

MINISTRY OF HEALTH OF THE REPUBLIC OF BELARUS

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MANUAL
FOR STUDENTS OF
3 COURSE OF ALL FACULTIES OF THE "GENERAL SURGERY"

Topic: **Plastic surgery**

QUESTIONS TO THE TOPIC.

1. Plastic surgery. Organization of assistance to the population. Plastic materials in surgery.
2. Methods of restoration of the skin.
3. Keloid and hypertrophic scars, similarities and differences. The causes that determine the appearance of scars. Force lines or Langer lines.
4. Types of free skin grafting.
5. Types of non-free skin plastics.
6. Plastic surgery of blood vessels, nerves, muscle tissue.
7. Transplantation of bone tissue and bone marrow.
8. Organ transplantation. The concept of tissue incompatibility, methods for overcoming it.
9. A heart, kidney, or liver transplant. Status of the issue in Belarus.
10. Microsurgery. Reimplantation of a limb. Techniques.
11. Reconstructive and plastic surgery on the limbs and their segments.

PLASTIC SURGERY

Plastic surgery - a section of surgery that restores the shape and function of tissues and organs.

The task of plastic surgery is to eliminate various defects that can be congenital or acquired, arise because of injuries, diseases, surgical interventions and cause functional or anatomical changes. Any surgical operation contains elements of plastic surgery, as it involves the restoration of tissues and organs.

In the city of Gomel, there are several plastic surgery centers, in which plastic surgeries are performed on the skin and subcutaneous tissue to eliminate defects. At the same time, doctors of other surgical specialties use the elements of plastic surgery in their daily work: applying cosmetic sutures to the skin (according to Halstead, McMillan-Donati, etc.), lengthening the tendon, hernioplasty, pyloroplasty, etc.

Materials used in plastic surgery are divided into:

- autogenous (your skin flap, etc.)
- allogeneic (from another person - a kidney transplant)
- isogenic (from the identical twin)
- syngenic (from a relative of the 1st line)
- xenogenic (from a representative of another species - pork "xeno-skin")
- prostheses

Methods for restoring the skin::

Autotransplantation:

- free skin plastic
- non-free skin plastic ☐ local
 ☐ from a distant area.

Allotransplantation: Brephoplasty

Xenotransplantation: pig skin is used to temporarily close a wound defect. To reduce the loss of fluid and protein, as well as the prevention of infectious complications.

In addition, there are research works on the use of an allofibroblast culture to close wound defects.

From free skin grafting methods, following methods have historic importance:

- Yatsenko-Reverden
- Yanovich-Chaynsky-Davis
- Tirsch
- Lawson-Krause

Now days, the most widely used method is free grafting with a split skin flap. In this case, a skin flap with a thickness of ≈ 0.3 mm is cut off from the donor surface (abdominal region, outer thigh, back, etc.) using a dermatome. This donor skin flap is transferred to the wound surface. The conditions

for transplantation of a split flap are: absence of infection (purulent process), healthy granulation of the closed surface, good blood supply of the defect. If it is necessary to increase the area of the skin flap, stitches can be staggered. After application to the wound surface, the skin flap is straightened, the excess is excised. An aseptic dressing is applied with antiseptic solutions (furasillin 1: 5000, 3% solution of boric acid, etc.). The donor surface is closed with a similar bandage. The next day after the operation, dressing is performed, the purpose of which is to identify infectious complications (suppuration of the skin flap), flap displacement, detection of marginal necrosis, etc. Sterilization solutions (Normal saline, furasillin, boric acid, etc.) are used for "Soaking" dressings of this skin flap. Subsequently, the skin flap grows due to intimate contact with granulations and edge epithelization appears by 7-10 days. Unclosed areas up to 5-10 mm in size subsequently independently closed due to regional epithelization.

The donor surface is subsequently closed due to 1) marginal epithelization, 2) cells of the basal layer, and 3) epithelium of the excretory ducts of the sebaceous and sweat glands, hair follicles. After 4-5 weeks, the donor surface is closed with a thin layer of the epidermis. After a while, from the same surface, a repeated skin flap may be taken. Thus, this method allows you to cover large areas of skin defects due to their own tissues, if needed repeatedly.

Among the methods of non-free skin grafting, a) local and b) from a distant area are distinguished.

