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**1. Asepsis - antisepsis. Sterilization of surgeon armarium and suture material.**

**General principles and methods of sterilization**

Sterilization (“sterilis” – unfruitful, lat.) – process of any microorganisms destruction using physical or chemical methods, which is carried out after pre-sterilization cleaning. Sterilization is thebasis of asepsis. Methods of sterilization must provide full deactivation of all microorganisms, including the most resistant, both pathogenic and nonpathogenic. As spores are the most resistant the possibility of use of certain sterilization methods is evaluated by the level of their sporicidal activity. The methods of sterilization used in practice must:

- be effective against bactericidal and sporicidal activity;

- be safe for patients and medical staff;

- notworsen working qualities of medical instruments.

In modern asepsis physical and chemical ways of sterilization are used. The choice of this or that way of sterilization is based onthe properties of the instruments sterilized.

**Classification of surgeon armarium**

All the surgeon armarium can be divided into three groups according to the used materials and other qualities: 1) metal (cutting and not cutting), 2) rubber (plastic), 3) optical.

As a rule, surgical instruments are made of chromium stainless steel,titan; therefore they can be sterilized using autoclave, dry heat, gamma radiation, andultrasound cold sterilization.

Sterilization of surgical instruments includes several steps, such as, disinfection, pre-sterilization cleaning and sterilization itself.

Now, considering the danger of hepatitis and HIV viruses spread the rules of pre-sterilization cleaning are equal to the methods of cleaning that provide full destruction of these viruses. The process of disinfection is combined with pre-sterilization cleaning: the instruments are put into a vesselno. 1 with Lizafin solution 1%, or nikaamitsid solution 0,25%; in15 minutes all fat and proteins are removed (pre-sterilization cleaning); then using the forceps the instruments are put into a vessel no.2containing disinfecting solution (disinfection), exposure period is an hour.

When the processes of disinfection and pre-sterilization cleaning complete, the instruments are washed under running water. Then they are washed with distilled water during 5 minutes (salt elimination), allowed to air dry or using a drying cabinet.

Use the uniform percent concentration of "Lizafin" during any modes of disinfection: “Lizafin”1%– 60 minutes; “Lizafin”1, 5% , 2% –15 minutes.

On completion of pre-sterilization cleaning the quality control is carried out. 1% of the simultaneously sterilized instruments is controlled, but not less than 3-5 items.

Quality control of pre-sterilization cleaning is carried out with the help of amidopyrin, phenolphthalein, azopiram tests as it allows to reveal residual of active chlorine, blood, cleaning agents, peroxydase, acids and rust. Self-check is carried out daily, a chief nurse carries out the quality control once a week, sanitary and epidemiological station – once a month.

**Technique of Azopiramtest**

Smooth instrumentsare wiped with a textile napkin wetted with azopiram solution. Apply 2-3 drops of azopiram solution on the instruments having grooves or channels, so that the solution passes through the channels and joints of the instrument parts. Then the instrument is left on a clear white napkin in order solution flows down, and then you can consider the result. The results received after 1 minute period aren't considered.

The results of Azopiram test. In the presence of blood or traces of it azopiram stains in violetcolor which quickly turns into pink-lilac. All the results of the tests are considered in the special control register – "pre-sterilization cleaning quality register".

Amidopyrin test. Mix 5% amidopyrin alcoholic solution, 30% acetic acid solution and 3%hydrogen peroxide solutionin equal quantities.The technique is the same as of Azopiram test. In the presence of blood or traces of it during the period of 1 minute the instruments get blue-violet coloring.

Phenolphthalein test. Make 1% phenolphtalein alcoholic solution using 95% ethyl alcohol. The technique is the same as of Azopiram test. In the presence of cleaning agents or their tracesduring the period of 1 minute the instruments stain in pink color.

**In case of positive tests, all the instruments must be exposed to pre-sterilization cleaningrepeatedly.** If Azopiram test shows traces of rust, such instruments are rejected and in the subsequent are exposed to anti-corrosion treatment.

Sterilization methods

1. Thermal methods of sterilization – autoclaving, airborne disinfection, glass bead sterilization, radiation.

2. Chemical - use of chemical sterilant, gas sterilization.

3. Radiation.

Autoclaving: process of sterilization is performed with the help of hot steam. An autoclave (a machine used for sterilization with the help of saturated steam under pressure) allows to heat water under high pressure what raises the boiling point of water and steam temperature respectivelyto 132,5°C(at a pressure of 2 atmospheres).

**Modes of steam sterilization.** At a pressure of 2 atmospheres and temperature 132°C the exposure period is 20 minutes (for the objects made of corrosion-resistant materials, glass, textile, rubber, ligature suture material).

At a pressure of 1,1 atmospheres and temperature 120°C the exposure period is 45 minutes (for rubber, latex, some types of plastic (high density polyethylene, PVC-compounds), ligature suture material). Sterility control of steam sterilization indicator (SSI)-132 °, SSI -120 °.

**Airbornesterilization**. Hot air sterilization (dry heat sterilization). The acting agent is heated air. Sterilization of that kindis carried out in special machines – dry heat sterilizers. Sometimes the objects are sterilized in special packing, but more often without it. Used for sterilization of metal objects, heat resistant glass and rubber.

The process of sterilization is performed at 180°C, exposure period is 60 minutes.

Terms of storage of the instrumentsare the same as of the sterile work surface – 6 hours. Sterility control of airborne sterilization indicator - 180 ° -60min.

**Chemical sterilization**

It is used when the other types of sterilization can cause damage of sterilized instruments(EGDS, colonoscopes, cystoscopes). Terms of storage - 3 days.

Sterilization modes:

- hydrogen peroxide solution 6%, at 18 °C – 360 min.;

- hydrogen peroxide solution 6%, at 50 °C – 180 min.;

- "Dezokson – 1" 1% at 18 °C – 45 min.;

- CIDEX solution 2% at 20-22 °C – 240 min. for metal;

- CIDEX solution 2% Solution at 20-22 °C – 600 min. for flexible endoscopes;

- Gigasept FF solution 10% – 600 min.

**Flexible endoscopes sterilization (fibrogastroscope, fibrogastroduodenoscope, fibrocolonoscope,** [**fiberoptic bronchoscope**](https://www.multitran.com/m.exe?s=fiberoptic+bronchoscope&l1=1&l2=2)**)**

Firstly the working part of the endoscope is being wiped with a textile napkin wetted with Salvanis solution 0,5% within 10 min.; then run fluid through the channels of the endoscope, all the valves and caps are soaked in Salvanis solution 0,5%. After the endoscope is washed under running water and dried, traces of blood or cleaning agents check is carried out using the Azopiram test within 1 minute.

**High Level Disinfection(HLD)**

The endoscope and itsparts are put into disinfectant solution "Anioxyde-1000" for 5 minutes, then the endoscope is washed from the disinfectant solution. Endoscopes arestored vertically in sterile two-layer cotton bags within 6 hours. Removable elements (caps, valves) must be stored separately in a sterile napkin on a medical therapy table.

**Sterilization of laparoscopic instruments**

**A. Pre-sterilization cleaning**

The instruments are washed with Lizafin solution 2%, internal ducts are brushed and washed with a syringe, then they are soakedin Lizafin solution for 15 minutes, laparoscopic cords are wiped twice withLizafin solution, washed under running water, rinsed with distilled water and dried at80°C.

**B. Sterilization**

It is carried out in ozone camera within 15 minutes.

Stored inthe ozone camera within 21 hours.

**Sterilization ofanesthesia machine**

Disinfection and pre-sterilization cleaning of all the removable parts in Lizofin solution 2% during 15 min.

Sterilization is carried out in Nika-Amitsid solution 1% during 15 minutes after the machine washed with distilled water and assembled. Nowadays when giving anesthesia individual bacterial viral filters and contours (system of tubes) are used for each patient.

**Gas sterilization.** Sterilization is carried out in gas sterilizers and in portable anaerobic jars of 2,0 and 2,7 liters. For gas sterilization usea special chemical mixture of an ethylene oxide in bromic ether atthe ratio of 1:2,5, ethylene oxide, ozone. The instrumentsundergo all the stages: before sterilization pass all stages of processing: disinfection, pre-sterilization cleaning and drying.

**Modes of gas sterilization.**

Package: two layers of polyethylene film, parchment, kraft paper, wet-strengthbag paper, standard pack of “Wipak Medikal”, “Vinar”, “Rexam” corporations, etc.

Sterilization time: 960 minutes (rubber, plastic, glass, metal).

**Glass bead sterilization.** Used only for dental instruments sterilization, without any packaging, not suitable for the further storing.

**Radiation sterilization (gamma irradiation).** This method allows to carry out sterilization at the high level, without any requirements to sterilized instruments and package, period of storing – up to 7 years.

**Prevention of implant infection.**

Includes providing strict sterility of all objects implanted into the patient's bodyas microorganisms staying in the human body can find more favorable conditions for their generation – or it can becomea "latent infection". Sources of implant infection can be: suture material, drainages, catheters, cardiac valve prostheses, vessels and joints prostheses, metal constructions, vena kava filter. The main source is suture material.

**Requirements to suture material:**

1. Biocompatibility – absence of toxic, allergic, teratogeniceffect of retention suture on the body tissue.

2. Biodegradation – ability of the material to decompose and eliminate out of the body. Suture material must hold tissues together tillthe scarformation, after that it isn't necessary.

3. Noninvasiveness – a)surface properties of a thread: all twisted and braidedsutures have rough surface, that is why there is a "sawing" effect. Only monofilamenthas a high level ofnoninvasiveness, b) the way how a thread and a needle are connected – noninvasive needles are better because a thread is swaged to a needle, c) manipulation properties of a thread: elasticity and flexibility, d) thread tenacity and its integritytill the scar formation. Scientific researches showed that thinner the thread, the lower reaction of the tissue. The thinnest thread – "0", the thickest thread – "No. 10".

Suture material classification

1. According to the ability of biodestruction:

1) absorbable: catgut suture, polyglykolide materials (polisorb, vicryl, dexon suture, polyurethane resin),

2) slowly absorbable (silk, kapron),

3) nonabsorbable: polyether, fluoropolymer, metal clips.

2. According to a thread structure:

1) Monofilament thread

2) Polyfilament thread: twisted, braided sutures

Needle diameter is determined considering a needle as a part of a circle. So needles may be: 1/4 circle, 3/8 circle, 1/2 circle, 5/8 circle. Needles classified by the form: pricking, cutting and blunt. Suture materials with antimicrobial activity are used for wound abscess prevention (letilan-lavsan thread, fluorine thread, acetate thread)

**Control questions:**

1. What do Asepsis and Antisepsis mean?

2. Classification of surgeon armarium;

3. Pre-sterilization cleaning of instruments and quality control;

4. Metal instruments sterilization;

5. Sterilization of optical instruments, rubber and synthetic;

6. Sterilization of instruments after clostridial anaerobic infection;

7. Sterilization of anesthesia machine;

5. Requirements for suture material.

**Tests on the topic: Asepsis - antisepsis. Sterilization of surgeon armarium and suture material.**

***Choose one correct answer***

1. PHYSICAL METHODS OF ANTISEPSIS INCLUDE

a) thermal sterilization

b) radiation sterilization

c) primary surgical treatment of the wound

d) bandage with antiseptic solution

***Choose the correct combination of answers***

1) a, b

2) b, c

3) c, d

4) a, c

2.STERILIZATION OF NON-CUTTING METAL INSTRUMENTS IS CARRIED OUT BY

1) boiling in distilled water

2) burning

3) in drying cabinet

4) boiling in soda solution

3. STERILIZATION OF INSTRUMENTS IN THE DRYING CABINET IS CARRIED OUT

1) AT 180º С – 60 min

2) AT 180º С – 20 min

3) AT 132º С – 60 min

4) AT 132º С – 20 min

4. PREVENTION OF IMPLANT INFECTION IS CARRIED OUT BY

1) metal instruments sterilization

2) suture material sterilization

3) operating room air sterilization

4) syringes sterilization

5. FOR EMERGENCY STERILIZATION OF THE INSTRUMENT NEEDED DURING THE OPERATION, YOU CAN USE

1) «Pervomur»

2) burning

3) ozonator

4) boric acid solution

6. WHAT DOES AZOPYRAME TEST CONTROL?

1) presence of organic impurities and traces of cleaning agents

2) only presence of blood

3) only presence of cleaning agents traces

4) sterility of the instrument

7. PRE-STERILIZATION CLEANING OF THE USED INSTRUMENTS BEGINS

1) with washing under running water

2) with soaking and washing in cleaning agent

3) with washing in disinfectant solution

4) with burning

8. DIRECT STERILITY CONTROL IS CARRIED OUT BY

1) the swab test method

2) the use of benzoic acid

3) the use of the IS-180

4) the Mikulich method

9. OPTICAL INSTRUMENTS STERILIZATION IS CARRIED OUT

1) by steam under pressure

2) in gas sterilizer

3) in drying cabinet

4) by burning

10. INDIRECT STERILITY CONTROL OF INSTRUMENTS IS PERFORMED

1) after each sterilization

2) daily

3) every ten days

4) by the specific order of the administration

11. SURGICAL ARMARIUM IS USED

1) during routine operations after receiving the results of bacteriological control

2) always after receiving the results of bacteriological control

3) immediately after sterilization

4) after pre-sterilization preparation

12. THE MODERN METHOD OF SUTURE MATERIAL STERILIZATION IS

1) silk sterilization by the Kocher method

2) radiation sterilization

3) autoclaving

4) all of the above is true

13. AFTER THE SUTURE MATERIAL IS STERILIZED BY IONIZING RADIATION, THE STERILITY IS PRESERVED

1) up to 5 years old

2) up to 1 year

3) up to 1 month

4) up to 3 days

14. THE SHELF LIFE OF INSTRUMENTS STERILIZED IN A DRYING CABINET IS

1) one day

2) can be used immediately after sterilization

3) three days

4) up to 6 hours

15. CAN YOU USE SURGICAL INSTRUMENTS UNTIL THE RESULTS OF BACTERIOLOGICAL CONTROL ARE OBTAINED?

1) you can't

2) possible only in emergency

3) you can always

4) possible only in selective surgery

16. IF THE PHENOLPHTHALEIN SAMPLE IS POSITIVE, THE INSTRUMENTATION IS SUBJECT TO

1) re-placed in a disinfecting solution

2) repeated rinsing

3) the pre-sterilization treatment cycle is repeated completely

4) re-boil in distilled water for 5 minutes

17. IF THE AZOPYRAM TEST IS POSITIVE, THE PHENOLPHTHALEIN TEST

1) is carried out, since this is a different test

2) not carried out

3) it depends on the type of instrumentation

4) it depends on the infection of the instrumentation

18. HOW IS PRE-STERILIZATION CLEANING OF INSTRUMENTS IN CONTACT WITH ANAEROBIC INFECTION CARRIED OUT?

1) start with a long rinse under running water

2) soak in 96% alcohol for 6 hours

3) wash in disinfectant solution (3% Aminaz Plus)

4) start with mechanical cleaning

19. IT IS POSSIBLE TO USE SUTURE MATERIAL THAT WAS STERILIZED BEFORE RECEIVING THE RESULTS OF BACTERIOLOGICAL CONTROL

1) possible only in selective surgery

2) possible only in emergency surgery

3) always possible

4) you can't use

20. ASEPSIS IS A COMPLEX OF MEASURES AIMED AT

1) fighting infection in a wound or human body

2) preventing infection from entering a wound or human body

3) prevention of sepsis development

4) elimination of sepsis signs

21. ANTISEPSIS IS A COMPLEX OF MEASURES AIMED AT

1) fighting infection in a wound or human body

2) preventing infection from entering a wound or human body

3) prevention of sepsis development

4) elimination of sepsis signs

22. DISINFECTION IS THE PROCESS OF DESTRUCTION OF ...

1) all microorganisms and their spores

2) only spore-forming microflora

3) pathogenic microflora

4) all nonspore-forming microflora

23. THE CHEMICAL METHOD OF STERILIZATION IS PERFORMED

1) by boiling

2) in drying cabinet

3) by a cold method with the use of antiseptics

4) in autoclave

24. AIRBORNE STERILIZATION INDICATOR CONTROLS

1) maximum temperature in drying cabinet

2) maximum temperature in autoclave

3) time period of maximum temperature in drying cabinet

4) time period of maximum temperature in autoclave

25. BACTERIOLOGICAL CONTROL OF INSTRUMENTS IS CARRIED OUT

1) after each sterilization

2) every 10 days

3) once a month

4) by the order of the operating room head

26. MINIMUM TEMPERATURE CAUSING DEATH OF SPORE-BEARING BACTERIA IS

1) 100 °C

2) 120 °C

3) 140 °C

4) 180 °C

27. THE MOST RELIABLE METHOD OF STERILITY CONTROL IS

1) melt of sulfur

2) use of airborne sterilization control indicator

3) melt of benzoic acid

4) method of bacteriological control

28. FIBROGASTROSCOPES, FIBROCOLONOSCOPES, FIBROBRONCHOSCOPES CAN BE USED AFTER

1) washing with cleaning agent

2) disinfection

3) high-level disinfection

4) any of the above methods

29. LAPAROSCOPES, THORACOSCOPES, ARTHROSCOPES CAN BE USED AFTER

1) sterilization

2) disinfection

3) high-level disinfection

4) any of the above methods

30. HIGH LEVEL DISINFECTION IS THE DESTRUCTION OF

1) all microorganisms and their spores

2) spore-forming microflora

3) pathogenic microflora, including tuberculosis, hepatitis, AIDS agents

4) all nonspore-forming microflora

31. THE INSTRUMENTS PACKED IN DOUBLE BLOTTING PAPER ARE MAINTAINED FOR…

1) 3 days

2) 1 week

3) 2 weeks

4) 4 weeks

32. THE INSTRUMENTS PACKED IN DOUBLE NONWOVEN FABRIC ARE MAINTAINED FOR…

1) 1 month

2) 3 months

3) 6 months

4) 1 year

33. THE INSTRUMENTS PACKED IN ONE SHEET OF NONWOVEN FABRIC AND ONE SHEET OF BLOTTING PAPER ARE MAINTAINED FOR…

1) 1 month

2) 2 months

3) 3 months

4) 4 months

34. STERILIZATION OF GLOVES IN AUTOCLAVE IS CARRIED OUT AT

1) 132 °C – 20 minutes

2) 126 °C – 30 minutes

3) 120 °C – 45 minutes

4) 110 °C – 60 minutes

35. “AMINAS PLUS” IS USED FOR

1) disinfection combined with pre-sterilization cleaning of instruments

2) disinfection of instruments

3) pre-sterilization cleaning of instruments

4) desalting

**2. Asepsis - antisepsis. Surgical disinfection of hands and disinfection of surgical area. Sterilization of surgical garb and dressing material.**

**ASEPSIS** – represents the system of the preventive actions directed against entering of microorganisms into a wound, tissue or human body during surgery, endoscopy and other medical manipulations.

The concept of antisepsis (anti- + suppurative) was brought by the English surgeon Pringl J. (1750) on the base of his observations. He studied the antiputrefactive effect of mineral acids, used for disinfection of sewage. In the beginning of the XIX century Pirogov N.I used for the treatment of wounds the solution of carbolic acid, silver nitrate, zinc sulphate, spirits, iodium. He considered a wound processing an infection and believed the possibility of fighting against it.

The Hungarian obstetrician Semmelweis noticed that the hands of surgeons became the source of childbed fever among pregnant women. He was the first doctor who used the solution of chlorinated lime for washing hands, disinfection of birth canals, surgical instruments and materials. He concluded that students who came directly from the dissecting room to the maternity ward carried the infection from mothers who had died of the disease to healthy mothers. He managed to decrease the birth sepsis 10 times.

In 1882 Trendelenburg constructed a machine for sterilization of surgical material and instruments using dry steam. In 1886 doctor Bloodgood invented rubber gloves for protection of surgeon's hands from infections. Since 1890 a surgeonWilliam Halsted started using gloves for protection of surgeon's hands.

E. Bergman and C. Schimmelbusch created a sterilizing machine for boiling surgical instruments; they created sterilizing dressing boxes.

The measures to prevent an infection from entering a wound are referred to as **asepsis**, while the measures causing destruction or deactivation of harmful microorganisms are generally called **antisepsis**.

The prevention of surgical infections can be represented by two principles. They must be considered in terms of the interrelationship between the source of infection and the way of its transmission and the susceptibility of the body. The source of infection means the living environment of microorganisms, the place of their growth. The infection can be either exogenous (from outside) or endogenous (from within the body).

The basic principle of an asepsis - everything that is in contact with a wound must be sterile, i.e. have no microorganisms on the surface.

All surgical patients must be divided into 2 types: clean and infected. Therefore, asepsis includes the following complex of actions directed at protection of a wound from infection: a) special, sanitary and hygienic, organizational arrangements performed in medical organization; b) observance of working rulesby a surgeon and surgical team (during operation or bandaging); c)disinfection of hands, d) sterilization of surgical instruments, materials, devices. To prevent the infection, it is necessary to know its sources and ways of distribution.

The major sources of endogenous infections include chronic infections outside the operational area (e.g. skin diseases, dental or tonsils conditions) or of the organs operated on (e.g. appendicitis, cholecystitis, osteomyelitis), as well as the oral, intestinal and respiratory saprophytes. The ways oftransmissioninclude direct contact, lymphogenous and haematogenous.

The main sources of exogenous infections include patients with purulent inflammation or healthy carriers of pathogens, and occasionally animals. The ways of transmission are usually as follows: airborne, direct contact and implantation.Microorganisms can get into the wound by three ways: aerial – by air (air with dust particles which transfer microorganisms, nasopharynx andtop airways of the body), by direct contact (surgical instruments, linen, dressings), by implantation way (suture material, artificial limbs or vessels, etc.)

The principle of observance of asepsis rules is based on planning and organization of the surgical hospital. The main structural units of the surgical hospital are: a) admission unit, b) diagnostic and treatment unit, c) surgery block.

The main aim of theadmission unit– distribution of patients into two groups: "clear" and "contaminated", sanitation and hygiene of patients (partial, full), depending on planned or emergency hospitalization. According to this principle surgical departments of multi-field hospitals are located on the top floors and rooms are adapted for frequent wet cleaning using antiseptics.

Organizational measures include access control for visitors, strict working arrangements of surgical departments, including special methods of their cleaning.

**Prevention ofan airborne infection.** The main methods of prevention of microorganism penetration include: correct space planning and corresponding equipment available; regular wet cleaning of rooms; air sterilization using the ultraviolet bactericidal lamps placed above the doorway at 2-3 m from each other (operational, dressing, procedure rooms, postoperative and resuscitation wards, contagious ward). In operational and dressing rooms it is obligatory towear masks, the personnel of surgical departmentsmust maintain and control personal hygiene, wear surgical overalls, caps and boot covers in the operational room.

The operational block is the cleanest place in the surgical hospital where observance of asepsis rules is strictly obligatory. The operational block is based on the principle of zonality that imposesincreasingasepsis requirements as approaching the operational room.

There are 4 zones of sterility in the operational room:

The 1st zone (absolute sterility) – space around the surgery table; the moststrict asepsis requirements (these are operational halls and sterilizing).

The 2d zone (relative sterility) - space which is directly connected with the operational room (pre-operating room, anesthetic room).

The 3d zone (limited) – rooms for blood storage room, storage room fortransportable equipment and other surgery devices, rooms for surgeons, nurses, anesthesiologists, laboratory.

The 4th zone (hospital-wide) – rooms which are not connected with passing through a sanitary inspection room.

The corresponding mode of sterility is reached by the compliance with certain measures of prevention of microorganisms’ distribution in operational room. For this purpose there are following types of cleaning of operational room:

Preliminary cleaning includes damp wipe of all horizontal surfaces and subjects at the beginning of the working day.

Routine cleaning is carried out during the day, includes collecting and removing of used dressing material, waste.

End-of-day cleaning is carried out at the end of the working day. It includes wet cleaning of window sills, heaters, furniture and floor with the use of antiseptics. After cleaning the room it is disinfected by ultra-violet light, using ultra-violet light irradiators for 60 minutes.

Deep cleaning is carried out once a week (fixed day). The equipment and walls are cleaned with the use of disinfectants.

There are ultrapure operating rooms for organs transplantation, burn patients having the wide port of infection. They are operating rooms with:

- laminar airflow (air goes through bacterial filter);

- hyperbaric chamber (surgeons must wear special pressure suits and breath apparatus);

- nonbacterial environment

The sterility control of the operational block is performed once a month by bacteriological examination of air.

For the prevention of direct contact infection it is necessary that everything in contact with a wound must be sterile. It is reached by sterilization of surgical instruments, surgical linen, dressing material, disinfection of hands and a surgical area.

**Preventive measures of contact and implantation infections**

Sterilization is achieved by means of physical and chemical methods.

Physical – thermal sterilization, ray sterilization - boiling, sterilization by steam under pressure, dry heat sterilization, gamma-radiation.

Chemical sterilization - sterilization by ethylene oxide, treatment by acetic acid, chemical therapeutic treatment. Sterilization in autoclave (water steam) is performed at 120-132° C, pressure - 1,1 atm/sm2 during 45 min. Ray sterilization - is performed by means of ionizing radiation. They use beta- and gamma-radiations. The ultrasonic sterilization is also possible - sterilizer is filled with some antiseptic, which under the influence of ultrasonic waves sterilizers surgical instruments.

Chemical sterilization: ethylen oxide possesses a bacterial effect. By means of gas sterilization you can sterilize the instruments which cannot be sterilized in autoclaves or air sterilizers. Ethylen oxide is used for sterilization of catheters, gloves, endoscopes, artificial blood-circulated apparatus.

**Sterilization of dressing material and surgical garb.**

Dressing material includes gauze-swabs, cotton swab, napkins, bandage, turunda, gauze sponges. Dressing material is prepared usually just before sterilization. Gauze swabs are divided into 50-100 pieces for convenience. Dressing material isn't reused and after application it is burned.

Dressing material must be biologically and chemically intact, have good hygroscopicity, be minimum loose, soft, elastic, must not injure tissue. It is cheap, easy to sterilize and it doesn`t lose its properties.

Surgical garb includessurgical coats, sheets, towels and underpads. It is produced of cotton. The reused surgical garb is washed separately from other types of linen.

Ways of putting dressing materialinto a sterilizing dressing box: the linen and dressing material put into the box so that it is possible to get out any of them, without touching another one, that is why every subject has its place in the sterilizing dressing box (general layout), or a certain sterilizing dressing box can be used for certain type of objects (specific layout); on-target layout–the sterilizing dressing box is used for sterilization of dressing material, surgical garb and instruments for a specific surgery (subclavian vein catheterization, epidural anesthesia, tracheostomy).

Dressing material and surgical garb are sterilized in autoclave at 132 °C; 2 atm – 20 minutes. Before sterilization it is packed in order for sterility maintenance.

Terms of sterility of fenestrated sterilizing dressing boxes – 3 days; sterilizing dressing boxes with antibacterial filter – 21 days. If the sterilizing dressing box is opened for taking a part of material, the material left in the boxis considered sterile during 6 hours.

Terms of sterility of double nonwoven fabric package – 3 months, blotting paper with a layer of nonwoven fabric – 2 months, kraft-paper bag – 3 days.

**Sterilization of instruments**

* By air sterilization carried out during 60 min at t° 180°C.
* Instruments made of corrosion-resistant metals or plastics are sterilized in hydrogen peroxide solution 6% at 180°C during 360 min. Instruments are also sterilized inthesolution of 3 components (2 % formaline, 0,3 % phenol, 1,5 % sodium bicarbonate) during 45 min.
* Syringes are sterilized in drying cabinetat180°C during 60 min.
* Endoscopes, catheters, cistoscopes are sterilized by means of sodium hypochlorite and glutaraldehyde , the duration is 45 minat 180°C

**Sterility quality control**

There are visual, physical, chemical, bacteriological types of control.

- *Visual control*. Check correctness of use of packaging materials, loading level of package and sterilization chamber, validity of the chosen sterilization method.

- *Physical control*. Estimate the indicators of monitoring instrumentation of sterilizing equipment: maximum thermometers, manometers and deviationsfrom the norm.

- *Chemical control*. It is carried out by means of chemical test indicators. Today it is necessary to use fourth-generation test indicators which allow to control all parameters of sterilization (pressure, temperature, time). There are test indicators for in-pack and out-pack control.

Indicators for in-pack control are placed into the package on three levels – in case ofgeneral layout (in case of mixed layout – a new test is used for each type of sterilized material). Such indicators allow to control sterilization parameters in package. Indicators for out-pack control are put into the certain places of thesterilization chamber.

Test indicators are checked directly after the end of sterilization (indicators for out-pack control) and after package is opened (indicators for in-pack control).

Rules of placing of test indicators into sterilization packaging:

- in case of general layout indicators are put on three levels (bottom, middle, top).

-in case of combined layout indicators are put on three levels andadditionally in the middle of each material type.

In sterilization packaging with soft material of small volume it is possible to use one test indicator in the middle.

*Bacteriological control* (direct control method) is performed by sampling of sterilized material, surgical instruments, hands of a surgeon. In operational block and intensive care unitsterilization control is carried out once in 10 days, in other units – once a month; the sanitary-epidemiological station performs such tests twice a year.

Among nonpercutaneous channels of exogenous infections the main place is taken by direct contact method which means the infection is spread by hands of surgical crew members.

**Disinfection of hands**

Disinfection of hands is removal of microorganisms from hands. The principle of hands disinfection: washing of hands, cleaning of nails, mechanical cleaning using a soap and a brush during 2-5 min, then disinfection with the use of disinfectants. A disinfectant must:

1. exterminate the bacterial flora quickly;
2. kill germs in gloves juice;
3. have a cumulative effect - hands must be free from microorganisms between disinfections;
4. not irritate the skin.

Nowadays mechanical cleaning and disinfection is most often used.

**Modern ways of hands disinfection**

Use of "Pervomur" (hydrogen peroxide) + formic acid. At first hands are washedwith soap and water, then hands are washed with "Pervomur" during 1 minute; with chlorhexidine 0,5% solution during 2-3 minutes; with Degmin, Degmitsin (cleaners) during 5-7 minutes; with Cerigel – film-forming antiseptics from the group of cleaners; with Evrosept during 2-3 minutes.

None of the existing methods of hands disinfection provides absolute sterility therefore all manipulations are performed by surgeons in sterile gloves.

**Surgical area disinfection**

Groccich-Filonchikov rule (1904-1908) is based on skin tanning which provides obturation of excretory ducts of sweat and oil glands andblocks the exit of germs onto the surface (smearing of10% iodine solution on hands).

It is used:

1) 5-10 minutes beforesurgery, 2) before incision, 3) before suturing, 4) after suturing.

This method excludes washing of surgical area with soap and brush, therefore during mechanical cleaning gasoline is used.

**Antisepsis** - system of measures directed on germs destruction in a wound or body. Depending on the nature of the used methods there are 4 types of antiseptics: 1. Mechanical; 2. Physical; 3. Chemical; 4. Biological.

The principle of modern antisepsis-complexity, simultaneous or consecutive use of all four types.

**Mechanical antisepsis**.

In 1898 Paul Leopold Friedrich proposed the primary surgical treatment of a wound by means of cutting off its borders which consist of necrotic tissue.

For this purpose a number of methods are used:

a)wound toilet - removal of debrides of the wound by washing itwith antiseptic. Use of modern equipment and methods of quantitative bacteriology allows to use a wide range of sterilizing liquids for washing.

b) initial surgical debridement – is carried out no later than 24-72 hours after wound received.

с) secondary surgical debridement- is carried out in cases when wound process is complicated by the infectious inflammation. Necrotic tissues are removed;the wound is examined whether there are pus pockets or purulent leakage. Suturing is not performed; surgery is finished by drainage of pus pockets.

**Physical antisepsis** helps to create unfavorable conditions for bacterial growth and toxicants and tissue decay products absorption. The drainage provides outflow of wound exudateand promotes removal of toxicants, germs and tissue decay products. Irrigation of gauze with hypertonic solutions highly increases its hydroscopic quality but tampons with wound exudation prevent the outflow from the wound, that is why they are not good for drainage.

The open method of treatment can be used. The wound is dry; as a result, unfavorable conditions for bacterial growth are created.

**Chemical antisepsis**. It is the method of infection control in a wound based on use of chemicals which have bactericidal and bacteriological effects.

Classification of antiseptics by purpose and method of use: 1) disinfectants for surgical instruments and washing of walls, floors; 2) antiseptics for disinfection of hands, washing of wounds, cavities; 3) chemotherapeutic agents–medication intake for infection control wound.

**Antiseptics for external use**

1. Haloids group - chlorine and iodine derivatives. Their interaction with hydrogen of a microbe cell causes coagulation of protoplasm proteins. There are chloramine B (0,5 – 2% solution), iodonate (1% water solution), uodopiron, and iodophorm.
2. Oxidants – create unfavorable conditions for anaerobic and putrefactive bacteria by releasing oxygen. There are: hydrogen peroxide solution (3% water solution), potassium permanganat (0,1-2% water solution).
3. Acids and alkalis - more often salicylic acid and boric acid, sodium hydrocarbonate are used.
4. Aldehydes: formaldehyde, glutaldehyde, and hexamethylenetetramine. Very toxic.
5. Alcoholes: strong disinfectants. Usually ethanol (70-96% solution) is used.
6. Hypertonic solutions - are weak antiseptics with irritating and counter-attracting effects. Hypertonic solutions of sodium chloride (10%) and glucose (10% and 40% solutions) are used.
7. Salts of heavy metals - are strong antiseptics causing protein coagulation of microorganisms. Many substances of this type are not used now because of their toxic effect. They are used in medications with silver.
8. Phenols are derivative products of coat tar, oil and resins. They denaturate and coagulate protoplasma proteinsin bacteria. There are carbolic acid, birch tar, Ichthyole and naphthalene oil.
9. Colourants – have the following mechanism of action: dehydration of microorganism proteins by colourants cations: methylene blue, brilliant green, and ethacridine lactate (Rivanol).
10. Detergents – are surface-activated substances from the group of ammonium bases. They are widely used for surgery area cleaning and for treatment. There are cerigel, degmicide, chlorhexidine, roccal etc.

**Biological antisepsis.** As differentiated from other types of antisepsis it is represented not only by biological methods of bacteria destruction. The biological antisepsis is divided into two parts: a) biological substances which are directly influencing microorganisms – direct action biological antisepsis (antibiotics, proteolytic enzymes, medications for passive immunization: medical serums, toxoids, gamma globulins, bacteriophages, hyperimmune plasma); b) substances and methods having stimulating effect on the body – mediate action biological antisepsis (ultraviolet irradiation, laser, transfusion of blood components, T-aktivin, interferon, interleukin, specific immune answer stimulating agents, vaccines,toxoids).

Alexander Fleming discovered penicillin in 1928.

**Main groups of antibiotics**

* Penicillin
* Cephalosporins
* Macrolids
* Levomycetins
* Tetracyclines
* Rifampicins
* Antibiotics of different groups
* Latest generation antibiotics
* Antifungal antibiotics

Principles of antibiotic treatment:

1) antibiotic treatment must be performed if required

2) in case of severe infectiona loading dose of antibiotics is used which is twice higher than general therapy dose, subsequently therapy is continued by usual doses as recommended

3) to control frequency of administration, for maintenance of bactericidal concentration of antibiotic in blood plasma.

4) it is necessary to choose antibiotic according to antibiotic sensitivity test. If antibiotic sensitivity isn't defined yet, the doctor must carry out the empiric therapy. Two principles of empiric therapy: 1) principle of the maximum range of action, 2) principle of reasonable sufficiency. Therefore in case of severe infection the combination of first stage antibiotics is administered(penicillin + macrolides + aminoglycoside), or monotherapy by second stage antibiotic is carried out (cephalosporin, semi-synthetic aminoglycoside). In hard medical cases reserve antibiotics are used.

5) In all cases it is necessary to consider compatibility of several groups of antibiotics and other antisepticsas antibiotics can heighten theeffect of each other (synergysm) or neutralize its effect(antagonism). Compatibility is determined by special tables or specified in the instruction.

6) Treatment duration is controlled by clinical efficiency, but even if body temperature is normalthe therapy is continued for 3-5 extra days.

7) Change of antibiotics group is performed in case ofsevere pyoinflammatory diseases – in 5-7 days; in case offlare-up of a chronic condition– in 10-12 days.

8) In all cases beginning with the fifth day of antibiotic therapy it is necessary to administer anti-kandida treatment by "Nystatin" or "Levorin".

9) In the presence of dyspeptic changes it is necessary to make stool test and in case of gut flora pathology carry out corrective therapy (themost effective are “Bactisubtil”, "Bifidumbakterin", "Befungin", "Laktobakterin").

10) Proper administration ways

**Sulfanilamide medications**

It is a large group of medications with antimicrobial action. They block methabolic processes in bacterial cells and cause bacteriostatic effect. There are sulfanilamides of short activity: streptocid, etazol, sulphadimezin; and sulfanilamides of prolonged activity: sulphapiridasin, sulphadimetoxin, sulphalen and others. Because of its low dissolubility, its residue may lead to liver bile blocking.

