectomy. The v. subclavia is a direct continuation of v. axillaris.

The surgical anatomy of subclavian vein is very important, because it is often needled and catheterized for introducing medications, vein blood pressure measuring, and diagnostic manipulation in the heart cavity.

The border between v. axillaris and v. subclavia is located on the inferior margin of the 1st rib. The vein lays on the upper surface of the 1st rib in spatium antescalenum, then goes to the level of sternoclavicular joint, where it combines with internal jugular vein while creating a brachiocephalic vein.

Subclavian vein goes in obliquity from down to top and from outside to inside. It does not change its position when we move upper limbs, because it is solidly connected to surrounding tissues.

As a result of adhesion of subclavian vein sheath with clavicle periosteum, the 1st rib and fascia clavipectoral, its lumen remains constant even in case of acute fall of circulating blood volume (CBV), when all other circumferential veins are stuck together.

The subclavian vein can be divided into three segments. First segment is located in trigonum clavipectorale, second – behind the clavicle, and third – in spatium antescalenum.

Postclavicular segment of v. subclavia is located on upper

surface of the 1st rib, which separates the vein from cupula of the pleura. Here the vein is located between the clavicle and anterior scalene muscle, which separates it from a. subclavia and trunk of brachial plexus.

Then v. subclavia goes to spatium antescalenum, passes above cupula of pleura while covering a. subclavia.

V. cephalica, v. suprascapularis, v. transversa colli, v. jugularis externa, v. cervicalis profunda, v. vertebralis, and chest or jugular lymphatic trunk fall into v. subclavia from above.

If long-standing fluid maintenance is necessary (peritonitis, major combustion, craniocerebral trauma, heavy loss of blood, etc) when superficial veins are absent, we use a puncture and catheterization of v. subclavia according to the method of Seldinger.

The puncture of v. subclavia is performed by means of subclavian or supraclavicular approach. The vein puncture according to Abaniak technique (1 cm down from the border of middle and internal third of the clavicle) is more useful at subclavian approach. The angle formed by upper edge of the clavicle and lateral crus of sternocleidomastoid muscle is a reference point during the vein puncture when using supraclavicular approach. The needle enters Ioffe's point, a bit upper from the top of the angle.

The puncture of the right vein with subclavian access is more dangerous, because:

a) large veins and lymphatic trunks fall into upper wall of v. subclavia;

b) above the clavicle the vein is located near to cupula of the pleura, and damage of the latter could result in pneumothorax. Below the clavicle the vein is separated from pleura with the 1st rib;



c) in the middle parts of infraclavicular region the vein covers a. subclavia and protects it.

The choice of v. subclavia for catheterization can be explained by its anatomic-functional peculiarities:

1) the vein has its permanent position and clear topographic-anatomical points of reference;

2) the vein lumen is big enough (12 – 25 mm in adults);

3) the vein's wall is fixed with muscular-fascial formations, what ensures its relative immovability and prevents it from collapse even in unexpected hypovolemia (decrease of blood circulation);

4) the high speed of blood circulation is a factor which prevents thrombosis.

Compression of v. subclavia in spatium costoclavicularis on exertion induces hypertrophy of valve wall and results in vein thrombosis. Thus Paget – Schroetter syndrome occurs. The symptoms of Paget – Schroetter syndrome are: progressive limb edema, sharp pain, cyanosis and affection of blood circulation in the limb.

There is a valve in the part of v. subclavia passage, between clavicle and the 1st rib. The damage of cups of the valve results in their thickening and parafunction. The balloon dilatation causes the destruction of thickened cups and improves the vein blood circulation. Thus, the Paget – Schroetter syndrome is successfully treated by means of endovascular surgery (thrombolytic therapy, balloon dilatation and aspiration thrombectomy).

A. thoracica superior springs from a. axillaris in trigonum clavipectorale and provides blood supply of the 1st and the 2nd intercostal spaces, and of a. thoracoacromialis, which penetrates fascia clavipectorale near the internal edge of m. pectoralis minor and gives off:

- rr. pectorales – provide blood supply of major and minor pectoralis muscles;

- r. acromialis – provides blood supply of acromioclavicular joint and participates in forming rete acromiale;

- r. deltoideus – provides blood supply of m. deltoideus.

V. axillaris is located downwards and up to the middle in trigonum pectorale, and a. axillaris is located upwards and outwards.

At this level plexus brachialis bifurcates into 3 fascicles. Fasciculus lateralis is located outwards and upwards from the arteria, fasciculus posterior – behind the arteria, fasciculus medialis – up to the middle and downwards from the arteria, and behind the vein.

Plexus brachialis is formed by anterior branches of four lower cerebrospinal nerves (C5 – C8). The part of anterior branch (C4 and Th1) also participates in forming plexus brachialis. They join together like this: the anterior branch of C5 joins with anterior branch of C6 while forming a truncus superior; the anterior branch of C8 joins with anterior branch of Th1 while forming a truncus inferior; and between them the anterior branch of C7 is located. The anterior branch of C7 forms a truncus medius. Superior, inferior and middle trunks with their short branches form pars supraclavicularis of brachial plexus (Fig. A.2).

Each of abovementioned trunks bifurcate into 2 branches: anterior and posterior one. Due to these branches the fascicles of plexus brachialis are formed at the level of inferior edge of the clavicle, or just in trigonum clavipectorale.

The process of their formation is explained by K. A. Hryhorovych the next way: the posterior divarications are joined together in one trunk and form a posterior cord of brachial plexus (fasciculus posterior). The frontal divarications of upper trunk are joined together with frontal divarications of the middle trunk and form a lateral cord of brachial plexus (fasciculus lateralis).

The frontal divarications of inferior trunk form a medial fascicle of brachial plexus (fasciculus medialis). Fasciculus posterior gives off n. axillaris and then passes into n. radialis. Fasciculus lateralis and fasciculus medialis bifurcate into 2 branches. The middle branch of fasciculus lateralis and lateral branch of fasciculus medialis join almost at the right angle, encircling a. axillaris and forming n. medianus. The outer branch of fasciculus lateralis forms n. musculocutaneus, which enters m. coracobrachialis. Medial branch of fasciculus medialis forms n. ulnaris, n. cutaneus antebrachii medialis and n. cutaneus brachii medialis.

The damage of plexus brachialis in adults is observed as complication from inflammation in the result of direct trauma, or during the treatment of dislocation of glenohumeral joint.

The damage of plexus brachialis quite often occurs in obstetric practice during childbirth: in case of fetus head, hand or leg traction, when fetus is overweight (more than 4000 g), or if fetus is in abnormal position (pelvic presentation, breech birth).

Depending on the level of brachial plexus damage we can distinguish the following types of paralysis:

Erb – Duchenne paralysis (superior type) – C5 – C6 – C7 rami or trunks of plexus brachialis;

Dejerine-Klumpke paralysis (inferior type) – C8 – Th1 rami or inferior trunk formed by them.

In case of Erb – Duchenne paralysis the function of m. deltoideus, m. biceps brachii and m. brachioradialis is affected, i. e. n. axillaris and n. musculocutaneus are damaged. A patient is not able to lift and shift his shoulder back, or bend his brachium in elbow joint.

In case of Dejerine – Klumpke paralysis we can observe paralysis phenomena, sensory anesthesia, and pupillary disorders. Dysfunction and atrophy of small muscles of the hand (thenar and hypothenar muscles, muscoli interossei

dorsales, muscoli interossei palmares and muscoli lumbricales). Sensory anesthesia of skin of the hand (cutaneous branches of n. radialis, ulnaris et medianus), medial surface of shoulder and brachium (n. cutaneus brachii medialis, n. cutaneus antebrachii medialis) occur.

A. thoracica lateralis originates from a. axillaris in trigonum pectorale and follows n. thoracicus longus till m. serratus anterior. Anteriorly a. axillaris is crossed by nn. intercostobrachiales. Having reached the exterior surface of m. serratus anterior, a. axillaris supplies this muscle with blood, and gives off lateral rami (rr. mammarii laterales).

Compression of neurovascular fascicle is possible within trigonum pectorale, which results in syndrome of pectoralis minor muscle (Wright syndrome). The symptoms of Wright syndrome are muscle-tonic neurodystrophic disorders of the pectoralis minor muscle and compression of neurovascular fascicle which passes below the muscle. Neurovascular fascicle is pressed behind the pectoralis minor muscle below the processus coracoideus to caput humeri. Compression of these formations may appear in cases of excessive shoulder abduction (immobilization after humerus fracture, sleeping with arms put behind the head). A patient complains of pain in pectoralis minor muscle area when he raises or abducts his arm. We can observe paresthesia, weakness of arm muscles, skin blanching, hand swelling, decrease of pulse in a. radialis.

The axillary vessels and plexus brachialis are surrounded by cellular tissue and located in fascial compartment formed by fascia clavipectoralis. The cellular tissue of trigonum clavipectoralis while the neurovascular fascicle upwards, joins the deep cellular tissue of trigonum cervicalis lateralis, and fissure anterscalenum. Downwards it joins the cellular tissue of axilla, and along a. et v. axillaris and nerves of plexus brachialis – with

subpectoral cellular space.

### **THORACIC AREA (regio mammaria)**

Area limits:

- above – the 3rd rib;
- below – the 7th rib;
- medially – linea parasternalis;
- laterally – linea axillaris anterior.

The skin is thin and movable.

In the subcutaneous tissue there are rr. cutanei anteriores et laterales nn. supraclaviculares. There are rr. mammarii laterales et mediales from intercostal nerves, superficial veins and branches of a. thoracoacromialis, a. thoracica interna, aa. intercostales anteriores in women.

Mammary gland (mamma) is covered by superficial fascia which forms a capsula. Fascial septums spring from capsula inside the mammary gland, between its lobules.

The capsule is attached to skin by means of connective tissue bands, and above to clavicle by means of suspensory ligaments of the breast (ligg. suspensorium mammae). The loss of compliance and distortion of connective tissue results in mastoptosis, what makes women to perform plastic surgery (mastopexy).

The thoracic area has three layers of cellular tissue. First layer is located between skin and fascia superficialis (capsule) of mamma. Second layer is located inside the capsule between the lobules of mammary gland. Third later is located between the deep lamina of fascia superficialis and fascia pectoralis propria.

The mammary gland comprises 15–20 radiary placed lobules. Each lobule has its own duct (ductus lactiferous), which forms a distention (sinus lactiferous) near the base of

the nipple.

In the middle of mammary gland there is areola mammae in the center of which the mammilla (papilla mammaria) emerges. The papilla mammaria of a young woman complies with the 5th rib. Montgomery tubercles emerge in the area of areola. On the top of Montgomery tubercles, the excretory ducts of glandulae areolares open, which appear at the end of pregnancy and exist during all the lactation period.

Sulcus intermammarius is located between left and right mammae. Behind the mamma capsule there is a layer of adipose tissue. Fascia pectoralis propria, m. pectoralis major and m. serratus anterior lie deeper.

***Blood supply of the mammary gland*** (Fig. A.3):

1) rr. mammarii mediales from rr. perforantes, from a. thoracica interna system;

2) rr. mammarii laterales from a. thoracica lateralis;

3) rr. perforantes from aa. intercostales.

Venous drainage to superior vena cava system occurs through the homonymous veins.

The lymph outflows from breast in different ways, what has a practical importance in metastatic spread through these ways in cases of malignant growth (breast cancer) (Fig. A.5). The main direction of lymph drainage from breast is axillary path which begins with 2 – 3 vessels which flow along the inferior border as great vessels of pectoralis major muscle and flow into nodi lymphoidei pectorales (Sorgius nodes). These nodes are located along a. thoracica lateralis on the level of the 2nd – 4th ribs. They are the most frequent focuses of metastasis.

From these nodes the lymph drains to axillary lymph nodes, nodi lymphoidei axillares centrales, and from nodi lymphoidei axillares centrales – to nodi lymphoidei axillares apicales which

are located along v. axillaris. From nodi lymphoidei axillares apicales the lymph drains to deep inferior cervix nodes or to subclavian trunk. The Troisier's lymph node has a clinical relevance which is palpated in metastases above the clavicle beside outer edge of sternocleidomastoid muscle.

From posterior part of mamma the lymphatic vessels go along transpectoral path upwards while passing through m. pectoralis major, go through nodi lymphoidei interpectorales Rotter's lymph nodes and fascia clavipectorale, and fall into nodi lymphoidei axillares apicales or into deep cervix (subclavian) nodes.

Moreover, the sternal path is important as well. It begins from medial sternal segments, goes through m. pectoralis major in intercostal spaces toward nodi lymphoidei parasternales which are located along internal sternal vessels. From nodi lymphoidei parasternales the lymph drains:

- from the left – into the left subclavian trunk and arch of thoracic duct;
- from the right – into the right subclavian trunk, right lymph duct or into nodi lymphoidei prepericardiaci.

Nodi lymphoidei prepericardiaci have connections with tracheal and tracheal-bronchial nodes, as well as with bronchial-pulmonic and infrapulmonary nodes.

Thus, metastasis of cancer from chest to lungs is possible. Along the intercostal lymph vessels, the intercostal lymph nodes anastomose with nodi lymphoidei intercostales and nodi lymphoidei prevertebrales. Thus, metastasis of cancer from chest to corpus vertebrae is possible as well.

The lymph vessels of right and left mammae are connected together as by means of lymphatic reticulum of skin so anastomoses of presternal lymph nodes from both sides.

The metastases of cancerous growths can effuse from

presteral lymph nodes along a. epigastrica superior et inferior into anteperitoneal cellular tissue, perineal lymph nodes, and abdominal cavity and gonads, and along ligamentum teres hepatis – into liver.

**Breast innervation** (Fig. A.4)

1) rr. mammarii laterales from n. cutanei laterales the 2nd – 7th intersotal nerves;

2) rr. mammarii mediales from r. cutanei anteriores the 3rd – 5th intercostal nerves;

3) nn. supraclaviculares from plexus cervicales.

The main function of mammae is a synthesis and secretion of milk. The structure and functions of mammae are significantly changing depending on different phases of menstrual cycle, pregnancy and lactation. The changes are determined by functionality of endocrine glands.

Among the defects we should mention increase of number of nipples (polythelia), and number of mammae (polymastia). When tissue of mammae loses its elasticity – mastoptosis appears (ptosis of mammae). In case of mastoptosis the plastic surgery is recommended for young women.

The men breast augmentation (gynecomastia) is not dangerous for men health, and the mastectomy is indicated for cosmetic reasons only.

The breast inflammation (mastitis) is frequently observed among lactating mothers. This disease is associated with infection invading the mammae through scratches and fissures from apostasis on skin surface, and through lactiferous ducts, and hematogenic and lymphatic sinuses as well.

According to localization we can distinguish: superficial abscesses, antemammary, abscesses located in the first layer of cellular tissue, abscesses or phlegmons located in the mamma (intramammary), and located behind the mamma



(retromammary).

The operation is performed under general anaesthesia. The inramammarial abscesses are lancing according to Angerer method. Fibroadenoma is the most frequent type of benign tumour. Fibroadenomae are slowly growing round nodes of firm or a bit elastic texture, with smooth or a bit lumpy surface, and are well-separated from surrounding tissues. Fibroadenomae are considered as precancer conditions, and are subject to operative treatment. The definitive treatment of mammary cancer is radical mastectomy.

Under the breast fascia there are muscles *mm. pectorales major et minor*, which cover chest cage in front, and *m. serratus anterior* and *m. latissimus dorsi*, which cover it sideways and from behind. The *m. obliquus abdominis externus* spring from lateral surface of thoracic cage and covers external surfaces of ribs and intercostal spaces.

In its turn intercostal spaces are filled with intercostal muscles, blood vessels and nerves. External intercostal muscles (*mm. intercostales externi*) fill intercostal spaces between the head of the ribs to the cartilage. *Membrana intercostalis externa* is their prolongation which looks like bright aponeurotic plates. The direction of muscle is from top to bottom and back to front.

Internal intercostal muscles (*mm. intercostales interni*) fill intercostal spaces from the lateral part of the chest to the costovertebral angle. The direction of muscles is from bottom to top and from the front to back. *Membrana intercostali interna* is the prolongation of muscles.

There is an intercostal slot between external and internal intercostal muscles bounded with costal sulcus. The slot is filled with adipose tissue where the intercostal neurovascular bundle is located. The elements of neurovascular bundle are

located in the following way: there are a vein on the top, a nerve on the bottom, and the artery is located between the vein and nerve (Fig. A.6; Fig. A.7).

The chest is supplied with blood by aa. intercostales posteriores from the thoracic part of aorta and by anterior intercostal arteries (aa. intercostales anteriores) from a. thoracica interna. The first and the second intercostal spaces are supplied with blood by the a. intercostalis suprema from truncus costocervicalis and a. thoracica superior from the first part of a. axillaris.

There are 10 pairs of posterior intercostal arteries; 9 of them are located in the intercostal spaces and the 10th pair, a. subcostalis is located under the 12th rib.

The right intercostal arteries are longer than the left ones. They go in front of thoracic vertebra and behind esophagus, thoracic duct, azygos vein and sympathetic trunk. Left intercostal arteries go behind the hemiazygos vein and sympathetic trunk. Near the head of the rib each artery divides into two parts: posterior (r. dorsalis) and anterior (r. anterior).

R. dorsalis gives r. spinalis which penetrates through the intervertebral foramina to the spinal canal and supplies the spinal cord and its membranes with blood. Among these branches it's necessary to mark Adamkevych artery which is located on the level of the 10th – 11th thoracic vertebra which is the main source of blood supply for spinal cord. Beside spinal branch, rr. cutanei mediales et laterales follow from the spinal branch to skin and back muscles.

The frontal branch is the prolongation of the main trunk of the back intercostal artery. It goes in the inner surface of m. intercostalis externus, and in front it is covered with fascia endothoracica, pleural tissue and mediastinal pleura.

Between the head of the rib and costovertebral angle the artery is located lower than its rib and can be damaged in thoracocentesis. From the costovertebral angle to the middle inguinal line the vessels go in the subcostal groove. That's why thoracocentesis should be done between scapular and posterior inguinal lines.

At the level of costovertebral angle the artery is located in sulcus costae, goes in the groove between mm. intercostales and in the middle inguinal line it anastomoses with interior intercostal artery, the branch of a. thoracica interna.

So, in the intercostal space is formed the arterial circle which consists of two arterial systems: thoracic part of aorta and subclavian artery. The circle is located only in the 6 upper intercostal spaces. In 5 inferior intercostal spaces there are only posterior intercostal arteries which go to the muscles of anterior abdominal wall with their frontal ends. They go through the groove between internal oblique and transverse muscles of abdomen. Anterior intercostal arteries branch off from the internal thoracic artery.

A. thoracica interna begins in the inferior semicircle of subclavian artery in its first section (to penetration into spatium interscalenum). It goes behind v. subclavia and then goes down. Through apertura thoracis it goes to the cavitas thoracis and descends parallel the edge of cavitas thoracis at the distance of 1 – 2 cm from this cavitas thoracis edge. It goes behind the costal cartilages and inner intercostal muscles. It is allocated till the level of the 2nd costal cartilage between pleura and endothoracic fascia, and covered with fascia endothoracica. M. transversus thoracis is also covered below the 3rd costal cartilage (cartilago costalis). Near the diaphragm at the level of the 7th costal cartilage (cartilago costalis) it divides into 2 branches: a. musculophrenica and a. epigastrica superior.

A. musculophrenica goes along the line of attachment of the costal part of the diaphragm. It gives off 5 inferior intercostal arteries to the muscles of intercostal spaces. It supplies the diaphragm and abdominal muscles with blood (Fig. A.8).

A. epigastrica superior breaks posterior wall of sheath of rectus abdominis muscle and is located on the posterior surface of the muscle and at the level of umbilicus it anastomoses with a. epigastrica inferior from a. iliaca externa.

There are different branches along the entire length from a. thoracica interna.

1. Rr. mediastinales go to the pleura, cellular tissue and lymph nodes of upper and anterior mediastinum.

2. Rr. thymi go to the thymus.

3. Rr. bronchiales and rr. tracheales go to bronchi and trachea.

4. Rr. intercostales anteriores go to the intercostal spaces.

5. A. pericardiophrenica begins at the level of the 1st rib, accompanies n. phrenicus going along the lateral surface of the heart, branches off its branches to heart and anastomoses with other branches of heart and myocardium.

That is why Fieschi operation and internal thoracic artery ligation in the 2nd intercostal space were performed for myocardial revascularization in ischemic heart disease. In recent years instead of Fieschi operation the mammary-coronary artery anastomosis is performed. Herewith the internal thoracic artery is sutured to one of the coronary arteries.

Venous drainage from the thoracic cage is supplied by:

1. Vv. thoracicae internae – drain blood from the anterior parts of intercostal spaces. They flow into v. brachiocephalica.

2. V. azygos – drains blood from posterior parts of intercostal spaces of the right side. It flows into vena cava.

3. V. hemiazygos – drains blood in the left posterior parts of 4th – 5th inferior intercostal spaces. It flows into azygos vein.

4. V. hemiazygos accessoria – drains blood from the 6th – 7th upper intercostal spaces at the left, and also from the esophagus and cellular tissue of posterior mediastinum. It flows into azygos vein.

Lymph nodes in the intercostal spaces pass along the intercostal neurovascular bundle. From anterior parts of intercostal spaces lymph outflows into the parasternal lymph nodes which are located along internal thoracic vessels; then into the right and left subclavian trunks. From posterior intercostal spaces lymph outflows through intercostal nodes into prevertebral nodes, and then into Van Hoorne's canal (thoracic duct).

Intercostal nerves pass behind subcostal groove, that's why thoracocentesis is made along the superior border of the rib.

Each of 12 pairs of cerebrospinal nerves has:

1. R. meningeus is sensitive and goes to the maters of spinal cord.

2. R. communicans albus contains antenodal sympathetic fibres which go to the nodes of sympathetic trunk.

3. R. dorsalis is mixed and divides into middle and lateral branches which provide innervation of skin and back muscles.

4. R. ventralis of thoracic nerve are called nn. intercostales. Each intercostal nerve having reached costal angle penetrates into the groove between external and internal intercostal muscles.