Local:

a) mobilization of the edges - with this method, the skin-subcutaneous flap is separated from the underlying fascia without disturbing the blood supply.

b) Relax incisions - the essence of the method is to create additional incisions with the subsequent mobilization of the skin flap to "divide" the size of the wound into several (2-3)

c) "Z" - plastic surgery aimed at excision of rough hypertrophic scars, with the prevention of their subsequent formation and the development of desmogenic contractures.

d) rotating (linguiform, Indian method) - grafting due to separation, mobilization of skin flaps and their mutual displacement.

From a distant area:

a) direct (Italian method) - transfer of the mobilized edge of the skin flap to the donor surface.

b) bridge-shaped (Sklifosovsky) - used to close the surfaces of the hand, forearm, etc.

c) migrating flap - a method of gradual transfer of the skin to close the skin defect in a remote (distant) area.

d) "Filatovsky" / stalked, tubular / flap - similar to the method of a migrating flap, but the flap is sewn along the cut line in the form of a "suitcase handle".

Brephoplasty - a skin transplant of stillborn fetuses not older than 6 months. In this type of allotransplantation, it is necessary to take into account the isoserological compatibility of the donor and the recipient.

The course of collagen fibers in the skin layer has a certain direction, which often coincide with the course of skin folds. These lines are called force lines or Langer lines. The same direction of the skin incision with the course of the of force lines provides, in the absence of a tendency to keloidosis, a thin and inconspicuous scar, which leads to such an access parameter as cosmetic. In the event of a mismatch (the course of the incision is perpendicular or at an angle to the force lines), more severe hypertrophic scars may form. When these scars are located in the area of the flexion surfaces, the formation of hypertrophic scars can lead to desmogenous contractures.

Keloid and hypertrophic scars.

All scars are divided into normal and hypertrophic:

An ordinary scar consists of normal connective tissue and has elasticity. The strength of scar tissue and their resistance to damage are acquired gradually.

Hypertrophic scars consist of dense fibrous tissue and are formed with excessive synthesis of collagen. They are characterized by rough, tight, ugly scars, rise above the surface of the skin, have a reddish tint, sensitive and painful, often cause itching. Among them, ordinary hypertrophic scars and keloids are distinguished.

An ordinary hypertrophic scar never extends beyond the area of damage, corresponds to the boundaries of the previous wound. Two factors play a leading role in the development of such a scar: large sizes of the wound defect and permanent scar trauma

A keloid - is a scar that invades the surrounding normal tissues, previously not involved in the wound process. Unlike ordinary hypertrophic scars, they often form on functionally inactive parts of the body. Its growth usually begins 1-3 months after epithelialization of the wound. The scar continues to increase even after 6 months and usually does not decrease or soften. Keloid scars occur after any, even minor injury (needle prick, insect bite), superficial burn. Scar stabilization occurs on average 2 years after its appearance.

The morphological structure of the keloid is an excessively growing immature connective tissue with a large number of atypical giant fibroblasts. The pathogenesis of keloid formation remains unclear to date. A certain role is played by autoaggression mechanisms on one's own immature connective tissue. Impairment of collagen synthesis may be due to genetic abnormalities.

With the development of keloids, electrophoresis with enzymes (lidase, terrilitin), ultrasound with hydrocortisone, application of ronidase, scar injection of lidase, compressive therapy, close focus x-ray therapy, cryotherapy, rhodon and hydrogen sulfide baths, exercise therapy and immobilized therapy are used. (immobilized therapy to change the hydration of scar tissue), herbal preparations (counter-tubex, madecassolum), excision of the scar with an intradermal suture, hormonal therapy (triamcinolone). However, it should be recognized that at present adequate methods for the prevention and treatment of keloid scars have not been found.

Angioplasty (Vascular plastic surgery):

In order to replace defects in arterial trunks in cases where it is not possible to directly connect the ends of the damaged vessel, a number of methods for restoring blood circulation using grafts and prostheses are proposed.

There are two main types of vascular plastic surgery: homoplasty, when a defect is replaced by a cut-off of a preserved arterial trunk taken previously from the corpse of a recently deceased (non-infectious) person, and alloplasty is the replacement of arterial trunk defects using plastic tubes (dacron, etc.).

As shown by research DeBeki, A.N. Filatova et al., The homograft is gradually absorbed and replaced by the scar tissue of the recipient.

