

**MINISTRY OF HEALTH CARE OF UKRAINE  
DANYLO HALYTSKY LVIV NATIONAL MEDICAL UNIVERSITY  
DEPARTMENT OF GENERAL SURGERY**

**GUIDELINES  
TO THE PRACTICAL LESSONS**  
for 3rd-year students of faculty of Dentistry

**TOPIC**

**Vascular diseases (arterial thrombosis and embolism, acute ischemia of the lower extremities)**

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## **1. RELEVANCE OF THE TOPIC**

Despite the progress of diagnostic and therapeutic technologies, the problem of treating patients with obliterating arterial diseases is still urgent. First of all, this is due to the continuing increase in the incidence of atherosclerosis, diabetes mellitus with the development of severe vascular complications, which significantly worsen the quality of life of patients, lead to disability and death. Obliterating diseases of the extremities rank first in terms of clinical significance and frequency and constitute the main group of organic arteriopathies available for surgical treatment. Atherosclerosis in more than 95% of cases is the cause of obliteration of arterial vessels of the lower extremities and pelvis. According to the WHO, more than 1/8 of the world's population suffers from some form of atherosclerotic vascular lesions, of which more than 20% of cases are affected by the arteries of the lower extremities and pelvis. Atherosclerosis of the vessels of the lower extremities is more often observed in men (the ratio of men to women is 10: 1) over 40-50 years old (according to the literature, the average age is  $68 \pm 5.5$  years), smokers lead a sedentary lifestyle and are overweight. Age is not a decisive factor in the development of atherosclerosis. The disease can occur in severe form, even in young people or people 30-35 years old. There is a high probability of progression of the occlusive process in the peripheral arteries in atherosclerosis - in middle-aged patients. After 70 years, the rate of development of atherosclerosis slows down. Thus, in patients of this age group, the elimination of complications of atherosclerosis, in particular arterial occlusion, is very promising. Acute arterial ischemia is most often a consequence of acute thrombosis of an existing stenotic arterial segment (in 60%) or embolism (30%). Differential diagnosis of these two pathological conditions is important, since these circumstances affect the tactics of treatment and prognosis. Other causes of arterial ischemia include trauma, iatrogenic injury, aneurysm, and heart defects.

Thromboembolism of the arteries of the extremities, pulmonary and mesenteric arteries - acute blockage of an artery by a thrombus is one of the catastrophic complications. Among cardiovascular diseases, thromboembolism ranks third after ischemia of the heart and brain. Pulmonary embolism occurs due to deep vein thrombosis of the lower extremities and pelvis. Thromboembolism of peripheral arteries - through the separation of blood clots that have formed in the heart, primarily with atrial fibrillation.

The risk of developing thrombosis after surgery:

Pelvic-femoral joint replacement - 60-65%;

Hip amputation - 20%;

Knee replacement - 25%;

Operations for malignant tumors of the abdominal cavity - 25%;

Abdominal interventions - 20%;

Gynecological interventions - 20%;

Neurosurgical interventions - 25%;

Mortality in thromboembolism of mesenteric vessels and pulmonary embolism - 60-70%.

Acute arterial ischemia is most often a consequence of acute thrombosis of an existing stenotic arterial segment (in 60%) or embolism (30%). Differential diagnosis of these two pathological conditions is important because these circumstances affect the tactics of treatment and prognosis.

## **2. SPECIFIC GOALS**

2.1. To be aware about the following: the main classifications of acute limb ischemia; definition of the terms arterial thrombosis and embolism; epidemiology; classification; clinical stages; diagnostics; differential diagnostics; methods of surgical treatment.