Six superior intercostal nerves go to the sternum and give branches called rr. cutanei anteriores which innervate skin of anterior thoracic wall. Five inferior intercostal nerves and infracostal nerve go to the anterior wall of abdomen, follow the arteries and lie in the groove between abdominal internal

oblique muscle and transverse muscle of abdomen. They penetrate into the sheath of rectus abdominis muscle, innervate this muscle, skin of anterior abdominal wall, parietal pleura and peritoneum.

Along the entire length from intervertebral foramen to the costal angle the nerve is covered only with endothoracic fascia, subpleural tissue and pleura. It causes pain radiation in pleuritis to the abdomen and muscles of anterior abdominal wall.

**THORACIC CAVITY (cavitas thoracis)** is the space limited by the internal surface of thoracic cage in front, on the side, from behind, and by diaphragm from below. Cavity walls are covered with endothoracic fascia. There are 2 pleural sacs and mediastinum, in the thoracic cavity.

## **PLEURA**

External, parietal pleura covers thoracic cavity inside and attaches to endothoracic fascia. Parietal pleura is divided into 3 parts: costal pleura (pleura costalis), diaphragmatic pleura (pleura diaphragmatica) and mediastinal pleura (pleura mediastinalis).

At the root of the lung parietal mediastinal pleura goes into abdominal pleura which joins with lung parenchyma and covers it from all sides.

There is pleural cavity between parietal pleura and visceral pleura. It's a very small slot filled with serous fluid (20 ml) which eases pleural rub while breathing. So, naturally pleural cavity almost does not exist. But in lung collapse, inflammatory processes, the volume of cavity can increase and reach big size.

The upper part of pleural sac which protrudes above

thoracic cavity into the triangle of the neck and covers the top of lungs is called cervical pleura.

Syntopy of cervical pleura:

- posteriorly – a. vertebralis, ganglion cervicale inferior and ductus thoracicus from the (left), head and neck of 1st rib (caput costae) and m. longus colli are covered with prevertebral fascia to which the cervical pleura is fixed by lig. transversopleurale (from the transverse process of VII cervical vertebra to the cervical pleura), lig. vertebropleurale (from the anterior surface of 1st thoracic vertebra to the posterior surface of cervical pleura). These ligaments are crossed for mobilization of upper part of lungs;

- outside and anteriorly – mm. scaleni;
- outside – brachial plexus;
- inside from the right – truncus brachiocephalicus;
- inside from the left – a. carotis communis sinistra;
- in front and on the top – a. subclavia;
- in front – v. subclavia;
- posteriorly and outside – trachea and esophagus.

Costal part of pleura adheres to the endothoracic fascia and is separated from it by the layer of subpleural cellular tissue.

It is mostly developed in the posterior parts of spinal column and easily separates together with pleural sac in case of urgent access to the organs of posterior mediastinum.

In the anterior division subpleural tissue is very thin and it's almost impossible to separate it from endothoracic fascia.

Mediastinal part of parietal pleura in the inferior frontal part attaches to the pericard with which it is bound with poorly marked tissue. There is phrenic nerve with a. et vv. pericardiophrenicae in the tissue.

The anterior edge of pleura is the transition line of costal part of pleura into mediastinal one. The right anterior edge passes from lesser supraclavicular fossa (fossa

supraclavicularis minor) downwards and to the middle of the right sternoclavicular joint, behind the head and body of sternum and at the level of attachment of 2nd rib cartilage it passes behind the median line to the anterior edge of the left side at the level of 3rd – 4th costal cartilages (cartilago costalis).

From here it goes down to the attachment point of the 6th rib to sternum, and deviates downwards out merging into inferior edge.

The anterior edge from the left begins from the left supraclavicular fossa, goes down and to the middle of left sternoclavicular joint, goes behind the left side of sternum to the 4th rib joint. It turns round the heart discharging downwards and outside then goes to the middle of cartilage of the 6th rib where merges into the inferior edge.

Between the anterior edges of the left and right pleuras the spaces of triangle are formed: in the suprasternal notch and behind the sternum above the 3rd rib there is superior interpleural area (area interpleurica superior) or thymus. The newborns and children have thymus, and the adults have cellular tissue and lymph nodes.

Downwards from the 4th rib with the help of incisura cardiaca the inferior interpleural area or Wojnicz – Sianożęcki triangle of safety is formed. From the side it is limited with parietal pleura and from below – with diaphragm. There is the frontal part of pericardium which is not adjacent to pleura and used by cardiac surgeon as access to the heart which is located beyond pleura and in pericardiocentesis in this space.

The inferior edge of pleura is the transition line of costal parietal pleura into diaphragmal pleura:

- linea parasternalis – the 6th rib;
- linea medioclavicularis – the 7th rib;
- linea axillaris anterior – the 8th rib;



- linea axillaris media – the 9th or the 10th rib;
- linea axillaris posterior – the 10th rib;
- linea scapularis – the 11th rib;
- linea paravertebralis – the 12th rib.

During the maximal deep breath lungs fill the whole pleural cavity. During moderate breath or expiration lungs do not reach the place of transition of pleura parts and they are called recessus pleurales. Angles are the part of pleural cavity in the area of transferring one part of parietal pleura into another.

There are pair recessus costomediastinalis. They are located between anterior parts of costal pleura which pass into pericardium making duplicate, and limiting area interpleurica superior et inferior. During surgery after median sternotomy in extrapleural access to pericardium, heart and great blood vessels these areas can be artificially widen for better access. In extrapleural access there still exists the integration of pleural sacs which helps to avoid the use of apparatus for artificial lung ventilation.

The biggest is costodiaphragmatic recess (recessus costodiaphragmaticus) which is limited by inferior edges of costal and diaphragm parts of parietal pleura. It has the depth to 9 cm along linea axillaris media from the 7th to the 10th ribs. Costodiaphragmatic recess is not filled with pulmonary tissue even deep deep breathing. It is the place of accumulation of exudate or blood and that's why is used for pleurocentesis.

There is the space before diaphragm filled with subpleural tissue which was described by O. V. Melnikov. It is located below costodiaphragmatic recess between diaphragm and thoracic wall. Subpleural tissue gives an opportunity to separate pleura from diaphragm and to have the direct and safe access to diaphragm what is used in extrapleural transthoracic access to subdiaphragmatic abscesses.

The third pair recessus is recessus phrenicomedialastinalis.

Parietal pleura is supplied with blood due to posterior intercostal, anterior thoracic, phrenic and musculophrenic arteries. Pulmonary pleura is supplied with blood due to vessels of lungs (pulmonary and bronchial arteries).

Venous blood is drained from parietal pleura into the system of precava and partially of postcava.

The lymph outflows from the costal part of parietal pleura of anterior thoracic areas into parasternal lymph nodes; from the posterior thoracic areas – into nodi parasternales; from diaphragmal pleura – into superior diaphragmal nodes (nodi phrenici superiores) and prepericardial lymph nodes (nodi prepericardiaci); from the mediastinum – into the lateral pericardium and paraesophageal lymph nodes.

### ***Pleura innervation***

The costal pleura is innervated with intercostal nerves. The mediastinal pleura is innervated with phrenic nerves. The diaphragmal pleura is innervated with 6 inferior intercostal nerves and with phrenic nerves.

The pulmonary pleura is innervated from pulmonary plexus which is formed of phrenic nerves, sympathetic trunk and pneumogastric (vagus nerve).

In disease or injury of pleura what leads to exudation, air or blood accumulation, the thoracocentesis is performed.

### **LUNGS (pulmones)**

There is paired respiratory system – lungs in the right and left parts of thoracic cavity.

Lungs have the irregular conical shape with rounded top (apex pulmonis) and wide basis (basis pulmonis). The lung surface is divided into three surfaces: costal surface (facies costalis), diaphragmal surface (facies diaphragmatica) and

mediastinal surface (*facies mediastinalis*). In adult people the apex of the lung protrudes through upper thoracic aperture to the neck, reaches the acantha of the 7th cervical vertebra from behind and 4 – 5 cm the suprasternal notch above – or 2 – 3 cm above the collarbone in front. The subclavian artery attaches to the apex of the lung at medial surface leaving sulcus on the lung (*a. subclavia*).

The lung basis attaches to the diaphragm by its diaphragmal surface (*facies diaphragmatica*). *Facies diaphragmatica* is concave according to the shape of convex diaphragm: more on the right and less on the left.

The right lung is limited from the liver with diaphragm, the left one – from the spleen, left kidney and adrenal gland, stomach, transverse colon and left part of the liver which adhere to the diaphragm from below.

There is sharp inferior edge which goes into costodiaphragmatic recess between the costal surface (*facies costalis*) and diaphragmal surface (*facies diaphragmatica*).

When breathing the inferior edge of the lung shifts 7 – 8 cm down. The sharp anterior edge of the lung penetrates into costomediastinal recess between the thoracic cage and heart and limits the costal surface (*facies costalis*) of the lung from the mediastinal surface (*facies mediastinalis*). The mediastinal surface (*facies mediastinalis*) is turned to the mediastinum and vertebral spine.

There are hila (*hilum pulmonis*) in the paramedian surface of the lung through which the primary bronchi (*bronchi principales*) and pulmonary arteries go into the lungs and through which the superior pulmonary vein and lower pulmonary vein go out. Besides primary bronchus, pulmonary artery and pulmonary veins there are lymph nodes (*nodi lymphoidei bronchopulmonales*), neuroplex and pulmonary

arteries and pulmonary veins in the hila of the lung.

There is a deep cardiac impression (*impressio cardiaca*) in the paramedian surface of the lung anteriorly and lower from the hila which is more expressed on the left lung.

There is a deep sulcus on the top and behind the root of the left lung due to the arch of aorta and descending part of aorta, in front of which there is esophagus attachment near the inferior edge of the lung. There is a recess of precava on the mediastinal surface of the right lung in front of the hila, and behind – there are sulci due to azygos vein and esophagus.

The borders of lungs are as follows:

- anterior and posterior lung borders and pleura coincide.

The inferior edge of the right lung:

- *lin. parasternalis* – the 6th rib;
- *lin. medioclavicularis* – the 7th rib;
- *lin. axillaris media* – the 8th rib;
- *lin. scapularis* – the 10th rib;
- *lin. paravertebralis* – the 11th rib.

### **SURGICAL ANATOMY OF THE ROOT OF LUNG**

The complex of anatomical formations which are located in the hilum pulmonis are the root of the lung (*radix pulmonis*).

The elements of root of the lung are located in the cellular tissue. The root is covered with mediastinal pleura. On the edge of hilum pulmonis the pulmonary pleura passes into pericardium and esophagus as two layers of serous membrane which anastomose and create triangular pulmonary ligament (*lig. pulmonale*). It is located in the frontal surface and stretches between the root of the lung on the top and diaphragm from below.

The width of the root of lung is 6 – 8 cm. Hilum pulmonis is located at the level of the 5th – 7th sternal cartilages posteriorly and anteriorly – at the level of the 2nd – 4th

sternal cartilages.

There is v. pulmonalis superior in the root of the right lung which is located anteriorly. There is a. pulmonalis from above and behind v. pulmonalis superior, and v. pulmonalis inferior passes lower and behind it. There is right primary bronchus behind pulmonary artery which protrudes the artery 2 – 11 mm above (Fig. A.9 (a)).

There is left pulmonary artery in the root of the left lung on the top. The superior pulmonary vein is located anteriorly and below from it. Bronchus is located below and behind pulmonary artery and superior pulmonary vein (Fig. A.9 (b)).

There is bronchus in the hilum of the right lung which is located on the top; the pulmonary artery is located anteriorly and below; and the pulmonary vein is located below. There is an artery in the hilum of the left lung. The bronchus is located below and there is inferior pulmonary vein below from it.

The veins are located anteriorly in the horizontal plane in the hilum of the lung; the pulmonary vein is located behind the veins and the primary bronchus – behind the pulmonary vein.

Bronchial arteries (a. bronchiales) attach to the inferior semicircle of primary bronchi. There are ascending part of aorta, precava, pericardium and the part of the right atrium in front of the root of the lung. There is azygos vein from above and behind the root of the lung.

The arch of aorta attaches to the root of the lung from above, esophagus and descending part of aorta – behind. The both roots (of right and left lungs) are crossed anteriorly with phrenic nerve which is accompanied by a. et vv. pericardiophrenicae. There is n. vagus behind the root.

Each lung is divided into lobes due to interlobar fissurae. Oblique fissure of the left lung (fissura obliqua) divides it into

superior and inferior portions. The projection line of this fissure onto thoracic cage passes from the 3rd thoracic vertebra acantha to the junction of the bone and costal cartilage of the 6th rib. If to lift the hand, the medial border of scapula will show the direction of the fissure.

There is also horizontal fissure (*fissura horizontalis*) in the right lung, which passes along IV costal cartilage from sternum to the projection line of the oblique fissure on the midaxillary line. The middle part is limited from superior part with horizontal fissure.

The lobes of lungs consist of segments. A segment is the part of lung parenchyma which is ventilated with the bronchus of the 3rd branching and has its own branch of pulmonary artery. That is why such parts are called bronchopulmonary segments (*segmenta bronchopulmonales*). Bronchopulmonary segment has the form of pyramid. The top of the segment is directed to the hilum of the lung and its basis – to the external surface of the lung. Each lung has 10 bronchopulmonary segments:

The bronchopulmonary segments in the upper part of the right lung are as follows:

- 1) apical segment (*segmentum apicale* [S<sub>i</sub>]);
- 2) posterior segment (*segmentum posterius* [S<sub>ii</sub>]);
- 3) anterior segment (*segmentum anterius* [S<sub>iii</sub>]).

In the middle lobe of the right lung:

- 4) lateral segment (*segmentum laterale* [S<sub>iv</sub>]);
- 5) mediastinal segment (*segmentum mediale* [S<sub>v</sub>]).

In the lower lobe:

- 6) superior segment (*segmentum superius* [S<sub>vi</sub>]);
- 7) mediastinal cardiac segment (*segmentum basale mediale (cardiacum)* [S<sub>vii</sub>]);
- 8) main anterior segment (*segmentum basale anterius* [S<sub>viii</sub>]);
- 9) main lateral segment (*segmentum basale laterale* [S<sub>ix</sub>]);

10) main posterior segment (segmentum basale posterius [S<sub>x</sub>]).

In the upper lobe of the left lung:

1) – 2) apical-posterior segment (segmentum apicoposterius [S<sub>I+II</sub>]);

3) anterior segment (segmentum anterius [S<sub>III</sub>]);

4) upper lingular lobe (segmentum lingulare superius [S<sub>IV</sub>]);

5) lower lingular lobe (segmentum lingulare inferius [S<sub>V</sub>]).

In the lower lobe of the left lung:

6) upper segment (segmentum superius [S<sub>VI</sub>]);

7) mediastinal cardiac segment (segmentum basale mediale (cardiacum) [C<sub>VII</sub>]);

8) main anterior segment (segmentum basale anterius [S<sub>VIII</sub>]);

9) main lateral segment (segmentum basale laterale [S<sub>IX</sub>]);

10) main posterior segment (segmentum basale posterius [S<sub>x</sub>]).

The pulmonary tissue is supplied with blood mostly due to 2 – 3 bronchial arteries which depart from the thoracic part of aorta and go along bronchi.

A. et vv. pulmonales are the vessels of lesser circulation and have the function of gas exchange between air and blood. The terminal branches of bronchial arteries of greater circulation anastomose with pulmonary arteries. Bronchial veins (vv. bronchiales) go into azygos vein (v. azygos) on the right, and into hemiazygos vein on the left.

Deep and superior lymphatic vessels drain lymph from the lungs. The superficial veins make surface vasculature which is located in visceral pleura. Deep vasculature is located in connective layers between the lung lobes.

Regional lymph nodes make the following groups:

1. Intrapulmonary lymph nodes (nodi lymphoidei intrapulmonales) are located in the lung parenchyma,

mostly in places of bronchial branching.

2. Bronchopulmonary lymph nodes (nodi lymphoidei bronchopulmonales) are located in the hilum. Their draining lymph vessels go to tracheobronchial lymph nodes.

3. The superior and inferior tracheobronchial lymph nodes (nodi lymphoidei tracheobronchiales superiores et inferiores) are connected to trachea and superior and inferior primary bronchi. Their draining lymph vessels go to the nodi lymphoidei paratracheales.

4. Nodi lymphoidei paratracheales are located along the trachea.

From the lung the lymph drains to the root of the lung and before entering lymphatic duct passes through one of these nodes. Most of the lymph is drained into the right lymphatic duct (ductus lymphaticus dexter). From the inferior parts of both lungs the lymph is drained by vessels which go through lobes of pulmonary ligaments to the lymph nodes of posterior mediastinum which are located along esophagus (nodi lymphoidei juxtaoesophageales).

Lung innervation is provided by sympathetic and parasympathic nerves. Sympathetic nerves cause bronchi dilatation and vasoconstriction. Parasympathic nerves contract bronchi, dilatate vessels, and increase secretion of mucous glands.

The branches of vagus nerves and thoracic pulmonary branches of sympathetic trunks form the pulmonary plexus (plexus pulmonalis) in the hila. It is quite important reflexogenic zone which should be blocked by novocaine during operations.

Lung nerves are connected with heart nerves by means of anastomoses.



## **INTERPLEURAL SPACE (Mediastinum)**

It's a complex of thoracic cavity organs located between two (right and left) mediastinal pleuras. The mediastinum is limited anteriorly by corpus and manubrium of sternum.

Behind – by corpuses of thoracic vertebrae.

Below – by diaphragm.

Above – by upper foramen of thoracic cage.

According to the modern opinion (Basle Nomina Anatomica, Ukrainian standard) the mediastinum is divided into two parts: mediastinum superius and mediastinum inferius.

Mediastinum superius is located above the root of the lungs and is separated from mediastinum inferius by conditional surface, which goes through junction point of manubrium of sternum with its corpus, and goes to 4th thoracic vertebra.

Pericardium divides the mediastinum inferius into anterior and posterior segments.

The mediastinum superius comprises:

- thymus or adipose tissue which replaces it;
- venae brachiocephalici;
- vena cava superior;
- aorta ascendens;
- arcus aortae with its branches;
- the upper part of esophagus;
- ductus thoracicus;
- trachea;
- n. phrenicus and n.vagus.

***Mediastinum anterius*** is located between the sternum and pericardium. It comprises internal thoracic vessels (arteries and veins), presternal lymphatic nodes, and inferior segments of thymus.

***Middle mediastinum*** comprises pericardium, heart, intracardiac

segments of large vessels, bifurcation of trachea, main bronchi, lung arteries and veins, and nn. phrenici which follow the pericardiophrenica vessels, lateral, pericardial and tracheobronchial lymph nodes.

***Mediastinum posterius*** is located between the posterior wall of pericardium and thoracic vertebrae. The mediastinum posterius comprises: esophagus, descending part of aorta, ductus thoracicus, v. azygos and v. haemiazygos, sympathetic trunks and nerves which depart from them, nn. vagi, periesophageal and prevertebral lymph nodes. Organs of mediastinum are covered with adipose tissue which plays an important role in generalization of purulent inflammatory processes.

We can distinguish: prepericardial, pretracheal and periesophageal cellular spaces. Prepericardial cellular space is located in mediastinum superius between the posterior surface of sternum and organs (thymus, vessels, pericardium). It has two layers separated by retrosternal fascia of Rudnev (fascia retrosternalis). It begins from the posterior wall of the thymus and ascends to the diaphragm. Its size depends on the length of thymus. The first cellulose layer is thinner. It attaches to the posterior surface of sternum and is called retrosternal space of Diakonov.

The second cellular layer is located deeper, between Rudnev fascia and Meier fascia, which is called septum mediastinale. It descends from the posterior part of the capsule of thyroid gland, passes along the anterior surface of trachea, then passes onto posterior surface of pericardium, and ends in tendinous center of diaphragm. This thin fascial plate can be considered as a septum between mediastinum medium and mediastinum posterius.

The abscesses of prepericardial cellular space can spread

along the anterior surface of pericardium to diaphragm, and then through Larrey's cleft (sternocostal triangle) and trigonum sternocostale dexter – to preperitoneal fatty tissue. They can also spread up to pretracheal cellular tissue of cervix.

We can also distinguish the pretracheal cellular space in mediastinum superius. It is limited by aortic arch from the left; v. cava superior, v. azygos and right artery of the lung from the right; tracheal bifurcation behind; thymus and posterior wall of pericardium in front.

The periesophageal cellular space is mostly expressed in mediastinum posterius. From above it joins with retropharyngeal space of cervix, and through hiatus aorticus of diaphragm and trigonum lumbocostale (Bochdalek's foramen) – with extraperitoneal space.

Purulent inflammations of mediastinal cellular tissue (mediastinitis) is a severe disease.

Cellular tissue of mediastinum comprises significantly expressed reticulum of arterial and venous vessels. The most important arterial vessels are bronchial arteries which take part in blood supplying of bronchopulmonary complex, trachea, esophagus, pericardium, wall of aorta, superior vena cava, nn. vagi, lymph nodes and cellular tissue of mediastinum.

From 2 to 6 bronchial arteries (rr. bronchiales) depart from the anterior semicircular part of aorta, in the point of transition of its arch arc into descending part. They form a lot of anastomoses with arteries of greater circulation (rr. of a. thoracica interna) and lesser circulation (a. pulmonales).

The veins of mediastinum don't have the valves, their walls are thin. Their damage during the operation results in air embolism.

***Organs of mediastinum superius*** (Fig. A.10)

## **THYMUS**

The thymus is located behind the sternum. In children it descends till the level of 5th costal cartilage. M. sternohyoideus, m. sternothyreoides and sternum are located in front of the thymus. At the sides it borders on mediastinal pleura.

From behind it borders on the left v. brachiocephalica, superior vena cava, arch of aorta, and pericardium.

The thymus is supplied with blood due to rr. thymici from a. thoracica interna, and rr. of a. thyroidea inferior.

The venous blood drains to the left v. brachiocephalica and v. thyroidea inferior. The lymph drains to mediastinal lymph nodes.

The gland is innervated by rr. of nn. vagi, n. phrenicus and truncus sympathicus. The growths which are formed from the rests of the thymus (thymomas), while overgrowing cause a compression of mediastinal organs which results in mediastinal syndrome. The symptoms of syndrome are: precordialgia, dyspnoea, cyanosis, heart disorders. Thus, the growths should be ablated.