In plastic surgery of vessels, various materials can be used. For plasty of marginal defects that may be sutured, a vascular suture is used.:

- Carrel
- Gorsley
- Rings of Donetsk
- mechanical

An autovein (most often a fragment of the large saphenous vein of the femur) and alloven may act as plastic material. As well as prostheses made of teflon, dacron, nylon. In some cases, a bypass anastomosis of narrowed areas (aortic-femoral bypass) can be performed.

Plastic surgery of nerves:

Damage to the nerve trunks of the limbs is one of the most common causes of severe disorders of the musculoskeletal system, leading to persistent dysfunction of the limb. Treatment of damage to peripheral nerves, especially if this damage is accompanied by the damage of the anatomical integrity of the trunk, is a very difficult task. This is due to the fact that after an injury degenerative changes in nerve fibers develop, making it difficult for the segments of nerves to grow together. Therefore, the main goal of surgical intervention during breaks in the nerve trunk is the convergence of the nerve segments and the creation of conditions for regeneration during the initial surgical treatment of the wound.

One of these conditions is the excision of the altered sections of the central and peripheral segments of the nerve trunk and matching them using sutures. The process of nerve regeneration after its interruption is very complicated. Waller in 1852 established that after nerve transection in the first 14-20 days, the peripheral ends of nerve fibers (axial cylinders), which have lost contact with the center (spinal cord cells), undergo throughout degeneration (Waller degeneration). At the same time,

Schwann cells multiply, and therefore the appearance of the peripheral segment of the nerve remains little changed. In the central segment of the nerve during this period also degenerative changes occur, ending in the formation of a neuroma (regenerative neuroma), in which there is an enhanced growth of young nerve fibers.

In order for the germination of nerve fibers to occur in the peripheral segment of the nerve, it is necessary to remove the end neuroma of the central segment and thereby create the conditions for the transition of axial cylinders into Schwann tubes of the peripheral segment of the nerve.

Germination of nerve fiber occurs slowly, under favorable conditions, not exceeding 1 - 1.5 mm per day. This explains the long process of restoration of the function of large nerve trunks, which lasts for many months. In the presence of a coarse scar between the associated segments of the nerve, germination slows down or axial cylinders (axons) do not penetrate into the peripheral segment at all.

In operations on nerves, a nerve suture can be used, as well as the release of a nerve from scar tissue - neurolysis. Indications for neurolysis are scar tissue pinching of the nerve trunk while maintaining its conduction.

The nerve suture was developed long ago. Nelaton in 1863, and Logier in 1864, for the first time used a nerve suture, but this operation was not widespread for a long time, since the methods for diagnosing peripheral nerve injury were not high, and the surgical technique did not provide the expected results. The work of a number of surgeons (Bethe, Pertes, A.G. Molotkov, Z.I. Geymanovich, V.N. Shamov, and others) improved the diagnosis and methods of operations on nerve trunks, which led to an improvement in the outcome of surgical interventions for peripheral wounds nerves and expansion of indications for this operation.

With neurolysis, the damaged nerve is isolated from the scar tissue of the nerve fiber or its damaged proximal and distal segments. These segments are captured with rubber or gauze strips and carefully cross the nerve above and below the neuroma within the healthy tissue. Evidence of complete removal of the neuroma is bleeding at the cut. Next, they begin to mobilize the processes for stitching them without tension. The ends of the nerve segments compare and impose nodal sutures for the epineurium.

Muscle and tendon transplantation in reconstructive surgery is mainly used for persistent disorders of movement in the joints of the limbs as a result of trauma to the peripheral nerves and for residual polyomyelitis. These operations are aimed at restoring active movements in the joints by moving the tendon of the full muscle to the attachment point of the paralyzed muscle.

In recent years, in addition to transplanting the entire tendon, it is proposed to perform an isolated transplant of muscle-tendon complexes (while maintaining blood supply and innervation). An example of this type of plastic surgery is the separate transplantation of the long head of the biceps muscles of the thigh onto the patella in paralysis of the quadriceps of the thigh (M.A. Akatov), and separate transplantation of the heads of the triceps muscle of the leg to the rear of the foot with pes equinus paralyticus (I.A. Movshovich).