**Control questions:**

1. What does Asepsis and Antisepsis mean?

2. The source and types of surgical infection. Methods of controlling.

3. The modern chemical agents for sterilization.

4. How to behave at the hospital. Rules of medical uniform. Clothes and hairs as a source ofnosocomial infection.

5. Requirements for the different kinds of dressing material.

6. Kinds of surgical garb. Preparation forsterilization.

7. What main parts does autoclave include? Modesof sterilization.

Control of sterility. Sterility quality control.

8. Methods of scrubbing before surgery.

9. Operative area cleaning.

**Tests on the topic: “Asepsis - antisepsis. Surgical disinfection of hands and disinfection of surgical area. Sterilization of surgical garb and dressing material”**

***Choose one correct answer***

1. BIOLOGICAL ANTISEPSIS INCLUDE

1) sulfanilamides

2) detergents

3) proteolytic enzymes

4) derivatives of nitrofuran

2. WHAT KIND OF CLEANING IS CARRIED OUT IN THE OPERATING ROOM WEEKLY

1) end-of-day

2) deep

3) routine

4) preliminary

3. THE INFECTION OF SKIN FLORA IS CLASSIFIED AS

1) endogenous

2) exogenous

3) direct contact

4) implantation

4. A TYPE OF DRESSING MATERIAL THAT CAN BE WASHED AND REUSED

1) cotton wool

2) lignin

3) gauze

4) dressing material is not reused

5. IN CASE OF ON-TARGET LAYOUT IN THE STERILIZING DRESSING BOX, ITS CONTENTS IS INTENDED FOR

1) an emergency surgery

2) a planned surgery

3) a planned surgery day in a large surgical department

4) for an emergency or planned surgery

6. ANNUAL MONITORING OF AUTOCLAVE TECHNICAL CONDITION IS CARRIED OUT BY

1) service technician

2) employee of hospital administration

3) medical equipment engineer

4) employees of the Ministry of Emergency Situations

7. PERIOPERATIVE HAIR REMOVAL IS PERFORMED

1) on the day of surgery

2) the day before surgery

3) it doesn't matter

4) 24 hours before surgery

8. WHAT IS USED FOR BIOLOGICAL ANTISEPSIS TODAY?

a) surfactants

b) vaccines

c) immunoglobulins

d) oxidizing agents

***Choose the correct combination of answers***

1) a, b

2) b, c

3) c, d

4) a, c

9. ONE OF THE CHARACTERISTIC STAGES OF OPERATING AREA PREPARATION ON INFECTED AREAS OF THE BODY

1) treatment with corrosive sublimate solution

2) daily local bath during the week before surgery

3) prophylactic administration of antibiotics

4) preliminary physiotherapy treatment

10. HOW MANY TIMES DURING SURGERY UNDER ANESTHESIA, THE OPERATING AREA IS TREATED WITH AN ANTISEPTIC

1) 2 times

2) 3 times

3) 4 times

4) 5 times

11. ONE OF THE CHARACTERISTIC STAGES OF OPERATING AREA PREPARATION ON INFECTED AREAS OF THE BODY

1) “Iodonat” treatment and sterile dressing the night before surgery

2) treatment with boric acid

3) prophylactic administration of antibiotics

4) treatment with brilliant green solution

12. IN CASE OF SPECIFIC LAYOUT IN THE STERILIZING DRESSING BOX, ITS CONTENTS IS INTENDED FOR

1) scheduled operating day in a large surgical department

2) one planned surgery

3) one emergency surgery

4) can be used for both planned and emergency surgery

13. IN CASE OF GENERAL LAYOUT IN THE STERILIZING DRESSING BOX, ITS CONTENTS IS INTENDED FOR

1) use in the dressing room

2) one planned surgery

3) one emergency surgery

4) a planned operating day in a large surgical department

14. BACTERIOLOGICAL CONTROL OF DRESSING MATERIAL STERILITY IS CARRIED OUT

1) daily

2) every time after sterilization

3) once a month

4) every 10 days

15. THE SINGLE CAUSE OF AUTOCLAVE EXPLOSION CAN BE

1) the pressure gauge is faulty

2) scale on the walls of steam generator

3) not enough water

4) increase the sterilization time

16. THE MAIN PURPOSE OF PRELIMINARY ASSESSMENT (BEFORE THE START OF STERILIZATION) AUTOCLAVE PURGE IS

1) to eliminate high humidity in the sterilization chamber

2) to increase temperature in the sterilization chamber

3) to preventautoclave explosion

4) to remove air from the sterilization chamber

17. MECHANICAL ANTISEPSIS INCLUDE

1) wound toilet

2) initial surgical debridement

3) opening of areas of purulent inflammation

4) all variants are correct

18. MAXIMUM STORAGE TIME OF STERILIZED MATERIAL IN A CLOSED STERILIZATION BOX (SCHIMMELBUSCH BOX) WITH BACTERIAL FILTER IS

1) 10 days

2) 14 days

3) 21 days

4) 28 days

19. MAXIMUM STORAGE TIME OF STERILIZED MATERIAL IN A CLOSED STERILIZATION BOX (SCHIMMELBUSCH BOX) WITH BACTERIAL FILTER AFTER OPENING ITS TOP FOR ONE TIME

1) 6 hours

2) 12 hours

3) 24 hours

4) 48 hours

20. MAXIMUM STORAGE TIME OF STERILIZED MATERIAL IN DOUBLE PILLOW-CASES IS

1) 12 hours

2) 24 hours

3) 2 days

4) 3 days

21. THE MOST RATIONAL WAY TO CONTROL STERILIZATION CARRIED OUT IN AUTOCLAVE AT THE PRESSURE OF 2.0 ATMOSPHERES

1) Mikulich method

2) steam sterilization tape indicator

3) antipyrine melting

4) benzoic acid melting

22. PHYSICAL ANTISEPSIS INCLUDES

1) wound drainage

2) wound toilet

3) initial surgical debridement of the wound

4) washing the wound with antiseptic

23. USED DRESSING MATERIAL MUST BE

1) put into a special bag and thrown into container "B" (fortop priority waste)

2) soaked in disinfectant solution, placed into a special bag and thrown into container "B" (for top priority waste)

3) soaked inchloramine solution 5% for 1 hour, put into a special bag and burned

4) sterilized in autoclave at 2 atm. for 20 minutes, put into a special bag and burned

24. BACTERIOLOGICAL METHOD FOR DETERMINING THE STERILITY OF AUTOCLAVED SURGICAL GARB AND DRESSING MATERIAL CONTROLS

1) autoclave operation

2) work of asepsis system in the medical institution

3) possibility of using the material

4) sterility of autoclaved material

25. WHICH ADVANTAGE DOES TAPE STERILIZATION INDICATOR HAVE OVER THE METHOD BASED ON THE MELTING OF CRYSTALLINE SUBSTANCES?

1) It is simpler

2) It controls not only maximum temperature, but also sterilization time

3) It does not pollute the atmosphere with crystalline substances vapors

4) It does not require special storage

26. WAYS OF EXOGENOUS BACTERIAL CONTAMINATION OF WOUNDS

a) direct contact

b) lymphogenic

c) hematogenic

d) implantation

***Choose the correct combination of answers***

1) a, b

2) b, c

3) c, d

4) a, d

27. WAYS OF ENDOGENOUS BACTERIAL CONTAMINATION OF WOUNDS

a) a non-sterile surgical instrument

b) penetration directly from a hollow organ

c) hands of medical personnel

d) the lymph flow and blood from purulent-inflammatory areas

***Choose the correct combination of answers***

1) b, d

2) a, b

3) a, c

4) b, c

28. WHAT IS CURRENTLY USED TO CARRY OUT BIOLOGICAL ANTISEPSIS

a) antibiotics

b) surfactants

c) vaccines, serum

d) oxidants

***Choose the correct combination of answers***

1) a, b

2) b, c

3) c, d

4) a, c

29. MINIMUM TEMPERATURE CAUSING DEATH OF SPORE-BEARING BACTERIA

1) 60°С

2) 80°С

3) 100°С

4) 120°С

30. UV STERILIZATION OF WARDS IS PERFORMED FOR PREVENTION OF

1) airborne infection

2) endogenous infection

3) direct contact infection

4) implantation infection

31. HOW MANY TIMES IS THE OPERATING AREACLEANED WITH ANTISEPTIC DURING SURGERY UNDER LOCAL ANESTHESIA?

1) 3 times

2) 4 times

3) 5 times

4) 6 times

32. ABSOLUTE STERILITY ZONE INCLUDES

1) operating room

2) operating and pre-operating rooms

3) operating, pre-operating and dressing rooms

4) rectangle around the operating table

33. INDICATIONS FOR ANTIBIOTICS PROPHYLACTIC USE IN SURGERY ARE

a) surgery in patients with primary and secondary immunodeficiency

b) surgery connected with foreign material implantation (vascular grafts, heart valves, etc.)

c) surgery related to the removal of lower extremities varicose veins

d) planned herniatomy

***Choose the correct combination of answers***

1) a, b

2) b, c

3) c, d

4) a, c

34. STORAGE TERM OF INSTRUMENTS STERILIZED IN THE DRYING CABINET ON THE TOOLBOX GRID

1) one day

2) three days

3) up to 6 hours

4) up to 12 hours

THE INSTRUMENTS BLOTTING PAPER ARE MAINTAINED FOR

35. SURGICAL GARB OR DRESSING MATERIAL PACKED IN DOUBLE CREPE PAPER REMAINS STERILEFOR

1) 3 days

2) 1 week

3) 2 weeks

4) 4 weeks

36. SURGICAL GARB OR DRESSING MATERIAL IN DOUBLE NON-WOVEN PACKAGING REMAINS STERILE FOR

1) 1 month

2) 3 months

3) 6 months

4) 1 year

37. SURGICAL GARB OR DRESSING MATERIAL PACKED IN 1 SHEET OF NON-WOVEN MATERIAL AND 1 SHEET OF CREPE PAPER REMAINS STERILE FOR

1) 1 month

2) 2 months

3) 3 months

4) 4 months

**3. Bleeding and methods of its control**

**Hemorrhage**(haemorragia)or bleeding, is the escapeof blood from damaged blood vessels.

There are bleeding, hemorrhage and hematoma. Bleeding is the process when blood actively escapes from a vessel (vessels) and comes into an organ, cavity of the body or outside. Hemorrhage - is the process when blood flow comes into any body tissue (brain, organs, etc.).

We speak about hematoma when blood collected outside the blood vessel leads to the formation of blood pockets.

**Classification of bleeding**

**1. Anatomic classification** – by the type of damaged vessel:

• Arterial – blood of scarlet color, characterized by rapid pulsing spurts;

• Venous – characterized by dark blood;

• Capillary – bleeding of the mixed character caused by damage of capillaries;

• Parenchyma – in case of parenchymatous organsdamage(liver, spleen, kidneys, etc.). Bleeding is usually prolonged. It is connected with the structure of these organs as their vessels are strongly connected with the stroma.

**2. Classification by the mechanism of beginning**:

* Mechanical failure (rupture) of the vessel wall;
* Arrosion hemorrhage. This type of bleeding takes place because of the pathology of vessel wall;
* Diapedetic hemorrhage;
* The violation of blood chemical composition. Hemophilia, scarlet fever, sepsis, scurvy and others cause bleeding sometimes. Toxins or beriberi lead to defects in vascular permeability and cause hemorrhage;
* Increased arterial and venous blood pressure. Diseases, such as essential hypertension, atherosclerosis sometimes causeinjury of vascular walls (blood stroke, hemorrhoidal bleeding, etc.);
* Violation of fibrillation (haemophilia, Werlhof’s disease, cholemic hemorrhage in patients with jaundice)

**Classification by the place of bleeding:**

• External

• Internal: a) visible, b) not visible

Internal bleeding is characterized by blood flow coming to different body cavities, tissues or organs. Visible internal bleeding - blood comes into the body cavities, over some period of time becoming visible in the changed look (in case ofgastrointestinal bleedingthe signs are gastric content resembling coffee grounds, tarry black stool, melena). Hematuria shows kidney bleeding and urinary tract bleeding, hemobilia is a sign of biliary system bleeding.

**Not visible internal bleeding** – blood loss that collects inside the various body cavities that is not visible for an eye:

• In the skull cavity (haemorragia cerebri).

• In the joint (haemartrosis).

• In the pleural cavity (haemothorax).

• In the abdominal cavity (haemoperitoneum).

• In the pericardium (haemopericardium).

**Classification by the time of hemorrhage developing**:

a) primary –is a direct result of a trauma, starts immediately after the wound

b) early secondary – during the first hours and days (about 3 days) after primary bleeding (before the infection development in the wound). It developsbecause of increased arterial pressure, absence of angiospasm due to blood loss, ineffective blood vessel ligation

c) late secondary - develops in 3 days after primary bleeding, isconnected with destruction of vascular walls as a result of purulent process in the wound

**Classification by bleeding progression**:

• Acute – severe bleeding, high blood loss during the short period of time;

• Chronic – long-term bleeding of small amounts

Loss of considerable volume of blood causing heavy disorders of vital organs is called acute massive blood loss. It is characterized by drop of systolic blood pressure, sharp weakness, sometimes loss of consciousness, dyspnea, oliguria.

**Pathogenesis of acute blood loss**. Acute blood loss causes deep reorganization of blood circulation and activate the most difficult compensatory strategies of broken homeostasis.

The development of acute massive blood loss is caused by three leading pathogenetic factors:

1) decrease in the volume of circulating blood;

2) loss of oxygen transport function of blood;

3) hemostasis system disorders (disseminated intravascular coagulation).

Volume of circulating blood (VCB) consists of the volume of circulating plasma and the volume of blood cells – globular volume. More than 90% of globular volume is provided by erythrocytes. VCB in adults takes about 7% of body weight or 70 ml/kg of body weight in men and 65 ml/kg – in women.

Acute blood loss leads to fast reduction of volume of the circulating blood. Sudden hypovolemia, as a powerful factor of a stress, causes vegetative and endocrine disorders. The main compensatory strategies of VCB loss are based on activation of sympathetic-adrenal system and hemodilution. The starting points ofsympathoadrenal system activation are: decrease of pressure in large vessels, especially in carotid arteries; damage of vessels adventitious membranewhere sympathetic fibers pass. In response to blood loss the pituitary-adrenal system is stimulated. Secretion of aldosterone and antidiuretic hormone is intensified, release of glucocorticoids influencing vascular permeability and tonus increases. In response to it certain adaptive mechanisms are turned on.

**Venous spasm** – veins are the main capacitor part ofblood stream, it contains 70% of all VCB, arteries – 15%, capillaries -12%, heart chambers – 3%. Narrowing of the venous bed easily supports a normal blood flow, despite the hypovolemia because the venomotor reflex makes up for the loss of 10-15% of VCB, i.e. 500 ml of blood in adult.

**Interstitial fluid inflow** –auto-haemodilution. Because of hypovolemia, andlow cardiac output syndrome, capillary hydrostatic pressure decreases that leads to movingof intercellular liquid to capillars. This mechanism can provide inflow of 10-15% of VCB to vessels during the first 5 minutes after blood loss. The main markers of haemodilution are hematocrit,hemoglobin level and erythrocytes number – these indicators are used in clinic for the assessment of blood loss volume.

**Tachycardia**– development of hypovolemia leads to venous inflow decrease and, respectively, low cardiac output. Developing tachycardia connected with the influence of sympathoadrenal system allows to support normal cardiac output for a certain period of time.

**Oliguria** – in case of hypovolemia there is stimulation of hypophythis antidiuretic hormone and aldosterone secretion. It leads to increase of water reabsorption, retention of sodium ions and chlorides.

**Hyperventilation** – at first adaptive hyperventilation is to increase suction function of thorax and blood inflow to the heart. Then its development is connected with metabolic changes in organs and tissues and acid-base disturbance.

**Peripheral arterial spasm -**is a transitional stage between compensatory and pathological reactions at blood loss – the most important support mechanism of arterial pressure and brain blood supply.

**Changes of the blood circulatory system**

As well as any adaptive reaction, activation of sympathoadrenal system leads both to positiveand negative consequences, which is identified by blood circulation centralization. Increase of venous tonus and peripheral arterial spasm is caused by influence of sympathoadrenal system. Generally there is alpha-adrenergic stimulation, thereforethe peripheral spasm is irregular – skin arteriolas, abdominal cavity and kidneys arteriolas, where a large number of alpha adrenoceptors are more constricted. On the contrary, coronary and brain vessels are poor in these receptors, so there is no vasoconstriction. Thus, the brain and heart are provided with blood at the expense of other organs - it is the so-called blood circulation centralization – biologically reasonable reaction.

At the same time blood circulation centralization leads to decreasedbloodflow in liver, kidneys, subcutaneous tissue. The low peripheral bloodflow and arterial hypoxemia lead to anaerobic metabolism development with accumulation of organic acids (lactic and pyroracemic) in tissues and blood. Acidosis develops that promotes capillary distension and sequestrationof 10% of VCB in them - so centralization is replaced by decentralization of blood circulation and in the final result it leads to the loss of effective VCB, uncontrolled hypotonia and death.

All adaptive mechanisms also have negative sides. Blood circulation centralization saving life within several hours along with brain and heart protection, conceals in itself the death threat though more delayed. This danger consists in deterioration of microcirculation, tissue hypoxia and disorders of organ and tissue metabolism.

At decrease the volume pressure in capillaries is considerably slowed down a blood-groove up to a full stasis of blood. In these conditions erythrocytes and other uniform elements of blood stick together among themselves and form large units, peculiar traffic jams which worsen microcirculation up to development of a sludge-syndrome even more.

Development of hypercoagulation syndrome is an inevitable consequence of slow capillary bloodflow. It leads todisseminated intravascular blood coagulation syndrome that not only strengthens disorders of capillary blood circulation, but also causes hemorrhagic shock.

Thus, first of all, the main functional disturbance at blood loss is connected not only with decreased level of hemoglobin, but also VCB reduction, microcirculation disorders and blood-clotting ability disorders.

**Clinic of acute blood loss**

The clinical picture of bleeding is characterized by blood loss volume, peculiarities of tissue injury, degree of vessels damage, and very important is the place of bleeding: outside, a body cavity, or body tissues.

**Local signs of external bleeding**.

Arterial external bleeding - the blood has bright red color, is characterized by rapid pulsing spurts.

Venous bleeding –a steady, slow flow of dark cherry blood.If the large veins are injured you can observe a pulsing flow, but it is connected not with the pulse, but with breath. Injury of neck veins is dangerousbecause of air embolism of brain or heart vessels.

At capillary bleeding of some bleeding vessels it isn't visible, blood oozes from a wound. Capillary bleeding quickly stops independently and can be dangerous only in case of low blood coagulability (hemophilia, liver disease, sepsis).

Parenchymatous bleeding is observed in case of parenchymatous organs injury: liver, spleen, kidneys, lungs. All the wound surface bleeds due to large number of blood vessels in internal organs.

In case of trauma or pathological process development the internal bleeding can be found. Diagnostics of internal visible bleedings is more difficult as blood gets outsidein one form or another after certain period of time. If bleeding occurs in hollow organ, blood flows through natural orifices, and it is difficult to define the source of such a bleeding. So, blood in the mouthcan be caused by bleeding of lungs,trachea, gullet, stomach, duodenum. Therefore the color and consistency of flowing blood are important: foamy blood of ruby colour – the sign of pulmonary bleeding, vomitresembling coffee grounds–the sign of gastric or duodenal bleeding. Black tarry stool (melena) is the sign of upper gastrointestinal bleeding, blood of ruby colour from rectum – the sign of sigmoid, colon or rectum bleedings.Urine of red colour (haematuria) can be the sign of kidney bleeding.

The clinic and diagnostics of internal not visible bleedings is the most difficult (especially, in the closed cavities: skull cavity, spinal channel, thoracic and abdominal cavities, pericardium, joint cavity). At pleural cavity bleeding (haemothorax) you can observe dullness of percussion sound in thorax, weakness of breath, mediastinal shift, respiratory distress.

Accumulation of blood within the peritoneal cavity (hemoperitoneum) is connected with closed abdominal injury, injuries of parenchymatous organs, mesentery vessels,tubal pregnancy, ovariorrhexis, etc. In addition to blood loss there are some local signs: abdominal distension, weak peristalsis, flank dullness, positive peritoneal signs. Joint cavity bleeding (haemartrosis) is shown by increased joint volume, sharp pain, function disorders.

Clinical implications of acute blood loss irrespectively of the source of bleeding are characterized by the general signs: skin pallor and humidity, small pulse, rapid breathing, decreased venous and arterial blood pressure.

Subjective signs: dizziness, dry mouth, nausea, seeing spots, increasing fatigue.

During theblood loss assessment its severity is also defined. It is based on the type of bleeding (arterial, venous). The speed of bleeding depends on caliber of blood vessels. Severity of internal bleedings must be determined by expressiveness of blood loss signs.

**Classification according to severity degree (V.I.Struchkov and E.W.Lutzevich )**

Class I Hemorrhage – easy degree – blood loss is up to 10 – 12% of blood circulating volume (500 – 700 ml). There are little hemodynamic changes. The patient feels satisfactory. Heart beat is slightly rapid, arterial pressure is normal. Hemoglobin rises up to 100 g/l (10 g %). Results of capillaroscopy: background is rosy, 3 – 4 capillary loops with quick homogenous bloodflow are determined.

Class II Hemorrhage – middle degree - blood loss is up to 15 – 20 % of blood circulating volume (1000 – 1400 ml). Apparent bleeding is determined. State of moderate severity. You can observe limpness, dizziness, hyperhidrosis, syncopes, skin pallor,rapid breathing, depressed reflexes, single vomiting or melena. The patient is often tachycardic (heart beat is 90 – 100 per min.). Arterial blood pressure is decreased to 90 mm Hg. Leucocytosis. Hematocrit is 0,38 – 0,32, hemoglobin is 80 – 100 g/l (8 – 10 g %). Urination quantity is decreased.

Class III Hemorrhage – severe degree – blood loss is up to 20 – 30 % of blood circulating volume (1500 – 2000 ml). Grave condition of the patient.You can observe skin palor, cold sweat, sudden vomiting and melena. Hemorrhage is accompanied by syncope. Visible mucous membranes are colourless. The patient yawns, feels thirst. Heart beat is rapid and thready. Arterial blood pressure is decreased to 60 mm Hg. Hematocrit is 0,30 – 0,32, hemoglobin is 50 – 80 g/l (5 – 8 g %). Oliguria is observed.

Class IV Hemorrhage– acute massive blood loss – loss of more than 30 % of blood circulating volume (more than 2000 ml). You can observe massive bleeding with prolonged loss of consciousness. Patient`s condition is critical, preagony. Pulse and arterial blood pressure are not fixed. Hematocrit is 0,23 and lower, hemoglobin is 50 g/l and lower. Anuria. Rapid blood loss more than 40% of the bloodvolume within a short period of time is fatal.

**Hemorrhagic shock** – one of the types of hypovolemic shock, it is determined if the blood loss is up to 25-30% of blood volume. There are three stages of hemorrhagic shock:

**Stage I** – the compensated shock (low cardiac output syndrome) is caused by blood loss which is well compensated by cardiovascular activity changes. Patient is in conscious state, skin is pale, extremity coldness,heart beat is weak, blood pressure is normal. Oliguria: diuresis is half reduced (normal is 30-40 ml/hour), central venous pressure is lowered or negative.

**Stage II** – decompensated shock – arteriolar spasm doesn't support normal hemodynamics. Heart beat is 120-140 beats per minute, pulse pressure is low (systolic blood pressure is lower than 100 mm Hg). Skin pallor, dyspnea, cyanosis, oliguria (less than 20 ml/h). The patient shows hypotonybecause of bloodflow disorders of liver, kidneys, heart, brain; acrocyanosis, dyspnea. There are the hollow tones of heart, "shock lung".

**Stage III** – irreversible hemorrhagic shock. It is characterized by long (more than 12 h.) uncontrolled hypotony, inefficiency of transfusion therapy, development of multiple organ failure.

**Bleeding diagnostics**

**I. Laboratory findings**

Research of laboratory data at bleeding is important for determination of blood loss volume and patients follow-up.

The following indicators are estimated:

1. Erythrocytenumber in peripheral blood (normally 4-5 x 1012 g/l)

2. Hemoglobin contents in peripheral blood (normally 125-160 g/l)

3. Hematocrit – the volume percentage of red blood cells in blood, measured as part of a blood test (normally – 40-50% for men and 40-45% for women).

Ways of determination of blood loss:

a) by actual bleeding volume in case of external bleeding,

b) by the weight of dressing (during surgery).

The above mentioned methods are inaccurate. Determination of degree of VCB loss in a certain patient is much more valuable.

1) Assessment of blood loss volume according to the shock index. Algover index (the ratio between the pulse and systolic pressure numbers, normally is 0,5, in case of blood loss it increases).

2) Deficiency of VCB can be defined in case of central venous pressure change – normally is 50-120 mm, its decrease is characteristic for blood loss more than 15-20% of VCB.

3) Polyglukin test – is used for determination of blood loss. Make an IV bolus injection of 200 ml Polyglukin, then measure central venous pressure – if it increases, blood loss is moderate. If central venous pressuredoesn't increase, blood lossis massive (>30% of VCB).

4) The volume of blood loss can be determined using MOORE formula.

**Ways of temporary control of bleeding**

Ways of temporary control of bleeding can be applied separately and in combination. Temporary control of venous and capillary bleedings is carried out byelevated position of the extremities and (or) applying compressing bandage, or wound packing.

Manual pressure of an artery is usedin extremity, neck and head bleedings,and carried out above the bleeding place in certain points. Pressing can be performed by the fingers of one hand, first fingers of both hands or a fist.

Humeral artery is pressed to a humeral bone by 4 fingers. Control of efficiency of the made manipulation is carried out on disappearance of forearm pulse and stop of bleeding.

Axillary artery is pressed by the first finger to the head of humeral bone on the anterior surface, on the border of axillary pole hair.

Subclavian artery is pressed by the first finger tothe first edge, behind the clavicle, on the outside of sternocleidomastoid muscle insertion.

Carotid artery can be pressed by the first or four other fingers to the spines of cervical vertebras at the level of cervical vertebrae (C6) tubercle, in the middle of the sternocleidomastoid muscle.

Femoral artery is pressed by two fingers to thesuperior pubic ramus, under the femoral arch. It should be noted that manual pressure of arteries can't be applied for a long time as the fingers can grow weak rather quickly.

Bleeding control using the maximum bending of an extremity. Control of forearm arteries bleeding is carried out by elbow flexion and fixing this position. You should put a gauze swab into the elbow pole. It is applied in case of wrist or lower third of the forearm arterial bleeding.

In case of arterial bleeding because of injury of subclavian, axillary, humeral arteries it is recommended to draw back both elbows with forearms bendingand apply bandage.

Popliteal artery is pressed by knee flexion. Thus it is necessary to put a gauze swab into the popliteal pole. It is used in case offoot and lower third of the shin bleedings.

During surgery the temporary control of bleeding is carried out by applying hemostatic clamps. It can be used for bleeding stop if a bleeding vessel is visible.

If there is no tourniquet, it is possible to use means turned out to be at hand. For example, you can use a scarf. For this purpose it is freely tied round an extremity above the bleeding place, then any subject (a stick, a plate) is fit into the loop and the scarf is twisted till the bleeding is stopped.

**Methods of permanent hemostasis.**

Methods of permanent hemostasis can be divided into four groups:

**1. Mechanical methods**

It is necessary to refer to this group the above given mechanical methods: using of compressing bandage, effective at capillary and venous bleeding, and tight swabbing thatstops bleeding of soft tissues and parenchymatous organs. Application of Blackmore probe is based on the same principle. It is used for arrest of hemorrhage from esophagus veins. The probe is inserted into the stomach, the gastric balloon which is fixed to the cardia is inflated. Then the esophageal balloon is inflated to press esophagus veins and stop the bleeding.

**Twisting of injured vessels.** In case of insignificant bleedings one-direction twisting of a vessel is sometimes applied (for example, during phlebectomy to stop small veins hemorrhage). The vessel wall is rolled, intima is destroyed and a blood clot is formed in the vessel lumen.

**Vessel ligation in an open wound.**Billroth's hemostatic forceps is used for temporary control of bleeding. Then the ligature is applied for the permanent hemostasis. For vessel ligation absorbable and nonabsorbable sutures are used made of silk, capron, etc. For better hemostasis two ligatures are applied on large vessels: a usual one and another with vessel underrunning (make one or two stiches around the blood vessel and tie it).

**Vessel ligation**. This method is used at heavyhemorrhage when it is impossible to find and tie the damaged vessel in an open wound. In this regard the unchanged tissues of the vessel are tied above the place of injury. The same method is also used in case of late secondary arrosive bleedings from septic wounds becausevessel ligation in a septic wound is not effective bandaging in a purulent wound is unreliable and it can lead to bleeding relapse.

**Clipping of a vessel**. It is used when vessel ligation is difficult or impossible to perform, for example, in case of various endoscopic surgeries or to stop thestomach ulcer bleeding.

**Applying of a vessel suture.** In case of main vessels injuryligationis dangerous because of possible necrosis developmentthat is why you can apply a vessel suture. It is used in beveled lacerations or at full crossing of a vessel. In the latter case vessels connect "the end into the end". Vascular forceps and atraumatic monofilamentsuture material are necessary for vessel suture performance.

**Vascular grafts**. In case of full crossing of a large vessel and traumatic defect application of a vessel suture is impossible that is why it is better to use an autodraft (hip saphenous vein orforearm superficial vein) or synthetic drafts.

In case of bleeding of remote vessels and impossibility of its control, injured artery embolization is performed. For this purpose various objects can be inserted into the vessel through a catheter actinglike a cork.

**Vessel sealing**. This method is applied for controlof bleeding from cancellous tissue vessels, for example, at craniotomy. For sealing a sterile wax or a special paste made of paraffin, wax and Vaseline is rubbed in the bleeding surface of cancellous bone.

**2. Thermal methods**

Thermal methods ofpermanent hemostasis are based on local use of low and high temperatures, electric current.

**Cryosurgery** – the method of surgical intervention based on the use of very low temperatures. Freezing of tissues with liquid nitrogen is used that leads to hemostasis. Used in case of brain, liver, vascular tumor surgery.

**Hot sterile solutions** increase blood’s ability to clot. A gauze swab is moistened in hot sodium chloride and insertedinto a wound for 5-7 minutes. Temperature of solution is 60 — 70 °C. It is used in cases when the application of mechanical methods of permanent hemostasis is impossible or ineffective.

**Electrocoagulation**, i.e. cautery of injured vessels with help of ultrahigh current.

Nowadays the doctors use microwave and ultrasonic knives, laser light (laser scalpel) and plasma scalpel for better hemostasis. **Microwave knife** – is a tool producing a special type of electromagnetic energy – microwaves distribution of which is accompanied with heat release. It allows to concentrate high-energy microwave field around a cutting edge. Due to microwaves absorption by tissues this method provides deep coagulation that is especially important for parenchymatous bleeding control.

**Ultrasonic knife**. In this tool ultrasonic energy is used. It limits damage to surrounding tissues.

**Argon-enhanced coagulation**. In this method ionized argon (so-called argon plasma) is used for exposure of tissues to highfrequency current without direct contact. Stream of argon – a colourless odorless inert gas - allows to coagulate tissuesof large scales, provides purity of an operational area, limitsdamage to surrounding tissues and reduces contact of medical staff with the patient's blood. This method is used for bleeding control of both surface wounds, and parenchymatous organs (liver, kidneys, spleen).

**Laser** is used for section, evaporation and simultaneous coagulation without damage to surrounding tissues. Mechanism of laser actionconsists in accumulation of energy in the bleeding vessel and stimulation of blood clotting. Laser use is accompanied by good hemostasis that allows to apply it during endoscopic and open surgeries.

**3. Chemical methods**

Surgeons use two main groups of medicines to provide permanent hemostasis. The first group has vasoconstrictive effect, the second group influences the system of hemostasis. Pathogenetically it is more reasonable to use medicines accelerating blood coagulation, but quite often in clinical practice medicines inhibitingfibrinolysis are applied.

For permanent hemostasis a number of chemicals having vasoconstrictive effect is used. Local administration of **Adrenalinesolution** (1:1000) has blood stopping effect by means of damaged vessels spasm. The vessel lumen is blocked that promotes formation of a blood clot. Adrenaline solution can be added to local anesthetic for reduction of bleeding during surgery. **Statizol** – is a combination drug having hemostatic effect due to the formation of elastic polymeric film closing the bleeding point. The aerosol dosage form is used in case of stomach ulcer and duodenum bleedings. After applying on the bleeding point and evaporation elastic film with good adhesion to the mucous membrane is formed. This film isn't washed away and rejected up to 2-3 days.

**Oxytocin, pituitrin and ergot derivatives** cause spasm,uterinemuscle contraction that leads to vasoconstriction and hemostasis.

One of the vasoconstrictive medications isthe synthetic analogue of a posterior pituitary hormone vazopressin - **remestip**. Its vasoconstrictive effect is connected with the increase of the tonus of vascular wall smooth muscles. It causes the narrowing of arteriolas, veins, venules, especially in abdominal cavity.

**Epsilon-aminocaproic acid** belongs to the group of drugs inhibiting fibrinolysis. It blocks plazminogen activators and partially inhibit plasmin activity. 5% solution (up to 100 ml)is administered intravenously. It can be entered into a stomach in case of gastric bleeding. **Аmben** also belongs toantifibrinolytic agents which inhibits fibrinolysis by competitive inhibition of plasminogen activating enzyme and suppression of plasmin formation.

**Dicynone (sodium etamsylate)** belongs to the group of vasoprotectives, improves vascular permeability, improves microcirculation and has hemostatic effect. The hemostatic effect is connected with the activation of thromboplastin formation.

**Vitamin K** participates in prothrombin formation and promotes normal blood coagulation. **Menadione, Vikasolum** are synthetic analogues of vitamin K which are used as specialdrugs for bleeding connected with the low number of prothrombin.

**4. Biological methods**

Biological methods of permanent hemostasis are based on application of **biologically sourced medications**. They are subdivided into **local administration medications** (body tissues or biologically sourced agents are used) and medications of**general influence** onblood coagulation system.

From the body tissues **the part of omentum** and **muscular tissue** rich with thrombokinase are most often used. A free part of tissues or tissues with feeding vascular pedicles arefixed to the hemorrhagic point.

Biological hemostatic medications for local administration are received from homo-or heterogeneous plasma, sometimes with collagen addition.

**Thrombin** is a natural component of blood coagulation system, it is received from donor blood. It promotes the transition of fibrinogen to fibrin. Thrombin is used only for local administration in the form of powder or solution.

**Fibrinogen** is also a natural component of blood, it is received from blood plasm. Under the influence of thrombin fibrinogen changes into fibrin and forms a clot. It is not used for local administration. Fibrinogen is administered together with thrombin and it can be found in local hemostatic medications, fibrin glues which includethe other factors of bloodcoagulation system in their structures (calcium salt, factor XIII).

**Hemostatic foam** is received from native blood plasm and thromboplastin. It is used for local administration in case of capillary and parenchymatous bleedings during surgeries, for control of bones, muscles and small vessels bleedings.

**Gelaspon** represents a foaming, specially processed gelatin received from pig skin. Appliedfor control of wound hemorrhage after surgeries. The medication is put in a wound and fixed with a sterile dressing.

**Biological antiseptic swab** is prepared from native blood plasmwith addition of gelatin, hemostatic and antimicrobialdrugs. It is applied for control of capillary and parenchymatous bleedings, including hemorrhage from polluted and infected wounds.

For capillary and parenchymatous bleedings control **Tachocomb** is used. Separate blood components and blood products are considered as the means of overall impact on the body promoting hemorrhage control. **Fresh frozen plasm (FFP)** is the component of donor blood received within 4-6 hours after blood exfusion by centrifuge method or apheresis with subsequent shock freezing at temperature 70 C. Plasm labile factors of coagulation remain in functional state.

**Cryoprecipitate** is a blood product which is used for bleeding control in patients with hemophilia A, angiohemophilia, and also serves as source raw materials for receiving refined concentrate offactor VIII.

**Fibrinolysis inhibitors** (aprotininum, contrykal, trasylol, traneksan) are used for depression of blood fibrinolytic activity.

**Control questions:**

1. The term of hemorrhage. Classification.

2. General and local symptoms of bleeding. Clinical pictures of arterial, venous, capillary, parenchymal bleeding. Features of not visible and internal hemorrhage.