To possess knowledge about:

- clinical manifestations of acute limb ischemia;
- special diagnostic methods;
- features of diagnosis and differential diagnosis of various types of acute limb ischemia;
- principles of an individual approach to solving the issues of surgical tactics in acute ischemia of the extremities;
- principles of surgical interventions in stage I of acute limb ischemia;
- principles of surgical interventions in stage II of acute limb ischemia;
- principles of surgical interventions at stage III of acute limb ischemia;
- principles of surgical interventions at stage IV of acute limb ischemia;
- therapeutic tactics for complications after surgery for acute limb ischemia;
- clinical manifestations of arterial thrombosis and embolism;
- features of the diagnosis and differential diagnosis of arterial thrombosis and embolism;
- principles of an individual approach to solving the issues of surgical tactics in arterial thrombosis and embolism;
- principles of surgical interventions for arterial thrombosis and embolism;
- principles of surgical interventions for arterial thrombosis and embolism of the abdominal organs;
- principles of surgical interventions for arterial thrombosis;

- principles of surgical interventions for arterial embolism;
- therapeutic tactics for complications after surgical interventions for arterial thrombosis and embolism.

2.2. To be able to: collect complaints, anamnesis of the disease, methodically correctly examine the patient, determine the pulsation of the arteries of the extremities in typical places, formulate a diagnosis, choose the most informative additional diagnostic methods and therapeutic tactics in acute ischemia of the extremities and in arterial thrombosis and embolism.

Additionally be able to:

- analyze and evaluate the patient's complaints;
- analyze and evaluate the data of the anamnesis;
- to evaluate the data of instrumental methods of diagnostics of the arteries of the lower extremities
- determine the stage of acute limb ischemia;
- to establish a diagnosis of acute limb ischemia;
- to formulate the diagnosis of arterial thrombosis and embolism;
- assist on operations performed for arterial thrombosis, embolism and acute ischemia of the lower extremities.

2.3. *To develop creativity on the basis of the studied clinical and diagnostic material:* to be able to interpret the collected diagnostic information, correctly analyze it and establish a diagnosis; determine therapeutic tactics depending on the stage of the disease and the presence of complications in patients with arterial thrombosis and embolism, which are complicated by acute ischemia of the extremities;

2.4. Educational goals: to form a deontological understanding when working with patients with acute ischemia of the extremities, to master the ability to establish psychological contact with this category of patients and their relatives, to develop a sense of responsibility for the timeliness and correctness of professional actions.

### **3. BASIC KNOWLEDGE, ABILITIES, SKILLS NECESSARY TO STUDY THE TOPIC (Interdisciplinary integration)**

Disciplines	To know	Be able to
<i>Previous disciplines:</i> human anatomy, histology,	Anatomy of the blood vessels of the extremities. The histological structure of the blood vessels and the structure of the bloodstream.	Determine the topographic anatomy of the blood vessels of extremities; physiological and

normal physiology, pathological physiology, pathological anatomy, propedeutics of internal diseases	Physiological function of blood vessels and the structure of the bloodstream. Pathogenesis of the development of various types of angiopathies and thrombus formation. Morphological changes in various types of angiopathies. Clinical manifestations and methods of instrumental and laboratory diagnostics of blood rheology disorders.	pathophysiological processes in the blood vessels of the extremities, clinical and radiological, angiographic symptoms of acute ischemia of the extremities.
<i>The following disciplines:</i> Hospital surgery, anesthesiology, clinical pharmacology	Epidemiology, classification, clinical signs, diagnosis, differential diagnosis, treatment tactics and prognosis.	Apply the acquired basic knowledge for a more detailed study of the problems of acute ischemia of the extremities, treatment of acute ischemia of the extremities.
Intrasubject integration	Part of acute limb ischemia in the structure of surgical diseases, the relationship of this pathology with other surgical diseases. Results and consequences of their treatment, preventive methods.	To evaluate the effectiveness of the results of treatment of acute ischemia of the extremities, to use preventive methods.