There are left and right brachiocephalic veins behind the thymus in cellular tissue of mediastinum superius. They are formed behind the corresponding sternoclavicular joint by means of junction of subclavian and jugular internal veins.

## **BRACHIOCEPHALIC VEINS**

V. brachiocephalica dextra goes all along over the total length from sternoclavicular joint to sternocostal synchondrosis of the 1st rib where they merge and form v. cava superior.

The mediastinal pleura and right n. phrenicus adhere to its lateral semicircle. Tr. brachiocephalicus and n. vagus are

located behind and to the middle. Thymus is located in front of the left brachiocephalic vein.

The arch of aorta, truncus brachiocephalicus, a. carotis communis sinistra, a. subclavia and n. vagus sinister are located behind vena brachiocephalica sinistra.

### **SUPERIOR VENA CAVA**

V. cava superior goes downwards from the place of formation. It is located behind the right edge of sternum, from the level of the 1st rib to the level of the 3rd rib. On the level of the 2nd intercostal space it goes in pericardial cavity adjoining v. azygos before. The ascending part of aorta is located to the left from the vein. It is covered by mediastinal pleura outwards. There is n. phrenicus dexter followed by a. and vv. pericardiacophrenicae between the vein and pleura. N. vagus dexter goes behind v. cava superior.

The inferior part of vein is located in the cavity of pericardium, in front of root of the right lung. There are anterior mediastinal lymph nodes along the vein.

### **AORTA**

The ascending part of aorta (pars ascendens aortae) is located in pericardial cavity. There is truncus pulmonalis in front. There is auricula dextra of pericardium on the right and in front. A. pulmonalis dextra is located on the right.

The ascending part of aorta (pars ascendens aortae) gives off aa. coronariae dextra et sinistra which originate from sinuses of Valsalva.

The arch of aorta goes throughout the length from the 1st to the 2nd cartilages to the left semicircle of the 4th thoracic vertebra, where it continues in descending part of aorta (pars descendens aortae).

The highest point of aortic arch is located behind the

manubrium of sternum, in the centre, 1–2 cm lower from incisura jugularis.

The arch of aorta rounds a. pulmonalis dextra, lung trunk bifurcation and left main bronchus adhering to anteroinferior part of trachea.

The vena brachiocephalica sinistra, n. phrenicus and n. vagus sinister are located in front of aortic arch. Mediastinal pleura adheres to the left lateral surface, and v. cava superior is located on the right. There are trachea, esophagus and ductus thoracicus behind the aortic arch. There is n. laryngeus recurrens sinister below and behind the aortic arch.

Truncus brachiocephalicus, a. carotis communis sinistra, a. subclavia sinistra originate from the bulging part of aorta from right to left.

The truncus brachiocephalicus goes in front and outside from the trachea, then goes up and rightward attaching to the vena brachiocephalica sinistra behind. On the level of articulatio sternoclavicularis it gives off a. subclavia dextra and a. carotis communis dextra.

A. carotis communis sinistra begins on the left and deeper from truncus brachiocephalicus. It goes up and outside crossing trachea in front and from the left. A. subclavia sinistra goes on the left from trachea. Nonspecific aortoarteritis, the aortic arch syndrome (Takayasu's syndrome) is characterized by inflammatory and destructive changes of aortic wall and large vessels which depart from it, their constriction and thrombosis. The syndrome manifests as chronic cerebral and upper limbs ischaemia.

## **PERICARDIUM**

Pericardium is an isolated sack with heart and large blood vessels in it. It consists of two layers: superficial fibrous pericardium (pericardium fibrosum) and inner serous pericardium (pericardium serosum). The pericardium fibrosum passes into vascular layer. The pericardium serosum is divided into two layers: visceral pericardium (lamina visceralis) which is the part of epicardium and covers myocardium, and parietal pericardium (lamina parietalis) which grows together with internal surface of pericardium fibrosum and covers it from inside.

Cavitas pericardiaca is formed between lamina visceralis and lamina parietalis which contains a small amount of serous fluid.

In tuberculosis, rheumatism or injury the amount of fluid (pericardial effusion) in pericardial cavity can increase. Herewith diastole is getting worse, the heart beat is disturbed what results in cardiac tamponade.

The pericardium looks like ill-formed, flattened cone, the basis of which is located on diaphragm, and its top – on ascending part of aorta.

Pericardium has five walls: anterior (sternocostal), two lateral (mediastinal), posterior and diaphragmal.

Sternocostal part of pericardium is directed to the front, adheres to corpus sterni and to the 4th and 5th intercostal spaces. In lateral segments and sometimes from above, the frontal pericardial wall is covered by mediastinal edges of parietal (right and left) pleuras. Free part of pericardium complies with left ribs ends from the 5th to the 7th rib cartilages, left inferior 1/3 of corpus sterni and upper 1/3 of ensisternum. The pericardium can be exposed here without danger of possible pleura damage. It is called “security

triangle” of Wojnicz – Sianożęcki.

The lig. sternopericardiaca go from the frontal part of pericardium to sternum, and are attached to sternum at the level of the 2nd rib.

Lateral parts of pericardium are covered by mediastinal pleuras, in adipose tissue of which n. phrenicus and vasa pericardiacophrenicae are located. The inferior wall of pericardium is located on diaphragm and is fixed with ligaments to it. V. cava inferior penetrates into pericardial cavity through the right segment of inferior wall.

Dorsal wall of pericardium adheres to the inferior part of trachea and organs of mediastinum posterius – esophagus, v. azygos, ductus thoracicus, thoracic part of aorta, n. vagus sinistra, and lymph nodes of mediastinum posterius. The aa. and vv. pulmonales go through the dorsal wall of pericardium, and aorta and v. cava superior pass from above. The parietal lamina of pericardium serosum passes into visceral lamina (epicardium). In the area of arterial and venous transition zones the recessus of pericardium are formed. Besides them we can distinguish more significant gaps – pericardial sinuses. We can recognize sinus transversus pericardii and sinus obliquus pericardii.

***Transverse pericardial sinus (sinus transversus pericardii, Teile)*** is limited:

- in front and from above – by ascending part of aorta and pulmonary trunk;
- from behind – by parietal lamina of pericardium which covers a. pulmonalis dextra;
- from below and behind – by left and right atriums.

The sinus transversus has left and right foramina. On the right the entrance in sinus transversus is limited:

- behind – by v. cava superior;
- in front – by the right edge of ascending part of aorta;



- below – by the right atrium and its auricula dextra.

On the left the entrance in sinus transversus is limited:

- in front and from above – by truncus pulmonalis and auricula sinistra;
- behind – by fold of the left vena cava (Marshall vestigial fold) which goes from a. pulmonalis sinistra to v. pulmonalis superior;
- below – by auricula sinistra.

Thus, the sinus transversus pericardii is located behind the ascending part of aorta and truncus pulmonalis. If to put the finger in sinus transversus pericardii one can bypass and press the ascending part of aorta and truncus pulmonalis. This technique is used in heart surgery and surgery of large blood vessels.

***Oblique pericardial sinus, Haller (sinus obliquus pericardii)*** is located behind the heart. We can see it if to move the apex of the heart up and right. Sinus obliquus pericardii can be the place of liquid and blood accumulation, and as a rule is drained during the surgery.

The sinus obliquus pericardii is limited:

- in front – by dorsal surface of atrium sinistra;
- behind – by dorsal wall of pericardium between the pulmonary vein entrances;
- on the right side and below – by v. cava inferior;
- on the left and from above – by left pulmonary veins.

The general source of blood supply of pericardium is a. pericardiophrenica, the branch of internal thoracic artery. Apart from it a. thoracica interna, rr. pericardiaci from thoracic part of aorta, branches from thymic artery, and branches from intercostal, esophageal, bronchial and mediastinal arteries take part in blood supply of pericardium.

Internal lamina of pericardium is mainly supplied with

blood due to coronal arteries. There are many inosculation (anastomoses) between vessels of internal and external laminae of pericardium. This fact was used by cardiac surgeons to improve blood supply of myocard in chronic coronary insufficiency (operative treatment according to method of Fieschi – internal thoracic artery ligature in 2nd intercostal space, lower from the level of origin of a. pericardiacophrenica).

The drainage of venous blood from pericardium is provided by the veins of the same name.

The lymph is drained from pericardium to nodi lymphatici prepericardiaci, nodi lymphatici pericardiales laterales, nodi lymphatici parasternales, nodi lymphatici tracheobronchiales, nodi lymphatici juxtaoesophageales and nodi lymphatici prevertebrales.

The pericardium is innervated due to cordial, aortal, pulmonary and esophageal nervous plexuses which are formed by means of branches of n. vagus, n. phrenicus, n. intercostalis and thoracic part of truncus sympathicus. They widely inosculate together. Those anastomoses are the reason of pain and reflexory muscular strain in damage or disease of pericardium what sometimes leads to improper laparotomy.

In inflammation of the parietal and visceral pericardium (pericarditis), the large amount of liquid accumulates in pericardial cavity what leads to acute cardiac tamponade.

The acute cardiac tamponade is observed when the heart is damaged. The symptoms of the acute cardiac tamponade (Beck's triad) are: low blood pressure, fast and considerable increase in central venous pressure and absence of palmus during roentgenoscopy of thoracic cavity organs. On ECG – abnormality of cardiac rhythm. In such cases the pericardiocentesis is performed.

The long-term effusion in pericardial cavity may cause the adherent pericardium which leads to the heart compression and dysfunction. In these cases the puncture and catheterization don't lead to any positive outcome. The pericardiotomy with cardiolysis is necessary.

## **SURGICAL ANATOMY OF THE HEART**

Heart (cor) is a caval muscular organ with four chambers which provides the sanguimotion in vessels of greater and lesser circulation. It is located in the middle mediastinum in pericardial space. It is located asymmetrically in thoracic cavity:  $\frac{2}{3}$  – to the left from the middle plane, and  $\frac{1}{3}$  – to the right. The longitudinal axis of the heart goes athwart from top to bottom, from right to left, and from back to the front.

### ***The borders of the heart***

Right border of the heart belongs to the v. cava superior and right atrium, goes from the upper edge of the 3rd costal cartilage to the lower edge of the 5th costal cartilage, 2 – 2,5 cm outwards from the right sternal line. From the 5th costal cartilage the right border passes into the lower one which complies with the right ventricle. It goes from right to left and downwards through the 5th intercostal space crossing the point of attachment to sternum of the right 4th costal cartilage to the 6th intercostal space leftwards, then crosses 6th costal cartilage and ends in the 5th intercostal space, by projection of cardiac apex 0,5 – 1,5 cm before midclavicular line.

Left border of the heart belongs to the left ventricle, left auricle and truncus pulmonalis. It goes upwards, originating from the 5th intercostal space archwise to the level of the 3rd left rib 2 – 3 cm before the edge of sternum. Then it goes to the 2nd intercostal space (2 cm from the left sternal line).

The heart has a basis directed upwards and backwards, and

apex turned downwards, leftwards and to the front. The basis is formed by right and left atriums and their posterosuperior surfaces. V. cava superior and inferior end by the right atrium of heart basis; the left and right pulmonary veins end by the left atrium. They form together radix cordis and fix the basis together. The apex of the heart is formed by the left ventricle and slightly by the right one. The apex of the heart and two ventricles are located intrapericardially (completely in pericardial cavity). The ascending part of aorta, truncus pulmonalis, and left and right atrial auricles are located in the pericardial cavity.

Vv. cavae and the both atrial auricles are covered by pericardium from 3 sides, i. e. – they are located mesopericardially, as their dorsal side is not covered by pericardium.

Pulmonary veins and two pulmonary arteries are located extrapericardially, that is pericardium covers only their anterior walls.

We can distinguish such surfaces of the heart as: anterior, sternocostal surface (facies sternocostalis), inferior, diaphragmal surface (facies diaphragmatica) and pulmonary one. The anterior and pulmonary surfaces form the blunt edge (margo obtusus) directed to the left, and anterior and inferior surfaces form the acute edge (margo acutus) directed to the right.

There are two compartments in the heart: upper (or superior-right), and inferior (or inferior-left). Atrioventricular sulcus (coronary sulcus of the heart – sulcus coronarius) is the border between the segments. The sulcus passes from left to right, and from up to down. There is the auricle of right atrium which covers v. cava superior and ascending part of aorta. Upwards and leftwards the sulcus coronarius passes under arterial cone which is a part of ventricles passing in aorta (left

ventricle) and trunkus pulmonalis (right ventricle), and passes to the dorsal surface. Truncus pulmonalis is the continuation of arterial cone which penetrates under the inferior surface of ascending part of aorta in the place of its transition into the arch (Fig. A.11).

There is anterior interventricular sulcus (sulcus interventricularis anterior), which is located to the left from the arterial cone and goes along the heart to its top. Turning backwards and upwards it passes into the posterior interventricular sulcus (sulcus interventricularis posterior) which joins coronary sulcus on the top.

The main source of blood supply is the left and right coronary arteries (a. coronaria dextra et a. coronaria sinistra). They originate in the Valsalva sinus at the level of upper layers of left and right semilunar valve. In the phase of systole their holes are closed by aortic valve, that is the heart receives blood during diastole when aortic valves are closed.

The left coronary artery (a. coronaria sinistra) goes from the left aortic sinus to the left part of coronary sulcus and is divided into anterior interventricular branch (r. interventricularis anterior) and circumflex branch (r. circumflexus).

The anterior interventricular branch is located in the anterior interventricular sulcus and goes to the apex of the heart (cardiac apex) alongside v. cordis magna. At the apex of the heart it anastomoses with the posterior interventricular branch from the right coronary artery.

The circumflex branch of the left coronary artery is the continuation of its main trunk, it rounds the heart from the left and is observed in the left part of coronary sulcus and on the posterior surface it anastomoses with the right coronary artery.

The right coronary artery (a. coronaria dextra) originates in the

right Valsava sinus and passes between the pulmonary trunk and right auricle, rounds the heart along the right coronary artery, passes into posterior surface of the heart and anastomoses with circumflex branch of the left coronary artery. The largest branch of right coronary artery is r. interventricularis posterior which is located in the right coronary artery and goes to the apex of the heart alongside v. cordis media.

Each coronary artery and their branches have their branchings. Branches of the left coronary artery supply with blood the left pulmonary atrium, anterior and most part of posterior wall of the left ventricle, part of anterior wall of the right ventricle and anterior part of interventricular septum.

The right coronary artery supplies with blood the right atrium, the conducting system of the heart, posterior wall of right and left ventricles, posterior part of interventricular septum, m. papillaris posterior of the left ventricle.

The branches of left and right coronary arteries anastomose with each other and form in the heart two arterial circles: lateral arterial circle located in the coronary sulcus and longitudinal arterial circle which is located in the anterior and posterior interventricular sulcus.

There are three types of blood supply of the heart: right coronary circulation in (90 % of people), left coronary circulation and balanced circulation. In balanced circulation both coronary arteries are developed and two posterior interventricular branches are be observed. In right coronary circulation the branches of right coronary arteries prevail and in left coronary circulation – branches of left coronary arteries. Knowing types of blood circulation helps surgeons to choose correct way in surgical treatment of coronary insufficiency.

### ***Venous drainage***

Most of big veins of the heart are merged into one common vein which is called coronary sinus (sinus coronarius) which is

located in the coronary sulcus on the posterior surface of the heart.

It has the following vessels:

- v. cordis magna which begins on the anterior surface of the heart and goes along anterior interventricular septum;
- v. cordis media is located in the posterior interventricular sulcus;
- v. cordis parva is located in the right part of coronary artery;
- v. posterior ventriculi sinistri is located on the posterior wall of left ventricle;
- v. obliqua atrii sinistri is located on the wall of left pulmonary atrium.

The smallest cardiac veins or Thebesius – Vieussens veins (vv. cordis minimae) in the amount of 20 – 30 small vessels go to the right heart cavity. In cardiac strain (respiratory insufficiency) these vessels drain blood to the right pulmonary atrium.

**Heart innervation** is provided by branches of cervical and thoracic segments of sympathetic trunk and also by branches of vagus nerves (parasympathetic innervation). They form plexus cardiacus on aorta and pulmonary trunk, the branches of which go to the cardiac muscle.

There are many parasympathetic fibres in the ascending part of aorta and pulmonary trunk which are the part of vagus nerves and recurrent laryngeal nerves. Parasympathetic nervous fibres slow down cardiac rhythm and narrow coronary arteries. That is why during the treatment of patients who suffer coronary heart disease plexotomia and coronary artery bypass graft are performed. Plexotomia or cutting of antenodal parasympathetic nervous fibres eliminates coronary arteries spasm. On the other hand cutting of antenodal parasympathetic nervous fibres

eliminates pain syndrome.

Cardiac conduction system plays an important role in physiology and pathology.

Cardiac conduction system (complexus stimulans cordis, s. systema conducente cordis) consists of Keith – Flack node, Aschoff – Tawara node, His bundle which branches in to right and left foot.

Keith – Flack node (nodus sinuatrialis) is atypical cardiomyocytes which are located under the epicardium on anterior surface of right atrium in the place of its merging with v. precava. Its cells are grouped around the central artery of Keith – Flack node. Keith – Flack node is the pacemaker and the source of cardiac automatism, the place of cardiac impulse formation.

Aschoff – Tawara node (nodus atrioventricularis) is located under endocardium of right atrium in its inferior-anterior segment. The node goes into the right fibrous triangle which is located in the place of right tricuspid, bicuspid and aortic valves junction and then it goes into atrioventricular bundle. Atrioventricular bundle goes through membrane of interventricular septum and branches into left and right foot.

A slow rhythm of heart rate (less than 40 beats/min) causes anemia, vertigo and loss of consciousness.

In ineffcient treatment of this condition with antiarrhythmic agents the surgical treatment is prescribed. It is implantation of cardiac pacemaker. It is sewed under hypodermic tissue of infraclavicular part. Electrodes are conducted through the subclavian vein into the right ventricle.

From the congenital heart defects ductus arteriosus is mostly observed. It is a vessel through which the pathological conjunction of aorta and pulmonary trunk is observed after birth.

The arterial canal branches off from the aortic arch at the left subclavian artery and goes obliquely up and down



entering the branching of the pulmonary trunk branching. Mediastinal pleura covers the arterial canal anteriorly. There are two nerves passing anteriorly to ductus arteriosus: vagus nerve and phrenic nerve. The recurrent laryngeal nerve rounds it behind, goes up and passes between the posterior wall of arterial canal and left main bronchus.

## **ESOPHAGUS**

There is esophagus among the organs of posterior mediastinum. Thoracic part of aorta is located from the left and posteriorly. In the inferior part of posterior mediastinum the esophagus shifts to the left and thoracic part of aorta shifts to the right, and esophagus is located anteriorly to aorta in the diaphragmal part (Fig. A.12).

Vagus nerves follow the esophagus forming plexus around it. The azygos vein (v. azygos) is located behind and to the right from esophagus. There are thoracic duct, right intercostal arteries, terminal sections of hemiazygos and accessory hemiazygos veins between azygos vein and aorta, behind esophagus.

The esophagus begins at the level of the 6th rib and going through the superior and posterior mediastinum ends in abdomen at the level of the 11th rib.

There are three parts of esophagus: pars cervicalis, pars thoracica and pars abdominalis. Esophageal stenosis has an important role. The first narrowing is located in the place of transition of pharynx into esophagus and that is why it is called pharyngeal narrowing. Stenosis is caused by musculation of inferior sphincter muscle of pharynx and cricoid cartilage. It is the narrowest place along the entire length of the esophagus which is located at the level of the 6th cervical vertebra called by Kilian as mouse of esophagus.

The second narrowing is called aortal because it is located in the place of crossing of aortic arch by esophagus. It is located at the level of the 4th thoracic vertebra.

The third narrowing is located at the level of the 5th thoracic vertebra in the place of attachment of esophagus to the left bronchus and is called bronchial stenosis.

The fourth narrowing corresponds to the level of esophageal opening and is caused by bundles of muscles around hiatus oesophageus. It is located at the level of intervertebral disk between the 9th–10th intercostal ribs.

The fifth narrowing is located at the section of transferring esophagus into stomach. It is the place of cardiac sphincter. The narrowing has some features:

- in this section stomach turns around its axis;
- there is sharp angle between esophagus and stomach (His angle);
- there is thickness of cardia muscular layer;
- there is fold of mucous membrane in the gastric cavity;
- cardiac sphincter is under control of vagus nerve and diaphragmal sphincter innervates the phrenic nerve.

Cardiac orifice is closed and opens when eating. It opens reflexly during swallowing. As a result of degenerative changes of Auerbach's plexus cardiospasm or esophageal achalasia occurs. Clinically it manifests as three symptoms: dysphagy, regurgitation and pain. The main method of treatment is cardioidosis with tube. If it is not effective then the cardiotomy with fundoplication is used.

In the esophagus narrowings the damages of its wall, tumors, and scars in burns can occur. Foreign bodies of esophagus stay at the level of jugular notch that is at the level of the first narrowing of esophagus.

Esophagus forms two curves. From the level of the 6th

cervical vertebra to the 5th thoracic vertebra it declines to the left from median line. From the level of the 5th to the 8th thoracic vertebra esophagus declines to the right and below the level of the 8th thoracic vertebra it declines to the left turning aorta anteriorly. Such anatomic features of esophagus lead to correct surgical treatment.

Access to the cervical esophagus is sinistral, to the middle thoracic part of esophagus – right transpleural and access to the inferior thoracic segment – left transpleural.

Esophagus goes along vertebra to branching of trachea. At the level of branching it forms the bend turning backwards. It forms the second bend at the crossing with aorta declining frontwards.

Thoracic segment of esophagus is located in the posterior mediastinum from the 2nd thoracic vertebra to diaphragm. There is upper third of esophagus (from the 2nd to the 4th thoracic vertebra) and in the thoracic segment – the inferior third of esophagus which is located from the branching of trachea to diaphragm (from the 8th to the 9th – 10th thoracic vertebra).

In the upper third the esophagus shifts to the left and is located behind and from the left of trachea. Left recurrent laryngeal nerve and left common carotid artery attach to this segment of esophagus which protrudes to the front.