3. What any ways are in a human body that start to work when it’s bleeding.

4. The severity of blood loss

5. Clinics of acute post-hemorrhagic anemia.

6. Health care delivery in case of hemorrhage. Methods of temporary and permanent hemostasis.

7. After hemorrhage therapy (replacement of circulating blood volume, anemia correction, recovery of renal function).

**Tests on the topic: «Bleeding and methods of its control»**

***Choose one correct answer***

1. THE LEADING ROLE IN THE MECHANISMS OF COMPENSATION IN THE FIRST MINUTES AND HOURS OF ACUTE BLOOD LOSS BELONGS TO

1) respiratory system

2) hematopoietic organs

3) cardiovascular system

4) fluid depot (subcutaneous fat, muscle)

2. MORE RELIABLE INDICATORS IN THE CLINIC OF ONGOING BLEEDING ARE

1) heart rate and blood pressure

2) hemoglobin and red blood cell counts

3) color of the skin

4) central venous pressure

3. WHAT IS THE CAUSE OF SECONDARY EARLY BLEEDING

1) increased blood pressure, vascular spasmolysis

2) purulent fusion of a thrombus

3) arrosion of the vessel

4) melting of the vascular wall by the inflammatory process

4. SECONDARY LATE BLEEDING STARTS AS A RESULT OF

1) arrosion of the vessel by purulent processes in soft tissues

2) violations of blood chemistry

3) increased blood pressure

4) vasospasm relief

5. THE INTERNAL VISIBLE BLEEDING OCCURS IN

1) the cavity of pericardium

2) soft tissue

3) the lumen of stomach

4) joint

6. THE INDICATOR THAT MOST FULLY REFLECTS THE SEVERITY OF BLOOD LOSS

1) pulse rate 100/min

2) collapse

3) hemoglobin - 80 g/l

4) number of red blood cells 3,0×1012/l

7. ALGOVER SHOCK INDEX IS THE RATIO

1) between systolic blood pressure and pulse

2) between systolic pressure and diastolic pressure

3) between pulse and systolic pressure

4) between pulse and diastolic pressure

8. The patient lost 800 ml of blood as a result of traumatic hip amputation. THE LOWEST NUMBER OF HAEMOGLOBIN AND RED BLOOD CELLS WILL BE FOUND IN

1) 6-12 hours

2) 12-24 hours

3) 24-48 hours

4) 72 hours

9. The patient has arterial bleeding from the middle third of the right forearm. THE TOURNIQUET IS APPLIED

1) in the lower third of the shoulder

2) in the middle third of the shoulder

3) in the upper third of the shoulder

4) in the upper third of the forearm

10. WHAT IS THE CAUSE OF SECONDARY LATE BLEEDING?

1) slipping-off ofvessel ligature

2) increased blood pressure, vasospasm relief

3) destruction of the vascular wall

4) insufficient control of hemostasis during surgery

11. SMALL INTESTINE BLEEDING IS CONFIRMED BY

1) video capsule endoscopy

2) fibrogastroduodenoscopy

3) colonoscopy

4) laparoscopy

12. The patient with acute gastrointestinal bleeding: heart rate -160, blood pressure 40/20 mm Hg, hemoglobin-26 g / l, erythrocytes -2,7×1012 /l. THE BLOOD LOSS IS

1) compensated

2) decompensated

3) on the verge of decompensation

4) subcompensated

13. BLACKMORE PROBE IS USED TO STOP BLEEDING OF

1) esophagus

2) stomach

3) duodenum

4) rectum

14. During clavicle surgery the subclavian vein is injured. THE MOST DANGEROUS COMPLICATION OF THIS INJURY IS

1) air embolism

2) shock

3) acute blood loss

4) phlebothrombosis

15. Carotid artery bleeding. FOR TEMPORARY HEMOSTASIS, THE CAROTID ARTERY IS PRESSED

1) to the transverse process of cervical vertebra C3

2) to the transverse process of cervical vertebra C6

3) to the transverse process of cervical vertebra C4

4) to the transverse process of cervical vertebra C5

16. WHAT IS USED FOR BIOLOGICAL TAMPONADE

1) body's own tissues

2) a large gauze swab

3) a blood clot

4) a napkin with hemostatic solution

17. WHAT INDICATORS ARE USED TO ESTIMATE THE VOLUME OF BLOOD LOSS

1) hourly diuresis

2) platelet number

3) prothrombin index, blood clotting time

4) number of red blood cells and hemoglobin in the peripheral blood, the level of hematocrit

18. INTERNAL NOT VISIBLE BLEEDING OCCURS IN

1) pericardial cavity

2) soft tissues

3) stomach lumen

4) joint

19. A patient with an open hip fracture, after anesthesia and infusion therapy, began to bleed profusely from the wound. WHAT KIND OF BLEEDING IS THIS?

1) early primary bleeding

2) late primary bleeding

3) early secondary bleeding

4) late secondary bleeding

20. HOW TO PERFORM PERMANENT HEMOSTASIS IN CASE OF SECONDARY ARTERIAL BLEEDING FROM THE INFECTED WOUND

1) vessel ligation in an open wound

2) retroclusion

3) vessel ligation above the injured point

4) combination of hemostatic therapy and antibiotics

21. THE DRUG USED FOR LOCAL HEMOSTASIS

1) hemostatic foam

2) vicasol

3) heparin

4) cryoprecipitate

22. LOCALIZATION OF BLEEDING IN CASE OF MELENA

1) lungs

2) upper gastrointestinal tract

3) rectum

4) kidneys

23. THE BIOLOGICAL METHOD OF HEMOSTASIS IS

1) wound tamponade with the use of omentum

2) adrenaline administration

3) intravenous administration of epsilon-aminocaproic acid

4) intramuscular administration of vikasol

24. THE FIRST AID FOR THE PATIENT WITH AN OPEN FRACTURE AND MAJOR ARTERY BLEEDING IS

1) administration of drugs for pain relief

2) tourniquet application

3) administration of cardiac and vasoconstrictive medications

4) immobilization of the limb

25. FOR CONTROL OF PARENCHYMATOUS BLEEDING

1) biological tamponade

2) vascular suture

3) bandage

4) bleeding vessels ligation

**4. Blood types and Rhesus factor. Definition of blood types.**

Blood type is a genetic biological sign, it is defined by existence or absence of corresponding group isoantigens and isoantibodies in plasma and cellular elements of blood.

On the basis of studying of isohemagglutination reaction (sludging of the blood of one person at its mixing with blood serum of another person) K. Landsteiner in 1900-1901 for the first time allocated three blood types – A, B,C.In 1906 J. Jansky finally proved that there are four blood types and offered classification which is used nowadays all around the world.

In 1928 the international classification of blood types was approved. It is accepted to distinguish four groups: **O (I), A(II), B (III)** and **AB (IV).** In Europe 44% of people have A(II) blood type; the O(I) group is the second most frequent and takes 39%, the B(III) group - 12%, AB(IV) group – 4-5%.

Today more than 700 various erythrocyte blood antigens forming 75 antigenic systems are revealed. Only 29 of them have clinical value, and 14 antigenic systems are the most significant: ABO, Rh-Hr, Kell-Gellano, Duffi, Kidd, Lewis (Lewis), MNSs, Lutheran, Rp, Xq, Ji, Auberqer, Dieqo, Dombrok, Colton, Scianna and others.

**Blood antigens**

Blood group antigens are called agglutinogens as they are usually revealed by agglutination test.

Agglutinogens have the following properties:

1) immunogenicity, i.e. ability to cause formation of immune antibodies when antigen entersthe body;

2) specificity (serologic activity), i.e. ability to enter into immunological reaction with the corresponding antibody, for example agglutination.

The agglutinogens which are located on the surface of formed elements are of practical importance because they cause isoimmunization (isosensibilization) and antibodies connect with these antigens during hemotransfusion, causing agglutination and hemolysis.

Agglutinogens of ABO, Rh-Hr and Kell systems are located on the surface of formed elements, that is why matching of blood is performedaccording to the agglutinogenic systems.

**Blood antibodies**

Group isoantibodies (agglutinins) of blood represent the gamma-globulin molecules forming 5 classes. The most significant are group antibodies of IgM, IgG, IgA classes.

**Agglutinins** have an ability to agglutinate homonymous blood antigens (property of**agglutinability**) – sludging of the blood and destruction of erythrocytes developing in a few minutes or hours. Other cytolysins (hemolysins), being fixed on erythrocytes, leucocytes or thrombocytes cause their hemolysis without sludging, but with obligatory participation of a complement. Antierythrocytic agglutinins are of the most practical importance.

According to the mechanism of formation antibodies are divided into natural, or congenital (α- and β-agglutinins which are genetically caused and existing throughout lifetime, for example) and immune, or acquired (some people get them as a result of immunization by nonshared blood antigens, for example, anti-A, anti-Rh agglutinins).

The following ways of immunization are possible:

Mismatch blood transfusion– a transfusion way;

Transplacental way - (mother is Rh-negative, fetus is Rh-positive).

Organs andtissues transplantation without their group compatibility – transplantation way;

Vaccines and serums administration – injection way;

Food immunization – enteral way.

According to the temperature of activity agglutinins can be cold or warm.

Cold antibodies (for example, α and β) are most active at temperature of +4 ° - +6 °C (reaction is also possible at temperature below +25 ° - +30 °C) and aren't active at temperature of +37 °C and above. That is why determination of a blood type using an ABO blood group system is carried out at room temperature. Warm antibodies (for example, antirezusly antibodies), are more active at temperature of +37 °C and above. In this regard determination of rhesus is carried out at temperature of +46 ° - +48 °C.

Depending on medium in which agglutinins cause agglutination reaction of the corresponding agglutinogens, they are divided into full and incomplete antibodies.

**General characteristic of system of ABO blood group system**

The system of ABO blood group antigens consists of three antigens: A,B and O, which, except erythrocytes, can be found in leucocytes, thrombocytes, tissue cells and blood plasm.

Two natural antibodies – agglutinins α (anti-A) and β (anti-B) belong to this antigenic system. Agglutinin α is linked only to A antigen, and agglutinin β – only to B antigen. 6 combinations of allelic antigens are possible – 00, A0, AA, B0, BB, AB.

As the hetero - and homozygous variants of antigen combinations (A0 and AA, B0 and BB) are included into one group, there are four main blood types: Oαβ (I) – the first, Aβ (II) – the second, Bα (III) – the third and AB0(IV) – the fourth.

In Russia and the majority of other countries alphanumeric designation of blood types is accepted: O (I), A(II), B (III), AB (IV).

O antigen is an independent weak antigen. It is of low practical importance and identified only using special serums.

A antigen is presented by several versions from A1 to A2. Most people with II blood type have A1 antigen (approximately 88%), rarely you can find A2 antigen (12%).

In the presence of A1 agglutinogen it is designated as A, and the index is used only for A2. In transfusiology A1 and A2 antigens are of great importance, respectively, there areblood subgroups A and A2, AB and A2B.

Persons with A(II) blood subgroups can have α2 extra-agglutinin[A (II) bα2 and AB (IV) α2], and those with A2 subgroup – α1 [A2 (II)bα1 and A2B (IV) α1]. In case of blood or erythromass transfusion the principle of transfusion of the same ABO group is used. However incase of life and death emergency, transfusion of an alternative groupcan be possible (but impossible in children).

The first blood type (I) (universal donor with type O(I) Rh negative blood) can be used for transfusion in emergency situation for persons with other blood type if there is no blood of the same type or no time for blood type determination. In this case drip transfusion is carried out in order agglutinins are diluted by the recipient’s blood.

In an emergency people with type AB (IV) blood (universal recipient) can get any other blood type.

The blood of alternative blood typescan be transfused only for replacement of blood loss no more than 500 ml.

It corresponds to**Ottenberg’s rule**: at small doses of blood transfusion (up to 500 ml) agglutinogens of the transfused blood are considered since they are exposed to agglutination.

And in case of high doses of blood transfusion agglutinogens and agglutinins of the recipient are considered since the amount of agglutinins α and βis sufficient not only for binding ofaqueous antigens A,B, but also for agglutination of recipient’s erythrocytes A, B, and AB.

Immunized universal donor having congenital high titre of natural agglutinins, is considered as a**dangerous universal donor**, and such blood transfusion causes hemolysis of recipient’s erythrocytes.

The universal recipient, immunized by any erythrocyte antigen, is considered as a**dangerous universal recipient** and he/she can't get any othertype of blood.

Bombay blood group for the first time identified in one of residents of Bombay is rare. There are no antigens A, B and O in erythrocytes, and in blood serum there are agglutinins α, β and anti-O. Recipients with such blood group can get only Bombay type blood.

In transfusiology there is a rule: any unusualdonor blood isunsuitable for transfusion!

**General characteristic of Rh-Hr system**

Rh blood group system has the greatest value for clinical practice. In transfusiology 6 antigens are of great importance.

For their designation two nomenclatures are used. According toWiener’s theory offered in 1942 there are antigens: Rh0, Rh', Rh'', Rh1w, Hr', Hr''.

Other theory offered in 1944 byRonald Fisher and R. R. Race uses alphabetic symbols: D, C, E, Cw, c, e. Rh antigensare inherited from parents and don't change during the lifetime. Rh antigens are located in erythrocyte membrane. D, C, E antigens are dominant, and c and e antigens are recessive.

In this regard it is possible to distinguish two blood types among recipients: Rh-positive (Rh +) which has D antigen in erythrocytes (more simply: DCE, DCe, DcE, Dce), and Rh-negative (Rh-) which doesn't haveD antigen (more simply dCE, dCe, dcE, dce).

**Blood type determination by means of tsoliklon**

Anti-A and anti-B monoclonal antibodies are produced by two various mouse hybridomas and belong to class M immunoglobulins.

Tsoliklon anti-AB represents a mixture of anti-A and anti-B monoclonal antibodies.

Monoclonal antibodies give faster and more expressed agglutination reactions with agglutinogens A or B, and the result of their interaction can be considered in 3 minutes.

Determination of a blood type is carried out by direct hemagglutination method: on a plate or a plane indoors in a good lightat +15-+25C.

A. Apply one big drop (0,1 ml) of tsoliklon anti-A and anti-B on a plate or a plane.

B. Near antigens put one small drop of the blood (0,02-0,03 ml) and mix the blood with reagent.

C. The plate or the plane needs to be shaken slightly within three minutes. Agglutination of erythrocytes with tsoliklons usually starts during the first 3-6 seconds, but it is necessary to observe for the period of three minutes because of later agglutination with erythrocytes containing weak kinds of A antigens.

D. The result can be positive or negative. The positive result is expressed in erythrocyte agglutination. In case of negative result the drop remains evenly painted in red color, there are no agglutinates.

**Blood type determination by crossmatching**

A. Blood type determination by crossmatching consists in simultaneous determination of group agglutinogens in erythrocytes by tsoliklons and group agglutinins in blood serum by means of test erythrocytes.

B. For blood type determinationexcept anti-A, anti-B and anti-AB monoclonal antibodies,O(I), A (II) and B (III) test erythrocytes are used.

C. The venous or capillary blood is used. The blood is centrifuged or left for 20-30 minutes for serum separation.

D. The process of determination is carried out on a white plane with the marks from the left to the right: anti-A, Anti-B.

E. Apply one big drop (0,1 ml) of test monoclonal antibodies

F. On the right apply one small (0,01 ml) drop of standard erythrocytes each under the marks O (I), A (II) and B (III)

G. Put one big drop (0,1 ml) of blood serum on to the prepared testerythrocytes. After that put erythrocytes of the testing blood by one small drop (0,01 ml) near each drop of the prepared monoclonal antibodies.

H. Antibodies and blood serum are mixed carefully with erythrocytes, using a stirring rod, the plane is shaken, then it is left for 1-2 minutes, after that again shaken. Observe the reaction for not less than five minutes.

I. During the process of agglutination with test erythrocytes, but not earlier than in 3 minutes, add one drop (0,05 ml) of isotonic NaCl solution each to the drops where agglutination has started. After that continue observation while shaking the plane before until the expiration of five minutes.

The accounting of reaction is made by comparison of the results received using test blood serums and erythrocytes.

Results of the reactions received using monoclonal antibodies and test erythrocytes must coincide, i.e. point to the presence of agglutinogens and agglutinins of one and the same blood type. These results can be expressed in four various combinations.

A. The studied blood didn't show agglutination with monoclonal antibodies what points to the fact that it has no group agglutinogens and doesn`t belong to O(I) group. Theblood serum gives negative reaction with test erythrocytes of O(I) group and positive reaction with A(II) and B(III) erythrocytes. It indicates the presence of agglutinins α and β in the blood, that confirms its belonging to O(I) group.

B. Anti-A monoclonal antibodies show the existence of agglutinogen A in the studied blood. But blood serum doesn't show agglutination with O(I) and A (II) test erythrocytes, i.e. the blood doesn't contain agglutinin α, but it agglutinates the erythrocytes of B(III) group, that shows the presence ofagglutinin β in its structure and its belonging to group A (II) β.

C. Anti-B monoclonal antibodies show the existence of agglutinogen B in the studied blood. But blood serum doesn't show agglutination with O(I) and B (III) test erythrocytes, i.e. the blood doesn't contain agglutinin β, but it agglutinates the erythrocytes of A(II) group, that shows the presence of agglutinin α in its structure and its belonging to group B (III)α.

D. Anti-A and Anti-B monoclonal antibodies show the existence of A and B agglutinogens in the studied blood. In this case it is necessary to conduct the research using anti-AB tsoliklon. If it also shows agglutination, carry out the sodium chloride test. The blood serum gives the negative reaction with test erythrocytes of all three groups that shows the absence of agglutinins and confirms that the blood belongs to AB (IV)ogroup.

**Errors while blood group determination**

There are two types of such mistakes.

**Errors of the first type**take place when agglutination test isn't considered where it actually is or must be.

The causes:

1) agglutination begins late or is poorly expressed because oflow activity of reagent, or the erythrocytes are of low specificity

2) too large drop of blood is taken

3) high temperature (above +25C), for example, hot weather.

**Errors of the second type**take place when agglutination test is considered where it isn't present or must not be.

The causes:

1) erythrocytes form strand coins which can be taken for agglutinates with the naked eye.

2) the studied erythrocytes show autoagglutination or reversible agglutination phenomenon, if an infected sample of blood is used

3) a plane with erythrocytes and blood serum is not shaken

**Control questions:**

1. The concept of antibodies and antigens. Properties of agglutinogen.

2. ABOblood groupsystem.

3. A-1 and A-2 subgroups.

4. The method of blood group determination using test blood serums and monoclonal antibodies.

5. Errors while I and II blood group determination. Rules of AB(IV) blood group determination.

6. Blood compatibility. Ottenberg’s rule. Blood group crossmatching.

7. The terms of “universal donor/recipient”, “dangerousuniversal donor/recipient”.

8. Wiener’s and Fisher-Race nomenclatures of Rh-factors. What does «Rh immunization», «Rh sensitization» mean? Rh compatibility.

**Tests on the topic: «Determination of blood type»**

***Choose one correct answer***

1. WHICH RH ANTIGEN HAS THE MOST PRONOUNCED ANTIGENIC PROPERTIES

1) C-antigen

2) D-antigen

3) E-antigen

4) c-antigen

2. BLOOD TYPE DETERMINATION BY CROSSMATCHING IS CARRIED OUT SIMULTANEOUSLY BY

1) test serums and red blood cells

2) test serums and tsoliklons

3) test red blood cells and tsoliklons

4) any of the above methods

3. When blood type determination by tsoliklons, there is agglutination with tsoliklon anti-A. THE RESULT SHOULD BE INTERPRETED AS

1) the first group of blood

2) the second group of blood

3) the third group of blood

4) additional research is required

4. THE RESULT OF BLOOD TYPE DETERMINATION BY TSOLIKLONS IS TAKEN INTO ACCOUNT IN

1) 3 minutes

2) 2 minutes 30 seconds

3) 4 minutes 30 seconds

4) 5 minutes

5. WHAT IS A BLOOD GROUP determined by tsoliklons, if there was agglutination with tsoliklon anti-A, anti-B and anti-AB

1) the first group of blood

2) the fourth group of blood

3) the second group

4) additional research is required

6. Patient, 36 years old with Rh-negative blood, no blood transfusion in anamnesis, a birth of Rh-positive child, transfusion of Rh-positive red blood cells was performed. EVALUATE THE EFFECT OF BLOOD TRANSFUSION

1) there is no risk of hemolytic shock

2) the question is not studied

3) hemolytic shock may occur

4) Rh status of the patient will change

7. RH ANTIGENS ARE CONTAINED IN

1) white blood cells

2) platelets

3) red blood cells

4) plasma

8. WHAT IS THE AGE OF A PERSON WHEN THE STABLE AGGLUTININ TITER IS DETERMINED

1) before birth

2) over the age of 2 years

3) by the end of the first year of life

4) by the age of 18

9. DETERMINE THE RH STATUS OF RECIPIENT'S BLOOD, which showedthe agglutination reaction with tsoliklon anti-D

1) Rh-positive

2) Rh-negative

3) it is necessary to study the anti-C tsoliklon

4) additional research with anti-C and anti-E tsoliklonsis necessary

10. It's been 2 minutes since the start of blood group determination by tsoliklon AB0. Agglutination with anti-B tsoliklon was determined and there was no agglutination with anti-A tsoliklon. YOUR ACTION IS

1) to continue monitoring

2) to determine the blood type again

3) to add sodium chloride

4) to make a conclusion about the blood type

11. DOES A RH-NEGATIVE PERSON HAVE RH ANTIGENS?

1) no, he/she doesn`t

2) yes, he/she does

3) the question is not studied

4) in exceptional cases, he/she does

12. AGE OF THE PERSON WHEN AGGLUTINOGENS CAN BE DETERMINED

1) before birth

2) over the age of 2 years

3) during the first year of life

4) in the first days after birth

13. The doctor decided to transfuse Rh-negative blood to Rh-positive patient during a routine operation. No blood transfusion in anamnesis. EXPLAIN THE CORRECTNESS OF THE CHOSEN TACTICS

1) the tactics is correct

2) the question is not studied

3) the tactics is wrong

4) you can transfuse 500ml. of blood

14. IN TRUE AGGLUTINATION, THE RED BLOOD CELL MEMBRANE IS

1) partially destroyed

2) not destroyed

3) destroyed

4) the question is not studied

15. IN CASE OF FALSE AGGLUTINATION, HEMOLYTIC SHOCK

1) does not occur

2) occurs

3) the question is not studied

4) may occur under certain conditions

16. OPTIMUM TEMPERATURE FOR BLOOD GROUP DETERMINATION IS

1) +26° - +28 C

2) room temperature

3) + 5° - +10 C

4) +46° - +48C in thermostat

17. IN CASE OF TRUE AGGLUTINATION, HEMOLYTIC SHOCK MAY OCCUR

1) yes

2) no

3) the question is not studied

4) can only occur under certain conditions

18. DONORS CAN BE PERSONS AGED

1) 16-50 years old

2) 16-60 years old

3) 18-50 years old

4) 18-60 years old

19. OTTENBERG RULE IS USED DURING

1) planned surgery

2) emergency surgery

3) radical surgery

4) palliative surgery

20. AGGLUTININ TITER OF A DANGEROUS UNIVERSAL DONOR IS

1) 1: 4

2) 1: 8

3) 1: 16

4) 1: 32 and above

21. OTTENBERG'S DIRECT RULE IS AS FOLLOWS: AT SMALL DOSES OF BLOOD TRANSFUSION (UP TO 500 ML) …. ARE CONSIDERED.

1) transfused blood agglutinins

2) transfused blood agglutinogens

3) agglutinins and agglutinogens of transfused blood

4) recipient’s agglutinogens

And in case of high doses of blood transfusion agglutinogens and agglutinins of the recipient are considered since the amount of agglutinins α and β is sufficient not only for binding of aqueous antigens A, B, but also for agglutination of recipient’s erythrocytes A, B, and AB.

22. OTTENBERG'S INVERSE RULE IS AS FOLLOWS: IN CASE OF HIGH DOSES OF BLOOD TRANSFUSION …. ARE CONSIDERED.

1) transfused blood agglutinins

2) transfused blood agglutinogens

3) agglutinins and agglutinogens of transfused blood

4) recipient’s agglutinogens

23. A DANGEROUS UNIVERSAL DONOR IS A PERSON WITH THE FIRST BLOOD TYPE

1) after viral hepatitis

2) having natural agglutinin high titer

3) who has previously undergone blood transfusion

4) after acute respiratory disease

24. A DANGEROUS UNIVERSAL RECEPIENT IS A PERSON WITH THE FIRST BLOOD TYPE

1) suffering from infectious disease

2) after flu

3) immunized by erythrocyte antigen

4) immunized by Rh factor

25. AGGLUTININS HAVE

1) immunogenicity

2) agglutinability

3) specificity

4) resistance

26. INCOMPLETE AGGLUTININS CAN CAUSE AGGLUTINATION OF RED BLOOD CELLS MEETING THE SAME AGGLUTINOGENS IN

1) colloidal media

2) saline media

3) colloidal and saline media

4) media with glucose addition

27. RH-D ANTIGEN IMMUNIZATION OCCURS IF

1) the mother is Rh-positive, and the fetus is Rh-negative

2) the mother is Rh-positive and the fetus is Rh-positive

3) the mother is Rh-negative, and the fetus is Rh-positive

4) the mother is Rh-negative and the fetus is Rh-negative

28. RECIPIENT'S RH-STATUS IS DETERMINED BY …. TSOLIKLONS

1) Anti-D

2) Anti-D and anti-C

3) Anti-D, anti-C and anti-E

4) by any of the above methods

29. DONOR'S RH-STATUS IS DETERMINED BY …. TSOLIKLONS

1) Anti-D

2) Anti-D and anti-C

3) Anti-D, anti-C and anti-E

4) by any of the above methods

30. IF THE RECIPIENT'S BLOOD TYPE AND RH STATUS ARE NOT KNOWN, BLOOD FOR TRANSFUSION IS

1) O (I) Rh positive

2) O (I) Rh negative

3) based on the indication of the blood type in the passport

4) without blood group and Rh-status detrmination, blood is not transfused

31. WHILE BLOOD GROUP DETERMINATION BY GEL METHOD, AGGLUTINATION IS CONSIDERED TO TAKE PLACE IF THE RED BLOOD CELLS

a) precipitated

b) remained on the gel surface

c) partially precipitated, partially remained on the surface

d) remained in the gel stratum

***Choose the correct combination of answers***

1) a, b

2) a, c

3) a, d

4) b, d

32. BY ORIGIN, ANTIBODIES ARE DIVIDED INTO

a) natural

b) cold

c) warm

d) immune

***Choose the correct combination of answers***

1) a, b

2) b, c

3) c, d

4) a, d

33. THE REACTION RESULTS FOR RH-STATUS DETERMINATIONBY MONOCLONAL ANTIBODIES ARE CONSIDERED IN

1) 2.5 minutes

2) 3 minutes

3) 5 minutes

4) 10 minutes

34. IN EMERGENCY SITUATION, IF THERE IS NO BLOOD OF THE SAME TYPE, O(I)RH-NEGATIVE BLOOD CAN BE TRANSFUSED IN A VOLUME OF NO MORE THAN

1) 100 ml

2) 500 ml

3) 1000 ml

4) 1500 ml

35. A DONOR WITH dce RHESUS ANTIGENS SHOULD BE CONSIDERED

1) Rh-negative

2) Rh-positive

3) additional study is necessary

4) it is necessary to repeat the study

**5. Transfusion of blood components and blood substitutes.**

Transfusion therapy is a separate and combined application of blood components, blood products, and blood-substitutes. This medical method in literature is quite often called "Infusion – transfusion therapy", regarding introduction of blood substitutes as infusion, and transfusion of blood, blood components and products as transfusion.

Transfusion therapy in the past was generally based on the use of whole blood.

The whole blood, is generally used as initial material for preparation of blood components.

**Blood components** are the main components of blood received by filtration, centrifugation and freezing according to the standard methods. Possibility of application of separate blood components allows to carry out purposeful transfusion therapy.

**There are following types of donor blood components:**

• carriers of blood gases;

• plasma-coagulation hemostasis correctors;

• vascular hemostasis correctors;

• blood components for immunosupportive therapy.

**Transfusion of blood gasescarriers**

In medical practice there are packed red blood cells and red blood cell suspension of several types.

Packed red blood cells – the component received after separation of whole blood by centrifugation method and removal of the part of plasma. The main hemotransfusionic media, wherehematocrit doesn`t exceed 80%. Depending on the preservative used, storage term of packed red blood cells at temperature +2-+6 °Cis 21-42 days.

**Packed red blood cells phenotyping**(not less than 5 antigens besides A, B, and D of Rh systemare defined).

It is used for the purpose of prevention ofalloimmunization to erythrocyte antigens. Transfusion of phenotyping packed red blood cells is indicated for children under 18 years, pregnant women, blood recipients in case of repeated transfusions.

**Filtered packed red blood cells**– hemocomponent received as a result of filtration of packed red blood cells using special leukocyte filters. Leukofiltration allows:

• to reduce the frequency of febrile nonhemolytic posttransfusion reactions;

• to increase the storage time since leucocytes in storage eliminate biologically active agents increasing permeability of the cell membrane that leads to increasing concentration of K+ ions, ph decrease, destruction of erythrocytes and exit of free hemoglobin;

**Packed red blood cells poor with leucocytes and thrombocytes**. After centrifugation of preserved blood a leuko-platelet layer is taken out. If you add 0,9% sodium chloride or solution with energy metabolism substrates (suspendable or resuspendable solutions) topacked red blood cells, such component will be called as red blood cell suspension. The majority of suspendable solutions contains sodium chloride, adenine, glucose and mannitol dissolved in water. The volume of suspendable solution usually makes 80-100 ml. Red blood cells suspension in resuspendable solution can be stored from 35 to 41 days. Use in case ofreplacement of blood loss and treatment of anemia.

Red blood cells suspension with normal saline solution (washed red blood cells) – represents the transfusive mediafree from leucocytes, thrombocytes, serum proteins and hemopreservative by means of multiple centrifugations and repeated 3-5-fold washing of packed red blood cells. Transfusion is indicated to the patients having posttransfusion reactions of nonhemolytic type in anamnesis and patients sensitized to leucocytes and thrombocytes antigens, serum proteins. The period of storage of packed red blood cells with normal saline solution at +4 °C – 24 hours from the moment of preparation.

Red blood cells suspension, defrozen and washed – at present there are several methods of cryopreservation of packed red blood cells with the use of cryoprotective solutions, allowing to preserve it for a sufficiently long time. The method of freezing and storing erythrocytes at low temperatures allows to get, complete erythrocytes after being defrozen and washed.

Erythrocytes can stay frozen for up to 10 years. The method of a cryopreservation allows to preserve rare blood types, to carry out quarantine (HIV control tests, viral hepatitis after 6 months). After being defrozen, packed red blood cells are washed with special glycerin solutions and resuspended in saline. The storage period is no more than 24 hours at +2 - + 6 ° С.

**Indications for blood gases carriers transfusion**

Introduction of blood gases carriers is aimed at replenishing the volume of circulating erythrocytes and maintaining the normal oxygen transport function of the blood in acute and chronic anemia.

Patients with blood loss of up to 20% of the circulating blood volume very rarely need blood gases carriers transfusions. Aiming at completely replacement of the lost erythrocytes volume is particularly dangerous. The indication for transfusion of blood gases carriers in case of acute anemia is the loss of 25-30% of thecirculating blood volume. The objective criterion of such blood loss is decrease ofhemoglobin below 70-80 g/l and hematocrit below 25% and the occurrence of circulatory injuries.

However, acute massive blood loss in the first hours is usually not accompanied by hemoglobin decrease, so its “high” level cannot serve as a reason for refusing blood transfusion. The clinical picture of blood loss severity is manifested by pallor of the skin, mucous membranes, especially the conjunctiva, desolation of veins, dyspnea and tachycardia. Dyspnea can be confirmed byparticipation ofneck muscles and wings of the nose during inhalation.

In these cases, the aim of transfusion therapy is to restore intravascular volume quickly to ensure normal organ perfusion, which is more important than increase of number of circulating red blood cells.

In this situation, it is necessary to immediately administer saline solutions, colloidal blood substitutes or albumin, fresh frozen plasma, followed by transfusion therapy, transfusion of blood gases carriers. Indications for transfusion of donor erythrocytes in case of chronic anemia are even more stringent.

For patients with chronic course of anemia, the most important is the elimination of the cause of anemia, that is, administration of pathogenetic therapy, and not the recovery of hemoglobin level using transfusions of erythrocyte-containing media. Only after all methods and means to eliminate anemia have been used, but the patient still shows pronounced clinical manifestations of hypoxia, transfusion of blood gases carriers is applied.

This category of patients shows the development of compensatory mechanisms: increase of cardiac output, right shift of oxyhemoglobin dissociation curve. All that leads to return of oxygen to tissues, decrease of physical activity, increase of respiratory rate.

At purpose of a transfusion of carriers of blood gases patients with chronic forms of anemia need to take the following provisions into account:

• to determine the clinical symptoms of anemia which dynamics will show whether transfusion is effective or not;

• not to administer transfusion of blood gases carriers, guiding only by hemoglobin level since it changes depending on the volume of transfused solutions, diuresis, level of cardiac decompensation.

In case of combination of heart failure and anemia transfusions must be careful because of hypervolemia hazards connected with the increased volume ofcirculating plasma. The rate of transfusion mediums administration (erythrocyte components) mustn't exceed 1-2 ml/kg of body weight an hour, with possible diuretics administration before transfusion.

**Transfusion of plasma-coagulation hemostasis correctors**

Fresh frozen plasma is a component of donor blood obtained within 4-6 hours after blood exfusion by centrifugation method or apheresis followed by shock freezing at -70 ° C. At the same time, labile plasma clotting factors remain in the functional state. It is stored at -30 ° C for 2 years. Generally, quarantined fresh frozen plasma is used after 6-month storage period and negative results of HIV, syphilis, hepatitis B and C tests. Donor of fresh frozen plasma should be of the same group as that of the recipient. For transfusion of more than 1 liter, antigen D compatibility ofdonor and recipient is obligatory. In emergency cases, if there is no plasma of the same type, AB (IV) plasma transfusion to a recipient with any blood group is allowed.

Fresh frozen plasma is used in case of coagulation system disorders:

* acute disseminated intravascular coagulation (DIC) syndrome, complicating the course of shocks of various origins (septic, hemorrhagic);
* acute massive blood loss of more than 30% ofcirculating blood volume (the amount of transfused fresh frozen plasma should be at least 25-30% of the total volume of transfusion media, that is, at least 800-1000 ml);
* liver disease, accompanied by decrease in the production of plasma clotting factors;
* overdose of indirect anticoagulants;

Fresh frozen plasma is defrostedover a pan of simmering water at + 37 ° C, under the control of thermometer, or using special defrosters. It is used within an hour after defrosting, cannot be re-frozen.

**Vascular hemostasis correctors**

Platelet Concentrate. Standard platelet concentrate is prepared from a single dose of preserved blood (450 ml).

An absolute indication is thrombocytopenia at the level of 20х/l (the norm is 180-320х/l) with clinically pronounced hemorrhagic syndrome due to platelet deficiency (disseminated intravascular coagulation syndrome, in case of massive hemorrhage, surgeries, labour, massive transfusion syndrome, surgeries with the use of artificial blood-circulation apparatus).

Platelet concentrate must be ABO and Rhesus antigen compatible. Storage period is 5 days.

**Blood components for immunosupportive therapy**

Leucocyte concentrate is a blood component with high granulocytes and lymphocytes concentration with an admixture of platelets and erythrocytes. The main function of granulocytes is phagocytosis of bacteria.

The main indication for leucocyte concentrate transfusion is decrease of granulocytes absolute number less than 0.5x109 / L in the presence of uncontrolled antibiotic therapy. The use of leucocyte concentrate transfusion is effective for neonatal sepsis. ABO and Rhesus compatibility is obligatory.

Rules of blood components transfusion.

1. Blood components are transfused only with the written consent of the patient or his legal representative (the decision is made by the council of physicians or duty doctor, indications must be reflected in case history)

2. Before transfusion, a container with the transfusion medium is kept at room temperature (+22 - + 24 ° C) for 30 minutes

3. Rapid transfusion of cold blood (blood components) can be dangerous.

4. Damaged package must not be used.

5. For transfusions of all hemocomponents, single-use systems with filter are used.

6. Hemocomponents transfused must be ABO, Rh-Hr and Kell compatible (compatibility testing before each transfusion, determination of patient's and donor's blood types, Rh factor).

7. Biological test is carried out regardless of the volume of blood transfusion medium and the rate of its administration.

8. You must not introduce any other medicines or solutions into a container with a blood component, except for sterile 0.9% sodium chloride solution (no more than 50 ml.)

**Plan of actions of the doctor duringblood components transfusion**

The doctor who is carrying out hemotransfusion must:

1. Evaluate initial indicators of patient’s condition (heart rate, arterial pressure, clinical blood and urine analysis), define indications (purpose, way, medium, a dose and rate of transfusion) and contraindications to blood components transfusion.

2. Collect obstetric and hemotransfusion history.

3. Talk to the patient and receive the voluntary informed consent.

4. Determinethe recipient’s blood type just before transfusion irrespective of earlier made tests and compare the received result with data in case history.