#### 4. PLAN AND ORGANIZATIONAL STRUCTURE OF THE LESSON

4.1. The list of practical skills on the topic and the degree of their assimilation by students:

№	Title of required skills by topic	Degree of assimilation of knowledge		
		Satisfactory	Good	Excellent

1.	To collect complaints and anamnesis in patients with arterial thrombosis and embolism and acute limb ischemia		+	
2.	Examine patients: -examination of the limbs; -determination of color and assessment of skin temperature -determination of pulsation of arteries in typical places			+ + + + +
3.	Conduct differential diagnosis of arterial thrombosis and embolism, acute ischemia of the extremities		+	
4.	Determine therapeutic tactics for arterial thrombosis and embolism, which are complicated by acute ischemia of the extremities		+	

#### 4.2. Methodological support of the lesson

1. Control materials for the preparatory stage of the lesson: questions, test tasks of the II level, tasks of the III level.
2. Materials for methodological support of the main stage of the lesson: indicative maps for the formation of practical skills, educational tasks of the III level, tests of the III level.
3. Control materials for the final stage: tasks, test tasks of the III level tests of the III level.
4. Materials of methodological support of self-training of students: indicative maps for the organization of independent work of students with educational literature.

#### 4.3. Instructional materials for mastering the specified professional skills and abilities.

Task	Note	Remark
Master the technique of	Execute in the sequence given:	-Skin color, temperature, presence of macerations, cracks, signs of

examining patients	1. Examination of the limbs; 2. Determination of color and assessment of skin temperature 3. Determination of pulsation of arteries in typical places	inflammation, weakening of arterial pulsation in typical places.
Learn to correctly evaluate and interpret the results of instrumental examination of blood vessels	Angiography dopplerography	-The state of the vascular wall, vascular pattern, the presence of filling defects, constrictions (their nature), additional collaterals. -Informative method for detecting blood flow disorders, used to diagnose blood flow and its nature.
Determine the treatment tactics for acute ischemia of the limbs	<u>Conservative therapy</u> It is used in the treatment of acute ischemia of the extremities at its various stages <u>Surgical intervention</u> a method for the treatment of acute ischemia of the limbs at various stages	<u>Drug therapy</u> consists in conducting anticoagulant, thrombolytic therapy, prescribing drugs that improve blood circulation and analgesics. Surgical interventions are indicated for acute thrombosis or arterial embolism, gangrene of the extremities.

## 5. METHODS OF ORGANIZING THE EDUCATIONAL PROCESS IN A PRACTICAL (SEMINAR) LESSON

### 5.1 Preparatory stage.

To emphasize (reveal) the meaning of the topic of the lesson for further study of the discipline and professional activity of the doctor in order to form motivation for purposeful educational activity. To familiarize students with specific goals and lesson plans.

Conduct a standardized control of the initial level of student training.



5.2. The main stage - should be structured and provide for the conduct of educational activities with students, depending on the types of training (practical, seminar), provide the student's educational activities with objects or models that are replaced in order to form new knowledge, skills, practical skills in accordance with specific objectives of the lesson.

Important for the assimilation of new knowledge and skills at the whole stage is the solution of situational tasks, the image of graphs, drawings, diagrams. It is desirable that the tasks for students at this stage are accurate and structured, completed in writing and checked by the teacher during the lesson, and the results are discussed.

### 5.3 Final stage.

The current activities of each student during the lesson are assessed, standardized final control, an analysis of student progress is carried out, the assessment of each student's activities is announced and posted in the journal of student visits and progress. The group leader simultaneously enters the grades into the record of the progress and attendance of classes by students, the teacher certifies them with his signature.

It is advisable to briefly inform students about the topic of the next lesson and methodological techniques for preparing for it.

## **6. TASKS FOR INDEPENDENT WORK IN PREPARATION FOR THE LESSON**

### *6.1. Theoretical questions for the lesson:*

1. Anatomical structure of the vessels of the lower extremities.
2. How many vessels supply blood to the limbs?
3. Name the arteries of the extremities.
4. What is acute ischemia?
5. What is thrombosis?
6. What stages does acute limb ischemia have?
7. What are the causes of thrombosis?
8. Name the complications of thrombosis.
9. How is thrombosis classified by localization?
10. What are the clinical manifestations of thrombosis?
11. What is embolism?