Mediastinal pleura attached on the right to the upper third of esophagus and is separated from it with the tissue. Due to this tissue, pleura is easily separated.

The thoracic duct and left subclavian artery are attached to the esophagus from the left. The middle third of esophagus is located to the right of median line. The aortic arch is attached to the esophagus anteriorly and on the left at the level of the 4th thoracic vertebra. The tracheal

bifurcation, left primary bronchus and tracheobronchial lymph nodes are attached at the level of the 5th thoracic vertebra. The thoracic duct is attached to the esophagus posteriorly. The descending part of aorta is attached on the left. The right vagus nerve and azygos vein are attached to the esophagus on the right.

Pericardium is located anteriorly in the inferior third of esophagus. Aorta is located posteriorly. Right vagus nerve is located on the right and passes to the posterior surface of esophagus. Mediastinal pleura is also located on the right and covers most surface of the third segment of esophagus and passes to its posterior surface. The left vagus nerve is located on the left and anteriorly.

Externally esophagus is covered with loose connective tissue where the vessels and nerves pass. Mediastinal pleura is attached to the lateral surface of esophagus above the root of the right lung. Near the root of the left lung pleura forms the fold which protrudes between vertebra and subclavian artery.

Esophagus is separated from pleura with azygos vein from the right and thoracic part of aorta from the left.

The mediastinal pleura covers the posterior wall of esophagus below the root of the lung from the right. From the left the wall of the esophagus is separated from the pleura with aorta.

The upper segment of esophagus is supplied with blood by inferior thyroid artery, bronchial arteries and esophageal arteries from thoracic part of aorta.

The middle and inferior segments of esophagus are supplied with blood by bronchial and esophageal arteries from thoracic part of aorta, among them the inferior esophageal artery named after Hovelak is distinguished. It departs from thoracic part of aorta at the level of the 8th costal rib. Aorta does not branch off below from the inferior esophageal artery

to the diaphragm.

The abdominal part of esophagus is supplied with blood by branches of the left gastric artery and arteria phrenica inferior.

Bandaging of the left gastric artery or inferior esophageal artery does not break blood supply to the organ. Simultaneous bandaging leads to blood insufficiency.

Venous blood draining is supplied with azygos and hemiazygos veins from the system of prevaca. Venous network of esophageal submucous layer is well developed. In the inferior segment of esophagus its venous network is connected with hepatic portal vein (Fig. A.13).

In hepatic cirrhosis this venous network drain blood from hepatic portal vein to the prevaca. At the same time the veins of inferior segment of esophagus widen and it leads to bleeding. The innervation of the esophagus is provided with azygos nerves (parasympathetic nervous system) and esophageal branches of thoracic part of sympathetic trunk.

Left and right azygos veins which pass along esophagus are available for visual examination and can be easily palpated during surgery.

The lymph is drained from the superior third of thoracic part into the upper tracheo-bronchial lymph nodes. From the inferior third of thoracic part the lymph is drained into periesophageal lymph nodes, coronal lymph nodes and left gastric nodes which are located along the left gastric artery. The immediate lymphatic drainage into thoracic duct is also possible. It explains Virchow's metastases (between the upper edge of the left clavicle and external edge of sternocleidomastoid muscle).

**THORACIC DUCT (ductus thoracicus)** is the biggest lymphatic vessel into which the lymph from the left part of the body, right lower extremity, right part of the pelvis and abdomen, right

posterior part of thoracic cage is drained. The length of the thoracic duct is 30–40 cm and its diameter is 2–4 mm. Over the total length of thoracic duct there are the following valves: one is above the diaphragm, 1–2 are located at the level of aortic arch, 1–2 are located in the cervical part. The thoracic duct is formed in the retroperitoneal space by joining of right and left lumbar trunks (*truncus lumbalis dexter et sinister*) at the level of the 12th thoracic vertebra and the 2nd lumbar vertebra to the right from aorta.

The initial part of thoracic duct has the dilatation (*cisterna chyli*). To the posterior mediastinum the lymphatic duct goes through the aortic hiatus and passes on the anterior surface of vertebra between the descending part of aorta and azygos vein behind esophagus. There are right posterior intercostal arteries, hemiazygos vein and additional hemiazygos vein behind the thoracic duct.

There is esophagus and *n. vagus* anteriorly. From the right the thoracic duct is covered with mediastinal pleura and can be damaged. The dextral chylothorax occurs. Daily long-term loss of several liters of lymph leads to cachexia and that is why in thoracic duct damage it is necessary to ligate it. After ligation of thoracic duct the lymph is drained through bypath.

At the level of the 5th thoracic vertebra the thoracic duct shift to the left and up, passes behind aortic arch and *a. carotis communis sinistra*, *n. vagus* and *v. jugularis interna*, anteriorly from *a. et v. vertebralis* it is attached to the cupula of the pleura forming the arch and turning *a. subclavia*. It drains into the left venous angle which is formed by *v. jugularis interna* and *v. subclavia*.

**AZYGOS VEIN (*v. azygos*)** is the continuation of *v. lumbalis ascendens dextra*. It drains into thoracic cavity through the

hiatus in the right crus of diaphragm. It goes up along the right semicircle of thoracic vertebra, anteriorly from the right posterior intercostal arteries, posteriorly and to the right from esophagus, from the side of the thoracic duct and to the middle of the right sympathetic trunk.

At the level of the 4th thoracic vertebra it shifts anteriorly and turning the root of the right lung goes into v. cava superior.

The branches of v. azygos drain into:

- 1) vv. intercostales posterior dextri;
- 2) v. haemiazygos;
- 3) v. haemiazygos accessoria;
- 4) vv. oesophageales;
- 5) vv. bronchiales;
- 6) vv. pericardiacae;
- 7) vv. mediastinales;
- 8) vv. phrenicae superiores;
- 9) pl. vertebrales internus et externus.

**The hemiazygos vein (v. haemiazygos)** is the continuation of ascending lumbar vein. It goes up along the left semicircle of thoracic vertebra and from the side and behind the thoracic part of aorta, anteriorly and to the middle of sympathetic trunk. At the level of the 6th – 10th thoracic vertebrae it shifts to the middle, goes behind the aorta and sinks into v. azygos.

**ACCESSORY HEMIAZYGOS VEIN (v. hemiazygos accessoria)** takes blood from the left upper posterior intercostal veins. It can sink into hemiazygos vein or azygos vein or into left brachiocephalic vein.

**THORACIC SECTION OF SYMPATHETIC TRUNK** is formed by the 9th – 11th ganglia thoracica which are joined with the help of

interganglionic rami communicantes (rr. interganglionares). The upper thoracic node merges with the inferior cervical node forming common ganglion cervicothoracicum or g. stellatum.

Communicating branches (rr. communicantes) branch off from the nodes to the spinal nerves. From the nodes of sympathetic trunk depart many internal branches which are the part of abdominal and thoracic autonomic plexuses (pl. aorticus thoracicus, pl. cardiacus, pl. oesophageus, pl. pulmonalis, pl. coeliacus, etc.). N. splanchnicus major and n. splanchnicus minor are the biggest branches among the ones of sympathetic trunk.

The visceral branches of the 5th – 11th thoracic vertebrae and their interganglionic rami communicantes go downwards and to the middle along the lateral surface of vertebra and connect to each other forming n. splanchnicus major which penetrates into retroperitoneal space through the hiatus in the crus of diaphragm and is the part of abdominal plexus (plexus coeliacus).

N. splanchnicus minor is formed due to 1 – 4 roots from the 9th to the 11th thoracic nodes. N. splanchnicus imus is formed from the 10th – 11th thoracic nodes. Nn. splanchnicus minor are located from the side of nn. splanchnicus major. Having penetrate into retroperitoneal space they go to the renal and abdominal plexuses.

Both sympathetic trunks are located on the heads of the 6th – 7th upper ribs. They are limited from pleural cavity with parietal pleura, subserous layer and endothoracic fascia.

Posterior intercostal arteries and veins cross sympathetic trunks at the posterior surface and v. azygos and hemiazygos are located anteriorly and to the middle of them.

N. splanchnicus major crosses v. azygos on the right, is attached to anteromedial surface and is located on the anterior



surface of thoracic vertebrae. The left n. splanchnicus major crosses v. hemiazygos accessoria, goes downwards and is located between the vein and aorta. Through the diaphragm the sympathetic trunks go behind and to the side of abdominal nerves.

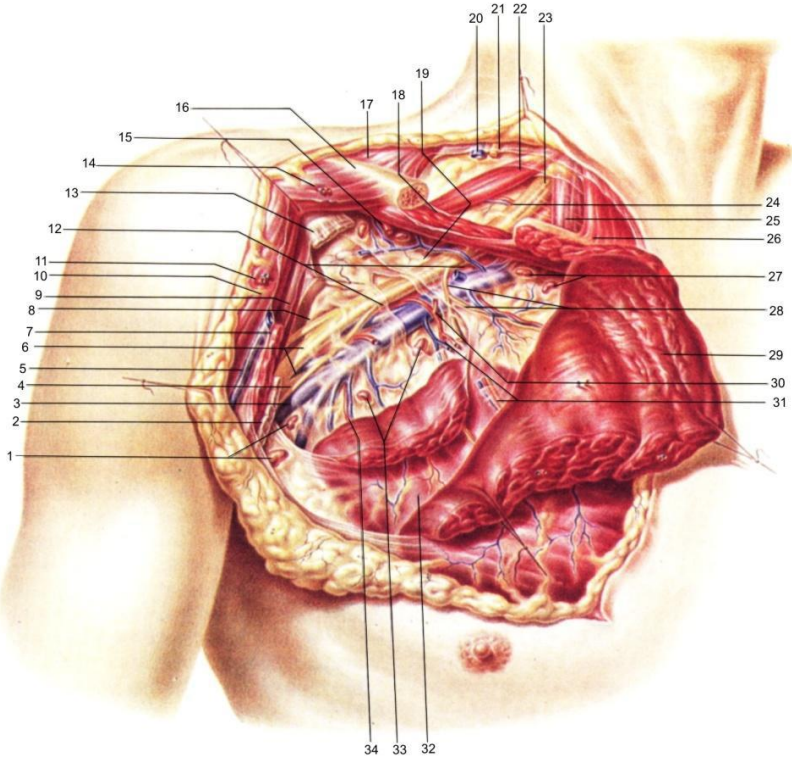
**THE THORACIC PART OF AORTA (pars thoracica aortae)**, or thoracic aorta (aorta thoracica) is the part of descending aorta from the level of the 4th thoracic vertebra to the aortic hiatus (level of the 9th – 10th thoracic vertebrae).

It is located along the anterior surface of thoracic vertebra. There is mediastinal pleura and left sympathetic trunk from the left. There is the root of sympathetic trunk anteriorly, esophagus and nn. vagi anteriorly and to the right, thoracic duct posteriorly and to the right, azygos vein on the right, hemiazygos and accessory hemiazygos veins posteriorly.

To the organs and walls of thoracic cavity the thoracic aorta gives the following branches:

- 1) rr. bronchiales;
- 2) rr. oesophagei;
- 3) rr. pericardiaci;
- 4) rr. mediastinales;
- 5) aa. phrenicae superiores;
- 6) aa. intercostales posteriores.

## **APPENDIX**



**Figure A.1** – Topography of vessels and nerves of the infraclavicular region:

1 – nodi lymphatici axillares; 2 – m. latissimus dorsi; 3 – v. axillaris; 4 – n. cutaneus antebrachii medialis; 5 – v. cephalica; 6 – n. medianus; 7 – m. pectoralis major; 8 – n. musculocutaneus; 9 – m. coracobrachialis; 10 – m. deltoideus; 11 – r. deltoideus a. thoracoacromialis; 12 – a. axillaris et a. subclavia; 13 – m. pectoralis minor; 14 – r. deltoideus a. thoracoacromialis; 15 – r. acromialis a. thoracoacromialis; 16 – clavicula; 17 – m. trapezius; 18 – m. subclavius; 19 – plexus brachialis (pars infraclavicularis); 20 – v. jugularis externa; 21 – n. supraclavicularis anterior; 22 – m. omohyoideus (venter inferior); 23 – plexus brachialis (pars supraclavicularis); 24 – a. et v. transversa colli; 25 – m. scalenus anterior; 26 – m. sternocleidomastoideus; 27 – nodi lymphatici infraclaviculares; 28 – nn. thoracales anteriores; 29 – m. pectoralis major; 30 – a. thoracoacromialis; 31 – rami pectorales a. thoracoacromialis; 32 – m. pectoralis minor; 33 – nodi lymphatici subpectoriales; 34 – a. et v. thoracica lateralis

Continuation of Appendix A

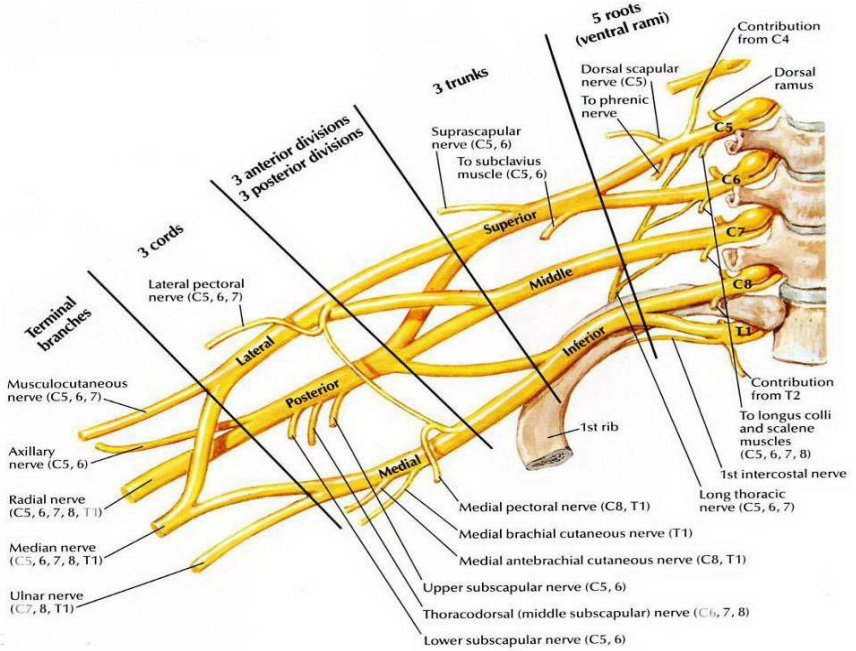
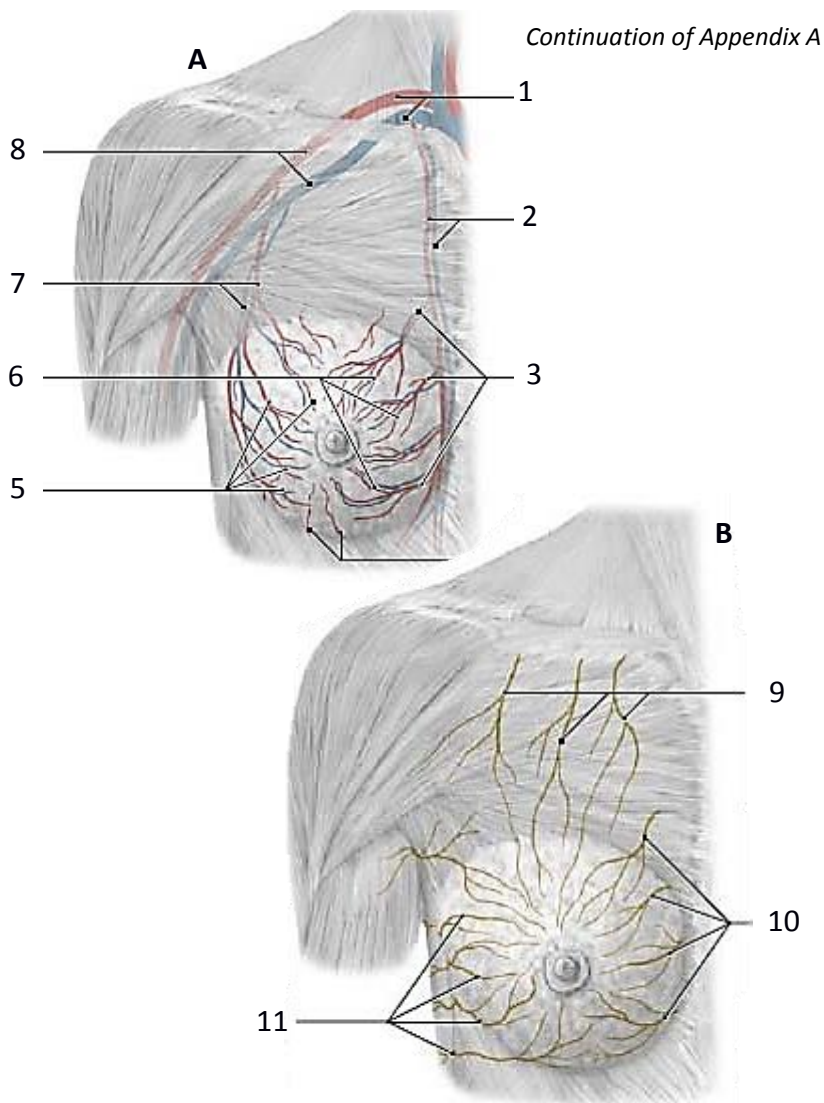


Figure A.2 – Brachial plexus

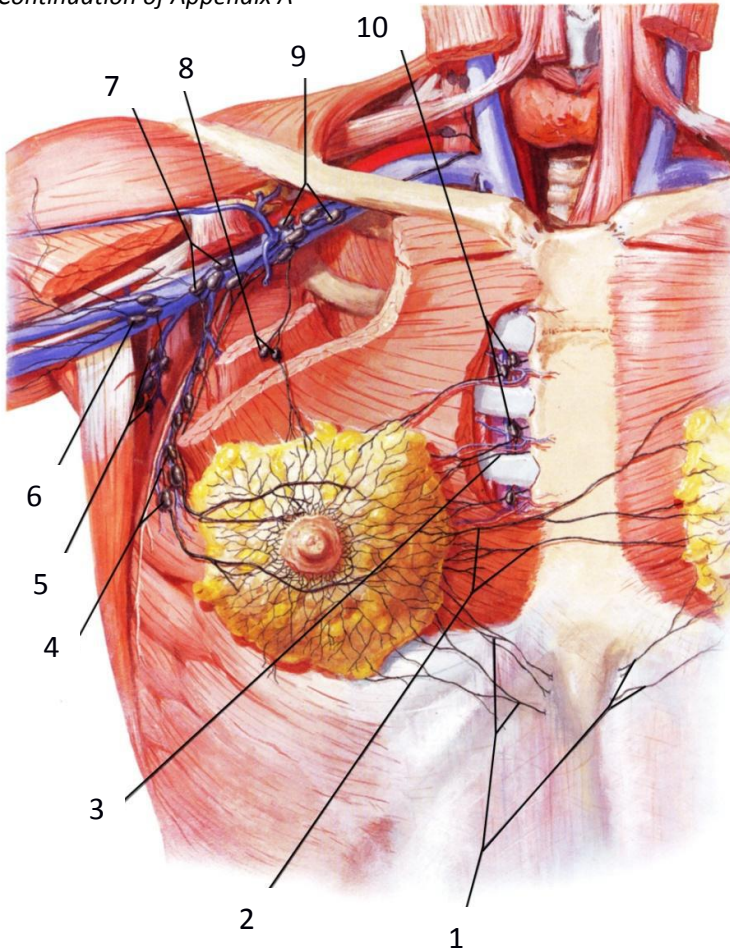


**Figure A.4 – Sensory innervation of the breast:**

**A:** 1 – subclavian a. and v.; 2 – internal thoracic a. and v.; 3 – perforating branches; 4 – mammary branches; 5 – lateral mammary branches; 6 – medial mammary branches; 7 – lateral thoracic a. and v.; 8 – axillary a. and v.;

**B:** 9 – supraclavicular nn.; 10 – intercostal nn., medial mammary branches; 11 – intercostal nn., lateral mammary branches

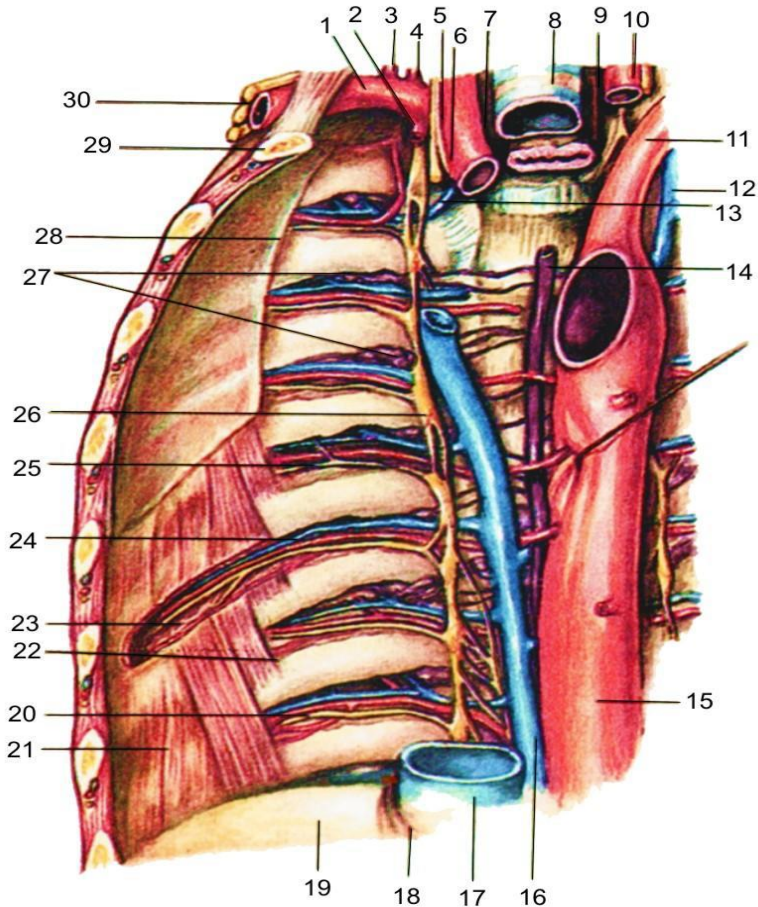
Continuation of Appendix A



**Figure A.5** – Lymphatic drainage from mammary gland:

**1** – lymphatic drainage to the inferior diaphragmatic nodes; **2** – lymphatic drainage to the contralateral mammary gland; **3** – lymphatic drainage to the anterior mediastinal nodes (nodi mediastinales anteriores); **4** – nodi axillares pectorales; **5** – nodi axillares brachiales; **6** – nodi axillares subscapulares; **7** – nodi axillares centrales; **8** – nodi axillares interpectoriales; **9** – nodi axillares apicales; **10** – nodi parasternales