5. Order the necessary transfusion medium.

6. Determine the suitability of blood components for transfusion.

7. Determine ABO and Rh blood-group specificity, compare the results with those designated on the container and specified in case history.

8. Carry out ABO compatibility blood testing.

9. Carry out Rh-Hr compatibility blood testing.

10. Verify the passport data of the patient and compare them with those in case history.

11. Carry out a biological test.

12. Perform blood transfusion.

13. Fill in medical documentation.

14. Observe the patient during posttransfusion period within 24 hours. **Contraindications to blood components transfusion**

Along with relative indications for blood components transfusion (id the patient can recover without transfusion), contraindications to hemotransfusion must be taken into account. They are:

• heart failure with symptoms of circulatory congestion of classIIB-III (myocardial infarction, septic endocarditis, heart defects, myocarditis, myocardiosclerosis, edema, ascites, etc.);

• heart and lung diseases, accompanied by congestion in the pulmonary circulation (pulmonary edema);

• arterial hypertension (hypertensive disease III);

• thromboembolic conditions (fresh thrombosis, embolism);

• acute and severe disorders of cerebral circulation;

• severe liver and kidneys dysfunction ( use of plasma is not contraindicated);

• allergic conditions and diseases (bronchial asthma, Quincke's edema, polyvalent allergy, etc.);

• severe atherosclerosis of the coronary, cerebral arteries and vessels of other areas;

• acute rheumatism;

• active tuberculosis;

• hemorrhagic vasculitis.

Having the above mentioned pathological conditions, blood transfusion can aggravate or cause hemodynamics and cardiac disorders, thrombosis, cerebrovascular disorders, hepatic or renal failure, severe allergic reactions or allergies aggravation. Thesecontraindications are not the reason for refusal to blood gases carriers transfusion and hemostasis correctors transfusion.

However, in case of medically indicated blood transfusions, it is necessary to take measures for prevention of adverse consequences.

**Assessment of transfusion medium suitability.**

Before transfusion, the container with a transfusion medium (packed red blood cells orred blood cells suspension, whole blood) is kept at room temperature for 30 minutes. It is permissible to warm the transfusion mediumover a pan of simmering water at + 37 ° C under the control of thermometer.

The container with plasma stored in a low-temperature freezer (temperature -25 ° -30 ° C) is defrosted in accordance with the rules of plasma defrosting: over a pan of simmering water at + 37 ° C under the control of thermometer.

Before each transfusion the doctor performingblood components transfusion, must check the donor’s passport data on the container:

• the donor's UPC code;

• individual number of the hemocontainer;

• full name of the donor;

• ABO and Rh blood group;

• production date and storage period;

• name of the blood service institution;

• blood-borne infections tests

It is necessary to evaluate the suitability of transfusion medium according to macroscopic evaluation of the blood container. The following parameters are checked carefully, without shaking:

• container closure integrity;

• correctness of certification;

• storage period;

• good quality of transfusion medium (no signs of hemolysis, clots, flakes, etc.)

**Pre-transfusion tests.** Regardless of the conducted hematological tests, immediately before blood transfusion, a physician or transfusiologist must determine the ABO blood type of the donor and the recipient using anti-A, anti-B and anti-AB monoclonal antibodies, compare the results with the case history and record on the container.

Donor erythrocytes, which are used for ABO-affiliation control or in blood compatibility testing, are obtained from a tubing segment of a plastic bag or from a system during initial filling with donated blood.

**Transfused blood compatibility testing**.

There are more than 700 antigens in erythrocyte membrane. Selection of blood for transfusion according to ABO and Rh compatibility does not guarantee that these and other erythrocyte agents will not meet with the recipient's possible immune antibodies. In this regard, individual compatibility testing takes a special place in blood transfusiology.

**ABO compatibility tests.**

Some people have anti-M and anti-N isoimmune antibodies. In most cases, these antibodies are active under the same conditions as ABO antibodies, i.e. cause agglutination of erythrocytes at room temperature. Therefore, if the patient has anti-M and anti-N antibodies, and the donor's erythrocytes contain these factors, then these blood groups incompatibility should be revealed during ABO blood group compatibility test. The recipient can`t receive this blood.

A cold test is carried out at room temperature +15 - + 25 ° С and reveals ABO blood group incompatibility. For this test, use a white porcelain or any other white plate with a wetted surface. There are the following recordson the plate: full name of the patient, blood group of the patient, full name of the donor, blood group of the donor and the number of blood container. Put 2-3 drops of the patient's serum onto the plate and add a small drop of the donor's blood so that the ratio of blood to serum is approximately 1:10. The blood is mixed with the serum with a dry glass rod, the plate is slightly shaken, then left for 1-2 minutes and again periodically shaken, while monitoring the reaction for 5 minutes.

If erythrocyte agglutination occurs in the mixture of the patient's serum and the donor's blood,you can see agglutinates first as small, then large lumps against the background of completely or almost completely discolored serum. It means that the donor's blood is incompatible with the recipient's blood.

After ABO blood group compatibility has been determined, you must be sure in Rh antigen D compatibility of the donor and the recipient. For this purpose, you can use other compatibility tests:

• test with 33% polyglucin solution;

• test with 10% gelatin;

• indirect Coombs' test;

• test on a plane at temperature of + 46-48 ° С.

**Value of Rh antigen compatibility test for other antibodies identification.**

When carrying out Rh-Hr antigen D compatibility tests it is possible to determine incomplete isoimmune antibodies against other antigens of Rh system: C, E, c, е, and sometimes against antigens of other systems of erythrocytes.

The compatibility test using the 33% polyglucin solution is carried out in a test tube during the period of 5 minutes without heating. The 33% polyglucin solution is used, prepared specially for laboratory purposes. For this test, use a tube of at least 10 ml. Write the full name, blood group of the patient and the number of the donor container on the test tube. Put 2 drops of recipient’s serum, one drop of donor blood and one drop of 33% polyglucin solutiononto the bottom of the test tube. The contents is mixed by shaking. The tube is kept almost in horizontal position, then it is slowly turned so that its contents spread along the walls. This spreading of the contents along the walls makes the reaction more pronounced. The contact of erythrocytes with the patient's serum while turning the tube should be continued for at least 5 minutes. After 5 minutes, add 2-3 ml of 0.9% isotonic NaCl solution into the test tube in order to get a pale pink color and mix the contents by inverting the test tube 2-3 times without shaking.

The result is assessed as follows: if erythrocyte agglutination is observed in the test tube as a suspension of small or large lumps against the background of enlightened or completely discolored liquid, this means that the donor's blood is incompatible with the recipient's blood. If the tube contents remains uniformly colored and there are no signs of erythrocyte agglutination in it, this means that the donor's blood is compatible with the recipient’s blood according to the Rh antigen D.

**Compatibility test using 10% of gelatin**

Technique: Put a drop of donor’s erythrocytes, 2 drops of recipient’s serum, 2 drops of gelatin into the test tube. The contents of the test tube is mixed by shaking, after that it is placed in a thermostat for 30 minutes at +46 - + 48 ° C. Then add 5-8 ml of physiological solution to the test tube (until slightly pink staining) and mix the contents by inverting the tube 1-2 times.

Evaluation of the result: the test tube is watched in the light with the naked eye or a magnifying glass. Agglutination of erythrocytes indicates that the recipient’s and donor’s blood are incompatible, absence of agglutination is the indicator of blood compatibility.

**Indirect Coomb’s test**

Technique: put a drop of the precipitate of three times washed donor erythrocytes into a test tube and 4 drops of recipient's serum. The contents is mixed by shaking, and then placed in a thermostat for 45 minutes at + 37C. After that time, erythrocytes are washed again for three times and 5% suspension in physiological solution is prepared. Add a drop of erythrocyte suspension onto a white porcelain plate, a drop of antiglobulin serum and stir it with a glass rod. The plate is periodically swung for 5 minutes.

Evaluation of the result: the tube is observed with a naked eye or a magnifying glass. Agglutination of erythrocytes indicates that the recipient’s and donor’s blood are incompatible, absence of agglutination is the indicator of blood compatibility.

**Biological test**.

The technique of a biological test is as follows:

• 10 ml of blood transfusion medium is transfused once at the rate of 2-3 ml (40-60 drops) per minute for 3-3.5 minutes;

• then transfusion is stopped and the doctor monitors the recipient’sgeneral state, pulse, respiration, blood pressure, skin color, and body temperature for 3 minutes;

• this procedure is repeated twice more.

If during this period the recipient shows even one of clinical symptoms as chills, back pain, feeling of heat and tightness in the chest, headache, nausea and vomiting, it requires immediate stop of transfusion and refusal of this transfusion medium. It is possible to continue the transfusion of saline solutions.

When transfusing blood components under anesthesia, reactions or incipient complications are judged by unmotivated increase of bleeding in the surgical wound, decrease of blood pressure and increased heart rate, change in the urine color during bladder catheterization, as well as by the results of early hematolysis test (Baxter test). For conducting the test, after transfusion of 50 ml of blood from the patient's vein, blood is taken into the test tube with sodium citrate (citrate can be replaced with heparin) in a ratio of 1: 9, and after centrifugation, the state of the plasma is visually assessed. Its pink coloration indicates hemolysis. In such cases, transfusion of this blood transfusion medium is stopped.

Patient follow-up during the early posttransfusion period.

The patient undergone hemotransfusion, must be monitored by the personnel on duty within 24 hours.

After hemotransfusion the doctor must control:

• clinical urine analysis;

• clinical blood analysis (hemoglobin and erythrocyte number);

• body temperature during the first 3 hours;

• macroscopic evaluation of the first pass urine;

• daily urine.

After plasma transfusion the doctor must control:

• coagulogram;

• level of whole blood protein;

• blood bilirubin.

All these data are put into the case history.

After transfusion the donor container with a small amount of remained hemotransfusion medium (not less than 5 ml), and the test tube with the recipient’s blood taken for individual compatibility testingare stored in refrigerator at +4-+6 °C within 48 hours for immunohematological and bacteriological studies demanded by the instruction in case of hemotransfusion complications.

**Blood products.**

1. Combined medications (albumin, protein). Carry out transport and detoxification function, maintain colloid-osmotic pressure of plasma. 5%, 10%, 20% solutions are stored for 5 years. Indications for administration: decrease in the level of plasma albumin to 25 g / l; protein consists of 80% albumin and 20% globulins, produced in bottles 250, 450, stored for 5 years. A biological test is recommended for transfusion.

2. Correctors of the blood coagulation system:

A) cryoprecipitate - contains blood coagulation factor VIII;

B) prothrombin-converting complex - protein fraction of blood plasma with a high content of blood coagulation factors II, VII, IX and X;

C) Fibrinogen

D) Thrombin

E) Biological antiseptic tampon

E) Human fibrin foam

G) Fibrinolysin

3. Medications of immunological action (anti-measles gamma globulin, anti-rhesus immunoglobulin - to prevent hemolytic disease of newborns, prevent sensitization of women with Rh-negative blood: prevents them from developing Rh antibodies; anti-staphylococcus, anti-tetanus, anti-influenza immunoglobulins)

**Hemotransfusion in pediatrics**

Distinctive features of newborns physiology dictate special rules for transfusions:

• all transfusions to newborns are considered as massive blood transfusions, because of their high sensitivity to hypothermia, sharp fluctuations of acid-base balance, ionic composition of blood;

• all transfusions to newborns must be carried out under the strictest control, it regards to both the volume of erythrocyte-containing transfusion media and the volume of blood taken for analysis;

• it is preferable to use defrosted or washed erythrocyte suspension;

• the rate of transfusion of erythrocyte-containing media should not exceed 2-5 ml / kg of body weight per hour under the control of hemodynamic and respiratory parameters;

• preliminary warming of erythrocyte-containing media is necessary in case of rapid transfusions (0.5 ml / kg body weight per minute). However, its overheating can lead to complications, as well as hypothermia because of transfusion of cold blood components;

• in case of acute bleeding with circulatory blood volume deficiency of more than 15% it is needed to carry out transfusion of 5% albumin solution at a dose of 20 ml / kg of body weight followed by transfusion of blood gas carriers and correction of hypovolemia;

• Heparin is the best blood preservative for premature and newborn infants. The immature liver of a newborn has a low capacity to metabolize citrate. Citrate intoxication, which is manifested by alkalosis and increased concentration of carbonates in plasma - a frequent post-transfusion complication in newborns, especially in premature babies;

• when selecting a donor of blood components, it should be remembered that the mother is an undesirable plasma donor for the newborn, since the mother's plasma may contain alloimmune antibodies against the newborn's erythrocytes, and the father is an unwanted donor of red blood cells, as the newborn can have antibodies against these antigens penetrated from the mother's bloodstream through the placenta;

• For premature newborns or fetuses in case of intrauterine transfusion, it is advisable to transfuse only cytomegalovirus-negative, leukocyte-free, irradiated packed red blood cells or red blood cells suspension;

• Plasma for children is transfused considering not only the blood type, but also the Rh-status.

**Blood substitutes.**

They are represented by transfusion medium with purposeful action on the body capable to replace a certain blood function, or it is infusion of fluids which are used instead of blood and its components according to special indications. Division of blood substitutes into 3 groups is conditional. The mechanism of action is determined by molecular weight:the higher it is,the longerit can remain in the blood stream, and it means that it has high hemodynamic activity.

**Hemodynamic blood substitutes**. Used for the treatment and prevention of shock of various origins. With the introduction of hemodynamic blood substitutes, the following effects are achieved:

• substitutional (hemodynamic blood substitutes, having a rather high molecular weight, remain in the patient's bloodstream for a rather long time and maintain blood pressure);

• hemodilutional (achieved by modeling the function of plasma proteins (albumin). Intravenous administration of them in a volume of 500 ml for 15 minutes reduces hematocrit by 4-6%);

• volemic (determined by the gain ofcirculatory blood volume in relation to transfused fluid in% ratio. 1 gram of dextran binds 20 ml of water from the intercellular space);

• hemodynamic blood substitutes contribute to disaggregation of blood cells;

• rheology and microcirculation are improved;

• blood viscosity decreases;

• primary and secondary hemostasis is affected.

**Dextran derivatives**

One of the representatives of colloids used in clinical practice is dextran, a polysaccharide of bacterial origin. It doesn’t cause pathological changes in organs, it is non-toxic, and its antigenic properties are insignificantly expressed. The group of medium molecular weight dextran medications includes: Polyglucin (Russia); Dextran (Poland, USA); Macrodex (Sweden); Intradex (England); Plazmodex (Hungary); Oktovertin (Germany).

**Taking into account the errors duringdextrans production, it is recommended to carry out a biological test**. The test is carried out by drop infusion!

**Technique of the biological test:**

• 15 drops of medication are administered;

• interval - 3 minutes;

• 30 drops of medication are administered;

• interval - 3 minutes;

• 30 drops of medication are administered;

• interval - 3 minutes.

Low molecular weight dextrans include **rheopolyglucin** (foreign analogue - **rheomacrodex**).

**Blood substitutes on the basis of gelatin**

**Gelatinol** - 8% solution of partially hydrolyzed gelatin, which is a denatured protein obtained from the collagen of animal tissues, gelofusine.

**Hydroxyethyl starch based blood substitutes.**

The main positive properties of blood substitutes based on hydroxyethyl starch:

• fast replacement of the lost blood volume due to the intravascular distribution (absence of edema);

• 100% or more of the volume is achieved in relation to the transfused volume of fluid;

• persistent volemic and rheological effects for 4-6 and more than 30 hours, respectively. (Stabizol HES, volekam)

**Blood substitutes of desintoxication activity.**

The effect of these drugs is connected with the sorption activity of their macromolecules, which are capable of binding to toxic substances and eliminating together with them out of the body. They are used to treat conditions accompanied by intoxication(Neohaemodes, hemosan).

**Blood substitutes for parenteral nutrition.**

The substances included in these medications maintain the water-electrolyte balance, plasma osmolarity, acid-base balance, fill in the energy resources of the body. Indications are:

• for treatment of weakened postoperative patients,

• burns of esophagus;

• hypoproteinemia conditions of various etiology;

• burn disease.

**Amino acids mixtures.**

Polyamine 8% (Russia), aminofusine (Germany), vamyn (Sweden), FreAmine (USA), aminosteril KE 10% (Germany), hepataine (Turkey).

According to biological properties, they surpass protein hydrolysates and practically displace them.

**Fat emulsions.**

Infuzolipol (Russia), intralipid (Sweden), lipofundin - C 20% (Finland).

They are made on the basis of emulsification of rose, cottonseed and vegetable oils. All new drugs are based on soybean oil.

**Regulators of electrolyte and acid-base balance.**

Crystalloid (saline, electrolytic) solutions in treatment of extreme conditions take a special place. Only with their help it is possible to make up for the losses of interstitial fluid quickly and effectively. Besides, they are capable to restore the osmotic pressure of plasma, normalize salt and water metabolism, increase circulating blood volume and water resources of the body in general. Normal saline and others belong to simple saline solutions.

**Electrolytic solutions** (sodium chloride, Ringer’s solution, Ringer-Locke’s solution, lactasol) are used for replacement of electrolyte losses.

**Infusion antihypoxic drugs**.

Mafusol, Reamberin is a saline solution containing Krebs cycle substrates (sodium fumarate). Used to correct salt and water metabolism.

Promotes:

• reduction of tissue hypoxia;

• restoration of cellular energy;

• correction of the acid-base balance of the blood;

• improves cardiac activity;

• improves kidney function.

**Blood substitutes with the oxygen transfer function**.

Blood and its components are still dangerous biological products that can be sources of blood-borne diseases, the cause of post-transfusion reactions and complications development. Blood prepared using preservatives is exposed to significant changes during storage.

An alternative to whole donor blood can be blood substitutes - oxygen carriers (OC).

Todaytwo directions in their production are being intensively developed:

• perfluorocarbon emulsions (PFC)

• modified hemoglobin solutions (MH)

These substances, replacing the main function of blood - oxygen transport - have a number of advantages:

• they are universal;

• do not require isoserological selection;

• the small size of PFC and MH particles ensures oxygen delivery to the cells of ischemic tissues through sharply narrowed capillaries under the conditions of disturbed microcirculation;

• safe in relation to infections transmission;

• have a long storage period;

• can be accumulated in large quantities and applied immediately.

Perftoran (Russia). It is a plasma substitute made on the basis of perfluorocarbons. It has gas transport, rheological, hemodynamic, diuretic, membrane stabilizing, cardioprotective and sorption properties. After intravenous administration, the half-life period of the drug is about 24 hours.

Indications for use: shock conditions, massive blood loss, multiple injuries, extensive burns, in organ transplantation.

Gelenpol (Russia) - created by the Russian Research Institute of Hematology and Transfusiology. The first Russian oxygen-carrying infusion solution based on modified human hemoglobin.

**Combined blood substitutes.**

These blood substitutes combine the qualities of several blood substitutes, including hemodynamic and detoxification effects, support the circulating blood volume and improve hematopoiesis.

**Polyfer (polyglucin modification). Reogluman.**

**Complications ofblood substitutes transfusion.**

Complications of infusion therapy can be associated with technical errors (hematoma, damage to adjacent organs and tissues, thrombophlebitis, embolism), as well as homeostasis changes (water intoxication with excessive fluid administration, hydrosarca with excessive salt administration, acidosis due to dilution caused by long-term intensive administration of normal saline; excessive hemodilution with a significant decrease in concentration of protein, hemoglobin and clotting factors, etc.)

Specific complications of fluid therapy are:

• hyperthermia;

• reactions to the administration of cold solutions, pyrogens, bacterial contaminated media;

• allergic reactions;

• anaphylactic shock;

• overdose of individual ions;

• sometimes an overload of the right circulation can occur, which leads to pulmonary edema (colloid solutions can cause an overload of blood circulation faster than crystalloid ones).

**Control questions:**

1. Moderntransfusiology.
2. The main transfusion media. Blood components, blood substitutes, blood products.
3. Whois calleda donor? Some contraindications to become a donor.
4. Instructions forstorage and transportation of blood components and products.
5. Doctor’s plan of action during blood transfusion.
6. The indications and contraindications for transfusion.
7. Occult hemolysis tests. ABO and Rh-compatibility testing. Biological test.
8. What mistakesduring transfusion must be avoided?
9. The clinical signsof post-transfusion complications, their treatment.
10. Transfusiologicalanamnesis and transfusionprotocol.

**Tests on the topic: «Blood transfusion»**

***Choose one correct answer***

1. ONE OF THE CONCEPTS OF MODERN BLOOD TRANSFUSION TACTICS IS AS FOLLOWS

1) there are no indications for transfusion of packed red blood cells

2) there are no indications for whole blood transfusion

3) there are no indications for plasma transfusion

4) instead of blood transfusion-transfuse blood substitutes

2. ONE OF THE CONCEPTS OF MODERN BLOOD TRANSFUSION TACTICS IS AS FOLLOWS: WHAT MUST BE TRANSFUSED AS INDICATED?

1) blood components

2) blood substitutes

3) whole blood

4) blood products

3. ONE OF THE CONCEPTS OF MODERN BLOOD TRANSFUSION TACTICS IS AS FOLLOWS

1) one donor - one recipient

2) one donor - two recipients

3) two donors - one recipient

4) the number of donors does not matter for the recipient

4. A CONTRAINDICATION FOR THE TRANSFUSION OF PACKED RED BLOOD CELLS IN CASE OF MASSIVE BLOOD LOSS IS

1) kidney failure

2) respiratory failure

3) any pronounced violation of the parenchymal organs function

4) there are no contraindications

5. IN CHRONIC ANEMIA THE INDICATION FOR TRANSFUSION OF PACKED RED BLOOD CELLS IS

1) severe clinical manifestations of anemia

2) decreased hemoglobin below 80 g / l

3) pronounced clinical manifestations of anemia that cannot be corrected during pathogenetic therapy

4) all of the above mentioned

6. A CONTRAINDICATION FOR TRANSFUSION OF PACKED RED BLOOD CELLS IN CASE OF CHRONIC ANEMIA IS

1) increased intracranial pressure

2) kidney failure

3) any pronounced violation of the parenchymal organs function

4) all of the above mentioned

7. PLATELET CONCENTRATE TRANSFUSION IS INDICATED IN CASE OF

1) hemophilia

2) acute anemia

3) thrombocytopenia, accompanied by hemorrhages

4) profuse bleeding

8. TRANSFUSION OF FRESH FROZEN PLASMA IS CARRIED OUT

1) without taking into account the blood group

2) taking into accountABO compatibility

3) taking into account ABO and Rh compatibility

4) in emergency, the plasma is transfused without taking into account its Rh-status

9. BIOLOGICAL TEST …. DURING TRANSFUSION OF FRESHLY FROZEN PLASMA

1) is not performed

2) is not performed in emergency situation

3) is performed

4) is performed in case of planned transfusion

10. INDICATIONS FOR TRANSFUSION OF FRESHLY FROZEN PLASMA

1) acute DIC

2) hemorrhagic shock

3) an overdose of indirect anticoagulants

4) all of the above mentioned

11. The patient is planned to undergo transfusion ofpacked red blood cells. According to transfusion anamnesis, there was a complication accompanied by renal failure after previous transfusion. IT IS NECESSARY

1) to refuse transfusion of red blood cells

2) to make an individual selection of packed red blood cells

3) to transfuse a minimum dose of packed red blood cells

4) totransfuse blood substitutes instead of packed red blood cells

12. The patient is planned to undergo transfusion of packed red blood cells. According to obstetric anamnesis, there was an immunological havoc. IT IS NECESSARY

1) to refuse transfusion of packed red blood cells

2) to make an individual selection of packed red blood cells

3) to transfuse a minimum dose of packed red blood cells

4) to transfuse blood substitutes instead of packed red blood cells

13. YOU CAN NOT TRANSFUSE BLOOD IF THERE IS NO INFORMATION ON THE CONTAINER ABOUT

1) bacterial number

2) HIV screening

3) maximum storage period of transfusion medium

4) all of the above mentioned

14. IN THE CASE OF BLOOD TRANSFUSION, THE DOCTOR MUST FIRST DETERMINE

1) the donor’s blood type

2) the recipient's blood type

3) indications for blood transfusion

4) contraindications for blood transfusion

15. DURING THE ABO INDIVIDUAL COMPATIBILITY TESTS, THE RATIO BETWEENDONOR’S DROPS OF BLOOD AND RECIPIENT’S SERUM MUST BE:

1) 1:1

2) 1:5

3) 1:10

4) 1:20

16. WHILE PERFORMING THE ABO INDIVIDUAL COMPATIBILITY TEST USE

1) the patient's blood and the donor’s serum

2) the recipient's serum andthe donor's blood

3) the donor’s blood and the recipient’s blood

4) the donor’s blood, recipient’s serum and 33% polyglucine solution

17. Agglutination occurred during the ABO individual compatibility test. YOUR ACTIONS ARE

1) to refuse blood transfusions

2) to carry out the Rh compatibility test

3) to carry out the indirect Coomb’s test

4) to carry out the biological test

18. IF ON THE TITLE PAGE OF THE CASE HISTORY THERE ARE DATA OF THE PATIENT'S BLOOD TYPE, CONFIRMED BY THE BLOOD TRANSFUSION DEPARTMENT, THE BLOOD TYPE …. BEFORE BLOOD TRANSFUSION

1) is determined

2) is not determined

3) is determined only for planned surgeries

4) is determined only for emergency surgeries

19. IF THERE IS DATA OF RH STATUS OF THE PATIENT ON THE TITLE PAGE OF CASE HISTORY CONFIRMED BYBLOOD TRANSFUSION DEPARTMENT, THE RH-STATUS … BEFORE TRANSFUSION

1) is determined

2) is not determined

3) is determined only for planned surgeries

4) is determined only for emergency surgeries

20. THE TYPE OF BLOOD FROM THE CONTAINER WITH THE KNOWN DONOR’S BLOOD … IN CASE OF TRANSFUSION

1) is not determined if there is a mark indicating the blood type in the container

2) is not determined if the blood type in the ampulla is confirmed by the doctor's signature

3) is determined in all cases

4) is determined in case of planned blood transfusion

21. IN CASE OF TRANSFUSION OF PACKED RED BLOOD CELLS FROM THE CONTAINER WITH THE APPROPRIATE MARK ITS RH STATUS

1) is not determined

2) is not determinedin case of emergency transfusion

3) is determined in all cases

4) is determinedin case of planned blood transfusion

22. WHILEPERFORMINGRH COMPATIBILITY TEST, USE

1) donor's blood + recipient's serum + 33% polyglucine solution + saline solution NaCl

2) donor’s blood + recipient’s blood + 33% polyglucine solution + saline solution NaCl

3) donor's serum recipient's blood 33% polyglucine solution + saline solution NaCl

4) donor’s blood + test anti-RH serum + 33% polyglucine solution + saline solution NaCl

23. Agglutination occurred during the RH compatibility test. YOUR ACTIONS

1) to refuse blood transfusions

2) to perform the Coomb’s test

3) to perform a biological test

4) to perform a blood transfusion

24. WHILE INDIVIDUAL BLOOD SELECTION, RH-SYSTEM COMPATIBILITY TEST CAN BE PERFORMED

1) using 33% polyglucine solution

2) using 10% gelatin solution

3) over a pan of simmering water

4) using any of above methods

25. CRYOFROZEN RED BLOOD CELLS CAN BE STORED FOR

1) 1 month

2) 1 year

3) 10 years

4) 25 years

26. A BIOLOGICAL TEST IS CARRIED OUT BY

1) single infusion of 50 ml of donor’s blood

2) 3-fold drip infusion of 10 ml of donor’s blood

3) 3-fold stream infusion of 25 ml of donor’s blood

4) 3-fold streaminfusion of 10-15 ml of donor’s blood

27. While performing a biological test by drip infusion of 10 ml of donor’s blood, the patient notes chest pain, retrosternal pain. YOUR ACTIONS

1) after 3-5 minutes, transfuse another 15 ml of donors blood bystream infusion

2) refuse blood transfusions

3) perform a slow drip infusion of the remaining blood

4) calm the patient down and infuse the remaining blood by small portions

28. IMMEDIATELY AFTER THE BLOOD TRANSFUSION, THE CONTAINER WITH THE REMAINING BLOOD MUST

1) be disinfected

2) be stored in the refrigerator for 2 days

3) be stored in the refrigerator for 7 days

4) be placed in a special container for medical waste

29. AFTER BLOOD TRANSFUSION, THE PATIENT NEEDS TO BE MONITORED FOR

1)1 hour

2) 3 hours

3) during the working day

4) 24 hours

30.BLOOD COMPONENTS INCLUDE

1) packed red blood cells, platelet concentrate, plasma

2) the markers of coagulation system

3) hemodynamic and detoxifying blood substitutes

4) all of the above mentioned

31. A BLOOD SUBSTITUTE, WHICH HAS A HEMODYNAMIC EFFECT IS

1) polides

2) voluven

3) aminocaproic acid solution

4) alvezin

32. A BLOOD SUBSTITUTE, WHICH HAS A DETOXIFYING EFFECT IS

1) refortan

2) polides

3) aminocaproic acid solution

4) lactosol

33. A DRUG THAT HAS A HEMOSTATIC EFFECT IS

1) refortan

2) polides

3) aminocaproic acid solution

4) alvezin

34. A BLOOD SUBSTITUTE USED FOR PARENTERAL NUTRITION

1) aminon

2) lipocaine

3) glucose

4) all of the above mentioned

35. A BLOOD SUBSTITUTE USED FOR REPLACEMENT OF PROTEIN DEFICIENCY

1) alvezin

2) lipofundin

3) stabisol

4) all of the above mentioned

36. A BLOOD SUBSTITUTE USED FOR REPLACEMENT OF FAT DEFICIENCY

1) refortan

2) alvezin

3) infusolipol

4) aminocaproic acid solution

37. BLOOD PRODUCTS ARE

1) combined medications

2) coagulation system correctors

3) immunological medications

4) all of the above mentioned

38. BLOOD PRODUCTS OF COMBINED ACTION INCLUDE

1) albumin, protein

2) voluven, stabisol

3) polyamine, aminon

4) infusolipol, lipocaine

39. BLOOD PRODUCTS THAT CORRECT THE COAGULATION SYSTEM INCLUDE

1) albumin, protein

2) cryoprecipitate, fibrinogen, thrombin

3) aminocaproic acid solution

4) platelet concentrate

40. BLOOD PRODUCTS OF IMMUNOLOGICAL ACTION INCLUDE

1) albumin, protein

2) cryoprecipitate, fibrinogen, thrombin

3) fibrinolysin, hemostatic sponge

4) gamma globulins

41. HEMODYNAMIC BLOOD SUBSTITUTES ARE USED FOR THE TREATMENT OF

1) various intoxications

2) shock of various origins

3) acidosis

4) dehydration

42. PERFLUOROCARBON EMULSIONS ARE USED FOR

1) replacement of acute blood loss

2) parenteral nutrition

3) fight against intoxication

4) maintaining theblood circulating volume

43. COAGULATION SYSTEM CORRECTORS FOR EXTERNAL USE INCLUDE

1) cryoprecipitate

2) prothrombin complex

3) thrombin

4) alampil

**6. Local anesthesia.**

In many areas of surgery, where endotracheal anesthesia is not obligatory and the only possible method of anesthesia, the methods of infiltration and regional anesthesia remain appropriate as the simplest and safest.

The essence of local anesthesia is the blockade of pain impulses with preservation of consciousness, carried out at different levels, starting from nerve receptors and ending with segments of the spinal cord.

Pain impulses are formed when free nerve endings are irritated. Their specificity is limited. The nerve fibers coming from them are combined in the nerve trunks, they are the part of the dorsal spinal roots. Having crossed the tractusspinotalamicus lateralis, the impulses rise into the thalamus, where they are switched to other parts of the brain. The pathways of pain impulses can be interrupted in different places.

There are following types of local anesthesia: terminal anesthesia (blockade of receptors by irrigating of mucous membranes with a local anesthetic solution) - which leads to interruption of impulses at the very beginning of the reflex arc; infiltrationanesthesia (blockade of receptors and small nerves), conduction anesthesia (blockade of nerve trunks and plexuses). Epidural and spinal anesthesia is a special type of conduction anesthesia where the blockade is performed at the level of the spinal roots.

Indications for local anesthesia are determined by its advantages: simplicity of technical implementation, minimal toxicity, efficiency, use in case of contraindication to anesthesia.

Contraindications: anesthetics intolerance, increased individual sensitivity, age below 10 years, mental illnesses, inflammatory or cicatricial changes of tissues. In addition, local anesthesia is contraindicated as the main type of anesthesia in long-term and traumatic surgeries and during surgery requiring artificial ventilation.

Mechanism of action of anesthetics: possessing lipidotropy, an anesthetic molecule concentrates in the membranes of nerve fibers, while they block the function of sodium channels, preventing the propagation of the action potential. When exposed to an anesthetic, the receptors lose their ability to perceive irritation andnerve impulse conduction becomes impossible.

According to the chemical structure, local anesthetics are divided into 2 groups: ester-type - derivatives of procaine (novocaine), chloroprocaine and tetracaine (dicaine) and amide-type - derivatives of lidocaine (procaine, mepivocaine, bupivacaine or marcaine).

Local anesthetics of ester type are exposed to rapid hydrolytic destruction in tissues and after a certain period of time lose their effectiveness - repeated injections of the drug are allowed here. Allergic reactions are possible.

Local anesthetics of amide type are not exposed to hydrolytic destruction in tissues, being excreted unchanged from the body, or they undergo partial decomposition in liver. With repeated administrations, the maximum allowable dose must be regarded. Do not cause allergic reactions.

Ester-type anesthetics:

1. Novocaine (procaine) is low-toxic. For infiltration anesthesia, 0.25% solution is used; for conduction anesthesia (epidural and spinal anesthesia) more concentrated solutions (0.5%, 1.0% and 2.0%) are used. During surgeries under local anesthesia, do not use more than 1000 ml of 0.25% novocaine solutionfor one hour of the operation.

2. Dikain (pantocaine) - is well absorbed through the mucous membranes and therefore is used for the production of surface anesthesia of the mucous membranes (0.5; 1; 2; 3% solutions). It is not suitable for infiltration anesthesia, since it is 10 times more toxic than novocaine.

Amide-type anesthetics (lidocaine group):

1. Lidocaine - does not cause irritation in tissues. The analgesic effect is 2 times higher than that of novocaine. Under surface anesthesia, the effect is 4 times higher than that of dicain. Anesthesia (infiltration, conduction) has effect in 1 minute. The advantage of lidocaine over novocaine (procaine) is that it is effective both in infiltration and superficial application.

2. Pyromecain - 0.5-1-2% solutions in ampoules. The maximum dose is 1000 mg. They are used mainly in ophthalmology and for surface anesthesia of the mucous membranes of the respiratory tract.

3. Bupivakin (marcain) - one of the most wide-spread modern drugs for infiltration and conduction anesthesia (spinal - 0.5-1%). The maximum dose is 2 mg per 1 kg of body weight. It is 2-3 times stronger than lidocaine.

4. Trimecaine (mezocaine) - 0.25; 0.5; 1,0; 2% solutions. The maximum daily dose is 2 g. Has more profound and prolonged anesthetic effect. It is used for all types of local anesthesia, but more often in epidural and conduction anesthesia.

Depending on the level of anesthesia and the method of administration, regarding the place of exposure of the anesthetic to the nervous system, various types of local anesthesia are distinguished:

1. Surface anesthesia. It is used only for anesthesia of mucous membranes, most often in ear, throat, nose, in ophthalmology and during endoscopic examinations. The mucous membranes are covered with anesthetic in the form of cream, ointment, spray or fluid. The most suitable for this purpose are dicaine solution or 0.5% -2% lidocaine solution.

2. “Vishnevsky local anesthesia”created by A.V.Vishnevsky, the so-calledmethod of "creeping infiltrate under pressure", is performed by layer-by-layer injection of 0.25% novocaine solution into the fascial sleeves of the human body. The anesthetic solution spreading in them, blocks the nerve branches and endings, causes immediate anesthesia. The essential condition of this anesthesia is a tight layer-by-layer infiltration of tissues with anesthetic solution along the surgical incision, with a constant change of the scalpel and syringe with novocaine solution: infiltration - incision.

3. The method of conduction anesthesia is based on the interruption of the conduction of nerve fibers by an anesthetic. Anesthetic solution is injected into the nerve or perineural tissue. The nerve is surrounded by membranes throughout, so more concentrated solutions are used (1-2% solution of novocaine, lidocaine, trimecaine). In case of stem regional anesthesia, an anesthetic solution is injected endoneurally (directly into the nerve trunk) or perineurally (into the tissue surrounding the nerve).

In outpatient practice, for fingers surgery, Oberst-Lukashevich method is most often used. Anesthesia is performed on the lateral surfaces of the finger, preferably using a tourniquet; after 5-10 minutes, the whole finger is anesthetized. For injuries with multiple fractures of the ribs, blockade of intercostal nerves is performed by injecting 10-15 ml of 1% novocaine solution under the lower edge of the ribs.