12. What are the clinical manifestations of embolism?
13. What stages does acute limb ischemia have?
14. Name the causes of acute limb ischemia
15. Name the complications of acute limb ischemia.
16. How is acute limb ischemia classified by localization?
17. What are the clinical manifestations of stage 1 of acute limb ischemia?
18. What are the clinical manifestations of stage 3 of acute limb ischemia?
19. What are the clinical manifestations of stage 4 of acute limb ischemia?
20. What are the clinical signs of stage 2 acute limb ischemia?
21. How is acute limb ischemia classified?
22. What methods are used to diagnose acute limb ischemia?
23. Methods for the treatment of acute ischemia of the extremities of 1-2 stages.
24. What are the medical tactics for acute ischemia of the extremities 3-4 stages
25. Name the methods of treatment of patients with post-traumatic ischemia of the extremities
26. What are the methods of prevention of acute limb ischemia
27. Name the methods of rehabilitation of patients after acute limb ischemia.

*6.2. Practical work (tasks) that are performed in the lesson:*

1. To find out the anamnesis in a patient with acute ischemia of the extremities.
2. To determine the pulsation of the vessels of the limbs.
3. To make an examination algorithm for acute limb ischemia.
4. To determine the indications for surgery in a patient with acute limb ischemia
5. To specify methods of conservative treatment of acute limb ischemia
6. To assist during surgical interventions.
7. To make an individual program of postoperative treatment of acute limb ischemia.
8. To diagnose complications after surgery for acute limb ischemia in the early and late postoperative periods.
9. To change dressings.
10. Carry out maintenance of drainages
11. To rinse drainages and inject drugs into them.
12. To remove the sutures
13. To write medical records
14. To interpret the results of laboratory and instrumental examinations.

*6.3. Topic content:*

Graph of the logical structure of the topic.

6.4. Arterial thrombosis and embolism. Classification of acute limb ischemia. Clinical stages. Diagnostics. Differential diagnostics. Surgical treatment.

## **6.5. Thrombosis**

### *Definition*

Thrombosis - intravascular coagulation of blood with the formation of a soft elastic mass (thrombus) in a certain section of the vessels - arteries or veins (rarely in a wide network of vessels) - with complete or partial closure of their lumen or in the heart cavity.

### *Epidemiology*

In more than 90% of cases, it occurs in patients with chronic obliterating arterial diseases of atherosclerotic (mainly) or endarteritis genesis. Men are sick more often than women. The peak incidence occurs in the 5-6th decade of life.

### *Etiopathogenesis*

A thrombus in the vessels is formed under the following conditions: slowing down of blood flow, morphological changes in the inner surface of the vessel and changes in the chemical composition of blood, its coagulation properties. Thrombosis of the arteries, especially the main ones, develops as a complication of atherosclerotic lesions (the final stage of it) or (less often) - trauma. With atherosclerosis and other diseases of the arteries, as well as injuries, there are all conditions for thrombosis - morphological changes in the arterial wall and turbulent type of blood movement, hypercoagulation of blood. Less commonly, arterial thrombosis is a complication of arteritis, for example, in periarteritis nodosa, thrombangitis obliterans and Henoch-Schonlein purpura and other rheumatic diseases. In hypertension, the arteries of medium and small caliber are most often affected.

Thrombus formation mechanisms:

1. Blood coagulation - coagulation.
2. Platelet adhesion - aggregation.
3. Adhesion of erythrocytes - agglutination.
4. Plasma protein deposition - precipitation.