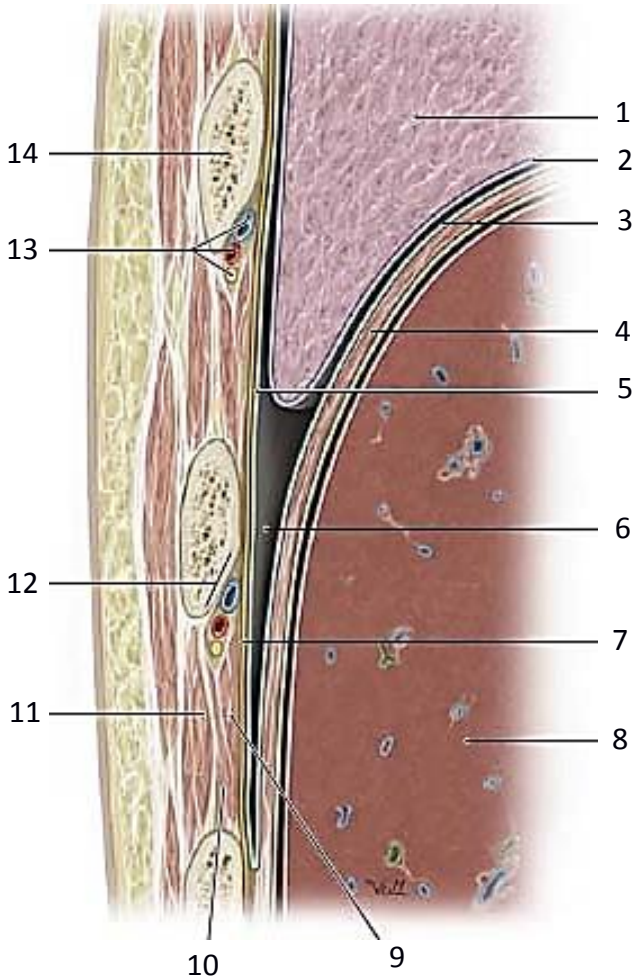
*Continuation of Appendix A*



**Figure A.6** – Topography of intercostal vessels and nerves:

1, 11 – a. subclavia; 2 – a. thoracica interna; 3 – truncus thyrocervicalis; 4 – a. vertebralis; 5 – n. vagus dexter; 6 – n. laryngeus recurrens dexter; 7 – truncus brachiocephalicus; 8 – trachea; 9 – esophagus; 10 – a. carotis communis sinistra; 12 – v. hemiazygos accessoria; 13 – v. intercostalis suprema; 14 – ductus thoracicus; 15 – aorta (pars thoracica); 16 – v. azygos; 17 – v. cava inferior; 18 – pericardium; 19 – diaphragm; 20 – n. intercostalis; 21 – mm. subcostales; 22 – mm. intercostales externi; 23 – m. intercostalis internus; 24 – a., v. intercostalis; 25 – r. communicans trunci sympathici; 26 – truncus sympathicus; 27 – nodi lymphatici intercostales; 28 – pleura costalis; 29 – 1st rib; 30 – plexus brachialis

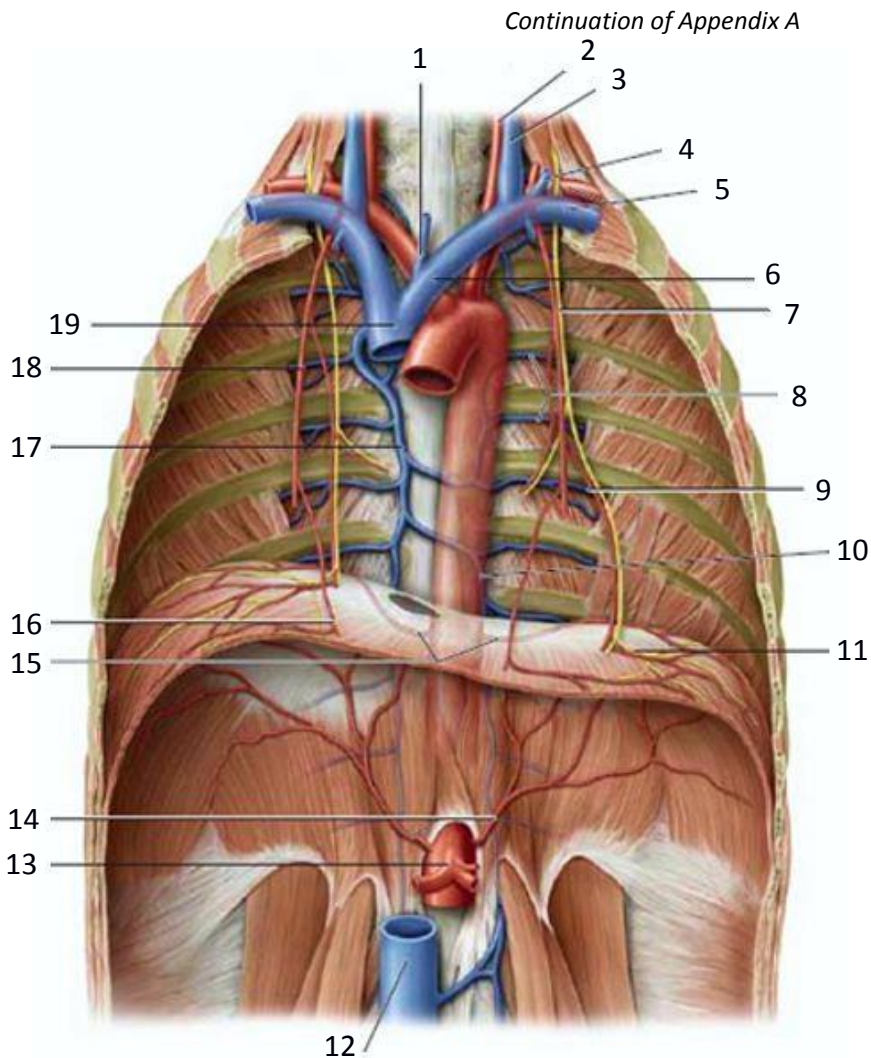
*Continuation of Appendix A*



**Figure A.7** – Course of the intercostal nerves:

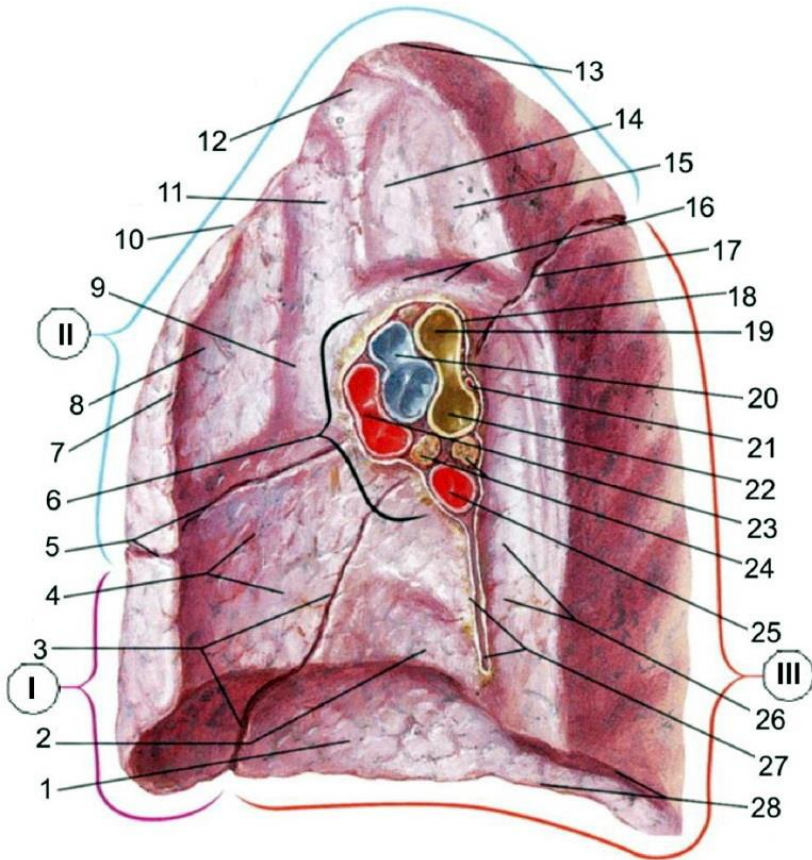
**1** – right lung; **2** – visceral pleura; **3** – parietal pleura, diaphragmatic part; **4** – diaphragma; **5** – parietal pleura, costal part; **6** – costodiaphragmatic recess; **7** – endothoracic fascia; **8** – liver; **9** – innermost intercostal; **10** – internal intercostal; **11** – external intercostal; **12** – costal groove; **13** – intercostal v., a., and n.; **14** – 8th rib





**Figure A.8** – Neurovasculature of the diaphragm. Anterior view of opened thoracic cage: 1 – inferior thyroid v.; 2 – common carotid a.; 3 – left internal jugular v.; 4 – left external jugular v.; 5 – left subclavian a. and v.; 6 – left brachiocephalic v.; 7 – left phrenic n.; 8 – posterior intercostal vv.; 9 – pericardiophrenic a.; 10 – hemiazygos v.; 11 – phrenic n.; 12 – inferior vena cava; 13 – celiac trunk; 14 – inferior phrenic aa.; 15 – superior phrenic aa.; 16 – musculophrenic a.; 17 – azygos v.; 18 – internal thoracic a.; 19 – superior vena cava

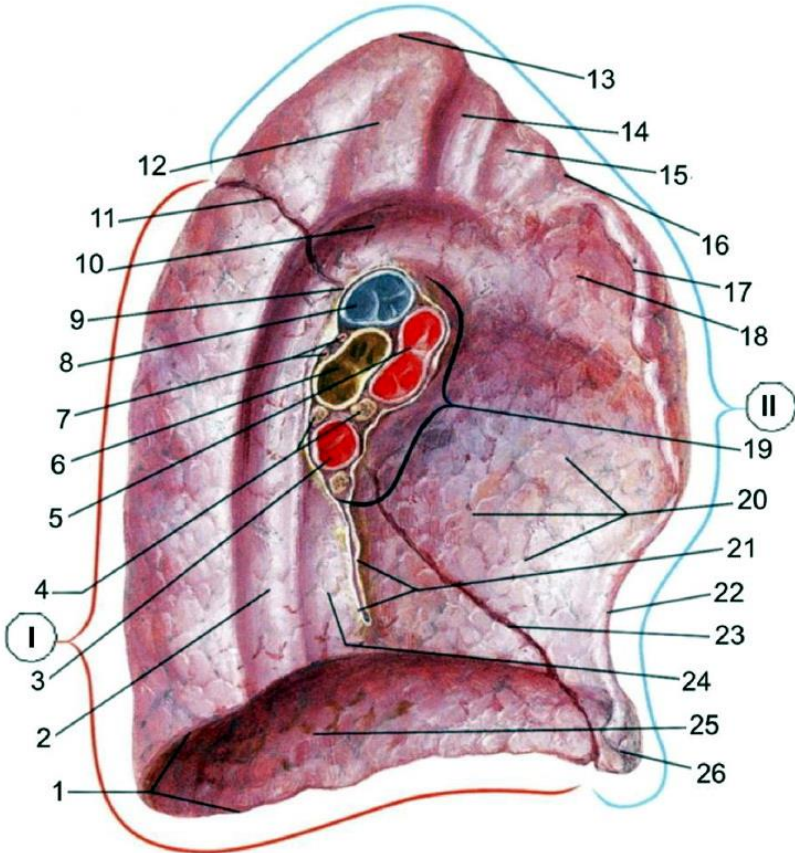
Continuation of Appendix A



**Figure A.9 (a)** – Topography of the right lung elements:

I – lobus medius; II – lobus superior; III – lobus inferior; 1 – facies diaphragmatica; 2 – depression from postcava; 3 – fissura obliqua; 4 – impressio cardiaca; 5 – fissura horizontalis; 6 – hilum pulmonis; 7 – margo anterior; 8 – the section of thymus and fatty tissue of anterior mediastinum; 9 – depression from precava; 10 – depression from the first rib; 11 – depression from brachiocephalic veins; 12 – depression from subclavian artery; 13 – apex; 14 – depression from trachea; 15 – depression from esophagus; 16 – depression from azygos vein; 17 – fissura obliqua; 18 – pleura visceralis; 19 – bronchus lobaris superior dexter; 20 – a. pulmonalis dextra; 21 – ramus bronchialis; 22 – right lobar bronchi; 23 – v. pulmonalis dextra superior; 24 – nodi lymphatici bronchopulmonales; 25 – v. pulmonalis dextra inferior; 26 – depression from esophagus; 27 – lig. pulmonale; 28 – margo inferior

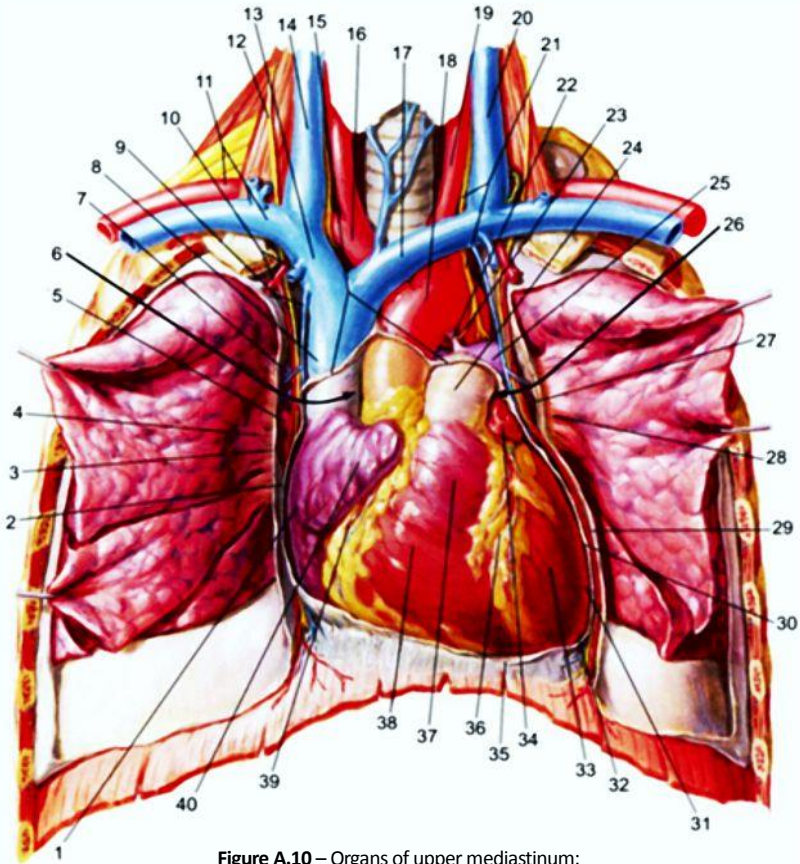
Continuation of Appendix A



**Figure A.9 (b)** – Topography of the left lung elements:

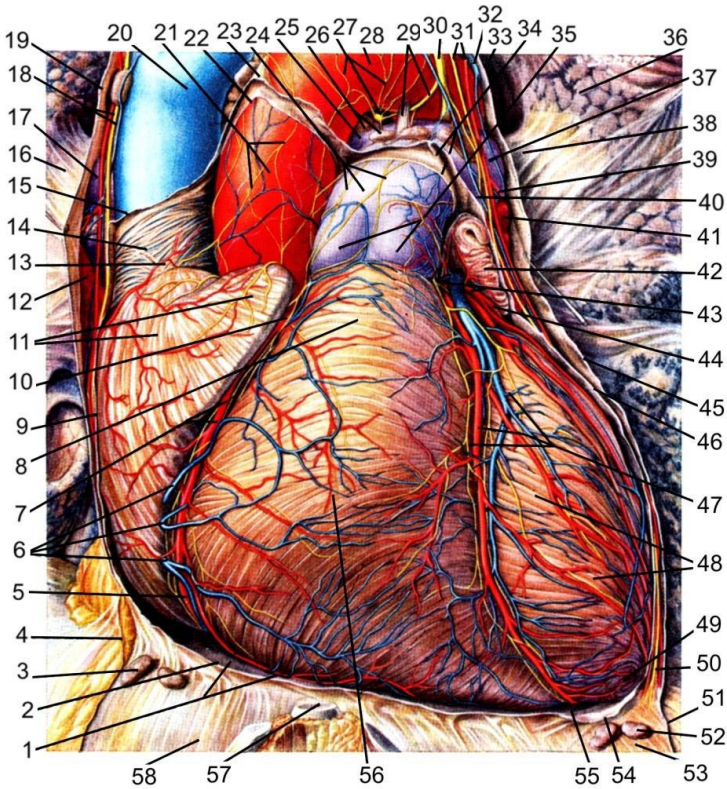
I – lobus inferior; II – lobus superior; 1 – margo inferior; 2 – depression from descending aorta; 3 – v. pulmonalis inferior; 4 – nodi lymphatici bronchopulmonales; 5 – v. pulmonalis sinistra superior; 6 – bronchus principalis sinister; 7 – rami bronchiales; 8 – a. pulmonalis sinistra; 9 – pleura; 10 – depression from aortic arch; 11 – fissura obliqua; 12 – depression from trachea and esophagus; 13 – apex; 14 – depression from subclavian artery; 15 – depression from brachiocephalic veins; 16 – depression from the first rib; 17 – margo anterior; 18 – the section of thymus and fatty tissue of anterior mediastinum; 19 – hilum pulmonis; 20 – impressio cardiaca; 21 – lig. pulmonale; 22 – incisura cardiaca; 23 – fissura obliqua; 24 – depression from esophagus; 25 – facies diaphragmatica; 26 – lingula

Continuation of Appendix A



**Figure A.10** – Organs of upper mediastinum:

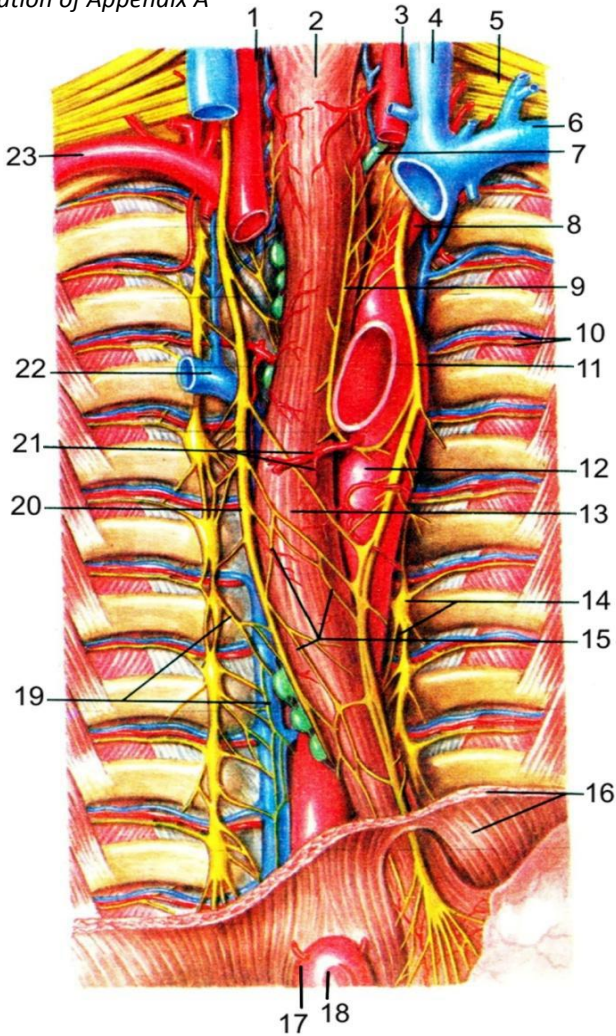
1 – atrium dextrum; 2 – pericardium; 3 – pleura parietalis, pars medialis; 4 – hilum pulmonis; 5 – v. pulmonalis dextra superior; 6 – sinus transversus pericardii; 7 – a. pulmonalis dextra; 8 – v. cava superior; 9 – n. phrenicus, a. et v. pericardiophrenica; 10 – a. et v. thoracica interna; 11 – a. et v. subclavia; 12 – n. phrenicus; 13 – v. brachiocephalica dextra; 14 – v. jugularis interna; 15 – pericardium; 16 – truncus brachiocephalicus; 17 – v. brachiocephalica sinistra; 18 – arcus aortae; 19 – a. carotis communis; 20 – v. jugularis interna; 21 – n. vagus (X); 22 – lig. arteriosum; 23 – n. laryngeus recurrens; 24 – truncus pulmonalis; 25 – a. pulmonalis sinistra; 26 – sinus transversus; 27 – v. pulmonalis; 28 – hilum pulmonis; 29 – pleura parietalis pars mediastinalis; 30 – pericardium; 31 – obtuse region of the heart; 32 – apex cordis; 33 – ventriculus sinister; 34 – auricula sinistra; 35 – sharp region of the heart; 36 – sulcus interventricularis anterior et ramus interventricularis anterior a. coronariae sinistrae; 37 – conus arteriosus; 38 – ventriculus dexter; 39 – sulcus coronarius et a. coronaria dextra; 40 – auricula dextra