Epidural anesthesia is a type of local anesthesia. The analgesic effect is achieved by blocking the sensory and ventral roots of the spinal cord. The anesthetic is injected into the epidural space between the outer and inner layers of spinal dura mater. Anesthesia of gangliated cord nodes achieved by the anesthetic spreading through intervertebral foramen, leads to blockade, reversible vasomotor paralysis and, as a result, expansion of arterioles and decrease of blood pressure due to the redistribution of blood.

Epidural puncture technique

The injection must be carried out along the medial line at the level of lumbar vertebrae III-IV. The spinal cord ends at the level of lumbar vertebra II. The patient is in a sitting position or lying on the side. To increase the space between spinous processes, the patient leans forward to the maximum. The line formed by iliac crests intersects with the body of vertebra IV, here anesthesia of the skin begins. Then, the Tuohy needle with a mandril is introduced into the skin, subcutaneous tissue and underlying ligaments in the sagittal plane. The mandril is removed, a syringe filled with saline with an air bubble is attached to the needle, the needle is introduced into the yellow ligament. At the same time, it is not possible to inject anesthetic solution, the air bubble in the syringe is compressed. After passing through the ligament, the bubble expands, and the solution starts to flow inside. This disappearance of resistance (Doliotti symptom) is the main sign of penetration into the epidural space, where 5 ml of anesthetic solution is injected. The anesthetic can be administered once, but it is also possible to insert a catheter through the lumen of the needle with intermittent administration of the anesthetic during or after surgery.

Complications of epidural anesthesia:

1. Vascular collapse - as a result of paralysis of vasoconstrictors innervated by the sympathetic nervous system, blood redistribution (stagnation of the circulation) occurs in the anesthetized area, accompanied by decrease of pressure.

2. Total cerebrospinal block - in case of accidental puncture of the dura mater and the introduction of anesthetic into the cerebrospinal fluid, asthe dosage of anesthetic is 10 times higher in epidural anesthesiathan in spinal anesthesia. As a result of the rapid spread of anesthetic to the medulla oblongata, collapse and respiratory paralysis.

Spinal anesthesia. The technique of spinal anesthesia at the first stage are the same as for epidural anesthesia. Specific features of spinal anesthesia is connected with the movement of a needle. After passing the yellow ligament, it is necessary to check if there is cerebrospinal fluid. If there is not, then the needle with mandril is introduced deeper until the fluid enters. After that, 3-4 ml of anesthetic (lidocaine, trimecaine) are injected. The most dangerous complication is collapse with uncontrollable hypotension, meningitis.

Novocaine blockade is the introduction of low-concentration solution of novocaine into various cellular spaces to block the nerve trunks in order to achievepain relieving or therapeutic effect.

**Control questions:**

1. Advantages and disadvantages of local anesthesia.

2. Types of local anesthesia. The term of premedication. Local anesthetic agents.

3. Anatomy of the spinal canal.

4. “Vishnevskiy anesthesia”, possible complications.

5. Novocaine blockade

6. Advantages and disadvantages of procaine lumbar block.

7. Intravenous and intraosseous technique of anesthesia.

**Tests on the topic: «Local anesthesia»**

***Choose one correct answer***

1. TERMINAL ANESTHESIA IS USED

1) during endoscopic examination of the stomach

2) in case of subcutaneous whitlow

3) in case offorearm phlegmon

4) in case of appendicitis

2. ADVANTAGES OF INFILTRATION ANESTHESIA ACCORDING TO A.V. VISHNEVSKY

1) vasoconstriction, relax of muscles of the operated area

2) does not injure tissue, well controlled

3) rapid development of anesthesia, allows to make hydraulic preparation of tissues

4) reduces blood pressure, causes drowsiness

3. CONTRAINDICATIONS FOR LOCAL ANESTHESIA ARE

1) general grave condition

2) kidney failure

3) ongoing internal bleeding

4) any of the above mentioned

4. WHAT TYPE OF ANESTHESIA IS NOVOCAINE BLOCKADE

1) conduction

2) infiltration

3) terminal

4) an independent type

5. THE ADVANTAGE OF LOCAL INFILTRATION ANESTHESIA IS

1) complete anesthesia

2) technical simplicity

3) muscle relaxation

4) controllability

6. FOR TERMINAL ANESTHESIA, IT IS PREFERABLE TO USE

1) 0.25% lidocaine solution

2) 0.5% lidocaine solution

3) 1% lidocaine solution

4) 5 to 10% lidocaine solution

7. THE AGENT USED FOR ALL TYPES OF ANESTHESIA (TERMINAL, INFILTRATION, CONDUCTION, EPIDURAL)

1) ethyl chloride

2) anesthesin

3) tetracaine

4) lidocaine

8. THE METHOD OF ANESTHESIA USED DURING FIBROGASTROSCOPY

1) pharynx anesthesia by Vishnevsky method

2) conduction anesthesia of pharyngeal nerves

3) irrigation and oropharyngeal lubrication with anesthetic

4) local anesthesia is not applicable for fibrogastroscopy

9. THE MAXIMUM PERMISSIBLE DOSE OF 0.25% NOVOCAINE SOLUTION ON THE DRIEDBASIS, WHICH CAN BE USED AS INFILTRATION ANESTHESIA DURING AN HOUR OF SURGERY IS

1) up to 1g

2) up to 2-2. 5 g

3) up to 3-5g

4) up to 6-10g

10. OBERST-LUKASHEVICH ANESTHESIA REFERS TO

1) terminal anesthesia

2) conduction anesthesia

3) infiltration anesthesia

4) epidural anesthesia

11. CONTRAINDICATION FO LOCAL ANESTHESIA IS

1) up to age 10

2) benign tumor

3) patients over age 80 years

4) all above mentioned is correct

**7. General anesthesia.**

Modern methods of pain relief provide not only the elimination of pain, but also control of basic functions of the body during surgery and in the near future after it.

**General anesthesia** is a medically induced reversible coma, analgesia, with relaxation of skeletal muscles and loss of protective reflexes.

Classification:

**1. Depending on the method of administration of drugs for anesthesia, there are:**

a) **Inhalation anesthesia** - in this case, the anesthetic enters the body in the form of vapors or gas, which, by diffusion through the alveoli, enter the body and are distributed throughout the body. Gases or volatile liquid drugs are inhaled through a face mask or tracheal tube;

b) **Non-inhalation anesthesia (intravenous anesthesia)** - carried out by intravenous injection of anesthetics. Non-inhalation methods also include intramuscular injections of anesthetics.

2. **Depending on thevolume of the drug used**:

1. **Mononanesthesia** - anesthesia, achieved using one drug

2.**Mixed anesthesia**- a mixture of 2-3 or more narcotic drugs is used at the same time (anesthesia, achieved by fluorothane + nitrous oxide).

3.**Combined anesthesia** (multicomponent anesthesia)

Combined anesthesia includes: introductory, maintenance and basis - anesthesia.

a) **induction of anesthesia** - short-term anesthesia, coming without the stage of excitement. It is used forputting a patient to sleep quickly, as well as to reduce the amount of the main narcotic drug;

b) **maintenance or main anesthesia**- anesthesia that is applied through the whole period of surgical operation;

c) **basis anesthesia**– superficial anesthesia, simultaneously with the main anesthetic another anesthetic is administered to reduce the dose of the main narcotic drug;

Modern anesthetic management consists of several components of general anesthesia:

**1) inhibition of mental perception (neurolepsy, sleep);**

**2) blockade of pain (afferent) impulses (analgesia);**

**3) inhibition of autonomic nervous reflexes (neurovegetative blockade, hyporeflexia);**

**4) gas exchange control;**

**5) blood circulation control;**

**6) stop of motor activity (muscle relaxation, myoplegia);**

**7) metabolismcontrol.**

**Inhalation anesthesia.** This type of anesthesia is achieved by the introduction of drugs through the respiratory tract. In this case, the narcotic substance enters through a face mask due to the patient's spontaneous inhalation, or is pumped mechanically with the help of anesthesia apparatus through a tracheal tube inserted into the trachea.

For inhalation anesthesia vapors of liquid drugs and gases are used.

**Inhalation anesthesia medications**

**a) fluid inhalation agents:**

1. **Halotane (fluothane)** - a fluid with a boiling point of about 50 ° C – nonflammable, inexplosive. Its effect is 4-5 times higher than the effect of ether and 50 times higher than nitrous oxide.

Positive properties: explosion safety, quick and pleasant introduction to anesthesia and quick anesthesia recovery, high analgesic effect (after 3-4 minutes analgesia starts), there is no excitement stage, the ability to give good muscle relaxation, suppression of the secretion of salivary and bronchial glands, bronchodilatatory effect, no irritation of the upper respiratory tract.

Negative properties: small therapeutic margin, inhibition of the sympathetic-adrenal system, depressing effect on the myocardium and respiration, the cardiovascular system, decreased sensitivity of heart muscle to catecholamines and the ability to cause arrhythmia, hepatotropic effect, therefore fluothane is used for short-term surgical interventions with mask anesthesia. It is more often used forexaggeration of nitrous oxide effect in the form of azeotropic mixture (2 parts of fluorothane +1 part of nitrous oxide with endotracheal anesthesia).

2. **Methoxyflurane** - has high analgesic effect, non-toxic.

3. **Enflurane-fluorinated ester** - has high narcotic effect, depressing respiration, pronounced myorelaxing effect

4. **Isoflurane, Sevoflurane - enflurane isomers-** less toxic than enflurane and fluothane; less toxic effect.

b) **gaseous inhalation agents**.

**Nitrous oxide** - an indifferent gas, unchanged excreted from the body through the lungs.

**Positive properties:** explosion safety, does not irritate the respiratory tract, quick introduction to anesthesia, does not affect vital organs and parenchymal organs, pronounced potentiating action with other anesthetics.

**Disadvantages:** low anesthetic power - it is impossible to achieve the surgical stages of anesthesia and muscle relaxation, pronounced excitement stage in children and alcoholics. Therefore, it is used for a short time during painful manipulations or in combination with other anesthetics.

**Cyclopropane** is 7-10 times stronger than nitrous oxide. Used only mixed with oxygen.

**Advantages:** large therapeutic margin, is not toxic to parenchymal organs, sufficient muscle relaxation, does not irritate respiratory tract.

**Disadvantages:**explosiveness, respiratory depression, arrhythmia, laryngospasm, psychosis; cyclopropane is used very seldom.

**Types of inhalation anesthesia:**

a) **Mask inhalation anesthesia** is indicated for short-term surgical interventions (during labor, painful dressings), when there are contraindications to endotracheal anesthesia, when it is impossible to intubate the trachea. Mask anesthesia can be performed using a mask only or an anesthesia apparatus.

b) **Apparatus-and-mask anesthesia** is safer, allows to apply oxygen, choose a dose of anesthetics accurately. Nevertheless, there are many contraindications for mask anesthesia: cardiovascular failure, hypertension, respiratory disease, liver disease with various dysfunctions, renal failure, anemia, shock.

c) **Endotracheal (intubation) anesthesia.**In this method of anesthesia anesthetic mixture passes through an tracheal tube inserted into the trachea or bronchus. This creates the possibility of performing controlled and assisted ventilation with great efficiency; airways remain unobstructed in any position of the patient (make sure that the tracheal tube does not bend). It also gives an opportunity for constant suction of mucus, secretion, blood and pus from trachea and bronchi; there are no dangerous complications such as tongue-swallowing, mandibular retraction, aspiration of vomit; the "dead space" is significantly reduced; the anesthesiologist does not interfere with the surgeon during face, neck or brain surgeries.

**Sequence of anesthesia administration**. Premedication - before a planned surgery, a sleeping pill (phenobarbital 2 mg / kg) and a tranquilizer (phenozepam 0.2 mg / kg) before bed.

In the morning 2-3 hours before surgery - droperidol (0.07 mg / kg), diazepam (0.14 mg / kg). 30 minutes before surgery - promedol (2% solution-1.0) atropine (0.01 mg / kg), diphenhydramine (0.3 mg / kg)

Stage I - induction to anesthesia. Can be performed using any narcotic agent, after administration the patient falls into a deep sleep, without the stage of excitement. The most used are barbiturates, fentanyl in combination with droperidol. The drugs are used in the form of 1% solution, injected intravenously at a dose of 400-500 mg. During this stage, muscle relaxants are administered and the trachea is intubated.

Stage II - maintenance of anesthesia. To maintain general anesthesia, you can use any narcotic agent that can protect the body from operational trauma (fluorothane, cyclopropane, nitrous oxide with oxygen), as well as neuroleptanalgesia. Anesthesia is maintained at the I-II level of the surgical anesthesia stage, to eliminate muscle tension muscle relaxants are used, which cause myoplegia of all groups of skeletal muscles, including respiratory ones. Therefore, the main condition of the modern combined anesthesia is artificial pulmonary ventilation.

Stage III – anesthesia recovery. By the end of surgery, an anesthesiologist gradually finishes the administration of anesthetics and muscle relaxants. Consciousness returns to the patient, spontaneous breathing and muscle tone are restored. After awakening, recovery of spontaneous breathing and skeletal muscles tone, the anesthesiologist extubates the patient.

For endotracheal anesthesia, tracheal intubation is performed using a laryngoscope and endotracheal tubes. Laryngoscope is a device for direct laryngoscopy. It can be equipped with a straight or curved blade, at the end of which there is a light source. To insert the tube into the trachea using the method of indirect laryngoscopy, it is necessary to administer muscle relaxants.

Muscle relaxants do not have sedative and analgesic effects, these drugs cannot be used when the patient is conscious.

**Schematic diagram of a universal anesthesia apparatus**

The narcotic respiratory gas is formed in the anesthesia apparatus by mixing gases of narcotic agents and oxygen.

Depending on the ratio between anesthetic gas inhaled and exhaled by the patient and the atmospheric air, there are 4 ways of anesthesia:

1. Open - the patient inhales a mixture of atmospheric air and anesthetic and exhales into the atmosphere of the operating room;

2. Semi-open –the patient inhales the narcotic gas, isolated from the atmospheric air, and exhales into the environment;

3. Semi-closed –the patient inhales only the narcotic gas and exhales partly into the apparatus, partly into the environment;

4. Closed - inhalation and exhalation are completely isolated.

Narcotic agents cause characteristic changes in all organs and systems. There is a certain regularity (staging) in the change of consciousness, respiration and blood circulation.

The main clinical signs that allow assessing the dynamics of anesthesia are:

a) consciousness, general appearance of the patient, skin color;

b) reaction to pain irritation;

c) muscle tension, motor response;

d) eye symptoms - pupil size, reaction to light, corneal reflex, ocular motility;

e) pharyngeal reflexes and respiratory rate;

f) pulse and blood pressure.

It is very important at this stage to evaluate the state of pupils: if the pupil is narrow and does not react to light, then this is an indicator of the correct course of anesthesia. Dilation of the pupil with increased reaction to light indicates the awakening of the patient. Dilation of the pupil without reaction to light is a dangerous sign of respiratory arrest.

**Stage I** - **analgesia** - is achieved with the use of ester during 3-5 minutes, the patient is conscious, drowsing, inhibited, gives syllable answers, there is no superficial pain sensitivity, touch and thermal sensitivity remains. During this period, it is possible to perform short-term surgical interventions, this stage is short-term, lasts 3-4 minutes. The skin of the face is red, the pupils react to light, the same size as before the anesthesia.

**Stage II**–**excitement** - is characterized by loss of consciousness. Along with that there are muscle tension, motor activity, speech excitation,hyperemic skin of the face, pupils are dilated, but react to light, tachycardia, blood pressure is increased, salivary glands secretion is increased. At this stage, vomiting,regurgitation, respiratory arrest due to hypercapnia may occur. The stage of excitement lasts from 1 to 12 minutes, starts after 5-7 minutes. There is no stage of excitementduring anesthesia with the use of barbiturates, nitrous oxide, cyclopropane, therefore, these substances are used for anesthesia induction.

**Stage III** - anesthetic sleep (surgical anesthesia) –there are 4 levels in it.

**Level I** - the patient is calm, breathing is regular, blood pressure and pulse rateare in the initial position. Pupils begin to narrow, the reaction to light remains. There is a smooth movement of eyeballs. The eyeballs are eccentrically located. The corneal and pharyngeal-laryngeal reflexes are preserved. Muscle tone is preserved, therefore, it is difficult to carry out abdominal surgery.

**Level II** - the movement of the eyeballs stops, and they are located in a central position. Pupils are constricted, the reaction to light is preserved, there is no corneal reflex disappears. Breathing is calm, the tone weakens, you can start surgery.

**Level III** – maximum-permissible - level of pupil dilation. The pupils are dilated, react only to strong light stimulation, the corneal reflex is absent, muscles are completely relaxed (including intercostal). You can observe shallow breathing, the jaw drops, tongue-swallowing may occur. It is unwanted to use anesthesia during Level III, because using muscle relaxants anesthesia can be carried out on more superficial level. Further deepening of anesthesia is connected, as a rule, with errors in its management and transition **to level IV**, which is characterized by acute respiratory depression (level of diaphragmatic respiration, pupils are dilated and do not react to light, the pulse is threadlike, blood pressure is not determined - postclinical death).

**Stage IV**–anesthesia recovery. As soon as supply of the narcotic agents stops, concentration of anesthetic in blood decreases, the patient goes through all stages of anesthesia in reversed order and regain consciousness.

**Noninhalation anesthesia** depending on the ways of anesthetic administration isdivided into: intravenous (primary effect is loss of consciousness, general anesthesia occurs along with the deep narcotic depression of central nervous system), intramuscular, subcutaneous.

**Neuroleptanalgesia(NLA)**. This method of anesthesia is achieved by intravenous administration of analgesics and antipsychotic drugs, which makes it possible to perform various surgical interventions without additional narcotic agents. Analgesia is achieved by administration of strong analgesics. The antipsychotic agent used in NLA causes a loss of mental activity up to loss of consciousness, which occurs due to depression of the central nervous system. Droperidol is one of these agents. The most perfect analgesic for NLA is fentanyl (it exceeds the effect of morphine by 100 times). Effect on the body: NLA ensures the stability of cardiovascular system even during the most traumatic stages of the surgery. The effect on the respiratory center is determined by the dose of fentanyl. Fentanyl has a pronounced analgesic effect when used high doses which depress respiration, therefore, if NLA is used as the main component of anesthesia, artificial pulmonary ventilation must be applied.

**Ataralgesia** is loss of consciousness caused by the use of sedatives or tranquilizers in combination with analgesics (seduxen, fentanyl).

**Complications of general anesthesia**

**Respiratory complications**

Hypoxia and hypercapnia invariably lead to violation of the acid-base balance in blood, which, in turn, can cause a number of complications.

Hypoxia and hypercapnia can be caused by:

1. **Airway obstruction**:

a) due to tongue-swallowing; this complication is observed with mask anesthesia by the time the surgical stage of anesthesia is reached. The tone of chewing muscles decreases, the lower jaw drops and the tongue falls back toward the throat, which can block the airway. In case of endotracheal anesthesia, such a complication occurs during induction of anesthesia and sometimes after untimely extubation;

b) due to a foreign body. Most often it is either a broken tooth, or falling false teeth (crown);

c) due to mucus, phlegm, blood;

d) due to gastric contents in case of vomiting and regurgitation - Mendelson's syndrome.

2. **Laryngospasm** - closure of the true vocal cords, causing the closure of larynx lumen. It occurs when irritated by mucus, blood, vapors of anesthetics, rough intubation or can occur reflexively.

3**. Bronchospasm**. Occurs because of medications administered (cyclopropane, proserin).

4. **Pulmonary edema**. Fluid accumulation (transudate in the alveoli and interstitial tissue). Is caused by circulatory disorders with increased blood pressure in small circle.

5. **Respiratory depression and apnea**. Caused by overdose of narcotic agents, prolongation of muscle relaxants action, hyperventilation during anesthesia.

6. **Atelectasis** - collapse of the lung or its part.

**Hemodynamic complications**

1. Disorders of heart rate (tachycardia, bradycardia, arrhythmia);

2. Cardiac arrest - syncope. Causes: overdose of drugs, irritation of vagus nerves;

3. Hypoxia, hypercapnia;

4. Hyperkalemia.

**Control questions:**

1. Types of general anesthesia. Narcotic analgesics, medicines for inhalation and intravenous anesthesia.
2. Stagesof ester anesthesia.
3. Anesthesia apparatus. The necessary instruments for anesthesia.
4. Preparation of patientfor anesthesia.
5. Muscle relaxants.
6. How to determine adequacy of anesthesia.
7. Indications for endotracheal anesthesia with artificial pulmonary ventilation.
8. Aim of induction anesthesia.
9. Sings of cardiac arrest and respiratory standstill.

**Tests on the topic: «Anesthesia»**

***Choose one correct answer***

1. MIXED ANESTHESIA IS THE USE OF

1) two drugs for anesthesia

2) multiple anesthetics, using a single way of administration

3) multiple anesthetics, using different ways of administration

4) drugs for anesthesia and local anesthetics

2. AS ONE OF THE INHALED ANESTHETICS, GAS IS

1) ester

2) isoflurane

3) chloroform

4) cyclopropane

3. REINFORCING ANESTHESIA – IS CHARACTERIZED BYADDITIONAL APPLICATION OF … TOGETHER WITH ANESTHETICS

1) a substance that, while not being a means for anesthesia, increases anesthesia

2) a substance that has a desensitizing effect

3) artificial hypothermia

4) all options are correct

4. FOR INTRAVENOUS ANESTHESIA … IS USED

1) ether

2) hexenal

3) trichloroethylene

4) nitrous oxide

5. FENTANYL IS

1) a neuroleptic

2) a narcotic analgesic

3) an antihistamine

4) a vagolytic

6. FOR PREMEDICATION BEFORE EMERGENCY SURGERY, THE MOST COMMONLY USED MEDICATIONS ARE

1) sodium ethaminal, phenobarbital, seduxen

2) promedol, diphenhydramine, atropine

3) seduxen, eufillin, no-shpa

4) caffeine, cordiamine, lobelin

7. FOR NEUROLEPTANALGESIA, USE

1) barbiturates and narcotic analgesics

2) sedatives and narcotic analgesics

3) antipsychotic drugs and narcotic analgesics

4) narcotic anesthetics and narcotic analgesics

8. FOR INTRAVENOUS ANESTHESIA, USE

1) calypsol, sodium thiopental, hexenal

2) analgin, anesthesin, novocaine

3) orthophen, ketorol, spazgan

4) diphenhydramine, suprastin, tavegil

9. COMPLICATIONS OF ANESTHESIA INCLUDE

1) vomiting

2) laryngospasm

3) regurgitation

4) everything is correct

10. FOR THE PREVENTION OF ASPIRATION SYNDROME IN URGENT PATIENTS, IT IS NECESSARY TO

1) empty the stomach using a probe

2) give lapactics

3) use soda 1 teaspoon, 30 minutes before the meal

4) use antispasmodic

11. IF THE PATIENT VOMITS DURING MASK ANESTHESIA, YOU MUST

1) lift the head end of the operating table, remove the mask and allow to breathe pure oxygen

2) turn the patient's head to the left side, clear the oral cavity of vomit

3) lower the head end of the operating table, perform the tracheostomy

4) perform tracheal intubation

12. TRACHEAL INTUBATION IS PERFORMED BY

1) air duct

2) tracheal tube

3) tracheostomy tube

4) laryngoscope

13. IF AFTER TRACHEA INTUBATION, BREATHING IS NOT HEARD, IT IS NECESSARY

1) to clean the intubation tube

2) to start resuscitation

3) to reintubate the patient

4) to perform tracheostomy

14. SPECIAL COMPONENTS OF ANESTHESIA INCLUDE

1) neuroleptanalgesia

2) hypothermia

3) tracheal intubation

4) muscle relaxation

15. THE FIRST STAGE OF ESTER ANESTHESIA IS CHARACTERIZED BY

1) clear consciousness

2) complete absence of consciousness

3) obtundation

4) excitement

16. THE SECOND STAGE OF ESTER ANESTHESIA IS CHARACTERIZED BY

1) hypotension

2) bradycardia

3) contraction of pupils

4) excitement

17. AT THE FIRST LEVEL OF SURGICAL ANESTHESIA

1) pupils are dilated, there is no reaction to light

2) pupils are narrow, there is no reaction to light

3) pupils are narrow, there is reaction to light

4) pupils are dilated, there is reaction to light

18. THE STAGE OF EXCITEMENT IS CHARACTERIZED BY

1) quick recovery from anesthesia

2) all stages of anesthesia passed through in reversed order

3) prolonged depression of consciousness

4) increased skeletal muscle tone

19. SPECIAL COMPONENTS OF ANESTHESIA INCLUDE

1) inhibition of mental perception

2) hyporeflexia a) analgesia; b) neurovegetative blockade

3) muscle relaxation

4) cold and pharmacological cardioplegia

20. GENERAL COMPONENTS OF ANESTHESIA INCLUDE

1) maintaining adequate gas exchange

2) artificial blood circulation (AIC)

3) superficial and deep hypothermia

4) hyperbaric oxygen therapy

21. DILATION OF PUPILS WITH THE PRESERVED REACTION TO LIGHT IS OBSERVED

1) in the first stage of anesthesia

2) in the second stage of anesthesia

3) in the third stage - the first level

4) in the third stage - the second level

22. THE MOST EFFECTIVE METHOD OF ARTIFICIAL PULMONARY VENTILATION IS

1) mouth to mouth

2) Silvester method

3)Schueller method

4) using Ambu-bag

23. A SEMI-CLOSED WAY OF ANESTHESIA IS CHARACTERIZED BY THE METHOD OF INTRODUCTION OF ANESTHETIC GAS AND ITS ELIMINATION AS FOLLOWS

1) inhale anesthetic gas with atmospheric air and exhale into the atmosphere

2) inhale anesthetic gas from anaesthetic apparatus and exhale into the atmosphere

3) inhale anesthetic gas from anaesthetic apparatus, exhale into the apparatus with a return to the circulation and partially into the atmosphere

4) inhale anesthetic gas from the anaesthetic apparatus, exhale into the anaesthetic apparatus with a full return to the circulation

24. A CLOSED WAY OF ANESTHESIA IS CHARACTERIZED BY THE METHOD OF INTRODUCTION OF ANESTHETIC GAS AND ITS ELIMINATION AS FOLLOWS

1) inhale anesthetic gas with atmospheric air and exhale into the atmosphere

2) inhale anesthetic gas from the anaesthetic apparatus and exhale into the atmosphere

3) inhale anesthetic gas from the anaesthetic apparatus, exhale into the apparatus with a return to the circulation and partially into the atmosphere

4) inhale anesthetic gas from the anaesthetic apparatus, exhale into the anaesthetic apparatus with a full return to the circulation

25. TO ACHIEVE SPINAL ANESTHESIA, ANESTHETIC MUST BE ADMINISTERED

1) between arachnoid mater and dura mater

2) under the arachnoid membrane

3) between soft medulla and spinal cord

4) between inner and outer sheets of dura mater

**8. Surgery. Pre- and postoperative periods**

Surgery or operation–is the act of specific mechanical impact on tissues and organs for therapeutic or diagnostic purposes. All operations are divided into diagnostic and therapeutic.

Diagnostic operations include: cavity and joint punctures in order to determine the nature of their contents; biopsy – sampling of areas of pathologically altered tissue for subsequent histological examination; cardiac catheterization and large great vessels catheterization; examination of cavities using special optical tools (thoracoscopy, laparoscopy, arthroscopy); opening of cavities in order to clarify the diagnosis or the extent of the pathological process and the possibility of performing surgery (laparotomy, thoracotomy).

Therapeutic operations–are operations performed to eliminate the consequences of diseases: appendectomy, cholecystectomy, gastric resection, etc.

The nature of medical operations depends on the localization and features of pathological process, urgency of operation, the possibility of full recovery or relief of the patient's condition.

According to the urgency, there are:

1) emergency operations performed immediately or during the next few hours after admission to a hospital. As a rule, the operation should be done within 2 hours from the moment of admission, and in case of life-threatening conditions (asphyxia and bleeding), it must be performed immediately. As a rule, indications for emergency surgery are all types of acute surgical infection and trauma.

2) urgent operations performed during first 1-7 days after admission; postponing the operation for a longer period can lead to disease progression and deterioration of the patient's condition

3) planned operations performed in a planned manner, which can be postponed without damage to the patient's health for an indefinite time.

There are radical and palliative surgical operations.

Radical operations are aimed at the complete removal of the pathological focus, as a result the recurrence of the disease in the future is excluded.

Palliative operations areaimed only at alleviation of the patient's condition without removing the pathological focus (esophageal cancer gastrotomy, bypass or artificial fistula in case of intestinal tumor).

Among palliative operations, symptomatic operations are distinguished aimed at removing of specific symptoms of disease (ligation of a vessel in case of inoperable stomach tumor bleeding).

The overwhelming majority of operations are one-stage, i.e. the required amount of surgical intervention is performed in one action. Sometimes it is connected with the high operational and anesthetic risk.

To reduce the risk and prevent intraoperative or postoperative complications, radical surgical intervention can be divided into several stages (in case of large bowel obstruction of tumor etiology, during the stage 1, colostomy is performed to eliminate the obstruction, after stabilization of the patient's condition, stage 2 is performed - resection of a part of the intestine with a tumor).

Often in surgical practice, there are cases when a patient has two or more diseases that require surgical treatment.

Performing several operations at a time without taking into account differences in surgical approach is called a concurrent, or simultaneous, surgical operation.

By the type of surgical technique, all operations are performed with the aim of:

"-tomy" - dissection, opening of an organ or tissue (laparotomy - opening of the abdominal cavity; abscessotomy - opening of an abscess). "-stomy" - external or internal diversion operations.

External diversion operation: cholecystostomy – bile diversion from the gallbladder; gastrostomy - external diversion of stomach contents.

Internal diversion (or anastomosis): gastroenterostomy (gastroenteroanastomosis); ileotransversostomy. "-ectomy" - complete removal of an organ.

In addition to the above mentioned, in surgical practice, "resection" is widely used, when during the operation a part of the organ is removed; "Extirpation" - complete removal of an organ with adjacent tissues and organs (in case of uterine cancer, complete removal of uterus and uterine appendages is performed); "Amputation" - removal of a part of the limb with the transection of the bone; "Disarticulation" - removal of a part of the limb is performed at the level of a joint space.

**Special operations:**

Special technological methods are used –in this case there are no traditional dissections, exposure of hollow organs, etc.: a) microsurgical; b) endoscopic (gastrofibroscopy, laparothoracoscopy, cystoscopy); c) endovascular.

Currently, there are two main types of endoscopic surgical operations: **distant** (operation in pneumoperitoneum is performed using special manipulators under video-controlled endoscopic onscreen vision; and **video-assisted**, during which certain stages of the operation are performed distantly, and other stages are performed through surgical mini-access.

Repeated surgeries – operations performed in connection with the developed complication in the early postoperative period (the prefix “re” is added): relaparotomy – repeated laparotomy due to the development of postoperative intra-abdominal complications; reamputation – repeated amputation of a limb because of gangrene or osteomyelitis of the residual limb.

Reconstructive surgeries are surgical interventions performed to eliminate unfavorable outcomes of primary surgeries: repeated resection of the stomach in dumping syndrome, biliodigestive anastomoses in postcholecystectomy syndrome.

Fromasepsis point of view, the meaning of which is to prevent pyoinflammatory complications, all surgical interventions, according to the degree of risk of inflammatory postoperative complications directly in the operation area, are divided into "clean", "clean-contamined ", "contamined" and "dirty".

Clean operations are planned operations without opening the lumen of a hollow organ, and the cause of the operation is not connected with any inflammatory diseases (hernia repair, spleen removal, heart defects surgery).

Clean-contamined operations are operations during which the lumen of a hollow organ is opened, planned surgical interventions (gastric resection, cholecystectomy).

Contamined operations are performed in case of inflammatory diseases of internal organs or the operation is accompanied by the opening of lumens of internal organs. It leads to entry of the contents of the hollow organ into the wound (gastrostomy, ileostomy).

Dirty operations - operations performed along with an existing infection in the operational area (peritonitis, abscesses, phlegmon, fistulas).

Surgical operation is the most important stage of the treatment process. However, in order the operation is maximum effective, appropriate preoperative preparation and qualified treatment in postoperative period are required.

**Preoperative period** is the time from the moment a patient is admitted to the hospital until the start of the operation. Its purpose is to minimize the risk during surgery and reduce postoperative complications development hazards. To achieve this goal, it is necessary to make a diagnosis after comprehensive examination of the patient, determine the indications, urgency and nature of the operation, prepare the patient for the operation.

Therefore, preoperative period is divided into:

- diagnostic stage – during this stage the main diagnosis is clarified, concurrent diseases are identified.

The diagnosis is made on the basis of patient's complaints, life and disease history, physical examination of the patient, taking into account laboratory data and methods of instrumental examination.

At diagnostic stage, indications for surgery are determined, which are divided into absolute and relative.

Absolute indications for surgery are diseases and conditions that present a danger to the patient's life and can only be eliminated by surgical intervention.

Absolute indications for emergency operations are called "vital".

This group of indications includes: internal and external bleeding, wounds, acute appendicitis, perforated ulcer, intestinal obstruction, constricted hernia, purulent soft tissue diseases.

Relative indications for surgery are diseases that do not threaten the patient's life, but their long-term course can lead to various complications (varicose veins, cholelithiasis, hernia).

Absolute contraindications for surgery are connected with concurrent diseases that present a danger to the patient's life, since surgical intervention in this case inevitably leads to worsening of the condition. They are decompensated cardiovascular, respiratory and renal-hepatic failure.

Surgical operation and anesthesia present a potential danger to the patient; therefore, the degree of operational and anesthetic risk is assessed, since an objective evaluation of the patient's condition allows to choose an adequate preoperative preparation, the type of anesthesia, the volume of surgery.

There are 4 types of preoperative preparation:

1. Psychological:

The patient is considered a priori in a state of anesthesia. No matter how strong-willed a person is, he always returns in his thoughts to the upcoming operation. He is tired of suffering, often you can observe agitation, but more often depression, increased irritability, poor appetite and sleep.

To minimize negative effects of this condition, it is possible to use medications (light tranquilizers), it is necessary to observe all the rules and requirements of deontology and manage the work of planned surgery department in an appropriate way (patients who have not yet been operated must be placed separately from those who have already undergone surgery).

2. General somatic - the aim is to achieve disordered body functions compensation, prevention of endogenous infection, fight against anemia, hypoproteinemia.

a) preparation of cardiovascular and respiratory systems. With normal activity of the cardiovascular system, special training is not required, but correct breathing is a skill necessary for the patient, especially if chest surgery is expected. If the patient has minor functional changes of cardiovascular system, their correction is necessary (use of antispasmodics, beta-blockers, medications that improve heart muscle metabolism).

b) thromboembolic complications. Therefore, all patients need to examine blood coagulation system and prevent its disorders(heparin, aspirin).

c) high-risk groups - patients with varicose veins, obesity, cancer and disorders of blood coagulation system, forced to spend a long time in bed. Often, people who are preparing for planned operation have anemia (hemoglobin is 60-70 g / l). Correction of these disorders is necessary, since a slower regeneration can be observed.

d) preparation of digestive system. Sanitation of the oral cavity is performed to fight latent infections that can lead to stomatitis and mumps. Lavage of abdominal cavity is performed before surgery, which includes mechanical cleaning. The patient must not take any food or water from the very morning in the day of operation. An enema is performed 12 hours before the operation. Usually laxatives are not administered. To increase the body's resistance to operational stress, it is necessary to take care of the metabolic liver protection and increase its glycogen reserves. To achieve this, glucose concentrated solution with vitamins are infused (ascorbic acid, group B). Methionine and ademetionine are also used.

e) preparation of urinary system. Before the operation, the examinationof renal function is carried out, because after the operation the patient will undergo massive infusion therapy, including administration of saline and colloidal solutions, glucose solutions, blood products and components.

3. Special preparation (bowel emptying, trophic ulcers cleaning in case of varicose veins, bronchial tree sanitation).

4. Immediate (shaving the surgical site, stomach emptying, etc.)

**Postoperative period**

This period determines the patient's further quality of life, since the completeness of recovery depend on its course (whether it is complicated or uncomplicated). During this period, the patient's body adapts to anatomical and physiological changes that were created by the operation.

Postoperative period starts with the end of the surgical operation and ends with a complete recovery of the patient or his/her disability.

Surgical operation and anesthesia lead to certain pathophysiological changes in the body, the intensity of individual metabolic processes changes, and the ratio of catabolism and anabolism is disturbed.