### *Clinical manifestations*

Symptoms of the disease are the same as in arterial embolism and depend on the severity of ischemia and the rate of its development. In general, it is believed that the development of ischemia in the presence of thrombosis is slower and not as bright as in the presence of embolism. However, on the basis of these signs, it is impossible to build a differential diagnosis. The main symptom may be a preliminary chronic vascular disease and the absence of embologic sources (heart disease, aneurysm, etc.). For additional methods of examination, it is necessary, first of all, to indicate angiography, which allows to establish the localization and length of the thrombosed segment, and most importantly, the state of the arteries located distal to the thrombosis. Angiograms show characteristic signs of chronic obliterating arterial lesions: segmental stenoses, formed collaterals. In case of embolism, on the contrary, the occlusion limit has a characteristic concave surface and abruptly breaks off, the overlying vessels have smooth walls, the collaterals are poorly expressed.

### *Diagnostics*

- Complaints of the patient, anamnesis
- General examination of the patient
- Non-invasive methods:
  - functional tests;
  - measurement of segmental pressure;
  - electrothermometry;
  - thermal imaging;
  - oscillography;
  - capillaroscopy;
  - capillarography;
  - volumetric sphygmography;
  - pO<sub>2</sub> measurement in tissues;
  - ultrasound (sonography, dopplerography).

Invasive methods:

- determination of tissue blood flow by xenon clearance (133x)
- aorto-arteriography.

### *Treatment*

In the presence of acute thrombosis, urgent surgery is indicated only in those cases that are accompanied by severe ischemia, threatening the viability of the limb. But even in these cases, all efforts should be aimed at preliminary clarification of operability (Doppler sonography, angiography).

In patients with not severe limb ischemia, restoration of blood circulation is best done in a delayed period. During this period, conservative therapy and a comprehensive examination of the patient are carried out.

Many authors put forward the following arguments in favor of delayed surgery: 1) clarification of local operability (condition of arteries), 2) development of collateral circulation, 3) improvement of the condition of soft tissues, 4) planned surgery always prevails over emergency (prepared by a team of surgeons, plastic material, etc.). Conservative treatment: 1) heparin therapy from the first hours at the rate of 30,000-40,000 units. per day every 4:00 under the control of a coagulogram, 2) Rheopolyglucin 400-800 ml. intravenous drip, 3) trental, 5.0 ml. 2 times, 4) aspirin 100 mg. per day after 2 days, 5) preparations of nicotinic acid (nikoshpan, Xanthinol nicothionate, halidor, etc.).

In some cases, fibrinolytic therapy is used. In this case, in the early stages, thrombus lysis is possible by endovascular supply of thrombolytic drugs to the thrombosed segment of the artery or intravenous administration of thrombolytics. With thrombolytic drugs, strepto- or urokinases, fibrinolysin, etc. are prescribed. All of them have serious side effects, therefore, the program of such treatment should be clearly defined, and patients should be observed in the intensive care unit. Before starting treatment, the main parameters of the blood coagulation system are determined.

## **6.6. Embolism**

### *Definition*

Embolism is the transfer of foreign particles by the blood stream and their blockage of the vessel lumen. The particle itself is called an embolus. Most often, an embolus is a separate fragment of a thrombus, less often another substance.

### *Etiopathogenesis*

In the development of embolism, reflex spasm of both the main vascular line and its collaterals is of great importance, which causes severe dyscirculatory disorders. Spasm of the arteries can spread to the vessels of the paired or any other organ (for example,

the reno-renal reflex in case of vascular embolism of one of the kidneys, pulmonary coronary reflex in case of pulmonary embolism).

The location of the embolism depends on the site of occurrence and the size of the embolus. The formation of an embolus in the veins of the systemic circulation: embolus that form in the veins of the systemic circulation (as a result of venous thrombosis) or in the right half of the heart (for example, in case of infection of endocardium), clog the arteries of the small circle, unless they are so small (eg, fat globules, tumor cells) that can pass through the pulmonary capillary. The location of the blockage in the pulmonary vessels depends on the size of the embolus. Very rarely, an embolus that occurs in the veins of the large circle can pass through a defect in the atrial or interventricular septum (thus bypassing the small circle) and cause embolism in the arteries of the systemic circulation (paradoxical embolism). Embolus that occur in the branches of the portal vein cause circulatory problems in the liver.