Bone grafting is one of the most effective surgical procedures for repairing defects of tubular bones. The purpose of this operation is to replace a bone defect, fix bone fragments and enhance bone regeneration processes. Therefore, bone grafting has spread not only to replace bone defects, but also for the treatment of non-healing fractures and false joints, in which regeneration processes are impaired. The existing methods of bone grafting are based on the idea of N.I. Pirogov on the possibility of engraftment of a bone graft on a leg, which he carried out for the first time in the form of a bone-plastic amputation of a leg (in 1852). Subsequently, Olby, Beer, N.N. Petrov, G.I. Turner, M.I. Sitenko, V.D. Chaklin et al. have developed the theoretical and practical issues of modern bone grafting.

By the type of material taken for transplantation, there are three main methods of bone grafting.:

- A) - autoplasty (of the patient)
 - homoplasty (lyophilized bone from a corpse)
 - heteroplasty (from cattle)
- B) - free bone grafting
 - bone grafting with a "sliding" graft

- bone transplant on the pedicle
- B) - intramedullary
- extramedullary.

In addition to this method, transplants can be fixed with suture material, wire, plates, screws.

In transplantology, in addition to organ transplants, transplantation of tissues and cell cultures has recently spread. The possibilities of tissue transplantation are increasing every year. Below are only the most common methods:

A) Bone marrow transplant - is widely used in the treatment of diseases of the blood system, for the correction of disorders in radiation sickness, with massive chemotherapy for cancer.

B) Transplantation of adrenal cell culture, β -cells of the pancreas, spleen, etc.

The corresponding organ is obtained from dead human fetuses, and sometimes from animals (pigs). Fetus cells at a certain stage of development are practically devoid of antigenic properties, which is important. After special treatment of the cells, they are planted on nutrient media and a cell culture is formed. The resulting cell culture is transplanted into the rectus abdominis muscle, injected into the splenic or renal artery. As a result, prolonged functional activity of transplanted cells is noted. Immunosuppression not required.

Transplantation of spleen tissue: autograft is usually used: after splenectomy (rupture of the spleen, etc.), the spleen is washed, crushed by a special technique and inserted into a specially formed pocket from a large omentum. After a few months, a splenoid is formed at the injection site - spleen tissue that performs the corresponding function. Transplantation of spleen cell culture is also possible.

Currently, in a number of clinical centers of transplantology, organ transplants are performed systematically with good immediate and long-term results. Organ transplantation became possible thanks to the development by A. Carrell of a vascular suture in 1902-1905. Further successes in organ transplantation were achieved thanks to a deeper understanding of the role of the immune system in transplant engraftment; development of methods for assessing the histocompatibility of donor and recipient tissues, overcoming incompatibility and suppressing the organ rejection reaction by the recipient organism; the development of technical details for the capture, preservation and transplant operation, as well as through the organization of donation and transplantation centers.

In 1992, the law of the Russian Federation on transplantation of organs and (or) human tissues was adopted, which created favorable conditions for the widespread use of organ transplants in practically hopeless patients. The most common was a kidney transplant; in the late 90s, up to 700 operations were performed (USA - more than 10,000, France - 2,000 operations per year). By 1993, 80 heart transplants were performed in Russia. More than 50 heart-lung complex transplants were performed in the world. A further increase in the number of transplants is hampered by a lack of donor organs. Patients awaiting transplantation are 2 times more than the number of patients who received an organ from a donor.

There are two main categories of donors, living and non-viable donors. Living donors are used only for transplantation of paired organs, in modern transplantology - only for kidney transplantation. Removal of an organ - only with his voluntary consent. It takes into account: donor health, immunological compatibility, anatomical and functional organ "health".

Non-viable donors can be people from 5 to 50 years old who died in ICU from the following diseases:

- isolated head injury (head injury)
- rupture of cerebral aneurysm
- some brain diseases
- suicides
- barbiturate poisoning.

In this case, the donor should not have organic diseases of the cardiovascular system and any diseases or complications of an infectious nature.

Non-viable donors are divided into 2 groups;

- 1) removal of organs and tissues from which is carried out after death;

2) the removal of organs and tissues is carried out after the death of the brain, with a working heart;

In the latter case, the following criteria exist for setting brain death:

- complete and persistent lack of consciousness;
- persistent lack of spontaneous breathing;
- the disappearance of any reactions to external stimuli and any types of reflexes;
- atony of all muscles;
- the disappearance of thermoregulation;
- a complete and stable absence of spontaneous and induced electrical activity of the brain (according to electroencephalography);
- angiography of cerebral vessels;
- consultation: neurologist, resuscitator, forensic medical expert, hospital official, confirming brain death. In the absence of the necessary specialists during duty, the staff of the consultation may include responsible duty specialists: resuscitator, therapist, surgeon, neurosurgeon, etc.