**Figure A.11 – Heart:**

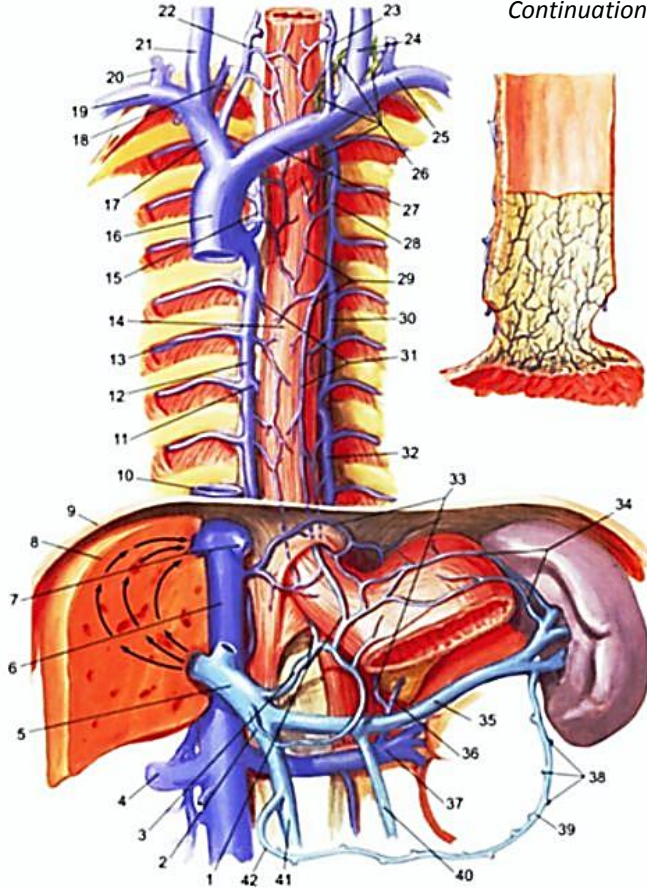
1 – r. marginalis a. coronariae d., margo acutus; 2 – pericardium; 3 – nodus lymph. mediast. ant.; 4 – pleura mediast.; 5 – a. coronaria d. (r. circumflexus) sulcus coron.; 6 – vv. cordis minimae; 7 – a. coronaria d., plexus coron.; 8 – conus art. ventric. d.; 9 – pericardium; 10 – a. coronaria d., sulcus coron.; 11 – auricula dextra; 12 – v. pulm. sup.; 13 – nodus sinuatrialis (Keith – Flack); 14 – v. cava sup.; 15 – pericardium; 16 – radix pulmonalis; 17 – a. pulmon. dextra; 18 – n. phren., a. pericardiophren.; 19 – pleura mediast.; 20 – v. cava sup.; 21 – aorta asc., plexus card. aortae; 22 – epicardium aortae; 23 – pericardium; 24 – a. pulmon., plexus card.; 25 – a. pulm. d.; 26 – nodi lymph. (cordis propr.); 27 – ganglion card. inf., plexus card. superf.; 28 – arcus aortae; 29 – n. recurrens sin., lig. art. (Botalli); 30 – n. vagus sin.; 31 – n. phrenicus sin., a. pericardiophren.; 32 – v. hemiazgygos access.; 33 – pleura mediast.; 34 – epicardium a. pulmonalis; 35 – bulbus arteriae pulmon.; 36 – pulmon. sin.; 37 – a. pulmon. sin.; 38 – radix pulmon. sin.; 39 – a., v. bronchialis ant.; 40 – pericardium; 41 – v. pulm. sup.; 42 – auricula sin.; 43 – a. coronaria sin., v. cordis magna; 44 – r. circumflexus a. coronariae sin.; 45 – pleura mediast.; 46 – pericardium; 47 – r. interventric. ant., v. cordis magna, sulcus interventr. ant., plexus coron.; 48 – ventric. sin.; 49 – apex cordis (vortex); 50 – n. phrenicus sin.; 51 – pleura mediast.; 52 – nodus lymph. mediast. ant. inf.; 53 – diaphragm; 54 – pericardium; 55 – incisura apicis cordis; 56 – ventric. dexter (myocardium); 57 – proc. xiph. sterni; 58 – diaphragm

Continuation of Appendix A



**Figure A.12** – Topography of esophagus:

1 – a. carotis communis dextra; 2 – pharynx; 3 – a. carotis communis sinistra; 4 – v. jugularis interna sinistra; 5 – plexus brachialis; 6 – v. subclavia sinistra; 7 – ductus thoracicus; 8 – a. subclavia sinistra; 9 – n. laryngeus recurrens sinister; 10 – a., v. et n. intercostales; 11 – n. vagus sinister; 12 – aorta thoracica; 13 – esophagus; 14 – truncus sympathicus; 15 – plexus esophageus nn. vagorum; 16 – diaphragm; 17 – aorta abdominalis; 18 – truncus coeliacus; 19 – n. splanchnicus major; 20 – n. vagus dexter; 21 – rr. esophagei aortae; 22 – v. azygos; 23 – a. subclavia dextra



**Figure A.13** – Esophageal veins:

1 – rami oesophageales; 2 – v. gastrica dextra; 3 – v. gastrica sinistra; 4 – v. renalis dextra; 5 – v. portae hepatis; 6 – v. cava inferior; 7 – vv. hepaticae; 8 – liver; 9 – diaphragm; 10 – v. cava inferior; 11 – place of entrance of hemiazygos vein into azygos vein; 12 – v. azygos; 13 – v. intercostalis; 14 – oesophagus; 15 – v. intercostalis superior dextra; 16 – v. cava superior; 17 – v. brachiocephalica dextra; 18 – v. vertebralis; 19 – v. subclavia; 20 – v. jugularis externa; 21 – v. jugularis interna; 22 – right v. thyroidea inferior; 23 – left v. thyroidea inferior; 24 – v. jugularis interna; 25 – v. subclavia; 26 – ductus thoracicus; 27 – v. brachiocephalica sinistra; 28 – v. hemiazygos accessoria; 29 – vv. oesophageales; 30 – v. hemiazygos; 31 – vv. comitantes n. vagi; 32 – v. hemiazygos; 33 – vv. phrenica inferiores; 34 – vv. gastricae breves; 35 – v. splenica; 36 – v. suprarenalis sinistra; 37 – v. renalis sinistra; 38 – vv. omentales; 39 – v. gastroenterica sinistra; 40 – v. mesenterica inferior; 41 – v. mesenterica superior; 42 – v. gastroenterica dextra

## Test questions

1. What vessels and nerves are identified in subcutaneous cellular tissue of subclavian region:
  - + nn. supraclaviculares, rr. cutanei anteriores, rr. cutanei laterales, v. thoracoepigastrica, v. cephalica;
  - a. thoracica lateralis, n. thoracicus longus, n. musculocutaneus, a. et v. thoracodorsalis, nn. intercostobrachiales;
  - nn. pectorales medialis, nn. pectorales lateralis, a. thoracica lateralis, a. thoracica suprema, n. thoracicus longus;
  - nn. supraclaviculares, rr. cutanei anteriores, v. basilica?
2. How is acute thrombophlebitis of subcutaneous veins of the anterior chest wall called:
  - + Mondor's disease;
  - Paget – Schroetter's syndrome;
  - Wright syndrome;
  - Grave's disease?
3. Where is superficial subpectoral space identified:
  - + between the deep leaf of fascia pectoralis and fascia clavipectoralis;
  - between the superficial leaf of fascia pectoralis and fascia clavipectoralis;
  - between the leaves of superficial fascia;
  - between the posterior surface of m. pectoralis minor and thoracic wall?
4. What anatomical formations delimit superficial and deep subpectoral space of breast:
  - + minor thoracic muscle and deep leaf of proper fascia of breast (clavicular costal fascia);



- minor thoracic muscle and superficial leaf of proper fascia;
- major thoracic muscle and superficial leaf of proper fascia;
- major thoracic muscle and superficial fascia?

5. Where is the deep subpectoral space identified:

- + between the posterior surface of m. pectoralis minor and chest walls;
- between the deep leaf of fascia pectoralis and fascia clavipectoralis;
- between the leaves of proper fascia;
- between the deep leaf of fascia pectoralis and fascia clavipectoralis?

6. What vessels and nerves are identified in the cellular tissue of superficial subpectoral space:

- + branches of a. thoracoacromialis, nn. pectorales medialis, nn. pectorales lateralis;
- a. thoracica lateralis, a. thoracica suprema, n. thoracicus longus;
- a. circumflexa humeri anterior, v. cephalica;
- branches of a. thoracica lateralis, a. thorocodorsalis?

7. What incision can expose subpectoral abscess:

- + along the inferior margin of major thoracic muscle;
- along the superior margin of minor thoracic muscle;
- along the margin of the broadest muscle of back;
- along the superior margin of major thoracic muscle?

8. What is the passage of v. axillaris in relation to the elements of neurovascular fascicule in trigonum clavipectorale:

- + v. axillaris – inferiorly, medially and anteriorly from a. axillaris;

- v. axillaris – inferiorly, laterally and anteriorly from a. axillaris;
- v. axillaris – superiorly and posteriorly from a. axillaris;
- v. axillaris – medially and anteriorly from plexus brachialis?

9. What is the passage of plexus brachialis in relation to the elements of neurovascular fascicle in trigonum clavipectorale?

- + plexus brachialis – superiorly and posteriorly from a. axillaris;
- plexus brachialis – inferiorly, medially and anteriorly from a. axillaris;
- plexus brachialis – superiorly and posteriorly from a. axillaris;
- plexus brachialis – medially and anteriorly from v. axillaris?

10. Identify the branches of a. axillaris in trigonum clavipectorale:

- + a. thoracica suprema, a. thoracoacromialis;
- a. thoracica lateralis;
- a. thoracica interna, a. transversa colli;
- a. circumflexa humeri anterior et posterior?

11. Identify the branches of a. axillaris in trigonum pectorale:

- + a. thoracica lateralis;
- a. thoracica suprema, a. thoracoacromialis;
- a. circumflexa humeri anterior et posterior;
- a. thoracica interna, a. transversa colli?

12. What is the frequency of usage of subclavian vein catheterization:

- + all of the following;
- constant placement, strict topographic-anatomic orienteer;
- has a significant lumen, does not stick;
- has high rate of blood circulation?

13. What is the reason of the puncture of right subclavian vein below the clavicle:

+ all of the following:

- large veins and thoracic lymphatic duct enter the upper wall of v. subclavia;
- above the clavicle located near the cupola of the pleura;
- below the clavicle the cupola of the pleura is separated from the vein by the 1st rib?

14. Determine the most appropriate point for v. subclavia puncture:

+ Abaniak's point;

- Yoffe's point;

- Erb's point;

- Gueneau de Mussy's point?

15. Where is Abaniak's point identified:

+ 1 cm below the boundary of medial and internal third of the clavicle;

- 1 cm above the boundary of medial and internal third of the clavicle;

- 1 cm below the middle of the clavicle;

- a little bit higher than the apex of the angle formed by lateral crus of sternocleidomastoid muscle and superior margin of the clavicle?

16. Where is Yoffe's point identified:

+ a little bit higher than the apex of the angle formed by lateral crus of sternocleidomastoid muscle and superior margin of the clavicle;

- between the crura of sternocleidomastoid muscle;

- 1 cm below the border of medial and internal third of the clavicle;
- 1 cm below the middle of the clavicle?

17. What is the adequate technique of subclavian vein puncture by Abaniak's method:

- + the needle is injected at a 45-degree angle to clavícula, at a 30-degree angle to the surface of the thorax, the cut is turned forwards and downwards, the needle is directed backwards and upwards, to the middle of superior margin of costal clavicular conjunction;
- the needle is injected focusing on the edge of the patient's nose, at a 45-degree angle to clavícula, to the surface of the chest, the cut is turned forwards and downwards;
- a little bit higher than the apex of the angle formed by the lateral crus of sternocleidomastoid muscle and superior margin of clavicle, to the middle of superior margin of sternoclavicular conjunction;
- all the above mentioned?

18. Characterize the technique of subclavian vein catheterization by Seldinger method:

- + with the needle the conductor is introduced to the vein, the needle is removed, through the conductor the catheter is introduced;
- with the needle the catheter is introduced to the vein, through the catheter the conductor is introduced;
- the needle is injected at a 45-degree angle to the surface of the chest, with the needle the catheter is introduced to the vein;
- all the above mentioned?

19. What symptoms develop at subclavian vein compression in costoclavicular interspace:

- + Paget – Schroetter syndrome;
- Mondor's disease;
- Grave's disease;
- Takayasu syndrome?

20. What is Paget – Schroetter syndrome characterized by:

- + progressive swelling resulting in disturbances of blood circulation in limbs, severe pain and cyanosis of the limb;
- dizziness, sonitus, reduction of visual acuity, headaches, paraesthesia;
- neurotrophic disturbances in minor thoracic muscle;
- all the above mentioned?

21. What are the methods of surgical treatment of Paget – Schroetter syndrome:

- + all of the following;
- thrombectomy with the help of Fogarty catheter;
- decompression of vein by excision of subclavian muscle and 1st rib;
- the shunt between the subclavian vein and internal jugular vein, or direct anastomosis between the external jugular vein and subclavian vein?

22. What vessels participate in the collateral blood circulation forming "scapular arterial circle" when subclavian artery is ligated:

- + r. profundus a. transversa colli → a. suprascapularis → a. circumflexa scapulae;

- a. circumflexa humera → a. thoracica lateralis → a. thoracica interna;
- a. thoracica suprema → a. axillaris → a. suprascapularis;
- a. cervicalis superficialis → a. suprascapularis → a. circumflexa scapulae?

23. What are the sources of blood supply of mammary gland:

- + a. thoracica interna, a. thoracica lateralis, aa. intercostales;
- a. thoracoacromialis, a. thoracica suprema, a. epigastrica superior;
- a. suprascapularis, a. circumflexa scapulae, a. axillaris;
- a. circumflexa humeri anterior et posterior?

24. What lymphatic nodes are more likely to metastasize in case of breast cancer:

- + nodi lymphatici pectorales (Zorgius nodes), nodi lymphatici axillares;
- nodi lymphatici parasternales, nodi lymphatici intercostales;
- deep cervical lymphatic nodes?

25. What is the major surgical method to treat benign tumors of mammary gland:

- + sectoral resection;
- Patey's mastectomy;
- Halsted – Meyer mastectomy;
- Urban – Holdin mastectomy?

26. What incision is used to expose intramammary abscesses:

- + Angerer's incision;
- Bardenheuer – Morestin incision;
- Gosse incision;
- Orr incision?

27. What incision is used to expose retromammary abscesses:

- + Bardenheuer – Morestin;
- Angerer's incision;
- Gosse;
- Orr?

28. Who is the author of the most frequently used and typical incision in radical mastectomy:

- + Gosse;
- Angerer;
- Orr;
- Bardenheuer – Morestin?

29. Name the author of arciform incision to approach the subclavian artery:

- + Dzhanelidze;
- Petrovsky;
- Bardenheuer;
- Langenbeck?

30. Name the author of T-like incision to approach the subclavian artery:

- + Petrovsky;
- Dzhanelidze;
- Kocher;
- Langenbeck?

31. What vessels and nerves run in deep subpectoral space:

- + a. et v. thoracica lateralis, n. thoracicus longus;
- v. cephalica, a. et v. axillaris;
- plexus brachialis;
- a. thoracica interna, aa. intercostales?

32. Who is the author of radical mastectomy when major and minor thoracic muscles are removed:

- + Halsted and Meyer;
- Urban and Holdin;
- Patey;
- Holdin?

33. Name the author of radical mastectomy when only minor thoracic muscle is removed:

- + Patey;
- Halsted;
- Meyer;
- Urban?

34. Name the authors of supraradical mastectomy:

- + Urban and Holdin;
- Patey;
- Halsted and Meyer;
- Petrovsky – Dzhanelidze?

35. Where is the ligature in subclavian artery ligation performed:

- + distally from truncus thyrocervicalis;
- proximally from truncus thyrocervicalis;
- distally from truncus costocervicalis;
- proximally from truncus costocervicalis?

36. What is Fogarty catheter during operations on vessels used for:

- + for thrombectomy;
- for prolonged intravenous infusion of medication;



- for intravenous urography;
- for the puncture of subclavian vein?

37. Where is cellular tissue that can be damaged in retromammary mastitis located:

- + behind the capsule of mammary gland;
- subcutaneously;
- between the leaves of suspensory ligament of mammary gland;
- beneath the minor thoracic muscle?

38. Identify the localization of Zorgius lymph node which is first damaged by metastasis in breast cancer:

- + beneath the external margin of major thoracic muscle at the level of the 3rd rib;
- above the clavicle behind the external margin;
- along the passage of the internal thoracic artery;
- in the center of fovea inguinalis?

39. What fascia forms a capsule of mammary gland:

- + superficial fascia of the breast;
- superficial leaf of proper fascia of the breast;
- clavicular costal fascia;
- visceral fascia?

40. What is supporting ligament of mammary gland attached to:

- + clavicle;
- coracoid process of scapula;
- big tubercle of humeral bone head;
- acromion process of scapula?

41. Within what triangle are superficial and deep subpectoral spaces joined:

- + clavicular costal triangle;
- thoracic triangle;
- subcostal triangle;
- the spaces are not joined?

42. In what layer is retromammary cellular space identified:

- + between the superficial fascia and superficial leaf of proper fascia of breast;
- between the major thoracic muscle and clavicular costal fascia;
- under the minor thoracic muscle;
- under the clavicular costal fascia?

43. What incision in suppurative subareolar mastitis is more reasonable from the anatomic point of view:

- + by the outer peripapillary circle;
- radial behind the peripapillary circle;
- by the transitional plicae of mammary gland;
- radial with the cut on peripapillary circle?

44. What incision in suppurative retromammary mastitis is more reasonable from the anatomic point of view:

- + by the transitional plicae, under the mammary gland;
- by the outer peripapillary circle;
- radial behind the peripapillary circle;
- radial with the cut on peripapillary circle?

45. What incision in suppurative intramammary (interstitial or parenchymatous) mastitis is more reasonable from the anatomic point of view:

- + radial behind the peripapillary circle;

- by the outer peripapillary circle;
- transverse incision above the inflamed organ;
- radial with the incision of peripapillary circle?

46. Identify the direction of incision to expose intramammary (parenchymatous and interstitial) mastitis:

- + radial direction;
- semicircular direction;
- oblique direction;
- vertical direction?

47. How long do external intercostal muscles extend:

- + from the head of the rib to the cartilaginous part of the rib;
- from the costal angle to the costal margin;
- from the head of the rib to the costal angle;
- from the costal margin to costal angles?

48. How long do internal intercostal muscles extend:

- + from the costal margin to costal angles;
- from the head of the rib to the cartilaginous part of the rib;
- from the vertebral column to the cartilaginous part of the rib;
- from the head of the rib to the costal margin?

49. How are the elements of neurovascular fascicle located from above to below:

- + vein, artery, nerve;
- artery, vein, nerve;
- artery, nerve, vein;
- nerve, vein, artery?

50. What arteries supply intercostal interspaces with blood:
- + aa. intercostales anteriores, aa. intercostales posteriores,
    - a. intercostalis suprema, a. thoracica suprema,
    - a. musculophrenica;
  - a. epigastrica superior, a. phrenica inferior, a. lumbales, truncus celiacus, a. suprascapularis;
  - aa. intercostales anteriores, aa. intercostales posteriores,
    - a. intercostalis suprema, a. epigastrica superior, a. phrenica inferior;
  - no right answer?

51. What is the passage of the right intercostal arteries:
- + behind the esophagus, thoracic duct, v. azygos and truncus sympathicus;
  - in front of truncus sympathicus, esophagus, thoracic duct, v. hemiazygos;
  - laterally from truncus sympathicus, esophagus, thoracic duct;
  - medially from thoracic duct, v. hemiazygos?

52. Where do left intercostal arteries pass:
- + behind v. hemiazygos and truncus sympathicus;
  - behind esophagus and thoracic duct;
  - in front of truncus sympathicus and esophagus;
  - in front of thoracic duct and v. hemiazygos?

53. What is identified behind aa. intercostales posteriores on the way from the head to the angle of the rib:
- + mm. intercostales externi;
  - mm. intercostales interni;
  - fascia endothoracica, subpleural cellular tissue, parietal pleura;
  - mm. transversus thoracis?

54. What is identified in front of aa. intercostales posteriores on the way from the head to the angle of the rib:

- + fascia endothoracica, subpleural cellular tissue, parietal pleura;
- mm. intercostales externi;
- mm. intercostales interni;
- mm. transversus thoracis?

55. Where do posterior intercostal arteries run on the way from scapular to the medial inguinal line:

- + in the costal sulcus, between intercostal muscles;
- below the proper rib;
- above the proper rib;
- in front of the proper rib?

56. Where do posterior intercostal arteries run on the way between the head and the angle of the rib:

- + below the rib located on the internal surface of mm. intercostales externi covered by fascia endothoracica, subpleural cellular tissue, parietal pleura;
- in costal groove, between intercostal muscles;
- above the rib;
- in front of the rib?

57. Where does a. thoracica interna run and what does it branch off:

- + lower semicircle of a. subclavia in trigonum scalenovertebrale;
- a. subclavia in spatium antescalenum;
- a. carotis communis in trigonum caroticum;
- pars descendens aortae in the chest?

58. What branches is internal thoracic artery divided into:

- + a. epigastrica superior and a. musculophrenica;
- a. epigastrica inferior and a. pericardiacophrenica;
- aa. intercostales posteriores and aa. mediastinales;
- aa. phrenicae superiores and rr. sternalis?

59. Where does blood from the anterior intercostal veins flow:

- + into v. thoracica interna;
- into v. azygos;
- into v. hemiazygos;
- into v. hemiazygos accessoria?

60. Where does blood from the posterior right intercostal veins flow:

- + into v. azygos;
- into v. thoracica interna;
- into v. hemiazygos and v. hemiazygos accessoria;
- v. portae?

61. Where does blood from the posterior left intercostal veins flow:

- + into v. hemiazygos and v. hemiazygos accessoria;
- into v. azygos;
- into v. thoracica interna;
- v. portae?

62. What is intercostal nerve on the way from the intervertebral opening to the costal angle covered by:

- + intrathoracic fascia, subpleural cellular tissue, parietal pleura;
- between mm. intercostales externi and mm. intercostales interni;

- it covers fascia endothoracica, runs behind the costal cartilages;
- behind mm. intercostales interni?