Embolism in the heart and arteries of the systemic circulation: embolus that occur in the left side of the heart and arteries of the systemic circulation (as a result of thrombosis of the heart or arteries), cause disorders in the distal parts of the systemic circle, that is, in the brain, heart, kidneys, limbs, intestine.

### *Classification*

Depending on the direction of movement of the embolus, there are:

- ordinary (orthograde) embolism (movement of the embolus along the bloodstream)
- retrograde embolism (movement of the embolus against the blood flow under the influence of gravity);
- paradoxical embolism (in the presence of defects in the atrial or interventricular septum, an embolus from the big circle veins, bypassing the lungs, enters the arteries).
- Air embolism
- Gas embolism with nitrogen (decompression syndrome)
- Fat embolism
- atheromatous embolism (cholesterol embolism)
- Embolism with amniotic fluid
- Tumor embolism
- Microbial embolism
- Embolism by foreign bodies

### *Clinical manifestations*

### *Thromboembolism of the vessels of the pulmonary circulation*

Clinical manifestations and significance of pulmonary embolism:

Embolus size is a significant factor in the degree of clinical manifestations of pulmonary embolism and its significance:

1) massive embolism - large embolus (several centimeters long and with a diameter, like in a femoral vein) can stop at the exit from the right ventricle or in the pulmonary artery trunk, where they block blood circulation. It cause sudden death as a result of the pulmonary-coronary reflex. Obturation of large branches of the pulmonary artery with an embolus can also cause sudden death as a result of severe vasoconstriction of all vessels of the pulmonary circulation, which occurs reflexively in response to the appearance of thromboembolism in a vessel, or spasm of all bronchi.

2) medium-sized embolism - often localized in the branches of the medium-caliber pulmonary artery. In healthy people, the bronchial artery supplies the lung parenchyma, and the function of the pulmonary artery is mainly gas exchange (not local tissue oxygenation). Therefore, a pulmonary embolus of medium size will lead to the appearance of a section of the lung, ventilated, but does not participate in gas exchange. This causes impaired gas exchange and hypoxemia, but lung infarction does not always develop. More often, a heart attack is formed in patients with chronic left ventricular heart failure (against the background of chronic venous congestion) or with pulmonary diseases, which also have impaired blood supply through the bronchial arteries, as a result of which the lung receives oxygen and nutrients, mainly from the pulmonary vessels. In these patients, impaired blood flow in the pulmonary artery leads to pulmonary infarction;

3) small embolism - obstruction of small branches of the pulmonary artery and can proceed without clinical symptoms - it depends on the prevalence of embolism. In most cases, embolus disintegrate under the influence of fibrinolysis. If there is a prolonged hit of numerous small embolus in the pulmonary circulation, then there is a risk of developing pulmonary hypertension.

**The clinical manifestations and significance of thromboembolism of the systemic circulation** are determined by the size of the affected vessel, the development of collateral circulation and the sensitivity of the tissue to ischemia. Infarctions of the brain, heart, kidneys and spleen can occur. A heart attack in the intestine and lower extremities develops only with occlusion of large arteries or with damage to the collateral circulation.

### *Diagnostics*

1. Complaints, anamnesis
2. General examination of the patient
3. Non-invasive methods:
  - functional tests;
  - measurement of segmental pressure;
  - electrothermometry;
  - thermal imaging;
  - oscillography;
  - capillaroscopy;
  - capillarography;
  - volumetric sphygmography;
  - pO<sub>2</sub> measurement in tissues;
  - ultrasound (sonography, dopplerography).
4. Invasive methods:
  - determination of tissue blood flow by xenon clearance (133x)
  - aorto-arteriography.