There are 3 phases of postoperative period:

1) Catabolic phase. Stress causes activation of sympathoadrenal and hypothalamic-pituitary-adrenal systems. It leads to increased secretion of glucocorticoid hormones, which can have different effect: irritation of the central nervous system (hypothermia, hypotension, depression, myoplegia), increased permeability of cell membranes, activation of catabolic processes and dystrophy development, negative nitrogen balance. At the same time, tissue catabolic processes are the source of necessary energy: mobilization of carbohydrate and fat reserves, and in critical situations, intensive consumption of structural protein components of individual organs and tissues, up to 30-40g. per day. The duration of this phase is on average 3-5 days, but it depends on the individual characteristics of the body, the severity of surgical trauma.

2) Involution phase. It is characterized by decrease of catabolic processes intensity and increase of anabolic processes and general tissue metabolism. It lasts 1-3 days, but in case of complicated catabolic phase, it can take more time.

3) Anabolic phase. During it anabolic processes prevail, restoration of reserve fats, carbohydrates and structural proteins is observed. The phase lasts 3-5 weeks, depending on the severity of previous changes.

In clinical practice, there are:

1. Early postoperative period - from the moment of operation to discharge from the hospital (from 1 to 5-7 days; corresponds to catabolic and involution phases).

2. Late postoperative period - the time after discharge from the hospital (lasts 2-3 weeks after the operation; it is determined by the clinical manifestations of anabolic phase).

3. Long-term postoperative period - rehabilitation period (starts from 3-4 weeks after the operation and lasts until the patient's working capacity is restored (up to 2-3 months, corresponds to the increase in body weight).

The most difficult and responsible is early postoperative period, asmost often during this period postoperative complications can occur.

Three main factors contributing to the development of complications:

1) postoperative wound; 2) forced patient’s position; 3) effect of operational trauma and anesthesia.

Wound complications in postoperative period are most common. All wound complications, taking into account the period of their occurrence, are divided into early and late. There is a clear morphological and temporal sequence of the development of wound complications.

Bleeding (external or internal) often occurs in 1-2 days after surgery.

Seroma is a limited interstitial accumulation of serous fluid or lymph located in the subcutaneous fat. Clinically, seroma manifests itself in 2-3 days after the operation, a feeling of wound fullness. It is necessary to perform wound catheterization and evacuate the exudate (without draining the seroma cavity).

Inflammatory infiltration develops in 3-6 days. The presence of infiltration is a sign of serous-infiltrative stage of inflammation. The patient can have complaints about the feeling of suture fullness, swelling and hyperemia of the wound edges. Body temperature is 37.2-38°C. The presence of infiltration is an absolute indication for revision of the wound, its catheterization and drainage.

Suppuration of the wound is diagnosed 6-7 days after the operation.

Eventration is the exit of internal organs outside the abdominal cavity through a musculocutaneous aponeurotic defect. In cases whereskin integrity is not disturbed, the eventration is called subcutaneous.

Late complications - ligature fistula, keloid scar, incisional hernia.

In early postoperative period, dysfunctions of nervous system, cardiovascular system, respiratory system, liver and kidneys can be observed.

1. Central nervous system disorders: postoperative psychosis is often observed. Psychosis can develop as a reaction to anesthesia (short-term), or due to intoxication of the body (intoxication psychosis). Intoxication psychosis is most often observed with diffuse peritonitis, total pancreatic necrosis, wet gangrene, sepsis, intestinal problemsobsessions, etc.

2.Cardiovascular system complications:

1) acute cardiovascular failure; 2) myocardial infarction; 3) pulmonary embolism.

3. Respiratory system complications:

1) lung atelectasis; 2) pneumonia, bronchitis; 3) acute respiratory failure.

4. Digestive system complications:

1) pouch leakage and development of peritonitis; 2) paralytic intestinal obstruction

5. Urinary system complications:

Pyelonephritis, acute renal failure.

6. Pressure injuries - simple necrosis of the skin and tissues due to microcirculation disorders as a result of their prolonged compression.

**Control questions:**

1. The term of operation. Choice of surgical procedure depending on the purpose. Possible dangers.
2. The problems of preoperative period. Preoperative conclusion.
3. Types of surgery preparation. The necessary conditions for preoperative and postoperative periods and the operative process.
4. The principles of postoperative period. Possible complications after an operation.
5. Management of patient in postoperative period.

**Tests on the topic: «Operation. Pre- and Postoperative Periods»**

***Choose the one correct answer***

1. RELATIVE INDICATIONS FOR SURGERY ARE DISEASES THE TREATMENT OF WHICH IS POSSIBLE BY

1) planned surgery

2) surgery and conservative therapy

3) emergency surgery

4) nonsurgical therapy

1. ANY SHOCK IS AN ABSOLUTE CONTRAINDICATION TO SURGERY EXCEPT

1) wound shock in torpid stage

2) wound shock in erectile stage

3) hemorrhagic shock with stopped bleeding

4) hemorrhagic shock with ongoing bleeding

1. AN ABSOLUTE CONTRAINDICATION FOR EMERGENCY SURGERY IS

1) ongoing bleeding

2) acute myocardial infarction

3) agonal and preagonal state

4) lack of necessary blood substitutes

1. WHAT IS CHARACTERISTIC OF THE CATABOLIC PHASE OF POSTOPERATIVE PERIOD

1) restoration of muscle and fat tissue

2)increased protein breakdown

3)increased protein synthesis

4) positive nitrogen balance

1. EMERGENCY OPERATIONS ARE PERFORMED
2. immediately or within several hours after hospitalization
3. within several days after hospitalization
4. within next 3-4 weeks after hospitalization
5. in a month after hospitalization
6. URGENT OPERATIONS ARE PERFORMED
7. immediately or within several hours after hospitalization
8. within several days after hospitalization
9. within next 3-4 weeks after hospitalization
10. in 2-3 months after acute attack relief
11. A SURGERY PERFORMED FOR TWO OR MORE DIFFERENT DISEASES IS CALLED

1) radical

2) explorative

3) palliative

4) simultaneous

1. THE DEVELOPMENT OF COMPLICATIONS IN THE POSTOPERATIVE PERIOD IS CAUSED BY

1) postoperative wound

2) forced patient’s position

3) operational trauma and anesthesia

4) all of the above mentioned

1. THE SOURCE OF PULMONARY EMBOLISM IS

1) intra-abdominal veins

2) deep veins of the lower extremities

3) deep veins of the upper extremities

4) veins of the surgical treatmentarea

10. COMPLICATION DEVELOPING IN THE EARLY POSTOPERATIVE PERIOD IS

1) early secondary bleeding

2) late secondary bleeding

3) suppuration of the postoperative wound

4) bedsores

1. PREVENTION OF PULMONARY EMBOLISM IN THE POSTOPERATIVE PERIOD IS PROVIDED BY

1) fibrinogen injection

2) strict bed rest

3) early activation of the patient

4) infusion of cryoprecipitate

1. A RELATIVE INDICATION FOR OPERATION IS

1) colon cancer

2) acute appendicitis

3) obstructive jaundice

4) varicose veins of the lower extremities

1. THE ANABOLIC PHASE IS CHARACTERIZED BY

1) increased decay of proteins and fats

2) increased synthesis of proteins and fats

3) decreased number of enzyme proteins

4) decreased glycogen synthesis

1. EXCISIONAL BIOPSY IS CHARACTERIZED BY THE FOLLOWING

1) theentire pathological focus is excised

2) the area of pathological formation is excised

3) it is carried out with a thin needle

4) it is carried out with a thick needle

1. BEFORE A PLANNED SURGERY, THE PATIENT UNDERGOES

1) complete sanitization

2) partial sanitization

3) delayed sanitization

4) only shaving the operation area

1. SPECIAL SURGERY INCLUDES

1) combined operations

2) mixed operations

3) microsurgical operations

4) reoperation

1. THE STANGE-HENCH TEST IS CARRIED OUT TO ASSESS THE FUNCTIONAL STATE OF

1) cardiovascular system

2) respiratory system

3) urinary system

4) nervous system

1. GENERAL PREPARATION FOR THE SURGERY IS AIMED AT

1) preparation of gastrointestinal tract

2) assessment of functional state of the patient

3) management of any disorders of body systems

4) preparation of the operating area

1. SPECIAL PREPARATION BEFORE SURGERY INCLUDES

1) chemotherapy for malignant tumors

2) premedication

3) drug preparation for thyrotoxicosis

4) blood transfusion for anemia

***Choose the right combination of answers***

1) a, b

2) a, c

3) a, d

4) c, d

1. IMMEDIATE PREPARATION BEFORE SURGERY INCLUDES

a) urinary bladder emptying

b) premedication

c) oral cavity sanitation

d) blood transfusion for anemia

***Choose the right combination of answers***

1) a, b

2) a, c

3) a, d

4) c, d

1. CLEAN-CONTAMINED OPERATIONS INCLUDES

a) gastric polyp removal

b) varicose veins removal

c) cholecystectomy in gallstone disease

d) cholecystectomy in acute cholecystitis

***Choose the right combination of answers***

1) a, b

2) a, c

3) a, d

4) b, c

1. CONTAMINED OPERATIONS INCLUDES

a) appendectomy

b) removal of the gastric polyp

c) cholecystectomy in gallstone disease

d) cholecystectomy in acute cholecystitis

***Choose the right combination of answers***

1) a, b

2) a, c

3) a, d

4) b, c

1. TREPANOBIOPSY ALLOWS TO PERFORM

1) pathological examination

2) cytological examination

3) microbiological examination

4) biochemical examination

**9. Tumors. Classification, clinic, diagnosis, treatment**

The tumor is the pathological formation, which is independently developing in organs and tissues, characterized by autonomous body height, a polymorphism and atypia of cells.

Biological properties of malignant tumors. Features of a malignant tumor as a disease are largely determined by the property of its cells, which have a number of features that distinguish it from normal cells:

Autonomy, uncontrolled growth, disobedience to those regulatory influences that limit or stop the multiplication of normal cells, is the most characteristic property of malignant tumor cells.

Anaplasia is a complete or partial loss by tumor cells of the ability, characteristic of differentiated normal cells, to form specific tissue structures and produce specific substances.

Atypism is a significant variability in the size and shape of cells, compared with the normal size and number of individual organelles, the shape and number of chromosomes:

Infiltrative or invasive growth is the ability of cells to grow in and destroy surrounding healthy tissue. The pathological behavior of tumor cells associated with such phenomena as invasion and metastasis is based on disturbances in the mechanisms of collective behavior of malignant cells in a multicellular organism. Tumor cells are characterized by impaired inhibition of reproduction, which depends on the density of the cell population;

Metastasis is the main method for the spread of cancer cells by separation from the main focus. As a result of the transfer of individual cells or small groups through the lymphatic and blood vessels, new foci of tumor growth are formed. Most of the cancer cells circulating in the vascular bed die after a certain period of time, the other part die from the action of antibodies, lymphocytes, macrophages. And only the smallest part of them finds favorable conditions for their existence and reproduction.

There are following types of metastases: a) intraorgan, b) regional, c) distant. Intraorgan metastases are tumor cells that have become detached and fixed in the tissues of the same organ in which the tumor has grown and given secondary growth.

There are three main pathways for metastasis:

a) Lymphogenous, tumor cells spread through the lymphatic vessels to the lymph nodes that are most closely located, and then to more distant ones (into the so-called metastatic collectors);

b) Hematogenous pathway of tumor spread - the drift of cells with blood flow into organs, most often - into the lungs and liver, since the liver filters blood from all unpaired organs of the abdominal cavity, and in the lungs the pulmonary circulation is closed;

c) The contact path of tumor spread - more often along the serous membrane, for example, a stomach tumor may have Schnitzler's metastasis; when removing the pleural drainage, metastasis may appear in the area of the drainage canal;

d) Recurrence is the re-development of a tumor after surgical removal or radiation chemotherapy.

Etiology of malignant tumors. Currently, there are many theories of the occurrence of tumors, but only a few of them are significant.

Virchow's irritating theory is the occurrence of tumors due to prolonged irritating effects of various factors on tissues. For example, the occurrence of lung cancer and stomach cancer in smokers.

Theory of embryonic origin of D. Kongame - the development of tumors from embryonic cells, detached during embryonic development, under the influence of any stimuli.

Zilberg's viral genetic theory - the introduction of various viruses into the cell leads to the formation of an oncogene that disrupts normal cell development.

The genetic theory is the transmission by inheritance of a propensity to a certain disease, which begins, develops when unfavorable external conditions are created.

Polyethiological theory - the combined effect of various factors leads to the formation of a tumor.

Classification.

The classification of all tumors is based on their division into benign and malignant ones. Benign tumors are characterized by relatively slow growth, maximum morphological similarity with the tissues from which they originated; a clear delimitation from the surrounding tissues by the capsule; they do not have a tendency to limitless progression, do not have infiltrative growth, do not metastasize, do not affect the general condition, do not recur after radical surgery, do not threaten the life of a sick organism.

Malignant tumors grow, quickly invading and invading neighboring tissues and organs, which is assessed as an infiltrative form of growth. The cells of a malignant tumor differ sharply from the cells of normal tissue by pronounced cellular atypism, polymorphism and impaired differentiation - anaplasia. The growth of a malignant tumor affects the state of the body, patients develop exhaustion, anorexia.

Malignant tumors metastasize and may recur after a course of any type of treatment.

Morphological classification of tumors is the most common. It makes it possible to determine the initial cellular and tissue identity of the tumor, its benignity or malignancy, details of the structure, and the degree of maturity.

Malignant tumor from the epithelium - cancer, from connective tissue - sarcoma.

From a clinical point of view, malignant tumors go through several stages in their development. Determination of the stage (degree of cancer spread) is based on the depth of organ damage, the presence or absence of metastases in the lymph nodes and distant organs.

There are I, II, III and IV stages of a tumor.

Stage I - the tumor occupies a limited area, does not grow beyond the organ wall, there are no metastases.

Stage II - the tumor does not spread beyond the organ, single metastases to regional lymph nodes are possible.

Stage III - a tumor of large size, the entire wall of the organ grows with multiple metastases to the regional lymph nodes.

Stage IV - tumor invasion into surrounding organs or a tumor with distant metastases.

In recent years, the international classification of malignant tumors according to the TNMGP system has become increasingly widespread.

It allows to get more accurate conclusion about the extent of the tumor spread, to form comparable groups of patients, to evaluate various methods of treatment. Particular importance is attached to the first three letters.

T - tumor, classified by tumor size, from T1 to T4.

N - nodulus - classified by the absence (N0) or the presence of metastases in regional lymph nodes of the first order (N1), second order (N2), distant lymph nodes (N3).

M - metastasis is classified by the absence (M0) or presence (M1) of distant metastases to organs.

G - grad - characterizes the degree. In this case, the determining factor is the histological indicator: G1 - highly differentiated tumors, low grade of malignancy, G2 - poorly differentiated tumors, moderate grade, G3 - undifferentiated tumors, high grade of malignancy. The lower the degree of differentiation of the tumor, the more malignant it is.

P - penetration - characterizes the degree of germination of their walls (only for tumors of hollow organs): P1 - tumor infiltration of the mucous membrane, P2 - tumor infiltration of the mucosa and submucosa, P3 - tumor infiltration of the mucosa, submucosa and muscular membranes, P4 - tumor infiltration of all layers the walls of the organ or going beyond it.

Clinic of malignant tumors. Malignant tumors at the beginning of their development are asymptomatic, hidden from the patient himself. In the early stages of the disease, patients almost never complain of pain, do not consider themselves sick, continue to work and lead a normal life. But fatigue, drowsiness, loss of interest in the environment, and decreased performance are noted.

Based on significant experience at the Oncological Institute named after V.I. Herzen, A.N. Savitsky came to the conclusion that, for example, in the clinical picture of initial stomach cancer, it is necessary to highlight not individual suspicious symptoms, but a certain clinical syndrome, namely:

1. Syndrome of the so-called small signs. In this syndrome, the most important place belongs not to local gastric symptoms, which usually only attract the attention of the patient and the doctor, but to general disorders, which, as a rule, pass by the patient himself and the doctor explains them by reasons not related to stomach damage.

Small Signs Syndrome includes the following symptoms:

a) a change in the patient's well-being, which usually appears several weeks or months before going to the doctor and is expressed in the appearance of general weakness, rapid fatigue, and decreased ability to work,

b) an unmotivated persistent decrease in appetite, sometimes a complete loss of it, up to and including aversion to food

c) the phenomenon of "gastric discomfort": loss of a physiological feeling of satisfaction from eating, unpleasant local gastric symptoms: overflow of the stomach, gas expansion, a feeling of heaviness, sometimes soreness in the epigastric region, occasionally - nausea, vomiting,

d) the unreasonable progressive weight loss of the patient, noticed either by himself or by others, pallor of the integument and other phenomena of anemisation,

e) mental depression - loss of joy in life, interest in the environment, in work, apathy.

2. Syndrome "plus tissue" - this symptom can be identified with the superficial localization of the tumor (skin, subcutaneous tissue, extremities), sometimes probing the tumor in the abdominal cavity. This syndrome can be detected with FGS, colonoscopy and bronchoscopy, and gastric fluoroscopy.

3. Syndrome of pathological discharge - with vascular germination - spotting, or bleeding.

4. Syndrome of dysfunction of the organ - for example, intestinal obstruction, violation of the act of swallowing.

Local signs of a malignant tumor can be: 1) increased density of formation, compared with a benign tumor; 2) a change in the shape of, for example, a lymph node from a bean to a round one or a transition from a smooth formation to a tuberous one; 3) low mobility due to involvement of the surrounding tissues in the process - the less mobile the tumor, the less likely it is to be removed.

The algorithm for examining patients with suspected tumor is as follows: taking anamnesis with an emphasis on heredity and the presence of chronic diseases; assessment of general and local clinical manifestations and laboratory and instrumental examination.

When collecting anamnesis, special attention is paid to identifying precancerous conditions, precancerous diseases.

Pretumor condition (precancer) - various pathological processes that precede the development of a malignant tumor, but do not necessarily turn into it.

Obligate precancer - sooner or later it will surely turn into cancer. In 80% - colon polyposis, bladder papilloma, melanosis.

For the development of malignant tumors, long-term action of resolving factors is required.

Diagnostics of malignant tumors. Laboratory diagnostics. The examination of the patient begins with a general blood test. For the presence of a malignant tumor, anemia can speak, which develops without bleeding, due to tumor intoxication, especially with damage to the stomach, colon, as well as increased ESR and an increase in the number of platelets, since the tumor often causes hypercoagulation.

From biochemical analyzes, fibrinogen, C-reactive protein can be increased as nonspecific factors indicating a problem in the body. Other blood and urine parameters rarely change in uncomplicated tumors.

In recent years, special importance in the diagnosis of tumors has been attached to the so-called tumor markers. Tumor markers are complex proteins with a carbohydrate or lipid component, synthesized in tumor cells at high concentrations. A large group of TM are secreted by tumor cells and accumulate in the biological fluids of cancer patients. The most common in clinical practice are the following tumor markers: alpha-fetoprotein (liver cancer), carcinoembryonic antigen (stomach cancer, colon cancer), prostate-specific antigen (for direct diagnosis of prostate cancer). One of the earliest ways to diagnose tumors is X-ray examination. It not only has not lost its significance against the background of other diagnostic techniques, but also with the advent of computed tomography and magnetic resonance imaging, has received a new round of development.

There are many methods of X-ray examination. Preventive fluorography of the population can detect lung cancer, as well as other pulmonary processes such as tuberculosis at an early stage of development, before the onset of clinical symptoms.

Fluoroscopy will reveal functional disorders that cannot be determined by other X-ray methods, for example, the absence of gastric motility in infiltrating cancer.

Radiography, performed, as a rule, in two projections, allows one to suspect central or peripheral lung cancer, metastatic lesions of the latter, tumors of the mediastinum, bones. Often, a more complete X-ray picture is given by the combination of X-ray and fluoroscopy methods, when targeted images are taken during the latter.

Ultrasound examinations allow you to see the structure of the examined organs, which are best dense, because liver, kidneys, spleen, pancreas, thyroid, prostate mammary glands, urinary, gall bladders. Here formations of several mm in diameter can be diagnosed.

Endoscopic examinations are required if cancer of a hollow organ is suspected: bronchoscopy, esophagogastroduodenoscopy, colonoscopy, sigmoidoscopy, cystoscopy, hysteroscopy. Video laparoscopy, video thoracoscopy, mediastinoscopy, retroperitoneoscopy are essential. These studies allow not only to visualize the tumor, to determine its exact localization, but also, most importantly, to verify (morphologically clarify) the diagnosis (cytologically or histologically).

One of the most important oncological principles at the present stage is the cytological or histological verification of the diagnosis. For cytology, the following are performed: examination of sputum, bronchial fluid taken during FGS, smears-prints on glass slides from various formations, with pathological secretions, in particular, from the mammary gland, as well as puncture biopsy, brush biopsy.

Complications of tumors

1. Infection of tumors - with the disintegration of the tumor.

2. Bleeding.

3. The tumor in the process of growth compresses the lumen of the esophagus, intestinal obstruction, “ishuria of the paradox”.

4. Perforation of the organ.

Treatment of malignant tumors.

Modern tumor treatment is usually combined. It is radical when the tumor is removed along with the pathways of metastasis; palliative, when the tumor is removed, but metastases are not removed; and symptomatic, when treatment is carried out only according to symptoms in inoperable patients.

The main method of treatment is surgical. Radical surgery is usually performed in the absence of distant metastases

An operation performed within healthy tissues is considered radical. At the same time, the rules of ablastic and antiblastic surgery are followed to exclude contact metastasis.

Ablastics is a set of measures for carrying out and observing the ablastic rule to exclude contact metastasis and dissimilation of tumor cells during the operation due to frequent changes of gloves and instruments, using an electric knife or a laser instead of a scalpel, removing the organ together with metastatic collectors, performing lymphodenectomy or lymphadenectomy, pre-bandaging the vessels throughout.

Antiblastic surgery is a system of measures for the destruction and removal of the remaining tumor cells from the operating field.

Radiation therapy. It is based on the fact that tumor cells are in continuous division, and in this state they are more sensitive to rays. Many years ago, only X-ray therapy was performed, and now, Y- or B-rays. Radiation therapy is indicated for stages 2-3 of the disease, when regional lymph nodes are involved in the process.

Chemotherapy. It’s shown with dissemination (multiple spread) of the process. It can be used as an independent radical treatment, for example, for leukemia, or as an adjunct to surgical treatment. As a rule, several courses of polychemotherapy are carried out, i.e. treatment with several drugs at once.

The basic principles of polychemotherapy are:

1) PCT is the more effective, the smaller the tumor, because mitosis occurs along the periphery of the tumor;

2) PCT is the more effective, the larger the dose of drugs;

3) PCT is the more effective, the less differentiated the tumor;

4) PCT is carried out under strict control of the level of leukocytes and platelets.

Complications of chemotherapy can be severe leuko-thrombocytopenia, hepatic-renal failure, because chemotherapy drugs are inactivated by the liver and excreted by the kidneys.

Hormone therapy. There are specific hormone therapy and nonspecific one. The latter (prednisolone) is carried out in the complex treatment of breast cancer, some systemic neoplastic diseases. Specific hormone therapy is carried out for cancer of hormonal organs.

Prevention of malignant tumors.

1. Individual: smoking cessation, moderate alcohol consumption, personal hygiene.

2. Solving environmental problems – fighting with carcinogens.

3. Treatment of chronic diseases.

4. Removal of benign tumors.

5. Full clinical examination of the population and early detection of tumors.

Dispensary observation.

Patients with precancerous diseases and malignant tumors are subject to dispensary observation by an oncologist.

They make up 4 clinical groups:

1) patients with precancerous diseases;

2) patients with a diagnosed malignant tumor, subject to special treatment;

3) patients after radical treatment;

4) inoperable patients subject to symptomatic treatment.

Features of the course of tumors in children.

1. More often than in adults, there is a systemic lesion.

2. The skeletal system is more often affected, less often the internal organs.

3. Tumor growth is more aggressive.

4. Radiation, chemotherapy and hormone therapy have significant limitations.

**Control questions:**

1. The etiology and clinic of tumors.

2. The difference of malignant tumor and benign tumor. Precancer.

3. Malignant tumor and benign tumor of different tissues.

4. International classification of tumors (TNM, G, P).

5. Development stages of malignant tumors. The ways of metastasis.

6. Modern diagnostics of malignant tumors.

7. Complications of malignant tumor.

8. The treatment of tumors. Chemotherapy, radiation therapy.

9. The prevention of tumors.

10. Clinical supervision for cancer patients.

**Tests on the topic: «Tumors. Classification, Clinic, Diagnosis, Treatment»**

Choose the one correct answer

1. THE MOST MALIGNANT TUMOR IS

1) keratinizing squamous cell carcinoma

2) lipoma

3) low-grade adenocarcinoma

4) undifferentiated cancer

2. RABDOMYOSARCOMA IS A MALIGNANT TUMOR DEVELOPING FROM

1) striated musculature

2) smooth musculature

3) epidermis

4) dermis

3. BY TNM CLASSIFICATION, LETTER «T» DESIGNATES

1) tumor size

2) the degree of tumor invasion

3) what part of the circumference of the hollow organ is the tumor

4) the degree of tumor differentiation

Choose the right combination of answers

1) a, b

2) a, c

3) a, d

4) b, c

4. BY TNM CLASSIFICATION, THE LETTER «N» IS THE PRESENCE OF

1) regional lymph nodes

2) distant lymph nodes

3) other organs

4) answers 1 and 2 are correct

5. LOW DIFFERENTIATED CANCER IS DESIGNATED

1) G1

2) G2

3) G3

4) C4

6. HIGH DIFFERENTIATED CANCER IS DESIGNATED

1) G1

2) G2

3) G3

4) C4

7. UNDIFFERENTIATED CANCER IS DESIGNATED

1) G1

2) G2

3) G3

4) C4

8. The patient was diagnosed with cancer of the left breast: in its upper-outer quadrant there is a tumor up to 1.5 cm in diameter, in the left axillary region a dense, enlarged, easily displaced painless lymph node is determined. Distant metastases were not revealed. DISEASE STAGE BY TNM SYSTEM IS

1) T1N1M0

2) T4N1M0

3) T1N0M0

4) T1N1M1

9. The patient was diagnosed with stomach cancer before the operation. The tumor in the antrum invades the mucous membrane. Regional and distant metastases were not revealed. THE PRELIMINARY STAGE OF DISEASE BY TNM SYSTEM IS

1) T1N1M0

2) T4N1M0

3) T1N0M0

4) T1N1M1

10. A patient with fibrogastroscopy revealed stomach cancer. Histological examination reveals cancer in situ. TUMOR GETS

1) mucous, submucous layer

2) mucous, submucous and muscle layers

3) mucous membrane to the basement membrane

4) mucous, submucous and muscle layers, serous membrane

11. MALIGNANT TUMOR IS CHARACTERIZED BY

1) infiltrating growth

2) lack of a capsule

3) metastases

4) all of the above

12. THE LETTER "P" IN ONCOLOGY DESIGNATES

1) tumor size

2) the presence of metastases

3) the degree of invasion

4) rapidity of growth

13. Histological examination of stomach cancer revealed the proliferation of the muscle layer to the serous membrane. THE DEGREE OF THE TUMOR INVASION CORRESPONDS

1) Р1

2) Р2

3) Р3

4) Р4

14. CHARACTERISTIC OF CLINICAL MANIFESTATIONS OF THE METASTATIC LYMPH NODE

1) painful, mobile with clear boundaries

2) dense, enlarged, bean-shaped

3) with fluctuation and hyperemia of the skin above it

4) enlarged, soft, painful

15. TUMOR METASTASIZES

1) by the lymphatic system

2) through the circulatory system

3) implantation

4) all of the above is correct

16. COLLECTORS OF METASTASIS IS

1) tissue presenting to the tumor

2) regional lymph nodes

3) distant organs

4) all of the above

17. A RECURRENT TUMOR IS ITS RECURRENCE IN

1) in the same place

2) distant metastases

3) regional metastases

4) all of the above

18. THE SYNDROME OF SMALL SIGNS OF MALIGNANT TUMOR ACCORDING TO SAVITSKY IS

1) bleeding

2) fatigue

3) pain

4) vomiting

19. THE FOLLOWING PALPATORY SIGNS ARE CHARACTERISTIC FOR MALIGNANT TUMOR

1) tuberosity

2) fuzzy contours

3) low mobility

4) all of the above

20. OPTIONAL PRECANCER IS

1) a precancerous disease, which must eventually turn into a malignant

2) a precancerous disease, not necessarily becoming malignant over time

3) malignant neoplasm of stage I

4) benign neoplasm

21. CANCER IS

1) any malignant tumors

2) epithelial malignant tumors

3) connective tissue malignant tumors

4) the presence of tumor metastases

22. PRECANCERAL DISEASES ARE

1) diseases accompanied by a deterioration in the blood supply to tissues

2) infectious diseases

3) chronic diseases with inflammation and tissue proliferation

4) diseases accompanied by a violation of tissue innervations

23. CHARACTERISTIC OF MALIGNANT TUMOR

1) autonomous growth

2) slow growth

3) the presence of a capsule

4) anaplasia

Choose the right combination of answers

1) a, b

2) a, c

3) a, d

4) b, c

24. BY TNM CLASSIFICATION, THE SYMBOL Т0 DESIGNATES

1) the absence of cancer

2) the presence of a tumor of small size

3) the absence of a primary tumor in the presence of metastases

4) the presence of a benign tumor

25. LEIOMIOMA IS A BENIGN TUMOR DEVELOPING FROM THE

1) bone tissue

2) nervous tissue

3) striated muscle tissue

4) smooth muscle tissue

**10. Purulent wounds.**

Purulent wounds are fundamentally different from those freshly infected by the development of an infectious process in the tissues.

There are following purulent wounds:

- primary purulent wounds - formed after operations for acute purulent processes;

- secondary wounds - festering aseptic wounds in the healing process, developed as a result of violation of the rules of asepsis.

The presence of a significant distance between the walls and edges of the wound and with the development of a purulent infection leads to secondary wound healing. Healing by secondary intention - healing through suppuration, through the development of granulation tissue.

For wound healing by secondary intention, conditions are necessary opposite to those that promote primary intention:

- significant microbial contamination of the wound;

- a significant defect in the skin;

- the presence of foreign bodies, hematomas and necrotic tissues in the wound;

- an unfavorable state of the body;

There are also three phases in secondary intention healing, but they have certain differences.

Phase I - inflammation (1st-5th day), characterized by a significant development of inflammatory edema and leukocyte infiltration of the tissue, and ends with the melting of necrotic tissues, their removal and purification.

Phase II of the wound process (from 6 to 14 days from the moment of injury) - the regeneration phase, ends with the filling of the wound defect with granulation tissue.

Phase III - scarring and epithelialization of the wound. It begins in 2-4 weeks. Epithelialization begins from the edges of the wound simultaneously with the formation of granulation tissue.

The given scheme of healing is universal for all types of wounds, the differences are only quantitative and relate to the amount of granulation and scar tissue formed, the area of ​​epithelialization and the duration of healing.

**Treatment of purulent wounds**

It is carried out taking into account the phase of the wound process.

The main task of secondary surgical treatment is to create conditions for maximum removal of wound microflora, which is achieved by prompt opening of all purulent leaks and excision of necrotic tissues.

After WMO, dressings with osmotically active substances and antiseptics, water-soluble ointments are regularly changed; to accelerate necrolysis - proteolytic enzymes; Ultrasound cavitation; vacuum treatment; treatment of the wound with a pulsating stream of antiseptic, etc.

**Osmotherapy** - dressings with hypertonic 0% sodium chloride solution. The movement of fluid will be from the tissues of the edges of the wound, where the concentration is 0.85% - into the dressing, where the concentration of salt is 10%, until the concentration is equalized to 0.85%. Dressings are made 1-2 times a day.

**Drainage** is a method aimed at ensuring the outflow of discharge from wounds, creating conditions unfavorable for the development of m / s, as well as ensuring control over the course of the local process.

Drainage objectives:

1) ensuring the outflow of the discharge;

2) control over the course of the process;

3) administration of medicines

Types of a drainage: passive, active, flowing and washing.

Now it is recommended to apply the punched tubular drainages from polyvinyl chloride material to a passive drainage or "cigar" drainages (the thin tube filled with a gauze). The locating of a drainage has to be such that outflow was carried out from top to down, by gravity.

The vacuum aspiration (by means of a rubber pear, a suction) promoting elimination of dead spaces, coalescing of edges of a wound, depression of penetration of a microflora from the outside is applied to an active drainage of a tight wound cavity. The locating of a drainage has to provide entering separated from below up, against gravity.

Flowing and washing drainage is carried out by an aspiration and washing method with installation of the counter punched drainages, on one of which medicine is entered, and on another outflow is carried out. Introduction can be jet and drop, fractional or constant. Outflow can be carried out in the passive and active way. This method protects wounds from secondary dissemination, promotes fuller excision separated, frames conditions of the controlled abacterial medium and favorable conditions for an adhesion of wounds.

Drainage complications:

1) obturation and abaissement of a drainage,

2) disturbance of tightness of the drained wound cavity,

3) prelum and damage of organs and tissues,

4) a microbial contamination through drainage tubes.

The problems of a bandage in the first phase of a wound process:

- excision of an excess exsudate,

- irreversible elamination of bacteria, toxins, wound detritis, mud, foreign matters,

- stimulation of a regidratation of necroses and acceleration of a necrolysis,

- the exsudate has to not only be absorbed by structure of material of a bandage, but also strongly keep in it.

Problems of a bandage in the second phase of a wound process:

- maintenance and adjustment of wet medium in a wound,

- protection of granulation tissue from mechanical damage during dressing,

-reliable protection against secondary infection.

Dressings applied during the regeneration phase should protect the wound from trauma and infection, not stick to the wound, and regulate the humidity of the environment in the wound, preventing both drying and excess moisture.

Dressing tasks in the third phase of the wound process:

Maintaining the wound in a moderately moist state, protecting the epithelium and the forming scar from mechanical damage during dressing, stimulating regeneration.

When the wound dries, a crust forms, which slows down epithelialization, and with excess moisture, epithelial cells die. From this it follows that the dressings should still keep the wound moderately moist and protect against injury. Preference in the 2-3 phase of the wound process is given to atraumatic dressings.

Dressings with indifferent and stimulating ointments or modern dressings "Hydrosorb" (hydrogel), "Hydrocoll" (hydrocolloid) are applied.

The final stage of the secondary surgical treatment is the secondary suture. It is applied to a granulating wound in conditions when the danger of wound suppuration has passed. Terms of application of the secondary suture - from several weeks to several months. It is used to accelerate wound healing.

An early secondary suture is applied to granulating wounds within 8 to 15 days. The edges of the wound are usually mobile, they are not excised.

A late secondary suture is applied at a later date (after 2 weeks), when cicatricial changes have occurred in the edges of the wound and the walls of the wound. The convergence of the edges, walls and bottom of the wound in such cases is impossible, therefore, the edges of the wound are mobilized and the scar tissue is excised. In cases where there is a large skin defect, a skin graft is performed.

Objective criteria for assessing the course of the wound process

1. The rate of wound healing is stable, the area of ​​the wound decreases by 4% per day. A slowdown in healing indicates the development of complications.

2. Bacterial control - normal, the number of microbes in the wound decreases and always falls below the critical level. An increase in their number to 105 and more per 1 gram of tissue indicates a local complication.

Principles of general treatment of patients with purulent wounds:

- antibacterial therapy;

- detoxification;

- hyperbaric oxygenation or oxygenobarotherapy.

- anabolic hormones;

- antistaphylococcal plasma;

- immunomodulators.

In recent years, immunotherapy has been associated with forced diuresis, hemosorption with selective elimination of certain toxic substances and plasmapheresis. The latter provides for the passage of blood through a special separator of blood cells, which separates the plasma from the formed elements.

**Control questions:**

1. The definition and classification of wounds.
2. Primary and secondaryhealing.
3. The origin of septic wounds. Phasesof wound process.
4. Thephase ofinflammation. Initial surgical d-bridement. Localandgeneral treatment.
5. Regeneration phase. Structure of granulations. Localandgeneral treatment.
6. The phase of epithelization. Localandgeneral treatment.
7. The risks andcomplicationsof septic wounds.
8. Active surgical treatment of septic wounds.
9. Primary and secondary suture.