63. Where is it necessary to make a puncture of the thorax:

- + in the 7th–8th costal interspace, between scapular and medial axillary lines, along the superior margin of the rib;
- in the 5th–7th costal interspace, along the inferior margin of the rib, between scapular and vertebral lines;
- in the 4th–5th costal interspace, between scapular and medial axillary lines, along the superior margin of the rib;
- between mm. intercostales externi and mm. intercostales interni?

64. Where is the superior boundary of the right cupula of diaphragm identified:

- + the 4th rib;
- the 5th rib;
- the 3rd rib;
- the 6th rib?

65. Where is the superior boundary of the left cupula of diaphragm identified:

- + the 5th rib;
- the 4th rib;
- the 3rd rib;
- the 6th rib?

66. What runs through hiatus aorticus of the diaphragm:

- + aorta, ductus thoracicus;
- esophagus, recurrent nerves;
- major and minor abdominal nerves;
- azygos and hemiazygos veins?

67. What runs through the esophageal opening of the diaphragm:

- + esophagus, vagus nerves;
- recurrent nerves and sympathetic trunk;
- major and minor abdominal nerves;
- azygos and hemiazygos veins?

68. What runs between muscle fascicles crus dexter et sinister of the right and left crura of the diaphragm:

- + truncus sympaticus, abdominal nerves, azygos and hemiazygos veins;
- recurrent nerves, vagus nerves, aorta, ductus thoracicus;
- vena cava inferior;
- esophagus, vena azygos and hemiazygos?

69. What runs through foramen of vena cava of the diaphragm:

- + inferior vena cava, branch of right phrenic nerve;
- superior vena cava, branch of right phrenic nerve;
- sympathetic trunk, recurrent nerves;
- major and minor abdominal nerves?

70. What is located between the sternal and costal part of the diaphragm to the left from xiphoid process:

- + Larrey's fissure;
- Bochdalek foramen;
- Morgagni fissure;
- trigonum lumbocostale?

71. What is identified between the sternal and costal part of the diaphragm to the right from xiphoid process:

- + Morgagni fissure;
- Larrey's fissure;



- Bochdalek foramen;
- trigonum lumbocostale?

72. What passes through trigonum sternocostale:

- + vasa thoracica interna;
- a. et v. musculophrenica;
- a. et v. pericardiophrenica;
- v. azygos and v. hemiazygos?

73. What is identified behind esophageal opening of the diaphragm:

- + aorta;
- pericardium;
- v. cava inferior;
- esophagus?

74. What is identified in front of esophageal opening of the diaphragm:

- + pericardium and heart;
- aorta;
- v. cava inferior;
- stomach?

75. What is identified in front of and to the right from esophageal opening of the diaphragm:

- + v. cava inferior;
- pericardium;
- heart;
- aorta?

76. What transmits pus from the cellular tissue of mediastinum to retroperitoneal cellular tissue:

- + hiatus esophageus, Bochdalek foramen, hiatus aorticus;

- Larrey's fissure, Morgagni fissure, v. cava inferior;
- esophagus;
- cupula of diaphragm?

77. What is attached to retroperitoneal part of the diaphragm:

- + pancreas, duodenum, kidneys and adrenal glands;
- stomach, heart, liver, gallbladder, spleen, lungs;
- v. azygos, liver, gallbladder, spleen, v. hemiazygos;
- spleen, bottom of the stomach, left lobe of the liver?

78. What is attached to the right cupula of diaphragm from below:

- + liver;
- stomach;
- spleen;
- pancreas, duodenum, kidneys and adrenal glands?

79. What is attached to the left cupula of diaphragm from below:

- + spleen, bottom of the stomach, left lobe of the liver;
- gallbladder;
- pancreas, duodenum, left kidney and adrenal gland;
- right kidney?

80. What is attached to the diaphragm from above:

- + pericardium, base of the lungs;
- stomach;
- gallbladder, spleen;
- kidneys and adrenal glands, liver?

81. What arteries penetrate the diaphragm superiorly and anteriorly:

- + a. musculophrenica, a. pericardiophrenica;

- a. phrenica superior;
- a. phrenica inferior;
- a. vertebralis?

82. What arteries penetrate the diaphragm superiorly and posteriorly:

- + a. phrenica superior;
- a. musculophrenica, a. pericardiophrenica;
- a. phrenica inferior;
- a. vertebralis?

83. What is the main vessel that nourishes the diaphragm:

- + a. phrenica inferior;
- a. phrenica superior;
- a. musculophrenica, a. pericardiophrenica;
- a. vertebralis?

84. Where does the venous blood from superior surface of the diaphragm flow:

- + into v. azygos et v. hemiazygos;
- into v. cava inferior;
- into v. portae;
- into v. cava superior?

85. Where does venous blood from inferior surface of the diaphragm flow:

- + into v. cava inferior;
- into v. azygos et v. hemiazygos;
- into v. portae;
- into vv. vertebralis?

86. What operation is most effective in paraesophageal hernia with reflux-esophagitis:

- + Nissen fundoplication;

- Heller's cardiomy;
- Kocher's mobilization;
- cardiolysis by Reno?

87. What is identified behind the cervical pleura:
+ a. vertebralis, ganglion stellatum, ductus thoracicus (to the left), head and neck of the 1st rib, m. longus colli;
- mm. scaleni;
- truncus brachiocephalicus;
- plexus brachialis?

88. What is identified externally and in front of the cervical pleura:
+ mm. scaleni;
- a. vertebralis, ganglion stellatum, ductus thoracicus (to the left), head and neck of the 1st rib, m. longus colli;
- truncus brachiocephalicus;
- plexus brachialis?

89. What is identified externally from the cervical pleura:
+ plexus brachialis;
- mm. scaleni;
- truncus brachiocephalicus;
- plexus brachialis?

90. What is identified medially to the right from the cervical pleura:
+ truncus brachiocephalicus;
- a. carotis communis;
- trachea, esophagus;
- plexus brachialis?

91. What is identified medially to the left from the cervical pleura:

- + a. carotis communis;
- truncus brachiocephalicus;
- ductus thoracicus;
- v. subclavia?

92. What is identified in front and superiorly from the cervical pleura:

- + a. subclavia;
- v. subclavia;
- plexus brachialis;
- ganglion stellatum?

93. What is identified in front of the cervical pleura:

- + v. subclavia;
- a. subclavia;
- trachea, esophagus;
- ductus thoracicus?

94. What is identified behind and medially from the cervical pleura:

- + trachea, esophagus;
- a. subclavia;
- plexus brachialis;
- a. vertebralis?

95. What is attached to mediastinal pleura in anterior-inferior part:

- + pericardium, a. et v. pericardiophrenicae, n. phrenicus;
- n. vagus, a. carotis communis, v. jugularis interna;
- trachea, esophagus;
- plexus brachialis?

96. Where is the right anterior boundary of the pleura to the right identified:

- + from minor supraclavicular fossa to the sternoclavicular joint, and further via manubrium and body of sternum, at the level of cartilage of the 2nd rib it goes behind the medial line, approaches the anterior boundary of the left pleura at the level of the 3rd–4th costal cartilages and ends at the point of attachment of the 6th rib to the breastbone;
- from minor supraclavicular fossa to the sternoclavicular joint, further along the right costal margin;
- from minor supraclavicular fossa to the place of attachment to the 4th rib;
- from minor supraclavicular fossa to the sternoclavicular joint, then goes downwards behind the left costal margin to the cartilage of the 4th rib, circumflexes the heart to the medial cartilage of the 6th rib?

97. Where is the left anterior boundary of the pleura to the left identified:

- + from minor supraclavicular fossa to sternoclavicular joint, goes downwards behind the left costal margin to the cartilage of the 4th rib, circumflexes the heart and descends to the medial cartilage of the 6th rib;
- from minor supraclavicular fossa to sternoclavicular junction, further via manubrium and body of sternum, and at the level of the 2nd rib cartilage goes behind the medial line, then approaches the anterior boundary of the left pleura at the level of the 3rd–4th vertebral cartilages and ends at the place of attachment of the 6th rib to the breastbone;
- from minor supraclavicular fossa to the place of attachment of the 4th rib;

- from major supraclavicular fossa to the breastbone, then goes to the middle of the 5th rib cartilage?

98. What is identified below the 4th rib between anterior boundaries of costal pleura:

- + triangle of safety of Wojnicz-Sianożęcki;
- thymus area;
- area interpleurica superior;
- recessus costomediastinalis?

99. How is the tumor developed from the remains of thymus called:

- + thymoma;
- fibrous adenoma;
- lipoma;
- sarcoma?

100. What syndromes are observed at presence of thymus tumor:

- + mediastinal syndrome;
- Petit syndrome;
- Bernard – Horner syndrome;
- syndrome McKenzie?

101. What are the symptoms of thymus tumor:

- + chest pain, dyspnoe, cyanosis, cardiac disturbances;
- enophthalmos, total ophthalmoplegia;
- lung collapse, pneumothorax, hemothorax, pleuropulmonary shock;
- aphonia?

102. What is the inferior border of pleura on linea medioclavicularis:

- + the 7th rib;
- the 8th rib;
- the 6th rib;
- the 9th rib?

103. What is the inferior border of pleura on linea scapularis:

- + the 11th rib;
- the 10th rib;
- the 9th rib;
- the 8th rib?

104. Identify the length of costodiaphragmatic recess on medial axillary line:

- + from the 7th rib to the 10th rib;
- from the 6th rib to the 9th rib;
- from the 8th rib to the 11th rib;
- from the 4th rib to the 11th rib?

105. What is the penetrating injury of the chest accompanied by:

- + lung collapse, pneumothorax, hemothorax, pleuropulmonary shock;
- enophthalm, total ophthalmoplegia;
- chest pain, dyspnoe, cyanosis, cardiac disturbances;
- arrhythmia?

106. What layers of soft tissues are involved in the first row of sutures in penetrating injury of the thoracic cavity:

- + pleura, internal thoracic fascia, periosteum, intercostal muscles;



- superficial muscles, proper fascia;
- skin and subcutaneous cellular tissue;
- inner thoracic fascia?

107. What layers of soft muscles are involved in the second row of sutures in penetrating injury of the thoracic cavity:

- + superficial muscles, proper fascia;
- pleura, internal thoracic fascia, periosteum;
- internal thoracic fascia;
- skin and subcutaneous cellular tissue?

108. Where is the entry of the lungs identified:

- + the 5th–7th thoracic vertebrae or the 2nd–4th rib;
- the 4th–7th thoracic vertebrae or the 1st–2nd rib;
- the 4th–8th thoracic vertebrae or the 4th–7th rib;
- the 5th thoracic vertebra or the 7th rib?

109. What is attached to the medial surface of the left lung behind its root:

- + descending aorta and esophagus;
- v. azygos and v. cava superior;
- v. cava superior, right atrium, pericardium, ascending aorta, n. phrenicus, a. and v. pericardiophrenicae;
- pericardium?

110. What is attached to the medial surface of the left lung in front and inferiorly from the entry:

- + pericardium;
- descending aorta and esophagus;
- v. cava superior and v. azygos;
- n. phrenicus?

111. What is identified in front of the right lung entry:  
+ v. cava superior, right atrium, pericardium, ascending aorta,  
n. phrenicus, a. et v. pericardiacophrenicae;  
- v. azygos;  
- descending aorta and esophagus;  
- bifurcation of trachea?

112. What is located superiorly and posteriorly from the right lung root:  
+ v. azygos;  
- v. cava superior, right atrium, pericardium, ascending aorta,  
n. phrenicus, a. et v. pericardiacophrenicae;  
- arch of aorta;  
- n. phrenicus?

113. What is attached to the root of the left lung from above:  
+ arch of aorta;  
- v. cava superior, right atrium, pericardium, ascending aorta;  
- n. phrenicus, a. et v. pericardiacophrenicae;  
- n. phrenicus;  
- esophagus?

114. What is attached to the root of the left lung from behind:  
+ esophagus, descending aorta, n. vagus;  
- v. azygos;  
- v. cava superior, right atrium, pericardium, ascending aorta,  
n. phrenicus, a. et v. pericardiacophrenicae;  
- arch of aorta?

115. What crosses both roots of the lungs anteriorly:  
+ n. phrenicus, a. et v. pericardiacophrenicae;  
- n. vagus;  
- truncus sympathicus;  
- arch of aorta?

116. What crosses both roots of the lungs posteriorly:

- + n. vagus;
- n. phrenicus a. et v. pericardiophrenicae;
- truncus sympathicus;
- arch of aorta?

117. What is the projection of fissura obliqua:

- + from spinal process of the 3rd thoracic vertebra to the place of junction of osseous part with cartilaginous part of the 6th rib;
- from the osseous process of the 4th thoracic vertebra to the place of attachment of the 6th costal cartilage to the breastbone;
- along the 4th costal cartilage, from the breastbone to the place of junction with the projection of oblique fissure along medial axillary line;
- from the breastbone to the medial axillary line?

118. What is the projection of fissura horizontalis:

- + the 4th costal cartilage, from the breastbone to the place of junction with the projection of oblique fissure along medial axillary line;
- from spinal process of the 3rd thoracic vertebra to the place of junction with osseous and cartilaginous part of the 6th rib;
- to the place of attachment of the 6th costal cartilage to the breastbone;
- from the breastbone to the medial axillary line?

119. What are the segments of the superior part of the right lung:

- + apical, posterior, anterior;
- lateral, medial;

- medial basal;
- apical, medial basal, anterior basal?

120. What are the segments of the medial part of the right lung:

- + lateral, medial;
- posterior, anterior;
- anterior basal;
- apical, medial basal, anterior basal, lateral basal, posterior basal?

121. What are the segments of the inferior part of the right lung:

- + apical, medial basal, anterior basal, lateral basal, posterior basal;
- superior lingular and inferior lingular;
- apical posterior;
- lateral, medial?

122. What are the segments of the superior part of the left lung:

- + apical posterior, anterior, superior lingular and inferior lingular;
- lateral, medial;
- apical;
- apical, medial basal, anterior basal, lateral basal, posterior basal?

123. How is the lateral approach to the organs of the thoracic cavity performed:

- + from the medial clavicular line to the posterior axillary line in the 4th–5th intercostal space;
- from the costal margin to scapular line in the 3rd–4th intercostal space;

- from the vertebral column to anterior axillary line in the 2nd–4th intercostal space;
- on medial axillary line?

124. What tissues are dissected at lateral approach to the organs of the chest:

- + all of the following;
- skin, subcutaneous cellular tissue and superficial fascia, thoracic fascia;
- m. pectoralis major, m. serratus anterior, intercostal muscles;
- internal thoracic fascia, parietal pleura?

125. How is the posterior lateral approach to the organs of the thoracic cavity performed:

- + from spinal processes of the 3rd–4th thoracic vertebrae on paravertebral line, around the angle of scapula and further on the 6th–7th intercostal space to anterior axillary line;
- from medial clavicular line to the posterior axillary line in the 4th–5th intercostal space;
- from the vertebral column to the anterior axillary line in the 2nd–4th intercostal space;
- all the above mentioned?

126. What tissues are dissected at posterior lateral approach to the organs of the thoracic cavity:

- + all of the following;
- skin, subcutaneous cellular tissue, superficial fascia, m. trapezius;
- mm. rhomboideus major et minor, m. latissimus dorsi, m. serratus anterior;
- intercostal muscles, internal thoracic fascia, parietal pleura?

127. What is identified in the root of the right lung anteriorly:

- + v. pulmonalis superior;
- a. pulmonalis;
- major bronchus;
- v. pulmonalis inferior?

128. What is identified superiorly and behind v. pulmonalis superior in the root of the right lung:

- + a. pulmonalis;
- major bronchus;
- v. azygos;
- n. phrenicus?

129. Where is the major bronchus of the right lung root identified:

- + above and behind a. pulmonalis;
- below and behind a. pulmonalis;
- in front of a. pulmonalis;
- below a. pulmonalis?

130. What is identified in the left lung root anteriorly:

- v. pulmonalis superior;
- a. pulmonalis;
- major bronchus;
- v. pulmonalis inferior?

131. Where is a. pulmonalis in the left lung root located:

- + above and behind v. pulmonalis superior;
- below and behind v. pulmonalis superior;
- above and behind major bronchus;
- below and behind major bronchus?

132. Where is the major bronchus in the left lung root located:

- + below and behind a. pulmonalis;
- above and behind a. pulmonalis;
- above and in front of a. pulmonalis;
- superiorly and in front of v. pulmonalis superior?

133. What is the first stage of the operation on the lungs:

- + pneumolysis;
- skeletonization of the lung root vessels;
- cutting and ligation of the pulmonary vein;
- all the above mentioned?

134. What are the organs of superior mediastinum:

- + thymus, vv. brachiocephalicae dextra et sinistra, v. cava superior, arcus aortae, trachea, upper part of esophagus, ductus thoracicus, n. vagus, n. phrenicus;
- v. azygos et v. hemiazygos;
- a. et v. thoracica interna, paramammary lymph nodes, distal part of thymus;
- pericardium, heart?

135. What are the organs of anterior mediastinum:

- + a. et v. thoracica interna, paramammary lymph nodes, distal part of thymus;
- pericardium, heart;
- intracardiac parts of large vessels;
- thymus, vv. brachiocephalicae dextra et sinistra, v. cava superior, arcus aortae, trachea, upper part of esophagus, ductus thoracicus, n. vagus, n. phrenicus?

136. Identify the organs of medial mediastinum:

- + pericardium, heart, bifurcation of trachea, aa. et vv. pulmonales, n. phrenicus, a. et v. pericardiacophrenica;

- a. et v. thoracica interna, upper part of the esophagus, ductus thoracicus, arch of aorta with vessels;
- esophagus, aorta, ductus thoracicus, v. azygos et v. hemiazygos;
- truncus sympathicus, n. vagus?

137. Identify the organs of posterior mediastinum:

- + esophagus, aorta, ductus thoracicus, v. azygos et v. hemiazygos, truncus sympathicus, n. vagus;
- pericardium, heart, bifurcation of trachea, aa. et vv. pulmonales, n. phrenicus, a. et v. pericardiophrenica;
- a. et v. thoracica interna, paramammary lymph nodes, distal part of thymus;
- v. cava superior?

138. Where is the first layer of posterior pericardial cellular space identified:

- + between posterior surface of breastbone and posterior pericardial Rudniev fascia;
- between Rudniev fascia and Meyer fascia;
- between Rudniev fascia and anterior surface of pericardium;
- between Meyer fascia and anterior surface of pericardium?

139. Where is the second layer of back pericardial cellular space identified:

- + between Rudniev fascia and Meyer fascia;
- between the posterior surface of breastbone and posterior pericardial Meyer fascia;
- between Meyer fascia and posterior surface of breastbone;
- between the posterior surface of breastbone and Meyer fascia?



140. What is pretracheal cellular tissue of mediastinum limited by:  
+ bifurcation of trachea, arch of aorta, a. pulmonalis, v. cava superior;

- esophagus, vertebral column, fascia prevertebralis;
- aa. et vv. pulmonales, n. phrenicus, a. et v. pericardiacophrenica;
- all the above mentioned?

141. Where can the pus from the posterior pericardial cellular space extend:

- + into the pretracheal space of the neck, along the anterior surface of pericardium to the diaphragm, Larrey's cleft and Morgagni fissure in preperitoneal cellular tissue;
- through hiatus esophageus of diaphragm into retroperitoneal cellular tissue;
- through Bochdalek foramen in retroperitoneal cellular tissue;
- all the above mentioned?

142. What is the surgical approach to drainage of anterior mediastinitis:

- + cervical, transsternal, transpleural mediastinotomy;
- posterior mediastinotomy by Nasilov;
- inferior lateral, posterior lateral and lateral thoracotomy;
- longitudinal sternotomy by Milton, through double pleural approach to the 4th intercostal space with transverse crossing of the breastbone?

143. Where can infection spread in posterior mediastinitis:

- + in spatium retroviscerale of the neck through hiatus esophageus, through hiatus aorticus and through Bochdalek foramen in retroabdominal cellular tissue;

- in pretracheal space of the neck, along the anterior surface of pericardium to the diaphragm, through Larrey's cleft in periabdominal cellular tissue;
- through Morgagni fissure in periabdominal cellular tissue;
- all the above mentioned?

144. What surgical approach is used to drain posterior mediastinitis:

+ all of the following;

- posterior extrapleural mediastinotomy by Nasilov;
- paravertebral incision with the resection of ribs;
- transperitoneal mediastinotomy by Savinykh – Rozanov?

145. What is identified in front of thymus:

+ breastbone;

- v. cava superior;
- v. brachiocephalica sinistra;
- mediastinal pleura?

146. What is identified laterally from thymus:

+ mediastinal pleura;

- vv. brachiocephalica dextra et sinistra;
- truncus brachiocephalicus;
- all the above mentioned?

147. What is identified behind thymus:

+ vv. brachiocephalica dextra et sinistra, v. cava superior, arch of aorta, pericardium;

- ductus thoracicus, esophagus, n. vagus;
- truncus brachiocephalicus;
- all the above mentioned?

148. What is attached to v. brachiocephalica dextra anteriorly:

+ thymus;

- v. cava superior;
- pericardium;
- n. vagus?

149. What is attached to v. brachiocephalica dextra laterally:

- + mediastinal pleura, n. phrenicus dexter;
- v. cava superior, mediastinal pleura;
- ascending aorta;
- truncus brachiocephalicus, n. vagus?

150. What is located posteriorly from v. brachiocephalica dextra:

- + truncus brachiocephalicus, n. vagus;
- mediastinal pleura, n. phrenicus dexter;
- esophagus, ascending aorta;
- all the above mentioned?

151. What is identified posteriorly from v. brachiocephalica sinistra:

- + all of the following;
- n. vagus, truncus brachiocephalicus;
- a. carotis communis sinistra, a. subclavia sinistra;
- arch of aorta?

152. Where is v. cava superior identified:

- + all of the following;
- behind the right costal margin;
- from the 1st to the 3rd rib;
- to the right from ascending aorta?

153. What is identified in front of aortic arch:

- + v. brachiocephalica sinistra, n. vagus, n. phrenicus;
- v. cava superior, truncus pulmonalis, n. laryngeus recurrens;

- a. carotis communis sinistra, a. subclavia sinistra;
- all the above mentioned?