When removing organs, it is necessary to strictly observe:

- asepsis rules;
- the organ is removed along with the vessels, ducts of the maximum possible length;
- after removal, the organ is perfused with a special solution (eg: Euro-Collins at a temperature of 6-10 ° C);
- after removal, the organ is immediately implanted (the organ is taken and transplanted in one operating room on parallel tables) or placed in special airtight transport containers for transportation to another hospital.

One of the main problems of transplantology is the histocompatibility of the recipient and the donor. This is due to the presence of various antigens in the body, and the selection of a donor is carried out taking into account them. In this regard, in America, Europe, unified banks of donor agencies have been created, where there is information about potential recipients and where information about potential donors is received.

At present, donor selection is carried out taking into account two main systems of antigens: ABO (resembling the Ottenberg rule) and HLA. However, it is impossible to achieve complete identity of the genotype, and a rejection reaction may occur in recipients after surgery. This is due to the reaction of the recipient's immune system aimed at the destruction, destruction of a foreign organ, tissue.

Rejection can be: a) super acute (on the operating table), b) early acute (within 1 week), c) acute (first 3 months), d) chronic (delayed in time). A vivid clinical manifestation of rejection was called the "rejection crisis".

The main methods for overcoming it are:

- compatibility on the ABO system, the coincidence of 2-4 antigens on the HLA system and negative cross typing;
- pharmacological immunosuppression:
- cyclosporin;
- azothioprine;
- prednisolone;
- orthoclone;
- anti-lymphocyte globulin, anti-lymphocytic serum.

The most common operation is a kidney transplant, first performed in 1902 by Carrell and Ullmann. In 1953, Hume - a successful kidney transplant from a related donor. In Russia in 1965 - successfully transplanted kidney by B.V. Petrovsky.

Indications are: stage III CRF (permanent hemodialysis), as the outcome of various kidney diseases.

Thermal ischemia - 45 minutes and cold - up to 40 hours. During this time, transplantation should be performed. Transplantation is carried out heterotopically - to the external iliac vessels, neoureterocystoanastomosis is formed.

Up to 1 year, 85% of the kidneys are with good function, 2 years - 75%. Some individual cases

are reported with up to 20 years.

Heart transplant: The priority in experimental animal transplantation of the heart, heart-lung complex belongs to the Russian scientist Vladimir Petrovich Demikhov, who developed the basic methods in the 50s of the XX century. The first heart transplant was performed on December 3, 1967 in Cape Town by Christian Bernard, who had studied with V.P. Demikhova. The patient after the operation lived 16 days. Death came from 2-sided pneumonia and a rejection crisis. In Russia, a heart transplant in 1968 was performed by A.V. Vishnevsky. The patient passed away after 33 hours.

An indication for transplantation is a disease with acute decrease in myocardial contractility with the development of heart failure, congenital and acquired heart defects.

Orthotopic heart transplant: usually, the operation of getting heart from donor and transplantation takes place simultaneously. In this case, a cardiopulmonary bypass apparatus is required.

Currently, the problem of artificial heart is being intensively solved.

Survive rate of patients is about up to 80% during the first year and up to 50% after 5 years.

Liver transplantation: indications for liver transplantation are various forms of cirrhosis, primary liver cancer, sclerosing cholangitis, and congenital malformations.

A liver transplant can be orthotopic (more often) and heterotopic. Currently, it is the most difficult operation in the way of technical and anesthesiology support. Duration - up to 10-12 hours, the possible volume of transfusion of blood products and blood substitutes up to 10-12 liters.

Thermal ischemia - 20 minutes, cold - 8 hours.

The development of optical equipment and the use of special microsurgical instruments made it possible to reconstruct the thinnest blood and lymph vessels, to suture nerves and made it possible to "sew" (reimplant) the limb cut off as a result of an accident or its part with full restoration of function. The method of microsurgery is also interesting because it allows you to take a patch of skin or an organ (for example, a gut) and use it as plastic material, connecting its vessels with arteries and veins in the required area. In addition to traumatology, microsurgical operations have become widespread in eye practice, neurosurgery.