**Tests on the topic: «Purulent wounds»**

***Choose one correct answer***

1. WHAT CORRESPONDS TO THE ESSENCE OF THE REGENERATION PHASE IN A PURULENT WOUND

1) replacement of the wound defect with granulation tissue

2) restoration of lost tissues

3) self-cleaning of the wound

4) development of scar tissue

2. In the wound there are areas of necrotic tissue, the walls of the wound are covered with a layer of fibrin, significant purulent discharge, skin hyperemia around the wound, edema. FORMULATE A DIAGNOSIS

1) aseptic wound

2) freshly infected wound

3) purulent wound in the phase of inflammation

4) purulent wound in the regeneration phase

3. There are remnants of necrotic tissue in the purulent wound. WHAT SHOULD THE BANDAGE BE APPLIED WITH?

1) Vishnevsky ointment

2) proteolytic enzymes

3) antibiotics

4) sulfonamides

4. WHAT PHASES OF THE WOUND PROCESS ARE SELECTED AT THE PRESENT TIME

a) inflammation

b) regeneration

c) hydration

d) dehydration

***Choose the correct combination of answers***

1) a, b

2) b, c

3) c, d

4) a, d

5. WHAT IS SHOWN IN THE SECOND PHASE OF A PURULENT WOUND

1) anti-inflammatory treatment

2) stimulating the growth of granulations

3) the promotion of the processes of wound cleansing

4) adequate drainage

6. WHAT PROTEOLYTIC ENZYMES ARE USED TO TREAT PURULENT WOUNDS

1) chymotrypsin and chymopsin

2) ampicillin and tetracycline

3) lipase and amylase

4) chlorhexidine and dioxydine

7. WHAT OINTMENT PROMOTES SELF-CLEANING OF THE WOUND

1) «Dexpanthenol» and «Actovegin»

2) «Levomekol», «Levosin»

3) furacilin and methyluracyl

4) Vishnevsky ointment

8. The wound discharge emits a sickly-sweet smell, bluish spots on the bandage. WHAT IS MOST LIKELY IN THE WOUND

1) staphylococcus

2) E. coli

3) pseudomonas aeruginosa

4) streptococcus

9. WHAT KIND OF SUTURE IS APPLIED AFTER EXCISION OF THE EDGES OF THE GRANULATING WOUND

1) provision seam

2) early secondary suture

3) late secondary suture

4) primary-delayed suture

10. WHAT KIND OF SUTURE IS APPLIED WITHOUT EXCISION OF THE EDGES OF THE GRANULATING WOUND

1) provision seam

2) early secondary suture

3) late secondary suture

4) primary-delayed suture

11. WHAT IS A RELIABLE SIGN OF THE VIABILITY OF TISSUES IN A PURULENT WOUND

1) bleeding

2) elasticity

3) color

4) consistency

12. A well-granulating wound in the regeneration phase has a size of 20x20 cm. WHAT SHOULD BE DONE IN THIS CASE

1) antibiotic therapy

2) skin grafting

3) ointment dressings

4) stimulating therapy

13. WHAT IS DETECTED IN THE TISSUES SURROUNDING THE PURULENT WOUND IN THE REGENERATION PHASE?

1) acidosis

2) alkalosis

3) neutral environment

4) everything is correct depending on the patient's condition

14. WHAT IS ADVISABLE TO USE FOR THE LOCAL TREATMENT OF A PURULENT WOUND INFECTED WITH A BLUE-GREEN PUS STICK

1) furacilin solution

2) boric acid

3) Vishnevsky ointment

4) methyluracil ointment

15. THE PRESENCE OF WHAT IS CHARACTERISTIC OF A PURULENT WOUND IN THE PHASE OF INFLAMMATION

1) anemia

2) leukocytosis with a shift of the formula to the left

3) leukopenia

4) leukocytosis with a shift of the formula to the right

16. A patient with heart failure has cyanotic, edematous granulations in the wound of the soft tissues of the lower leg. WHAT IS CARRIED OUT FOR THE IMPROVEMENT OF GRANULATIONS

1) cardiac therapy

2) red blood cell transfusion

3) vitamin therapy

4) antibiotic therapy

17. WHAT ARE THE TYPES OF WOUNDS ACCORDING TO THE DEGREE OF INFECTION

1) stabbed, chopped, bitten, bruised

2) infected, operating, accidental

3) aseptic, freshly infected, purulent

4) penetrating, non-penetrating, torn

18. WHEN THE WOUND IS CONSIDERED SECONDARY PURULENT

1) after opening the focus of purulent inflammation

2) as a result of suppuration of the aseptic wound

3) as a result of suppuration of the wound after PHO

4) true 2 and 3 of the statement of

19. THE TERM «EVENTRATION» MEANS

1) infringement of the contents of the hernial sac

2) a system of measures aimed at eliminating intestinal paresis in the postoperative period

3) prolapse through the wound of the abdominal organs

4) dissection of the stomach wall

20. WHAT COMPLICATION REQUIRES IMMEDIATE REVISION OF THE WOUND IN THE EARLY POSTOPERATIVE PERIOD

1) bleeding from the wound

2) edema of the wound edges

3) increased blood pressure

4) allergic skin rashes

21. WHAT PROMOTES NORMALIZATION OF THE WOUND PROCESS IN DIABETES MELLITUS

1) the use of antibiotics

2) getting up early

3) rational insulin therapy

4) vasodilators

22. WHAT SHOULD BE THE TACTICS OF A POLYCLINIC DOCTOR WHEN DIAGNOSING A PURULENT WOUND COMPLICATED BY LYMPHANGITIS AND REGIONAL LYMPHADENITIS

1) antibacterial therapy

2) pricking the focus of inflammation with an antibiotic

3) referral of the patient to the hospital

4) urgent blood test

23. WHAT DOES AN ACTIVE SURGICAL TREATMENT OF A PURULENT WOUND?

1) rational surgical treatment

2) the use of tubular drains

3) surgical treatment, drainage, suturing with active drainage

4) surgical treatment, drainage, suturing with discrete flow-aspiration washing

24. TYPES OF WOUND HEALING

1) secondary intention

2) by primary intention

3) healing under the scab

4) all of the above is true

25. WHEN IS GENERAL ANTIBACTERIAL THERAPY PERFORMED IN THE TREATMENT OF PURULENT WOUNDS

1) isolation of associations of microorganisms from wound exudate

2) complication of the wound process with lymphangoitis, lymphadenitis

3) determination of the sensitivity of microflora to antibiotics

4) all of the above is true

**11. Aseptic and infected wounds.**

A wound is any damage accompanied by a violation of the integrity of the integumentary tissues - skin or mucous membranes.

Depending on the type of the acting force (sharp knife, hammer blow), its direction and the direction of the main lines of the skin (according to Langer), the shape of the wound edges can be different (cut, lacerated, scalped wounds, etc.).

The clinic of wounds is determined by the presence of a defect in the skin or mucous membranes, bleeding, pain.

The severity of the pain syndrome is due to the following factors:

1) Localization of the wound (where there are a large number of receptors: fingertips, peritoneum, pleura) - severe pain;

2) the nature of the wounding weapon - the sharper, the less damage to the receptors;

3) the state of the macroorganism - (no pain in alcoholics, drug addicts, spinal gliosis).

The intensity of bleeding is due to:

1) the localization of the wound;

2) the nature of the wounding weapon (the sharper, the stronger the bleeding);

3) the state of the coagulation system.

The hiatus is caused by the contraction of the elastic fibers of the skin. The severity of the divergence of the cutaneous edges of the wound is determined by the ratio of its axis to Langer's lines.

Classification:

Taking into account the cause of damage, wounds are divided into:

-intentional (they are also operational)

-random (household, industrial, combat)

Depending on the presence of microbial flora in the wound, the following wounds are distinguished:

Aseptic (sterile) - applied in the operating room, but the name is conditional, because in fact, truly aseptic wounds are rare. However, the degree of bacterial contamination of surgical wounds, especially pathogenic or opportunistic microflora, is much lower than the critical dose - the minimum amount that causes an infectious process.

Any wound inflicted outside the operating room within up to 3 days from the moment of injury is considered freshly infected.

In surgical practice, there is an axiom that any accidental wound should be considered infected. However, the presence of an infection in a wound does not necessarily mean the development of a purulent process. For its development, a combination of factors is necessary, which include significant trauma and tissue necrosis, the presence of blood in the wound cavity, its clots, the presence of a sufficient concentration of pathogenic microbes in the wound.

The critical level of bacterial contamination, at which a purulent-infectious process can occur in the body, is 100,000 microbial bodies per 1 gram. of tissue.

If there is a favorable habitat in the wound for microorganisms in the form of blood and tissue decay products, it reduces the critical level of contamination to 10,000 microbial bodies per 1 gram. of tissue.

Purulent wounds are fundamentally different from freshly infected wounds in that an infectious process is already developing in them; in the tissues, the inflammatory process, necrosis, and the formation of purulent exudate are expressed.

Simple wounds are distinguished when there is damage only to the skin and mucous membranes, and complex ones, if the wound defect is combined with damage to muscles, bones or internal organs.

Wounds resulting from mechanical damage are uncomplicated, and in combination with burns, radiation damage - to complicated.

In relation to body cavities, non-penetrating and penetrating ones are distinguished. The latter are characterized by the penetration of the wound channel into the abdominal and chest cavity, the joint cavity, skull, etc.

By the nature of tissue damage, there are:

Cut wounds are applied with a sharp object, they can be deep, but the surrounding tissues are slightly damaged, the edges are even.

Punctured wound ones are applied with a narrow object, have a small area and great depth, there is no gaping, the surrounding tissues are not damaged, but damage to deep-lying structures (nerves, vessels, organs), internal bleeding is possible.

Compound wounds are applied with a blunt object. Characterized by a wide area of ​​damage to the surrounding tissues with the development of necrosis, severe pain syndrome.

Loose - formed when struck with a blunt object with great force. All signs of bruised wounds are characteristic, but the zone of necrosis is even greater, crushing of deep-lying tissues, bone fractures occurs.

Torn - formed by a glancing blow with a blunt object. Characterized by uneven edges, skin detachment and necrosis - sometimes over a large area.

Chopped - are applied with a heavy sharp object and combine the properties of cut and bruised wounds. Characterized by deep and extensive damage to the surrounding tissues, bone fractures, crumbling of the edges, severe pain and dehiscence, moderate bleeding.

Bitten - occur as a result of an animal or human bite. They can have a considerable depth with a small lesion area and are always highly contaminated with virulent microflora, often accompanied by the development of a purulent or putrefactive infection, it is possible that animal toxins, rabies virus enter the wound.

Gunshots have significant differences from other wounds.

For gunshot wounds, there are three areas of damage:

1.zones of destruction (wound channel),

2. zones of direct traumatic necrosis (contusion of surrounding tissues from the impact of lateral impact energy)

3. Zones of molecular shock.

By the nature of the wound channel, mechanical wounds are divided into through, blind and tangential.

**Aseptic wounds.**

Only surgical wounds after elective operations or wounds after their primary surgical treatment are considered aseptic.

In the absence of complications, aseptic wounds heal by primary intention.

Conditions for this:

1) absence of infection in the wound,

2) with linear wounds, with contact of the edges and walls of the wound,

3) when suturing a wound

During wound healing, as a rule, there are 3 phases of the course of the wound process.

Phase I - inflammation (1-5th day), begins immediately after injury, is characterized by the development of inflammatory edema and leukocyte tissue infiltration.

In this first phase (period of vascular changes, phase of inflammation, exudative phase), four factors come to the fore:

1. Changes in the permeability of the walls of blood vessels due to the release of histamine, serotonin and other mediators of inflammation with subsequent exudation;

2. Migration of leuko-erythro- and platelets to the area of ​​injury;

3. Synthesis and swelling of collagen fibers in the wound area;

4. Acidosis as a consequence of anaerobic tissue metabolism due to oxygen deficiency.

Regeneration phase II:

In the absence of complications, a quick (48-72 hours) onset of regeneration occurs. The convergence and retention of the edges of the wound after its formation promotes tight juxtaposition of tissues, their primary "gluing" with fibrin.

Phase III - scar formation and reorganization - starts from 15 days to 6 months.

After suturing the aseptic wound, it is drained to evacuate the wound discharge into a hygroscopic aseptic dressing.

The term for removing stitches from an aseptic wound depends on the location, size of the wound, the presence of local and general conditions for regeneration.

Approximately: in the area of ​​the face, neck - for 4-6 days; the area of ​​the anterior abdominal wall - 7-10 days; chest area, shin and foot - 10-12 days.

**TREATMENT OF INFECTED WOUNDS**

Tasks - elimination of early life-threatening complications, prevention of further infection.

First aid includes: a) temporary stopping of bleeding, b) bandaging, c) transport immobilization.

Assistance at the hospital stage: tasks - prevention and treatment of wound complications, acceleration of healing, restoration of functions of damaged organs and tissues.

The basic principles of modern treatment: strict adherence to asepsis, surgical treatment, active drainage, early closure of wounds (primary and primary delayed and secondary sutures, autodermoplasty), targeted antibacterial and immunotherapy.

Primary sutures are applied before the development of granulation tissue, secondary sutures after.

In all cases of contaminated wounds (except for small surface injuries), it is necessary to carry out primary surgical treatment of wounds.

The surgical field after processing is delimited with sterile linen. After anesthesia with a sharp scalpel, the wound edges are excised from 0.5 to 2 cm within the healthy tissue, all damaged, contaminated and blood-soaked tissues are removed. If the wound is punctured, then it is dissected. After excision of the contaminated tissue, all instruments are replaced with clean ones, the wound is delimited with a fresh sterile sheet and gloves are changed. Then the bleeding is stopped and the wound is sewn up in layers.

The primary surgical suture is used as the final stage of the primary surgical treatment of the wound in order to:

a) restoration of the anatomical continuity of tissues

b) prevention of secondary microbial contamination of the wound

c) creating conditions for primary wound healing

Indications for the application of the primary suture:

a) the absence of abundant contamination of the wound,

b) the possibility of excision of all non-viable tissues,

c) the safety of the blood supply to the wound,

d) the possibility of convergence of the edges of the wound without coarse tension,

e) the condition of the wounded is not burdened by starvation, blood loss, infectious disease,

f) the wounded must be under the supervision of a surgeon,

g) wounds of the abdominal and chest cavities.

The primary delayed suture is applied 4-5 days after the operation (before the appearance of granulations); in the absence of signs of suppuration.

It can be applied in the form of provisional (situational sutures), which are applied during the operation, and tightened after a few days, making sure that there is no danger of wound suppuration.

In order to reduce the contamination of the wound with microorganisms, it is advisable to supplement the surgical treatment of the wound:

1) washing it with a pulsating jet of liquid under pressure;

2) evacuation of the wound surface with simultaneous washing;

3) exposure of a wound filled with an antiseptic solution with ultrasound with a frequency of 20-50 kHz,

4) processing the most contaminated areas with a laser scalpel beam.

From the timing of the primary surgical treatment are distinguished: 1) early, 2) delayed and 3) late primary surgical treatment of wounds.

Early surgical treatment of wounds is performed in the first 24 hours after injury, it is most effective in the first 6-12 hours - before the clinical manifestations of inflammation in the wound, ends with the imposition of primary sutures.

Delayed primary surgical treatment is carried out from 1 to 2 days from the moment of injury under the guise of antibiotics, during the period of initial inflammation.

Late primary surgical treatment - after 3 days, when the inflammation is close to maximum and the infectious process already begins - in this situation, the wound is not sutured, only secondary sutures are allowed for 7-20 days.

**Complication of wounds**

Early complications of aseptic wounds include: bleeding, hematoma in the wound, gray, the formation of inflammatory infiltrate, wound suppuration, necrosis of the wound edges, eventration of internal organs.

Late complications include: postoperative hernia, ligature abscess and fistula, keloid and hypertrophic scar, trophic ulcer, scar ossification, contractures.

Wound hematomas are formed in the wounds closed by a seam owing to an incomplete stopping of bleeding during operation or as a result of early secondary bleedings.

Necroses of surrounding tissues - develop at disturbance of microcirculation in the corresponding area at an operational traumatization of tissues, the wrong suture.

Wound fever - its development is promoted by necrosis, foreign matters in a wound, a clump of liquid or a blood, disturbance of local blood supply and the general factors influencing the current of a wound process, and also a high virulence of a wound microflora.

Divergence of edges of wounds meets in the local or general factors presence complicating an adhesion and at too early excision of seams.

With laparotomy, the wound breakdown can be complete (eventration - exit to the outside of the internal organs), incomplete (the integrity of the peritoneum is preserved) and hidden (the skin suture is preserved). The divergence of the edges of the wound is eliminated by surgery.

Prophylaxis of complications provides keeping of asepsis, accuracy of carrying out primary surgical treatment, hemostasis, care with tissues during operations, postoperative control and care of a wound, carrying out immunological prophylaxis.

Preventive antibiotics of infectious complications aseptic and the recently infected wounds depend on a type of an operational grant and is shown in case of an appreciable bacterial content of a wound or conditional radicalism of its surgical treatment.

Depending on degree of microbial flora all operations share on 4 look: 1) pure or aseptic operations (planned, without opening of a lumen of internals) At pure operations to an preventive antibiotics, as a rule don't prescribe.

2) conditionally aseptic operations (operations with a probable becoming infected, an intervention with opening of a lumen of organs) - the antibiotic is entered before operation, and the following dose within the next 8-12 hours. 3) operations with high danger of a becoming infected - conditional infected (appendectomy) - the preparation is entered before operation, and also within 24-48 hours.

4) "dirty" operations - infected (the emergency interventions concerning purulent processes - antibiotics are entered before operation and then within 3-5 next days.

**Control questions:**

1. The definition of wounds.
2. The classification according to the degree of infection.
3. Primary healing. Conditions for healing by primary intention.
4. When should you remove the skin suture?
5. Complications from postoperative aseptic wounds (early and late), their causes, symptoms, principles of treatment and prevention.
6. Complications during a forming of postoperative scar.
7. The role of primary and secondary infections in the development of wound healing.
8. First aid for injuries. The technique of primary surgical treatment of the wound (PST) and the pathophysiological significance of its components (dissection, excision, etc.).The conditions for using of primary and primary delayed suture.
9. Contraindications to primary surgical treatment and primary suture.

10. Features of PST wounds penetrating into the joint.

11. Seroprevention of infection.

**Tests on the topic: «Aseptic and infected wounds»**

***Choose one correct answer***

1. THE LATE PST OF THE WOUND IS CARRIED OUT AFTER

1) 24 to 48 hours

2) from 48 to 72 hours

3) from 36 to 48 hours

4) from 48 to 60 hours

2. THE DIAGNOSIS OF SUPPURATION OF THE ASEPTIC WOUND IS CONFIRMED

1) an increase in the level of white blood cells in the general blood test

2) by shifting the leucoformula to the left

3) the presence of infiltrate in the wound

4) revision of the wound by a grooved probe

3. A PATIENT IN A STATE OF SHOCK PHO IS CARRIED OUT

1) immediately upon receipt

2) the next day

3) after removing the patient from shock

4) no later than 2 hours after receipt

4. EARLY PHO IS CARRIED OUT DURING

1) the first day

2) the second day

3) the third day

4) before the infection develops in the wound

5. THE PRIMARY SUTURE AFTER THE PHC IS NOT APPLIED WHEN

1) osadnenii edges of the wound

2) uncertainty about the quality of the PHO

3) gaping wounds

4) the presence of capillary bleeding

6. PRIMARY SURGICAL TREATMENT IS PERFORMED IN THE TREATMENT OF WOUNDS

1) aseptic

2) freshly infected

3) purulent

4) any

7. ASEPTIC WOUNDS CAN BE COMPLICATED

1) early secondary bleeding

2) late secondary bleeding

3) any kind of bleeding

4) bleeding complication is not typical

8. DRAINAGE OF THE ASEPTIC WOUND IS CARRIED OUT IN ORDER TO

1) reduction of pain syndrome

2) prevention of bleeding from the wound

3) for the outflow of wound discharge

4) all of the above is true

9. FOR EMERGENCY PASSIVE SPECIFIC SEROPROPHYLAXIS OF TETANUS OF FRESHLY INFECTED WOUNDS, USE

1) antistaphylococcal plasma

2) tetanus toxoid

3) tetanus serum

4) fresh frozen plasma

10. FOR EMERGENCY ACTIVE SPECIFIC SEROPROPHYLAXIS OF TETANUS OF FRESHLY INFECTED WOUNDS, USE

1) tetanus toxoid

2) AKDS

3) antistaphylococcal Y-globulin

4) adsorbed staphylococcal toxoid

11. COMMON COMPLICATIONS OF WOUNDS INCLUDE

1) traumatic shock

2) hematoma

3) nerve damage

4) all of the above

12. TREATMENT OF AN ASEPTIC WOUND INCLUDES

1) a rare change of the aseptic dressing

2) aseptic dressings with Vishnevsky ointment

3) daily replacement of drains in the wound

4) pricking the wound with a solution of novocaine with antibiotics

13. THE SUTURE APPLIED TO THE WOUND, AND TIED IMMEDIATELY AFTER THE PHO IS CONSIDERED

1) primary-deferred

2) primary

3) secondary early

4) secondary late

14. PST IS EXPOSED TO WOUNDS

1) aseptic

2) freshly infected

3) purulent

4) any of above mentioned

**12. Clinic and diagnostics of fractures of long tubular bones.**

Fracture is a violation of the bone integrity along the length caused by mechanical stress (trauma) or the influence of metabolic process in the bone (tumor, inflammation).

Fracture classification:

1. According to the origin and reasons of development, fractures are divided into congenital and acquired.

Congenital fractures are caused by abnormal changes in the bones of the fetus and injury to the mother's abdomen.

Acquired fractures are divided into two subgroups: traumatic and pathological. The latter are caused by changes in the bone under the influence of a tumor, osteomyelitis, tuberculosis.

2. Depending on the damage to certain organs or tissues, fractures are distinguished between complicated and uncomplicated fractures.

Complicated fractures include open fractures when the skin or mucous membrane at the fracture site is damaged, which creates conditions for microbes to penetrate the wound and develop inflammation in the bone fracture zone.

Complicated fractures also include damage to large vessels, nerves, and internal organs.

With closed fractures, damage to the skin does not occur.

3. By the nature of bone damage, fractures can be complete or incomplete.

When the fracture extends to the entire diameter of the bone, the fracture is called complete.

If the fracture surface does not extend across the entire diameter of the bone, the fracture is called incomplete.

4. In relation to the fracture line to the longitudinal axis of the bone, fractures are distinguished: transverse, oblique, helical.

5. According to the position of bone fragments relative to each other, fractures are without displacement and with displacement:

a) in width (adlatum),

b) authenticity (ad longitudineum),

c) at an angle (adaxin),

d) rotary (adperipherium).

Distinguish between primary and secondary displacement.

Causes: 1) under the influence of painful muscle contracture - distal,

2) the gravity of the bone fragment,

3) improper immobilization.

6. By localization:

a) epiphyseal (intra-articular),

b) metaphyseal,

c) diaphyseal.

Epiphyseal fractures - for the processes of consolidation (fusion), localization is the most unfavorable, often accompanied by dislocation of an articular fragment, fracture-dislocation, which makes it difficult to establish short fragments in a normal position and fix them.

Metaphyseal fractures are often accompanied by adhesion or knitting of peripheral and central fragments.

From a clinical point of view, the concept of crossover includes not only damage to the bone, but also the simultaneous damage to the surrounding soft tissues caused by both trauma and the impact of displaced bone fragments. There are ruptures of muscles and blood vessels with the formation of a hematoma.

The volume of the poured out blood even in the absence of damage to the large vessels with a fracture of the leg bones is on average 500 ml, with diaphyseal fractures of the femur - up to 1000 ml, with fractures of the pelvic bones - up to 2000 ml.

Fracture process.

A live human bone represents a solid body with a low limit of elasticity. Under the influence of the external force which isn't exceeding limits of its elasticity, the bone is quickly deformed and again takes the initial form. If the arising force exceeds this limit, the bone is fractured.

The form of bone destruction depends on two main moments:

1) sizes, durations and directions of influence of external force;

2) physical properties of the bone – its structure, hardness, elasticity. These properties aren't identical at people of different age and in different bones of a skeleton.

The bone consists of compact substance and spongy. Distribution of compact and spongiform substance depends on functional features. Durability and elasticity depend on certain ratios of the organic and inorganic substances changing throughout all life.

Depending on a point of force application, fractures from a direct trauma (in a zone of the appendix of a trauma), or an indirect trauma (fracture arises far from a place of application) are distinguished – spinal fracture when falling on feet from height.

Taking into account the direction of the operating force fractures from including shift, from a flexure, from torsion are distinguished.

Slanting, spiral or helicoid fractures are distinguishedrespectively. Such shin fractures arose at skiers from falling with simultaneous sharp turn of a trunk aside at strongly fixed foot.

**Fractures healing process**

Bone recovery after injury is a complex biological process that begins immediately after a fracture.

Pathological changes in fractures and their fusion can be divided into 3 periods:

a) changes directly related to trauma and the development of aseptic inflammation;

b) the period of bone formation;

c) the period of restructuring of the callus;

At the time of the fracture and in the first days after it, hemorrhages, death of connective tissue cells, and the development of aseptic inflammation are noted in the area of ​​injury. Serous tissue permeation, emigration of leukocytes, clinically manifested by tissue edema are observed.

Simultaneously with edema, the process of alteration occurs - destruction, necrosis of dead or soft tissues and bones damaged cells. Blood flowing out of damaged intraosseous and muscle blood vessels, traumatic edematous fluid forms extravasate around the bone fragments, which coagulates from the second day.

Simultaneously with the cleansing of the fracture zone from dead cells and tissues, the process mesenchymal tissue begins from 2-3 days, which lasts for 10-14 days (the first stage of fracture fusion).

The developed young mesenchymal tissue fills the defect in the bone, the space occupied by the hematoma both between and around the bone fragments and fixes the latter.

In the area of ​​the newly formed tissue, complex biochemical processes occur that determine the conditions for tissue regeneration. The accumulation of acetylcholine and histamine determines hyperemia - vasodilation, in this regard, blood supply improves, the accumulation of acid and alkaline phosphatase increases, the accumulation of phosphorus and calcium increases due to both decalcification of bone fragments and intake with blood.

At this stage, there is a process of active formation of blood vessels due to the capillaries of the periosteum and endosteum, Haversian canals, bone marrow and the formation of granulation tissue. The newly formed vessels suture the formed primary callus. Osteoid tissue is formed.

Initially, the bone defect is filled with fibroblasts, vessels, osteoblasts; due to the development of the latter, osteoid tissue is formed, constituting a soft (primary) callus, the formation of which lasts 5 weeks (fibrous-bone callus), this ends the second stage of fracture union, which began from 10-14 days.

The regenerate formed between the fragments in the fracture zone and around them is usually called the callus, which consists of several layers, depending on the sources of tissue formation.

There are 4 sources of callus formation.

Callus is formed due to the proliferation of endosteum cells, osteon canals, Haversian canals, periosteum, and connective tissue surrounding the fracture site. Each of these sources of bone formation gives rise to the development of a special layer of callus.

From the periphery to the center, the paraosal, periosteal, intermediate and endostal layers of callus are isolated. All layers develop at the same time.

The paraosal layer of callus develops from the soft tissues surrounding the fracture site.

The development of the periosteal layer of the callus begins from the first days of the fracture: the cells of the cambial layer of the periosteum multiply and by 5-6 days the defect between the bone fragments is filled with a large number of fibroblasts, vessels, osteoblasts - this is the most massive layer of callus. The intermediate layer is formed from the cellular elements of the bone tubules (Haversian canals) of bone fragments.

The endosteal layer is the innermost layer of the callus. It develops from the cells of the endosteum, bone marrow of peripheral and central bone fragments.

Then there is a further restructuring of the callus - the transition of the regeneration process to the third stage - the calcification of the osteoid tissue - lasts 3-4 months. There is a reverse development of blood vessels, edema disappears, inflammation disappears - a secondary callus is formed.

Several factors affect the bone healing process:

1. General factors. Slower bone fusion is observed in elderly and senile people, which is due to a decrease in their tissue reparative capacity, as well as in people suffering from chronic diseases (tuberculosis, amyloidosis, diabetes mellitus, obesity);

2. Anatomical and physiological features of bones affect the fusion of fractures: the reparative capacity of flat bones is lower than that of tubular bones;

3. Local factors that reduce bone regeneration and slow down the healing of fractures:

a) severe trauma, extensive damage to soft tissues, periosteum, bone;

b) circulatory disorder in the fracture zone due to damage or vascular disease;

c) violation of innervation in the fracture zone due to damage or disease of the nerves;

d) intra-articular fractures

e) incomplete reduction or insufficient fixation of the fragments;

f) development of infectious complications

g) interposition of tissues - finding between fragments of bones of muscles, fascia, aponeurosis.

Thus, reparative bone regeneration can be conventionally represented as the following stages:

Stage I fracture concrescence - formation of mesenchymal tissue (2 weeks)

Stage II - the formation of soft (primary) callus (5-6 weeks)

Stage III - the formation of secondary callus (3-4 months)

Stage IV - functional bone remodeling (up to 1 year).

Clinical diagnosis of a fracture is based on an analysis of clinical symptoms, anamnestic data and a number of probable and reliable signs in the area of ​​the fracture.

Probable signs include pain and swelling, deformity, and dysfunction;

Reliable signs - pathological limb mobility in an unusual place (outside the joint) and crepitus of fragments.

Dysfunction is judged by the preservation of active movements. As a rule, immediately after the injury, the patient cannot move the limb or part of it due to severe pain.

Pathological mobility is a reliable sign of a fracture. It must be identified carefully so as not to damage the tissue surrounding the fracture. Bony crepitus is determined manually. The limb is fixed above and below the fracture and shifted to one side or the other. The crunch of fragments rubbing against each other is an absolute sign of a fracture. Due to tissue trauma, identification of the last two symptoms should be resorted to in exceptional cases.

During a clinical examination of a patient with a fracture, the length of the limb is measured, the pulsation of peripheral vessels, skin sensitivity, active movements of the fingers or toes are determined to determine possible damage to the vessels and nerves of the limb.

X-rays to determine the integrity of the bone play an important role in the diagnosis. This method allows you to determine the presence of bone damage, the fracture line and the type of displacement of the fragments. X-rays are taken not only when a fracture is suspected, but also when a clinically clear diagnosis is made.

1. The X-ray should be done in 2 projections: direct and lateral;

2. The structure of the bone tissue is clearly visible;

3. One of the nearby joints should be captured;

4. There should be no artifacts;

5. There should be markings (right, left);

6. In children, shoot a symmetrical segment.

According to radiographs, the types of displacement of fragments are determined:

1) displacement of fragments along the length with overlapping one after another with shortening of the limb and divergence of fragments;

2) displacement of fragments in width with contact;

3) displacement at an angle, open inward, outward, anteriorly, posteriorly;

4) displacement of fragments along the periphery (rotational) is determined by an X-ray gram, capturing two joints in two projections.

**Control questions**

1. Definition of the concept and classification of bone fractures.

2. Mechanism of limb fractures.

3. Pathological anatomy of fractures of long tubular bones. The approximate amount of blood loss in closed fractures.

4. Regularities of fracture healing. Stages of callus formation.

5. Complications of fractures at the time of injury (traumatic shock, fat embolism, etc.) and in the healing process (delayed consolidation, pseudarthrosis, etc.).

6. Plan of examination of a traumatic patient.

7. Local symptoms of fractures and their identification (examination data, palpation technique, etc.)

8. X-ray anatomy of a healthy bone and X-ray symptoms of fractures.

**Tests on the topic: «Clinical picture and diagnosis of fractures of long tubular bones»**

***Choose the one correct answer***

1. A RELIABLE SYMPTOM OF A FRACTURE IS

1) tenderness to palpation

2) swelling in the area of injury

3) crepitus of fragments

4) bruising

1. IN FRACTURES OF THE BRACHIUM AND UPPER THIRD OF THE ANTEBRACHIUM, OBLIGATORY STUDIES OF THE FUNCTIONS OF THE HAND ARE

1) active movements in the joints of the hand, fingers

2) passive finger movements

3) hand dynamometry

4) measuring the range of motion of the hand and fingers

1. TRANSPORT IMMOBILIZATION WHEN PERFORMING X-RAYS ARE

1) remove if it affects the quality of the radiograph

2) not removed

3) removed for closed fractures

4) removed in the absence of reliable signs of fracture

1. PATHOLOGICAL FRACTURE IS POSSIBLE IN

1) inflammatory lesions of soft tissues around the bone

2) pneumonia

3) metastases of a malignant tumor in the bone

4) deep thrombophlebitis of the extremities

1. THE ABSOLUTE FEMUR LENGTH IS MEASURED BETWEEN

1) the top of the greater trochanter and the lateral epicondyle of the thigh

2) the tip of the greater trochanter and the lateral edge of the tibia

3) the upper anterior spine of the ileal crest and the lateral epicondyle of the thigh

4) inguinal fold and medial epicondyle of the thigh

1. THE ABSOLUTE BRACHIUM LENGTH IS THE DISTANCE BETWEEN

1) the acromial process of the scapula and the olecranon

2) a large tubercle of the shoulder and its lateral epicondyle

3) a large tubercle of the shoulder and elbow bend

4) the acromial process of the scapula and the elbow bend

1. TO REFINE THE TYPE OF FRACTURE AND DISPLACEMENT OF THE FRAGMENTS, X-RAYS ARE PERFORMED

1) in direct projection

2) in lateral projection

3) in frontal and lateral projection

4) at the discretion of the doctor

1. BONE FRAGMENTS SHIFT

1) along the length, along the axis

2) at an angle, along the length

3) in width

4) all of the above

1. A FRACTURE IS CONSIDERED OPEN IF

1) there is any wound on the same segment in the projection of the fracture

2) there is any wound on adjacent areas of the body

3) only when the bone fragments remain in the wound

4) aseptic dressing is not applied

1. ALONG THE LINE OF FRACTURE OF THE BONE, FRACTURES ARE

1) transverse, oblique

2) longitudinal, T-shaped

3) helical

4) all of the above

1. LOCAL COMPLICATIONS OF FRACTURES INCLUDE

1) damage to nerves, blood vessels

2) traumatic shock

3) fat embolism

4) segment deformation

1. GORINEVSKAYA'S RULE IS APPLICABLE FOR BONE FRACTURES OF

1) pelvis

2) femur

3) foot

4) hand

1. A TEST WITH AXIAL LOAD IS CONDUCTED FOR

1) any fractures

2) suspicion of a fracture and the absence of its absolute signs

3) open fractures

4) suspected fracture & dislocation

1. A RELIABLE SYMPTOM OF BONE FRACTURE IS

1) local hyperthermia

2) pathological mobility

3) local edema

4) local soreness

1. FAT EMBOLISM AFTER A FRACTURE IS PROMOTED BY

1) lack of transport immobilization

2) the presence of transport immobilization

3) performing local anesthesia

4) all of the above

1. EARLY COMPLICATIONS OF FRACTURES INCLUDE

1) damage by fragments of internal organs

2) slowed down consolidation

3) false joint

4) all of the above

1. INTERPOSITION OF SOFT TISSUES IS

1) displacement of bone fragments

2) hematoma formation

3) ingress of soft tissues between bone fragments

4) soft tissue damage

1. BLOOD LOSS AT A CLOSED FEMUR FRACTURE IS ABOUT

1) 200 ml

2) 500 ml

3) 800 ml

4) 1000 ml

**13. Treatment of long tubular bones fractures.**

Treatment of patients with bone fractures pursues two main goals – to save the victim's life and complete restoration of the anatomical integrity of the bone and limb function.

There are the following stages of medical care.

First aid includes the following measures:

a) Stopping the bleeding - as one of the temporary ways to stop bleeding (tourniquet, finger pressure, pressure bandage, wound tamponade).

b) Prevention of shock - includes pain relief (promedol, morphine, analgin, tramal).

c) Transport immobilization - the main task of transport immobilization is to ensure the immobility of fragments of broken bones for the period of transportation of the victim to a hospital. Transport immobilization helps to reduce pain and is one of the most effective anti-shock measures. Immobilization of limbs is carried out using standard (factory-made) splints: Kramer`s, Diterichs`, pneumatic.

Carrying out transport immobilization it is necessary to follow the following rules:

anesthesia has to precede splinting;

before splinting an aseptic bandage is applied to the wound surfaces, and at arterial bleeding – a tourniquet;

splints are applied directly to clothing or any cloth is laid between the skin and the splint; Cramer's splint is always modeled on a healthy limb before being applied; the reliability of fixation of the damaged segment is achieved due to the immobilization of the joints located above and below the fracture zone (in case of a hip fracture, all 3 joints of the limb are fixed) to the aseptic dressings and hemostatic tourniquet, free access should be maintained, not blocked by the elements of the immobilization splint; transport immobilization is performed in a functionally advantageous position.

At the stage of providing specialized care, complete clinical and radiological diagnostics are carried out, and the further treatment program is determined.

**Fracture Treatment Principles:**

1.Closed one-stage reduction of bone fragments.

2. Creation of immobility of matched bone fragments - immobilization.

3. Application of means and methods that accelerate the formation of callus.

The provision of the above principles is achieved by using one of the three main methods of treatment: conservative, by skeletal restoration and surgical osteosynthesis.

Conservative treatment of fractures is used if there is no displacement of the fragments or the existing displacement is easily eliminated, with the comparison of the fragments without violating the integrity of the skin.

The reposition of the fragments consists in eliminating their displacement, and accurately matching the bone along the fracture line. The outcome of treatment - the restoration of normal function of the limb - is largely determined by the complete elimination of the displacement and accurate apposition of the fragments.

One-step forced reduction of fractures is performed manually or with special devices.