154. What is identified behind the arch of aorta:

- + trachea, esophagus, ductus thoracicus, n. laryngeus recurrens sinister;
- v. brachiocephalica sinistra, n. vagus, n. phrenicus;
- a. carotis communis sinistra, a. subclavia sinistra;
- all the above mentioned?

155. Identify organs located intrapericardially:

- + apex of the heart, both ventricles, ascending aorta, pulmonary trunk, left and right atrial auricles;
- vena cava, both atria, pulmonary veins and arteries;
- base of the heart, right auricle;
- all the above mentioned?

156. Identify organs located mesopericardially:

- + vena cava, both atria;
- apex of the heart, both ventricles, ascending aorta, pulmonary trunk, left and right atrial auricles;
- base of the heart, right auricle;
- all the above mentioned?

157. Identify organs located extrapericardially:

- + pulmonary arteries and veins;
- vena cava, both atria;
- apex of the heart, both ventricles, ascending aorta, pulmonary trunk, left and right atrial auricles;
- all the above mentioned?

158. Identify the walls of pericardium:

- + sternocostal wall, mediastinal, posterior, diaphragmatic;

- two lateral or pulmonary walls, sternum, costal, vertebral;
- right and left pulmonary surfaces, precardiac-ventricular wall;
- anterior and posterior interventricular walls, diaphragmatic wall?

159. What part of pericardium does not include mediastinal pleura and can be used for puncture:

- + edges of the left costal cartilages from the 5th to the 7th, left inferior third of the body of the sternum, left superior third of xiphoid process;
- ends of the left costal cartilages from the 5th to the 6th, left superior third of sternum, left inferior third of xiphoid process;
- ends of the right costal cartilages from the 5th to the 7th, right inferior third of the body of the sternum, right superior third of xiphoid process?

160. What is attached to the lateral surface of pericardium:

- + mediastinal pleura, n. phrenicus, vasa pericardiacophrenicae;
- n. vagus, n. laryngeus recurrens, v. azygos;
- v. cava superior, pulmonary veins, aorta, pulmonary trunk;
- v. cava inferior?

161. What passes through the right part of inferior wall to the pericardial cavity:

- + v. cava inferior;
- mediastinal pleura, n. phrenicus, vasa pericardiacophrenicae;
- pulmonary trunk;
- all the above mentioned?

162. What is the posterior wall of pericardium attached to:

- + all of the following;

- lower part of trachea, esophagus, v. azygos;
- thoracic lymphatic duct;
- thoracic aorta, left vagus nerve?

163. Where are vortex of pericardium identified:

- + in the area of passage of parietal leaf of serous pericardium to a visceral one;
- between the fibrous leaf of pericardium and parietal leaf of serous pericardium;
- in the anterior-inferior part of pericardium;
- between fibrous and serous pericardium?

164. What can develop in acute cardiac tamponade:

- + Beck's triad;
- Naffziger's syndrome;
- Takayasu syndrome;
- Loreen-Epstein?

165. What is Beck's triad characterized by:

- + sharp reduction of arterial pressure, considerable increase of central venous pressure, absence of heart pulsation in X-ray examination;
- increase of arterial pressure, reduction of venous pressure, increase of liquor pressure, arrhythmia;
- mediastinopericarditis, chest pain behind the breastbone, enlarged heart revealed by X-ray;
- sharp reduction of heart beat, considerable increase of central venous pressure?

166. What is necessary to do in adhesive pericarditis:

- + pericardectomy, cardiolysis;
- pneumolysis;
- fundoplication;

- periaortic plexectomy?

167. What is the right boundary of the heart composed by:

- + v. cava superior, right atrium;
- v. cava inferior, right ventricle;
- left atrium;
- left ventricle, left auricle, pulmonary trunk?

168. What is the inferior boundary of the heart composed by:

- + right ventricle;
- left atrium;
- left ventricle, left auricle, pulmonary trunk;
- right atrium?

169. What is the left boundary of the heart composed by:

- + left ventricle, left auricle, pulmonary trunk;
- left atrium;
- v. cava inferior;
- v. cava superior, right atrium?

170. Where is the right boundary of the heart identified:

- + from the superior margin of the 3rd costal cartilage 2–2.5 cm from the right sternal line to the inferior margin of the 5th costal cartilage;
- from the inferior margin of the 3rd costal cartilage 2–2.5 cm to the middle of the right sternal line;
- to the superior margin of the 5th costal cartilage to the right, left and downwards across the 5th intercostal space crossing the point of attachment of the 6th costal cartilage;
- to the right side of breastbone, the 6th left intercostal space crossing the cartilage of the 6th rib, ends in the 5th intercostal space not reaching 0.5–1.5 cm the left medial clavicle line?

171. Where is the inferior boundary of the heart identified:

- + it goes to the right, left and downwards across the 5th intercostal space, crossing the place of attachment of the 6th costal cartilage to the sternum on the right, to the 6th intercostal space on the left, crossing the cartilage of the 6th rib, ends in the 5th intercostal space at distance of 0.5–1.5 cm to the left medial clavicular line;
- from the inferior margin of the 3rd costal cartilage, 2–2.5 cm to the middle of the right sternal line;
- from the superior margin of the 3rd costal cartilage to the superior margin of the 5th costal cartilage;
- from the superior margin of the 3rd costal cartilage, 2–2.5 cm from the right sternal line to the inferior margin of the 5th costal cartilage?

172. Where is the left boundary of the heart identified:

- + from the 5th intercostal space arcuate to the level of the 3rd rib not reaching 2–3 cm the level of sternum, going upwards to the 2nd intercostal space 2 cm to the left sternal line;
- from the inferior margin of the 3rd costal cartilage, 2–2.5 cm to the middle of the right sternal line;
- from the 5th intercostal space to the superior margin of the 5th costal cartilage;
- from the superior margin of the 3rd costal cartilage, 2–2.5 cm from the right sternal line to the inferior margin of the 5th costal cartilage?

173. Identify the surfaces of the heart:

- + sternocostal, diaphragmatic, pulmonary;
- sternocostal, mediastinal, posterior, diaphragmatic;



- two lateral or pulmonary surfaces, costal, vertebral;
- precardiac ventricular, anterior and posterior interventricular, diaphragmatic?

174. What is the root of the heart composed by:

- + vena cava, pulmonary veins;
- aorta, pulmonary trunk;
- v. cava superior;
- v. cava inferior?

175. What is identified between the anterior and lateral surfaces of the heart:

- + obtuse margin;
- acute margin;
- coronary sulcus;
- sulcus interventricularis anterior?

176. What is identified between the anterior and inferior surfaces of the heart:

- + acute margin;
- obtuse margin;
- coronary sulcus;
- sulcus interventricularis anterior?

177. Identify the direction of coronary sulcus:

- + from left to right, from up to down;
- horizontally, from up to down;
- vertically;
- over anterior medial surface?

178. Where is pacemaker located:

- + under the epicardium on anterior-medial surface at the entrance of v. cava superiorly to the right atrium;

- under the myocardium on anterior-lateral surface at the entrance of v. cava inferiorly to the right atrium;
- below the endocardium, on the interatrial septum;
- below the epicardium, on the sternocostal surface, the point of opening of the pulmonary trunk?

179. What is a common type of blood supply among the population:

- + right;
- left;
- uniform;
- all the above mentioned?

180. What is necessary to be done in ineffective conservative treatment of arrhythmic patients:

- + implantation of pacemaker;
- aortocoronary shunting;
- mammary coronary anastomosis;
- angioplasty?

181. Where do the majority of large veins open:

- + into sinus coronarius;
- into the right atrium;
- into v. cordis magna;
- into v. cordis media?

182. What can be done during the operation of aortocoronary shunting to eradicate the spasm of coronary arteries in postoperation period:

- + periaortic neurectomy;
- implantation of pacemaker;
- mammary coronary anastomosis;
- maintainance of extracorporeal blood circulation?

183. What operations are performed for myocardial revascularization in treatment of IHD?

+ all of the following;

- balloon angioplasty of coronary sulcus;
- mammary coronary anastomosis;
- aortic coronary shunting?

184. What is sinus transversus pericardii in front and from above limited by:

- + ascending aorta and pulmonary trunk;
- v. cava superior et v. cava inferior;
- right atrium and right auricle;
- parietal leaf of pericardium that covers a. pulmonalis dextra?

185. What is sinus transversus pericardii from behind limited by:

- + parietal leaf of pericardium that covers right a. pulmonalis;
- posterior wall of pericardium between the confluence of pulmonary veins;
- v. cava superior et v. cava inferior;
- ascending aorta and pulmonary trunk?

186. What is sinus transversus pericardii from below limited by:

- + right and left atria;
- parietal leaf of pericardium that covers a. pulmonalis dextra;
- truncus pulmonalis;
- all the above mentioned?

187. What is the entrance to sinus transversus pericardii from the right limited by:

- + right margin of ascending aorta;
- v. cava superior;
- right atrium and right auricle;
- truncus pulmonalis?

188. What is the entrance to sinus transversus pericardii posteriorly to the right limited by:

- + v. cava superior;
- posterior wall of pericardium between the confluence of pulmonary veins;
- ascending aorta;
- pulmonary trunk?

189. What is the entrance to sinus transversus pericardii inferiorly to the right limited by:

- + right atrium and right auricle;
- v. cava inferior and truncus pulmonalis;
- ascending aorta and pulmonary trunk;
- pulmonary trunk and left auricle?

190. What is the entrance to sinus transversus pericardii in front and from above limited by:

- + pulmonary trunk and left auricle;
- right atrium and right auricle;
- pericardial fold (Marshall fold) that goes from the left pulmonary artery to the left superior pulmonary vein;
- v. cava superior?

191. What is the entrance to sinus transversus pericardii posteriorly from the left limited by:

- + pericardial fold that goes from the left pulmonary artery to the left pulmonary vein;
- pulmonary trunk and left auricle;
- v. cava superior;
- left atrium?

192. What is the entrance to sinus transversus pericardii from the left limited by:

- + left atrial auricle;
- v. cava inferior;
- truncus pulmonalis;
- ascending aorta?

193. What is sinus obliquus pericardii in front limited by:

- + posterior surface of the left atrium;
- left atrial auricle;
- v. cava superior;
- pulmonary trunk?

194. What is sinus obliquus pericardii from behind limited by:

- + posterior wall of pericardium between the confluence of pulmonary veins;
- v. cava superior;
- arch of aorta;
- posterior surface of the left atrium?

195. What is sinus obliquus pericardii inferiorly from the right limited by:

- + v. cava inferior;
- v. cava superior;
- confluence of the left pulmonary veins;
- left atrium?

196. What is sinus obliquus pericardii from the left above limited by:

- + left pulmonary veins;
- right pulmonary veins;
- v. cava superior;
- truncus pulmonalis?

197. What are the ways to perform puncture of pericardium on the side of xiphoid process:

- + Larrey and Marfan's;
- Pirogov and Karavanov's;
- Lotheissen and Reich's;
- Wojnicz-Sianożęcki?

198. Where is the point of puncture needle in pericardial puncture according to Larrey's technique located:

- + in the angle composed by xiphoid process and attachment to the 7th costal cartilage;
- below the apex of xiphoid process;
- in the 4th intercostal space to the left, 2 cm from the sternum;
- in the 5th intercostal space to the left, 2 cm from the sternum?

199. Where is the point of puncture needle according to Marfan's technique located:

- + under the apex of xiphoid process;
- in the angle composed by xiphoid process and attachment of the 7th costal cartilage;
- in the 4th intercostal space to the left, 2 cm from the sternum;
- in the 5th intercostal space to the left, 2 cm from the sternum?

200. What is the purpose of performing periaortic plexectomy:

- + to eradicate spasm of coronary arteries by crossing preganglionic parasympathetic fibers that are the parts of vagus nerve, to relieve pain by crossing afferent sympathetic fibers;

- to eradicate arrhythmia;
- to eradicate spasm of coronary arteries by crossing afferent sympathetic fibers;
- to relieve pain by crossing preganglionic parasympathetic fibers that are the part of n. vagus?

201. What is the way to expose pericardium in heart wounds:

- + longitudinal and parallel, in front of n. phrenicus;
- transverse and behind n. vagus;
- parallel to the front between confluence of the left pulmonary veins;
- all the above mentioned?

202. What is the way to drain pericardial cavity at suturing heart wounds:

- + pleural cavity is drained in the 7th–8th intercostal space to make the “window” in the inferior part of pericardium;
- through the drainage tube output into the 4th intercostal space on the medial axillary line;
- all the above mentioned?

203. What is the passage of arterial duct (Botallo duct):

- + all of the following;
- leaving the arch of aorta;
- opposite the left subclavicular artery;
- entering the bifurcation of pulmonary trunk?

204. What is identified on the anterior wall of arterial duct:

- + mediastinal pleura, n. vagus, n. phrenicus;
- esophagus, inferior vena cava;
- sympathetic trunk, v. portae;
- recurrent nerve?

205. What is identified between the posterior wall of arterial duct (Botallo duct) and major bronchus of the left lung:

- + recurrent nerve;
- mediastinal pleura, n. vagus, n. phrenicus;
- brachiocephalic trunk, sympathetic trunk, v. portae;
- thoracic lymphatic duct?

206. What special instruments are used to perform mitral commissurectomy:

- + Satinsky clamp, Dubost's expander, Rummel tourniquet, Schumacher's sternotome;
- Payr's clamp, Langenbeck's hook, Mikulicz expander, clamp of Dogliotti – Vyshnevsky;
- fenestrated Potts forceps, Dothril's clamp, Bier's arc saw;
- all the above mentioned?

207. Identify the boundary of superior mediastinum:

- + from above – upper than the lung roots, below the point of joining the body with the presternum in the direction of the 4th vertebra;
- above the level of lung roots, below the line of tracheal bifurcation;
- from above – below the lung roots and the point of joining the body of the breastbone with xiphoid process in the direction of the 6th vertebra;
- from above – upper than the superior margin of aortic arch, below the point of joining the body of the breastbone with its xiphoid process in the direction of the 4th vertebra?

208. What are the boundaries of superior third of thoracic part of esophagus:

- + from ThII to ThIV vertebra to the superior margin of aortic arch;



- from CIV to CVI vertebra to tracheal bifurcation;
- from ThIV to ThVI vertebra to the level of diaphragm;
- from ThV to ThVII vertebra from the superior margin of aortic arch to tracheal bifurcation?

209. What are the boundaries of the medial third of thoracic part of esophagus:

- + from ThV to ThVII vertebra, from the superior margin of aortic arch to tracheal bifurcation;
- from ThVIII to ThX, from tracheal bifurcation to the diaphragm;
- from ThIV to ThVI vertebra to the level of diaphragm
- from ThII to ThIV vertebra to the level of the superior margin of aortic arch?

210. What are the boundaries of the inferior third of thoracic part of esophagus:

- + from ThVIII to ThX, from tracheal bifurcation to diaphragm;
- from ThV to ThVII vertebra, from the superior margin of aortic arch to tracheal bifurcation;
- from ThVIII to ThX, from tracheal bifurcation to the entrance of stomach;
- from ThII to ThIV vertebra to the level of the superior margin of aortic arch?

211. Identify the level of pharyngeal narrowing of esophagus:

- + at the level of the 6th cervical vertebra;
- at the level of the 4th cervical vertebra;
- at the level of the 5th cervical vertebra;
- at the level of the 7th cervical vertebra?

212. At what level is the aortic narrowing of esophagus located:

- + at the level of the 4th thoracic vertebra;
- at the level of the 5th thoracic vertebra;
- at the level of the 6th thoracic vertebra;
- at the level of the 3rd thoracic vertebra?

213. Where is bronchial narrowing of esophagus identified:

- + at the level of the 5th thoracic vertebra;
- at the level of the 4th thoracic vertebra;
- at the level of the 6th thoracic vertebra;
- at the level of the 3rd thoracic vertebra?

214. At what level is the diaphragmatic narrowing of esophagus located:

- + the 9th–10th thoracic vertebrae;
- the 8th thoracic vertebra;
- the 9th thoracic vertebra;
- the 12th thoracic vertebra?

215. Identify skeletopy of the left superior flexure of esophagus:

- + from the 6th cervical vertebra to the 2nd thoracic vertebra;
- from the 3rd thoracic vertebra to the 4th thoracic vertebra;
- from the 3rd cervical vertebra to the 3rd thoracic vertebra;
- from the 2nd thoracic vertebra to the 5th thoracic vertebra?

216. Identify skeletopy of the right flexure of esophagus:

- + from the 2nd thoracic vertebra to the 5th thoracic vertebra;
- from the 6th cervical vertebra to the 5th thoracic vertebra;
- the level of the 8th thoracic vertebra;
- from the 3rd thoracic vertebra to the 9th–10th thoracic vertebrae?

217. Identify surgical approach to the cervical part of esophagus:

- + left lateral on the anterior margin of sternocleidomastoid muscle;
- right lateral on the anterior margin of sternocleidomastoid muscle;
- along medial cervical line;
- Kocher's collar incision?

218. What is the surgical approach to the medial sternal part of esophagus:

- + right lateral transpleural;
- left lateral transpleural;
- Savinykh – Rozanov's sagittal diaphragmotomy;
- Milton's longitudinal sternotomy?

219. What is the surgical approach to the inferior thoracic part of esophagus:

- + left lateral transpleural, transabdominal sagittal diaphragmotomy (Savinykh – Rozanov's);
- right lateral transpleural;
- longitudinal sternotomy (Milton's)?

220. Identify the interrelationship of the esophagus with mediastinal pleura above the root of the lungs:

- + right mediastinal pleura is attached to the lateral wall of esophagus, the left one forms a fold that is exposed between the column and left subclavicular artery;
- right mediastinal pleura is separated from esophagus by v. azygos;
- the left mediastinal pleura is separated from esophagus by descending aorta;
- to the right esophagus is separated from the pleura by azygos vein, to the left it is separated from the pleura by thoracic aorta?

221. Identify the interrelationship between esophagus and mediastinal pleura at the level of the root of the lung:

- + to the right esophagus is separated from the pleura by v. azygos, to the left – by thoracic aorta;
- to the right mediastinal pleura covers the lateral wall of the esophagus;
- to the left esophagus covers mediastinal pleura laterally and posteriorly;
- to the right mediastinal pleura covers lateral and posterior wall of esophagus, to the right it is separated from esophagus by thoracic aorta?

222. What is interrelationship between esophagus and mediastinal pleura below the root of the lungs:

- + mediastinal pleura covers lateral and posterior wall of esophagus from the right, from the left it is separated from esophagus by thoracic aorta;
- from the right mediastinal pleura is separated from esophagus by v. azygos;
- from the left mediastinal pleura covers lateral wall of esophagus;
- right mediastinal pleura is attached to the lateral wall of esophagus, the left mediastinal pleura forms a fold that is exposed between the vertebral column and left subclavicular artery?

223. What is identified to the left and behind esophagus:

- + pars descendens aortae;
- v. azygos;
- ductus thoracicus;
- truncus sympathicus?

224. What is identified to the right from esophagus and behind it:

- + v. azygos;
- aorta;
- v. hemiazygos;
- truncus sympathicus?

225. What is identified behind esophagus:

- + ductus thoracicus, right posterior intercostal arteries, terminal parts of v. hemiazygos et v. hemiazygos accessoria;
- v. azygos, truncus sympathicus, n. vagus to the left;
- n. laryngeus recurrens dexter et sinister;
- n. laryngeus recurrens sinister, a. carotis communis sinistra?

226. What is attached to the esophagus in front of the superior third of thoracic part:

- + n. laryngeus recurrens sinister, a. carotis communis sinistra;
- a. subclavia sinistra;
- ductus thoracicus, right posterior intercostal arteries, terminal parts of v. hemiazygos et v. hemiazygos accessoria;
- truncus brachiocephalicus?

227. What is attached to the superior third of thoracic part of esophagus to the right:

- + mediastinal pleura;
- ductus thoracicus, a. subclavia sinistra;
- n. laryngeus recurrens sinister;
- a. subclavia dextra?

228. What is attached to the superior third of thoracic part of esophagus to the left:

- + ductus thoracicus, a. subclavia sinistra;
- a. carotis communis sinistra;

- aortic arch, tracheal bifurcation, left major bronchus;
- n. laryngeus recurrens sinister?

229. What is attached to the medial third of thoracic part of esophagus in front:

- + arch of aorta, bifurcation of pleura, left major bronchus;
- ductus thoracicus, a. subclavia sinistra;
- n. vagus sinister;
- mediastinal pleura?

230. What is attached to the medial third of sternal part of esophagus to the left:

- + pars descendens aortae;
- tracheal bifurcation, truncus sympathicus;
- n. laryngeus recurrens sinister;
- n. vagus dexter, v. azygos?

231. What is attached to the medial third of thoracic part of esophagus to the right:

- + n. vagus dexter, v. azygos;
- ductus thoracicus;
- truncus sympathicus;
- mediastinal pleura?

232. What is attached to the inferior third of thoracic part of esophagus in front:

- + pericardium;
- aorta;
- tracheal bifurcation;
- ductus thoracicus?

233. What is attached to the inferior third of thoracic part of esophagus to the right:

- + n. vagus, mediastinal pleura;
- v. azygos;
- ductus thoracicus, truncus sympathicus;
- pericardium?

234. What is attached to the inferior third of sternal part of the esophagus to the left:

- + n. vagus;
- mediastinal pleura;
- ductus thoracicus;
- truncus sympathicus?

235. What is the location of ductus thoracicus in posterior mediastinum:

- + all of the following;
- on the anterior surface of vertebral column;
- behind esophagus;
- to the left from v. azygos and to the right from aorta?

236. Where is v. azygos in posterior mediastinum located:

- + all of the following;
- on the anterior right surface of vertebral column, in front of right posterior intercostal arteries;
- behind and to the right from esophagus;
- laterally from the sternal duct, medially from the right sympathetic trunk?

237. Where is v. hemiazygos in posterior mediastinum located:

- + all of the following;
- over the left anterior lateral surface of thoracic vertebrae bodies;
- laterally and posteriorly from thoracic artery;
- anteriorly and medially from truncus sympathicus?

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