### *Treatment*

The operation of choice is embolectomy. The best results are obtained in the early stages (68 hours) after the development of the embolism. This is explained by the terms of tissue tolerance to ischemia, which for the extremities is within these limits. At later stages, the development of irreversible tissue changes is possible. However, the timing itself does not determine the indications for surgery. A reliable guideline is the severity of limb ischemia, which depends on several factors: 1. the level of occlusion, 2. the size of the thrombus, 3. the state of collateral circulation, 4. central hemodynamics. Thus, embolectomy can be successfully performed even after several days if the limb is still viable. Tactically, an urgent operation is required (within 12:00 from the moment of admission of the patient) with ischemia of 2 - 3 degrees. In case of embolism, the operation proceeding with ischemia of the 1st degree can be delayed by 1 or several days.

Conservative treatment: 1) heparin therapy from the first hours at the rate of 30,000-40,000 units. per day every 4 hours under the control of a coagulogram, 2) Rheopolyglucin 400800 ml. intravenous , 3) trental, 5.0 ml. 2 times, 4) aspirin 100 mg. per day after 2 days, 5) preparations of nicotinic acid (nikoshpan, Xanthinol nicothionate, halidor, etc.).



In some cases, fibrinolytic therapy is used. At the same time, in the early stages, thrombolysis is possible by endovascular supply of thrombolytic drugs to the thrombosed segment or intravenous administration of thrombolytics. With thrombolytic drugs, strepto- or urokinases, fibrinolysin, etc. are prescribed. All of them are distinguished by serious side effects, therefore the program of such treatment should be clearly defined, and patients should be observed in the intensive care unit. Before starting treatment, determine the main parameters of the blood coagulation system.

## **6.7 Acute limb ischemia**

### *Classification*

IS (ischemic stress) - at rest, pain and other symptoms are absent and appear only during exercise;

- ischemia 1a degree - numbness, cold snap, paresthesia of the limb;
- ischemia of 1b degree - the same symptom combined with pain syndrome;
- ischemia of 2a degree - the phenomenon of paresis (impaired sensitivity and limitation of active movements in the joints)
- ischemia of 2b degree - complete plegia of the limb;
- grade 3a ischemia - the development of subfascial edema;
- grade 3b ischemia - limb contracture;
- grade 3 ischemia - irreversible gangrenous changes with total contracture.

### *Clinical manifestations*

The main symptom of acute ischemia is pain in the affected limb. It comes on suddenly and has a strong character. Together with pain, patients often note a feeling of numbness in the limb.

On examination, a change in the color of the skin of the limb is striking: from pale to "marble" color. In the late stage of ischemia, when thrombosis of the venous bed occurs, the skin color becomes cyanotic.

With comparative palpation, a difference in skin temperature is noticeable, especially in the distal parts of the limb. There is also a disorder of all types of sensitivity (pain, tactile, deep). The limit of sensitivity disorder does not coincide with the level of artery occlusion, but is below, should not mislead the diagnostician.

An equally characteristic symptom is a violation of active movements in the joints of the limb, which vary in degree from restriction to complete plegia. In the late stage of severe ischemia, passive movements due to muscle and joint stiffness may also be

absent. Contracture of the joints is an unfavorable sign indicating the nonviability of the limb.

An absence of pulse in arteries distal to the level of the blockage is also one of the important symptoms. Slow filling of the saphenous veins also indicates poor circulation. Sometimes there is increased pulsation in the arteries located proximal to the occlusion, determined by comparative palpation.

In advanced cases, there is a sharp muscle pain on palpation, rigidity and subfascial edema.

### *Diagnostics*

1. Complaints of the patient, anamnesis.

2. General examination of the patient.

3. Non-invasive methods:

- functional tests;

- measurement of segmental pressure;

- electrothermometry;

- thermal imaging;

- oscillography;

- capillaroscopy;

- capillarography;

- volumetric sphygmography;

- pO<sub>2</sub> measurement in tissues;

- ultrasound (sonography, dopplerography).

4. Invasive methods:

- determination of tissue blood flow by xenon clearance (<sup>133</sup>Xe);

- aorto-arteriography.