In case of traumatic amputation of a limb or its segments, it is necessary to put this segment in a clean plastic bag, then tie it in a knot so that the segment is inside a closed cavity, then unscrew the bag (it turns out to be a "bag in a bag") and cold (4-6 ° C) water is poured inside, (in the absence of water it is possible to use snow, ice - which is less desirable). In the absence of a bag, water, snow, this segment is closed with clean cloth (for example, a clean handkerchief) and transported together with the patient to the nearest hospital, providing first and parallel first aid, first medical, medical, specialized care.

In case of impossibility of re-implantation, or the development of impairment, necrosis, operations can be finished with amputations at this level, or at another level, depending on the indication. There is also a certain number of patients with traumatic amputations of the distal extremities (hands, feet, fingers, etc.). In order to rehabilitate such patients back in the 19th century, various operations were proposed aimed at the possibility of using the affected limbs. The Italian surgeon Wangetti (1898) suggested that amputation of the forearm should make the forearm flexor tendons loop. The German surgeon Sauerbruch (1916) proposed stitching together the biceps and triceps muscles of the bone filing of the stump of the shoulder and suturing the resulting loop with skin. A bone polished pin is inserted into the skin channel formed under the loop, to the ends of which were fixed wires that connected to the artificial fingers (kinematization or Kruckenberg procedure). One of the successful types of kinematization of the stump is the operation of splitting the stump of the forearm according to Kruckenberg (1917). Its purpose is the creation of two thumbs from the radius and ulnar bones - "claws". The essence of the operation is the division of the flexor and extensor muscles into two groups - the ulnar and radial (opening, claws, compression is carried out by a round pronator). With traumatic amputation of the thumb, the operation of phalangization is used. The purpose of this operation is to create from the I metacarpal bone - the "finger", by dissecting the skin-subcutaneous flap and moving the muscles. (G.A. Albercht).

On the lower extremities for various traumatic lesions, as well as other diseases, various plastic surgeries are used: bone-plastic amputation of the lower leg according to Pirogov (1852). The purpose

of this operation is the maximum preservation of the supporting limb length and the preservation of support (on the calcaneal tubercle). Gritti-Szymanowski bone-plastic amputation of the thigh (1857) - the essence of the operation is that the stump of the distal femur is covered with an anterior skin-tendon-bone (stumping of the anterior part of the patella) flap. In addition, the stump is closed by a muscular-fascial flap in various fasciomyoplastic amputations.

MCQS FOR THE TOPIC

1. Autogenous transplantation is ...
 - 1) transplant from person to person;
 - 2) the donor and recipient are the same person;
 - 3) transplantation from animals to humans;
 - 4) the donor and recipient are identical twins;
 - 5) the donor and recipient are first-degree relatives.

2. Replantation is a type of free transplant...
 - 1) when tissues and organs are transplanted back to their original place;
 - 2) when tissues or organs are moved from one part of the body to another;
 - 3) when tissues or organs are moved from one organism to another;
 - 4) all of the above.

3. Z - shaped plastic is applied:
 - 1) In plastic surgery of the nose;
 - 2) In plastic surgery of the ears;
 - 3) In plastic surgery of the stump of limbs;
 - 4) In deformation of the skin with rough scars.

4. Non-free skin plastic surgery includes:
 - 1) Tirsch method;
 - 2) the Yatsenko-Reverden method;
 - 3) the Lawson-Krause method;
 - 4) the "Indian" method.

5. The main cause of organ transplant failure is:
 - 1) the development of cancer;
 - 2) graft rejection reaction;
 - 3) bacterial complications;
 - 4) inhibition of bone marrow function.

6. A transplant of a migrating skin stem suggested:
 - 1) Herzen;
 - 2) Filatov;
 - 3) reverse;
 - 4) Yatsenko.

7. To replace aortic bifurcation, --- is used:
 - 1) own vein;
 - 2) prostheses from dacron and teflon;
 - 3) own artery;
 - 4) all of the above.

8. The first successful heart transplant to a person was carried out by:

- 1) Demidov;
- 2) Carrel;
- 3) Bernand;
- 4) Vishnevsky.

9. The most difficult in technical terms is transplantation of:

- 1) hearts;
- 2) kidneys;
- 3) liver;

10. Bernand was the first in the world to have a successful transplant of:

- 1) kidneys;
- 2) liver;
- 3) heart;
- 4) complex "heart-lungs".

ЛИТЕРАТУРА

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