### *Treatment*

The main method of treatment for acute limb ischemia is surgical, aimed at restoring blood flow in all patients who have no absolute contraindications for surgery. The absolute contraindications are: 1. agonal state of the patient, 2. gangrene of the limb. Relative contraindications are: 1. Ischemic stress or 1 degree in elderly patients (70-80 years old) with severe concomitant diseases, 2. with embolism of the end sections of the arteries of upper or lower extremity, 3. with embolism of the arteries of the upper extremity with relative compensation of blood circulation and severe general condition. The operation of choice is embolectomy.

## 7. ASSIGNMENTS FOR SELF-CONTROL

### *A. Tasks for self-control (test tasks)*

1. Endarterectomy can be:
  - a) full, partial
  - b) direct, indirect
  - c) retrograde
  - d) open, semi-closed, closed
  
2. What is the main factor in the development of atherosclerosis?
  - a) Dyslipoproteinemia.
  - b) Diabetes
  - c) Adrenal hyperfunction.
  - d) Frequent hypothermia.
  - e) Smoking.
  
3. Aortoarteriography by percutaneous catheterization of the aorta through peripheral arteries is developed:
  - a) Petrovsky B.V.
  - b) Sukhareva I.
  - c) Seldinger
  - d) Pokrovsky A.B.
  - e) Mondor
  
4. In obliterating atherosclerosis, the following are affected:
  - a) small arteries
  - b) aorta and main arteries
  - c) artery-venous shunts
  - d) communicative veins
  - e) capillaries
  
5. With obliterated endarteritis, the following are affected:
  - a) peripheral artery

- b) aorta and main arteries
- c) arteriovenous shunts
- d) communicative veins
- e) capillaries

*B. Situational tasks for self-control:*

1. The injured patient has a cut wound of the lower limb with isolated damage to the anterior tibial artery. It was revealed that the artery stump pulsates. You have no experience with vascular suture. Your tactics:
  - a) Perform temporary artery bypass grafting, involving a vascular surgeon
  - b) Ligate the artery and perform primary surgical debridement
  - d) Make an attempt to repair the artery yourself
2. During the revision of the groin wound, a defect of the femoral artery with a length of about 2 cm was found. Specify the optimal method for performing artery prosthetics
  - a) a segment of the femoral vein after its reversal
  - b) a segment of the axillary vein after its reversal
  - c) a linear synthetic prosthesis of the corresponding diameter
  - d) a segment of the great saphenous vein after its reversal
  - e) a segment of the small saphenous vein after its reversal
3. A patient with mild post-traumatic shock and trauma of the femoral artery with moderate ischemia should receive the following treatment:
  - a) Complete recovery from shock and then performing a recovery operation
  - b) Temporary artery bypass grafting, complete removal from shock and then performing a reconstructive operation
  - d) Simultaneous recovery from shock and reconstructive artery surgery
  - e) Performing limb amputation and anti-shock therapy
4. The victim after an undiagnosed closed injury of the popliteal artery has a contracture of the muscles of the leg, impaired passive movements in the ankle joint, subfascial edema of the limb against the background of oliguria, hyperazotemia, acidosis. Therapeutic tactics:

- a) A patient has II degree of limb ischemia and he is needed a reconstructive operation on the popliteal artery
- b) A patient has III degree of limb ischemia and he is needed a reconstructive operation on the popliteal artery, followed by detoxification therapy
- d) A patient has IV degree of ischemia, irreversible tissue changes, restoration of blood flow in the limb is life-threatening. Limb amputation is needed
- e) It is needed an observation, intensive detoxification therapy, the introduction of large doses of diuretics

5. During venectomy, mistakenly, instead of the great saphenous vein , the femoral, popliteal and posterior tibial arteries were removed. An error was found intraoperatively. Your tactics:

- a) It is necessary to amputate the limb
- b) Perform autovenous bypass
- c) Perform autoarterial bypass
- d) Engage a vascular surgeon in the operation
- e) Perform autoarterial bypass grafting and drain the removed artery beds