All therapeutic measures, including reduction of fragments, immobilization, should be provided with adequate anesthesia. The pain causes a reflex muscle contraction, which holds the fragments in a displaced position and prevents them from reposition. Pain relief for fresh fractures is easily achieved with the introduction of 20 ml. 1-2% solution of novocaine in the area of ​​the fracture. The injected solution of novocaine mixes in the area of ​​the fracture with blood and soaks the surrounding tissues. If the solution gets into the hematoma, then the pain and spastic muscle contraction immediately stop.

The directed fragments are usually held in the correct position with a plaster cast, after which a control X-ray examination is performed. Most often, the following types of plaster casts are used: longet covering 2/3 of the circumference of the limb; circular; fenestrated, for access to the wound surface; bridge-like, consisting of two or more circular fragments connected by plaster bridges; spica cast, combining a circular bandage on the limbs with a circular bandage at the level of the pelvis or abdomen; "Boot", from the toes to the knee joint; plaster "corset", circularly covering the chest and abdomen with spinal fractures.

When applying plaster casts, several general rules should be followed:

1. Give the limbs a functional advantageous position.

2. There must be good reduction of bone fragments.

3. A plaster cast should be applied to two nearby joints.

4. Keep the ends of the toes or toes open.

5. Quilted jackets made of plain cotton are placed under the bone protrusions.

6. The bandage should be carefully modeled, fit evenly, but not squeeze the underlying part of the body.

7. In the course of treatment with plaster casts, mandatory X-ray control of the position of bone fragments and the development of callus is carried out.

Disadvantages of plaster immobilization.

1) A position is not always successful.

2. Inability to keep bone fragments in massive muscle tissues.

3. Immobility of the entire limb causes muscle atrophy, joint stiffness, phlebitis, lymph-venous stasis, it is difficult to lie down for elderly patients.

The method of skeletal traction (a functional method of treatment) is used for diaphyseal fractures of the thigh, lower leg bones, shoulder fractures, as well as in cases when, with a pronounced displacement of fragments, one-step manual reduction fails.

The method of permanent traction provides for both reposition and retention of fragments. Cutaneous and skeletal traction is used. When treating fractures with permanent traction, consider:

1) the traction is carried out in the middle physiological position of the damaged limbs, i.e. in a state of equilibrium between the antagonist muscles. It is achieved by the position of the limb laid on Beller splints,

2) the reposition should be carried out along the axis of the central fragment, i.e. a peripheral fragment should be placed along the axis of the central one,

3) the tensile load should increase gradually, which contributes to

painless and gradual muscle stretching and repositioning,

4) it is necessary to create counter-stretching, for example, raising the leg

the end of the bed.

The size of the load is determined by the degree of displacement of bone fragments, muscle development and the patient's weight. The approximate weight for fractures of the lower limbs is 15% of the body weight for a hip fracture, and 10% of the body weight for a tibia fracture, or it is equal to the first figure of body weight + half of its value for a hip fracture. To provide counter-draft, the bed is raised to different heights depending on the load used: with a load of 6-10 kg - by 30 cm, with a load of 11-15 kg - by 70 cm.

The reposition of the fragments lasts 1-3 days, after which the reparation period begins, the formation of callus, which lasts an average of 4-6 weeks, depending on the location and type of fracture.

To create an increasing thrust during the reposition of fragments, the load increases gradually over the course of a day, starting from 4-5 kg ​​and every 2 hours 1-2 kg is added. Upon reaching the reposition of the fragments, the weight is reduced to 4-5 kg ​​(50% of the initial value) in order to prevent overstretching of the muscles and the divergence of the fragments.

Advantages of the method:

1. Accuracy and controllability of gradual reduction.

2. Reduces the risk of contractures, stiffness.

3.Can heal limb wounds.

4. Apply physiotherapy methods, massage.

Disadvantages:

1.Pin-track osteomyelitis, damage to blood vessels, nerves during wire conduction.

2. The need for long-term inpatient treatment, forced position of the limb. It is necessary to take care of the complete restoration of the functions of the limbs. This is achieved by treating fractures using a functional method, which means the use of active movements in the joints.

One of the options for skeletal traction is the method of extrafocal compression-distraction osteosynthesis using Ilizarov, Gudushauri and Volkov-Oganesyan devices. This method allows for gradual reduction and reliable fixation with their metered compression due to special rings and half-rings with pins fixed in them, passed through bone fragments on both sides of the fracture and at a considerable distance from it. Ring-shaped metal structures move in relation to each other along the screw rods, due to which a single load axis is created on the injured limb with the distribution of the support function not only on it, but also on the metal rods.

Advantages of the method: impact on the bone outside the zone of damage, accurate matching of fragments, functionality - the possibility of full movement in the joints, early loading, the possibility of lengthening the limb, the possibility of treating false joints with compression.

Disadvantages: the complexity of the apparatus and the operation, the possibility of damage to the wires of the nerves, blood vessels, wire osteomyelitis.

In clinical practice, in a number of cases, they resort to surgical treatment of bone injuries by means of classical osteosynthesis. This method is absolutely indicated for: interposition of soft tissues between bone fragments, ineffectiveness of conservative methods of reduction and fixation of bone fragments, the presence of double and multiple fractures, open fractures, damage by fragments of bones of vital organs. Surgical treatment is contraindicated: In severe general condition, cardiovascular failure, any purulent process in the body, be careful in children, it is better to use a Kirschner wire so that there is no violation of the growth zone.

The connection and retention of bone fragments can be achieved in various ways using metal materials (pins, plates, screws, bolts, wires) - metal rods are inserted into the bone (intermedullary osteosynthesis), or metal plates are applied and fixed with screws from the outside (extramedullary osteosynthesis) bone fragments can be connected with screws, bolts, metal wire. All these types of bone joints are used for surgical intervention directly in the zone (focus) of the fracture. The fracture site is exposed surgically, open reposition of the fragments is carried out and then fixation with one of the means, depending on the location and type of the fracture.

Recently, nickel and titanium alloys have become widely used, which have the property of remembering the original shape - the so-called metals with memory.

The disadvantages of this method are additional tissue trauma at the site of the fracture, destruction of the bone marrow throughout with intramodular osteosynthesis, the need for reoperation to remove the structure after fracture consolidation (after 8-12 months).

Complications in treatment of fractures.

general:

1. Traumatic shock.

2. Fat embolism.

3. Posthemorrhagic anemia.

local:

1. Osteomyelitis.

2. nearthrosis.

3. ununited fracture.

4. malunion.

5. bedsore.

6. Ankylosis.

Residual effects:

1. Amyotrophy.

2. Arthrosis of adjacent joints.

3. Chronic phlebitis – a chronic venous failure.

**Delayed adhesion and resistant failure of of bones connection in the fractures.**

Deviations from a normal adhesion of bones during treatment of fractures can cause delayed union or nearthrosis. Terms of formation of a nearthrosis are 9-10 months after fracture, during this period there is a closing of the medullar channel.

Reasons for the delayed consolidation:

1. Malreduction of fragments;

2. insufficient immobilization (at a skeletal traction);

3. Partial or full interposition of tissues;

4. defects after excision of osteal fragments;

5. osteomyelitis of osteal fragments in a fracture zone;

6. Trophic disturbances due to nerves injury by an appreciable trauma of soft tissues.

Signs of delayed consolidation are: pathological mobility of a limb in a fracture place, a hyperemia of tissues, swelling, atrophy of muscles, pain at an axial load.

During conservative treatment of the delayed consolidation careful immobilization is applied for the entire period. It is necessary for fresh fracture healing. The immobilization is performed by a plaster bandage or devices for a compression osteosynthesis.

Massage, therapeutic exercises, electrophoresis with ions of Ca, anabolic steroid hormones are usedto improve osteanagenesis.

The treatment of nearthrosis is surgical: to exsect cicatrical tissues between fragments, to refresh their ends, to open medullar channels and carefully put together the fragments. The osteal fragments are fixed with the compression device either bone autotransplantants or with surgery in the sort of "the Russian lock".

**Control questions:**

1. The treatment of long bone fractures:
   1. tasks
   2. - steps  
      - principles  
      - methods
2. First aid in caseof closed andopen fractures. Thetypes of transporttiresand technologyof their application.
3. Anesthesiaof fracture and principles of treatment.
4. Technique for manual reposition and frame reduction.
5. Technique of skin and skeletal traction. Necessary appliance.
6. Indications and contraindicationsfor surgical treatmentof fractures
7. What does

-closed intramedullary osteosynthesis,

-extramedullary osteosynthesis,

-extrafocal osteosynthesis

mean?

1. What period is necessary to recover after fracture?
2. The treatment of delayed union and nearthrosis.

**Tests on the topic: «Treatment of fractures of long tubular bones»**

***Choose one correct answer***

1. FIRST AID IN OPEN FRACTURE WITH ARTERIAL BLEEDING BEGINS WITH THE:

1) immobilization of the limb

2) administration of an arterial tourniquet on the limb above the level of the fracture

3) bandaging the wound of the limb

4) carrying out anti-shock therapy

1. TRANSPORT IMMOBILIZATION AT THE PREHOSPITAL STAGE IN CASE OF A SHOULDER FRACTURE IS PERFORMED BY

1) Diterichs' splint

2) plaster split

3) Cramer’s splint

4) Böhler`s splint

1. REPOSITION OF FRACTIONS CAN BE

1) one-step, gradual

2) achieved by skeletal traction

3) open, closed

4) all of the above is true

1. THE PRINCIPLE OF REPOSITION CONSISTS IN

1) traction of the limb for the peripheral fragment along the axis of the central fragment

2) traction of the limb for the central fragment along the axis of the peripheral fragment

3) straightening the limb with angular deformity

4) putting together the bone fragments

1. TRANSPORT IMMOBILIZATION PROVIDES THE

1) traumatic shock prevention

2) reposition of fragments

3) asepsis of the wound with open fractures

4) stop bleeding

1. THE INDICATIONS FOR THE IMPLEMENTATION OF SKELETAL TRACTION ARE

1) transverse thigh fractures

2) transverse shaft fractures

3) impacted fractures

4) interposition of soft tissues

1. A SPOKE FOR SKELETAL TRACTION FOR OBLIQUE FRACTURE OF THE FEMUR DIAPHYSIS IS PASSED THROUGH THE

1) greater trochanter

2) the diaphysis of the thigh below the level of the fracture

3) tibial spine

4) patella

1. GORINEVSKAYA'S RULE ASSERTS THAT:

1) the lower the level of the hip fracture, the more medially the distal fragment is displaced

2) the higher the level of the hip fracture, the more laterally the central fragment is displaced

3) the higher the level of the hip fracture, the more laterally the distal fragment is displaced

4) the displacement of bone fragments on the thigh does not depend on the level of the fracture

1. THE DITERICHS’ SPLINT IS USED FOR TRANSPORT IMMOBILIZATION UNDER

1) shoulder fracture

2) forearm fracture

3) thigh fracture

4) shin fracture

1. FENESTRATED PLASTER CAST IS USED

1) for closed fractures

2) for fractures with displacement

3) with applying skeletal traction

4) with open fractures

1. IN A SHOULDER FRACTURE, \_\_\_\_ JOINT(S) MUST BE IMMOBILIZED.

1) one

2) two

3) three

4) four

1. SPLINTS THAT ARE USED FOR TRANSPORT IMMOBILIZATION

a) Dieterich’s

b) Beller’s

c) Cramer’s

d) CITO

***Choose the right combination of answers***

1) a, c

2) a, b

3) b, c

4) b, d

1. IN FRACTURE OF THE BONES DIAPHYSIS OF THE FOREARM, THE PLASTER CAST IS APPLIED FROM

1) the fingers to the upper third of the shoulder

2) metacarpophalangeal joints to the upper third of the shoulder

3) the metacarpals to the lower third of the shoulder

4) fingers to the elbow joint

1. PREVENTION OF TRAUMATIC SHOCK BEGINS AT THE \_\_\_ STAGE

1) first aid

2) first medical aid

3) hospital treatment

4) specialized medical care

1. AT THE PRE-HOSPITAL STAGE OF CARE, THE EASIEST METHOD OF IMMOBILIZATION IS

1) application of a plaster cast

2) immobilization with Cramer’s splint

3) autoimmobilization

4) immobilization with Dieterich’s splint

1. SKELETAL TRACTION IN THE FACTURE OF THE HIP IS CARRIED OUT WITH THE USE OF A \_\_\_ SPLINT

1) Dieterich’s

2) Cramer’s

3) Beller’s

4) CITO

1. IN EXTRAMEDULAR OSTEOSYNTHESIS, THE FIXING STRUCTURE IS PLACED

1) in the bone marrow canal

2) on the bone

3) outside the fracture zone

4) all of the above is true

1. TOTAL LOSS OF MOBILITY IN THE JOINT IS DEFINED BY THE TERM

1) ankylosis

2) contracture

3) rigidity

4) stiffness

1. DURING THE IMPOSITION OF SKELETAL TRACTION, THE KIRSHNER’S SPOKE IS PASSED THROUGH THE BONE USING
2. an osteotome

2) a drill

3) a surgical hammer

4) a puncher

1. BY DESIGN, PLASTER CASTS ARE

1) circular, longitudinal

2) fenestrated, bridged

3) folding, longitudinal circular

4) all of the above

1. THE ABSOLUTE INDICATION FOR OPERATIVE TREATMENT OF FRACTURES ARE

1) signs of damage by fragments of blood vessels, nerves

2) impacted fracture

3) fracture with displacement at an angle

4) all of the above

1. COMPLICATIONS OF FRACTURE HEALING INCLUDE

1) joint stiffness

2) muscle hypotrophy

3) delayed consolidation

4) pain and swelling

1. WHAT CONCENTRATION IS USED FOR THE SOLUTION OF NOVOCAINE FOR THE BLOCKADE OF THE FRACTURE AREA?

1) 0,25%

2) 0,5%

3) 1-2%

4) 10%

1. THE APPROXIMATE VALUE OF THE LOAD FOR SKELETAL TRACTION IN THE FRACTURE OF THE THIGH IS \_\_ OF THE BODY WEIGHT.

1) 10%

2) 20%

3) 15%

4) 25%

1. WHICH PART OF THE DIETERICH’S SPLINT IS APPLIED FIRST?

1) the outer part of the splint

2) the inner part of the splint

3) outsole

4) the order in which the splint parts are installed does not matter.

1. AT THE SCENE OF THE ACCIDENT ANESTHESIA WHEN RECEIVING A FRACTURE IS CARRIED OUT BY

1) novocaine blockade of the fracture site

2) intramuscular injection of analgesics

3) conduction anesthesia

4) in any of the above way

1. DELAYED CONSOLIDATION IN TREATMENT OF FRACTURES DEVELOPS DUE TO

1) general reasons (old age, chronic intoxication, metabolic disorders)

2) local reasons (incorrect reposition of fragments, insufficient immobilization)

3) local reasons (interposition of soft tissues between bone fragments)

4) 2 and 3 answers are true

**14. Etiology, pathogenesis, clinic of thermal burn.**

The damage of tissues caused by action of high temperature, chemicals, current radiation is called as a burn.

Respectively, on an etiological factor, distinguish thermal, corrosive, radial and electric burns.

Thermal burns represent the most widespread type of lesions.

For the characteristic of lesion depth there is standard 4 sedate classification:

I degree – hyperemia and a skin edema;

II degree – lesion of epidermis with bubbles;

III a degree – necrosis of epithelium and blankets of a derma with conservation of hair bulbs, sweat and sebaceous glands;

III b – death of all derma (with hair bulbs, sweat and sebaceous glands with transition to a fat);

IV degree – necrosis of all skin and the tissues located under it.

Burns of I, II, III a degrees are surface, heal independently as cuticularization sources are kept (a cambial layer of an epithelium, lead-out ducts of sebaceous sweat glands, hair follicles).

Burns of III and the IV degrees are deep and struck all possible sources of body height of an epithelium therefore independent closing of defect is impossible.

Depending on depth of damage distinguish the following types of neogenesis of an epithelial integument: vertical (at I and II degrees), insular (III and degree) and horizontal (III degree).

During the first hours and days it is difficult to determine lesion depth. Approximately in the first two days for definition of a damage rate it is possible to investigate painful sensitivity – painful sensitivity at burns of III a degree it is sharply lowered, and at III and the IV degrees sensitivity is absent (needles).

It is possible to use a thermometry method – skin circulation failure is followed by dropping of its temperature that allows to differentiate burns of III a and III b degrees. Temperature of burns of III b is 1,5-2 °C lower than III a. Precisely it is possible to determine lesion depth for 7 – 14 days after a trauma. Severity of a burn depends on depth and the area of a lesion which is usually expressed as a percentage to the general surface of a body. Surface area of a skin fluctuates from 15 000 to 21 000 cm2.

Determination of the burn area is made by means of various methods.

Rule of "nine" (Wallace, 1951). According to this rule, the area of separate areas of a body is peer or multiple "9".

The head, neck – 9%,

lower extremity of 18%,

femur of 9%,

anticnemion and foot of 9%,

external genitals of 1%,

forward and lower speak rapidly trunks on 18%.

The rule "palms" - Glumov's method (1953). The size of a palm of the sick person makes 1% of all surface of a skin. Usually at determination of the area of combustions use rules of "nine" and "palms".

Postnikov's method. If the burns don't occupy completely any area of a body, and settle down separate sites, at a difficult lesion use the table of the areas of separate parts of a body; to total area. The area of burns on Postnikov's method is measured by applying on them sterile cellophane and inking the contours of a burns.

For measurement of the area of a burn across Vilyavin special forms (skitets) with the printed silhouettes against tables are necessary. The ruled silhouettes are shaded with colored pencils, and calculation of the area make according to the table.

Forecasting burn severity.

At adults of middle age critical state is a state when a total burn of the I degree or the II-III a degrees is 30%, III b burn – the IV degrees is 10-15% is considered life-threatening.

At adults the rule "one hundred" - age + the total area of burns a as a percentage approximately matters: to 60 – the forecast favorable, 61-80 – rather favorable, 81-100 – doubtful, 101 and more – adverse (only for adults). More exact is the Franc index: it is based on the assumption that the deep burn makes condition of the patient three times heavier than surface burns. Therefore if 1% of a surface burn is equated to unit, a deep burn – to 3 units. The sum of indicators of surface and deep burns makes the Franc index.

The forecast of a burn is favorable if an index of Franc makes less than 30 units; rather favorable – if 30 – 60 units, adverse – more than 91 units.

Severity of damage is defined by three major factors: depth (degree) of a burn, the area of a lesion (in %); localization.

For designation of burns Yu.Yu. Dzhanelidze's formula is offered. A burn is characterized by fraction, in numerator there is the area of a lesion, and in a denominator – burn degree is specified. In addition, an etiological factor is indicated before the fraction (thermal burn, chemical or radiation), and after all the main affected areas are the head, neck, trunk.

Thermal burn .

**Clinical picture:**

Local changes in a burn are shown as a serous or serosanguineous inflammation – a burn dermatitis which outcome depends on depth and the area of a burn and character of the affecting factor.

At the I degree burn there are diffuse redness and slight swelling appearing in some seconds at a flame, boiled water, a steam burn or in some hours after sunshine – severe burning pain in the burn area. In 3-5 days peels, sometimes there is a small pigmentation.

At the II degree burn – redness, swelling, pain; bubbles are formed immediately – their contents at first is transparent, then it turns turbid due to protein coagulation and admixture of cellular elements. In 10-12 days the burn heals without scars.

The III degree burn in general is characterized by an eschar. With dry necrosis, the skin is dry, dense, brown or black, insensitive to touch. With wet necrosis, which occurs more often when exposed to steam, boiling water, the skin is yellowish-gray, edematous. Subcutaneous fatty tissue is loose, edematous. In the future, there is a demarcation of dead tissue, accompanied, as a rule, by infection and suppuration. Purulent-demarcation inflammation develops, then necrosis is rejected and the wound is cleaned, the regeneration phase begins: granulations are formed, epithelialization and scarring occur. Burns of III a degree are characterized by a combination of exudation and necrosis (thick-walled blisters). With a burn of III a degree, one can count on independent insular epithelialization due to the preserved hair follicles, sweat and sebaceous glands, while marginal epithelization occurs at the same time. With a burn of III a degree, one can count on independent insular epithelialization due to the preserved hair follicles, sweat and sebaceous glands, while marginal epithelization occurs at the same time. At a burn of the IV degree – implications of necrotic changes it is more expressed, than at a burn of the III degree, the tissue carbonization is quite often observed.

Recovery at the I degree happens within a week. At uncomplicated II degree – about 2 weeks. Terms almost don't depend on the area. At the III degree rejection of a scab happens in 2 weeks, the granulating wound is bared. Emergence on it lilac-blue islands of an epithelium testifies to III and degrees, absence – to III degrees. An adhesion happens to formation of granulations and cicatrixes. At III and they plane, at III – rasping, disfiguring. Terms of an adhesion depend on the area.

Burn disease

At surface burns more than 15% of a surface of a body or at deep on the area more than 10% of a surface of a body the burn disease develops.

The burn disease is a complex of clinical symptoms – various disturbances of activity of organs and systems which set should be considered as a burn disease (at elderly and deep lesions even 5% of a body can lead children to a lethal outcome).

During a burn disease 4 periods are distinguished:

1. Burn shock – proceeds about 3 days.

2. A burn toxemia – 7-8 days (10-15 days according to Petrov).

3. A septicotoxemia – from 10 days (from 2-3 weeks to 2-3 months) – the beginning of the period is bound to a casting-off of necrotic tissues.

4. Recovery period. It is observed after a spontaneous adhesion of wounds from operational restoration of an integument.

Burn shock.

The peculiar features of burn shock distinguishing it from traumatic are:

1) lack of a hemorrhage,

2) expressed blood plasma loss,

3) hemolysis,

4) peculiar dysfunction of kidneys.

In development of shock it is necessary to allocate two main pathogenetic mechanisms:

1. The excessive painful impulsation leads to CNS function change – at first exaltation, and then inhibition of a cortex and subcortical layer, excitation of the center of sympathetic, nervous system and rising of function of endocrine glands. It causes entering augmentation in a blood of an antidiuretic hormone of a pituitary body, catecholamins.

2. Due to a thermal lesion of a skin and subjects of tissues under the influence of mediators of an inflammation there are both local and serious general disorders: blood plasma loss, microcirculation disturbances, massive hemolysis, change of water and electrolytic balance and acid and main equilibrium, disturbance of functions of kidneys.

The leading factor of burn shock is blood plasma loss, caused by rising of permeability of walls of capillaries, the maximum later after a combustion develops 6-8 hours a hypovolemia, promotes further disturbance of microcirculation in kidneys, a liver, a pancreas – the necrosis in a combustion zone, formation of ulcers develops in a gastrointestinal tract secondary. The hemolysis is the reason of the raised content of potassium in plasma. Permeability of vessels is broken right after a combustion, but clinically expressed value reaches 6-8 hours later. The developing hypovolemia becomes the reason of hemodynamic disorders, disorders of microcirculation and DVS-of a syndrome.

During the first hours after a burn the volume of extracellular liquid decreases by 15-20% due to intensive evaporation from a burn surface, through the healthy skin, with respiration, with a vomitive masses. Reduction of a renal blood flow because of a vasospasm, decreases of circulating blood volume, a hemolysis, disturbance of rheologic properties of a blood is the reason of an oliguria.

For erectile phase of shock the general exaltation of the patient, rising of a ABP, hurried breathing is characteristic – 2-5 hours last, then the torpid phase develops. Modern adequate therapy can prevent this phase. The wrong delivery of health care, overdue inadequate treatment, an additional traumatization of the burn develops more serious torpid phase, to the forefront there are inhibition phenomena.

According to the clinical course, there are 3 degrees of burn shock:

I degree - heart rate 90 per minute, blood pressure - normal or increased, hourly urine output is not reduced, patients are agitated.

II degree - with damage to 21-60% of the body surface - inhibited, weakness, consciousness preserved, pulse 100-120 per minute, hypotension, chills, temperature below normal, thirst, hematocrit 60-65%, metabolic acidosis.

III degree with thermal damage to 60% of the body surface in 1-3 hours after the burn, confused consciousness, lethargy, stupor. Pulse is threadlike, A / D decreases to 80 mm Hg. Art., macro-microhematuria, urine of dark brown color (like "meat slops"), then anuria, hemoconcentration, hematocrit up to 70%, hyperkalemia, decompensated acidosis, t <36˚ С.

The burn shock lasts from 2 to 48 hours, after which, with a favorable outcome, peripheral blood circulation and microcirculation begin to recover. The body temperature rises, diuresis is normalized. During this period, signs of the 2nd stage of burn disease - acute burn toxemia - begin to appear.

Acute burn toxemia develops a maximum of 2-3 days after a burn, lasts 10-15 days. The end of this period coincides with the beginning of the suppurative process in burn wounds. Toxemia can develop following burn shock or without shock.

Burn toxemia develops both as a result of intoxication of the body with protein breakdown products, toxic substances absorbed from burned tissues and possessing antigenic properties, and as a result of toxins released by microbes that seed the burn surface. The manifestations of toxemia depend on the nature of necrosis: with wet necrosis, dead tissue is quickly rejected and this period is shorter, but more severe. With dry necrosis, the rejection is longer, but this period is easier for patients.

The development of burn toxemia is associated with the appearance of nonspecific toxins (histamine, serotonin).

The cardinal symptoms of toxemia are: fever up to 38-39 ° C., Of central origin (cerebral edema, thermoregulation disorders), agitation, delirium, insomnia, symptoms of toxic myocarditis from the heart (tachycardia, deafness of tones, hypotension, congestion in the small circle of blood circulation), foci of pneumonia. From the gastrointestinal tract: anorexia, thirst, vomiting, dry tongue, jaundice, during the period of toxemia, plasma loss stops, high proteolytic activity of blood serum is noted in the blood. Burn toxemia lasts 10-15 days. In the blood - rapidly progressing anemia, hypoproteinemia, increased bilirubin (indirect and direct). In the urine - protein, cylinders, patients often die at this stage. The immediate cause of death is often pneumonia.

Septicotoxemia - 10-14 days after the burn. It follows acute toxemia and continues until recovery (epithelialization of the burn surface) or death of the patient. In time, the beginning coincides with the rejection of the burn scab and the beginning of the local purulent process.

This period is divided into two phases:

Phase I from the beginning of scab rejection to complete cleansing of the wound in 2-3 weeks;

Phase II of the existence of granulating wounds until they are completely healed.

Phase I clinic:

It has a lot in common with toxemia - signs of purulent intoxication, high fever, weakness, chills, anemia, toxic hepatitis).

Phase II is characterized by the appearance of various complications of an infectious nature: a) pneumonia, b) acute gastrointestinal ulcers (Kurling), c) burn exhaustion - wounds do not heal, granulations do not mature, d) burn sepsis - early - during a period of violent inflammation in a burn wound, and late sepsis - 5-6 weeks after injury (when the wounds are cleared of dead tissue).

Clinically, septicotoxemia is characterized by resorptive fever - insomnia, tachycardia (the phenomena of toxic myocarditis, microcirculation disorders persist), the phenomena of alimentary dystrophy associated with anorexia, dysfunction of the stomach deepen, bacteremia appears, turning into sepsis, wound exhaustion. General purulent infection, sepsis comes to the fore. Due to intoxication, many of the symptoms coincide with the previous phase. Hypoproteinemia, anemia, and exhaustion continue and increase. This phase is inherent in deep and extensive burns.

Reconvalescence - the elimination of a burn wound does not mean complete recovery. On the part of the internal organs, disturbances persist, the temperature normalizes, fatigue persists, in 10% of burned patients there are signs of pyelonephritis, amyloidosis, signs of cardiovascular insufficiency.

**Control questions:**

1. The characteristic of the thermal factors that cause burns.
2. Skin histopathological feature and regeneration.
3. The classification of burns.
4. How to measure the burn area.
5. Changes associated with burns of various degrees.
6. The periods and duration of burn disease.
7. The features of
   * burn shock;
   * toxemia period;
   * toxicoseptic period.
8. Haematic picture and biochemical changes in different periods of burn disease.
9. General and local complications of burns.

**Tests on the topic: «Etiology, pathogenesis, clinical picture of thermal burns»**

***Choose the one correct answer***

1. IN III A DEGREE BURNS \_\_ ARE EXPOSED TO NECROSIS

1) the skin and subcutaneous tissue

2) the entire epithelium and the skin itself to the subcutaneous tissue

3) the epithelium and apex of the basement membrane

4) not only soft tissues, but also bones

2. IN III B DEGREE BURNS, SELF HEALING AND EPITHELIZATION IS POSSIBLE IN CASES WHEN THE DIAMETER OF THE AREA OF THE DEFEATED AREA DOES NOT EXCEED

1) 5-6 cm

2) 10-12 cm

3) possible, regardless of the area

4) 2-3cm

3. Four days after a burn of II-III degree, 40% of the body surface, the patient's pulse rate is 100 bpm; BP is 100/70 mm Hg, 5-10 ml of urine per hour is released through the catheter. THE CONDITION OF THE PATIENT SHOULD BE ESTIMATED AS A

1) continuing burn shock

2) severe general infection

3) acute renal failure

4) chronic renal failure

4. The burn surface occupies more than half of the right arm and the right half of the body. RELIABLE DATA ON DETERMINING AREA BURNS CAN BE OBTAINED BY USING

1) B.N. Postnikov’s method

2) the rule of nines

3) G.D. Vilyavin’s method

4) the rule of "palms"

5. THE STAGE OF BURN SEPTICOTOXEMIA ENDS AFTER THE

1) complete healing of the burn wound

2) elimination of infection in the wound

3) restoring protein levels

4) all of the above is true

6. THE STAGE OF BURN TOXEMIA CONTINUES TO THE

1) epithelialization of the wound

2) scab rejection

3) normalization of body temperature

4) all of the above is true

7. The burn surface covers the entire body. RELIABLE TO DETERMINE AREA OF BURN BY USING THE

1) the rule of nines

2) G.D. Vilyavin’s method

3) the rule of "palms"

4) B.N. Postnikov’s method

8. IN A TORPID PHASE OF SHOCK OF THE III DEGREE, THE BLOOD PRESSURE IS EQUAL TO

1) less than 90/60 mm Hg

2) more than 100/70 mm Hg

3) less than 120/60 mm Hg

4) more than 120/90 mm Hg

9. DURATION OF BURN SHOCK

1) up to 1 day

2) up to 2 days

3) up to 3 days

4) up to 4 days

10. The entire burn surface is covered with pustules of various sizes with serous fluid. BURNS CAN BE INTERPRETED AS

1) fresh IIIa degree

2) fresh II degree

3) infected III degree

4) IV degree

11. THE MOST FULL DEPTH OF SHOCK IS CHARACTERIZED BY THE

1) pulse, blood pressure, respiration

2) pulse, blood pressure, diuresis

3) pulse, respiration, temperature

4) pulse, respiration, skin color

12. THE ERECTIL STAGE OF BURN SHOCK CAN LAST UP TO

1) 30 minutes

2) 2 hours

3) 6 hours

4) 3 days

13. The burn surface occupies small areas of the skin on different segments. BURN AREA CAN BE DETERMINED BY USING

1) the rule of nines

2) the rule of "palms"

3) B.N. Postnikov’s method

4) G.D. Vilyavin’s method

14. In a patient with 20% I-II-III degree burns of the skin, 10 ml of urine was obtained through an indwelling catheter within one hour. THIS DATA \_\_\_ THE DIAGNOSIS OF BURN SHOCK

1) confirms

2) rejects

3) questions

4) needs additional research to confirm

15. INSULAR REGENERATION IS CHARACTERISTIC FOR

1) I degree burns

2) II degree burns

3) IIIA degree burns

4) IIIB degree burns

16. BURN SHOCK DIFFERS FROM TRAUMATIC SHOCK BY

1) bradycardia

2) severe plasma loss

3) lack of consciousness

4) all of the above

17. IN IIIB DEGREE BURNS NECROSIS SPREADS

1) on the epithelium and all layers of the skin itself

2) for the entire epithelium

3) on the skin and subcutaneous fat

4) on the epithelium and superficial layers of the dermis

18. IN ACCORDANCE WITH THE CLASSIFICATION TO THE TERM "DEEP BURNS", THERE ARE BURNS

1) only IV degree

2) IIIA, IIIB and IV degree

3) IIIB and IV degree

4) II and IIIA degrees

19. IN IIIA DEGREE BURNS \_\_ ARE EXPOSED TO NECROSIS

1) papillary layer and glandular epithelium

2) epithelium, papillary and reticular layers of the skin

3) epithelium at the axis of the papillary layer

4) the entire epithelium

20. HEALING IIIB DEGREE BURNS OCCURS BY

1) insular regeneration

2) physiological regeneration

3) marginal regeneration

4) any type is possible

21. The Frank index in a patient with a thermal burn is 68 units. IN THIS CASE FORECAST IS

1) favorable

2) relatively favorable

3) questionable

4) unfavorable

22. ACCORDING TO THE RULE OF NINES, THE BURN AREA OF THE ENTIRE UPPER EXTREMITY IS

1) 1%

2) 9%

3) 18%

4) 27%

**15. Treatment of burns**

**Local treatment of burns**

First aid for burn injury is aimed at eliminating the thermal factor and cooling the burned areas (water, ice bubbles, snow - for 10-15 minutes, then an aseptic bandage, analgin, drinking, warmth, wrapping (no medical bandages). - analgin, anesthesia with drugs, the duration of transportation is not more than an hour, if more than an hour, then intravenous administration of blood-substituting fluids and electrolyte solutions, anesthesia (nitrous oxide), abundant alkaline drink.

Local treatment begins with the primary cleaning of the burn wound: tampons moistened with 0.25% ammonia solution, 3-4% boric acid, or warm soapy water, wash away the contamination, treat with alcohol. The exfoliated epidermis is removed, large bubbles are cut, the contents are dried, small ones are not touched. Cleaning of the burn surface is carried out in patients without shock.

Treatment of burn wounds can be conservative and operative. The choice of method is determined by the depth of the lesion. Conservative treatment is the only and definitive method for surface burns that heal within 1-2 to 4-6 weeks. With deep burns, prompt restoration of the skin is necessary.

Closed method (main): wet-drying dressings with an antiseptic and ointments are applied to the burnt surface. Their purpose is to protect against secondary infection and injury, absorb the discharge and fight infection.

In case of 1st degree burns, an ointment bandage is applied to the damaged surface - healing within 4-5 days.

Burns of the II degree – after primary toilet of wounds apply bandages with ointment on a water-soluble basis. Change of a bandage in 2-3 days – heal in 7-12 days.

Burns of III degree – it is necessary to seek for conservation or formation of a dry eschar.

If the affected area is presented by a dry eschar, the dry bandage, if a soft eschar, the wet drying bandage with an antiseptic for dehumidification of a surface of a burn is applied. In 2-3 weeks the eschar is torn away and under it either the false skin, or the centers with the serous and purulent discharge – apply the wet drying bandages, to adhesion acceleration salve dressings – a cuticularization in 3-4 weeks. Now there are two main approaches to treatment of deep burns:

the first - maintaining a wound for a spontaneous casting-off of necrotic tissues, a second-early necretomy and a dermal plasty of a burn wound.

Local conservative treatment of deep burns during the first 7-10 days should be aimed at creating conditions for the formation of a dry burn scab. This period is characterized by the formation of a granulation shaft and the beginning of the processes of scab rejection. To accelerate this process, drugs can be used to enhance proteolytic processes. The most widely known and widely used drugs are 40% salicylic and benzoic acid ointment, papain. Applied to the surface of the burn scab, they penetrate through it, causing softening and promoting lysis of the underlying tissues.

After rejection of the scab, the bottom of the wound is granulation tissue. Further tactics after removal of the scab (regardless of whether there was an independent rejection or with the help of chemical necrectomy) should be aimed at the earliest possible cleansing of the wounds from the remnants of necrosis.

Benefits of the closed method of treating burns

a) Creating a microclimate under the bandage,

b) insulation of contacting surfaces,

c) transportability,

d) the possibility of using on an outpatient basis,

e) protects against secondary infection, hypothermia.

Disadvantages:

a) the trauma of dressings,

b) deterioration of conditions for observation,

c) the phenomenon of intoxication during lysis and rejection of necrotic tissues.

**Surgical treatment of deep burns**

In treatment of burn wounds apply three types of surgical interventions:

1) necrotomy,

2) early necretomy with immediate closing of a surface of a wound with a graft

3) the delayed dermal plasty – after conservative treatment and a casting-off of a scab.

1. Necrotomy

It reduces the compression of the underlying tissues, increases the respiratory excursion with deep burns of the trunk. Circular or exciting extensive superficial burns of the chest and extremities are indication for it.

With a properly made necrotomy, the edges of the incision diverge independently by a width of 1-2 cm. The incision is carried out along the entire length of the scab.

Necrotomy can be used for long-term non-rejection of a burn scab. Dissection leads to an increase in proteolytic and suppurative processes in the underlying tissues, which contributes to the rejection of the scab.

2. Necretomy with wound defect closure. Duration of a spontaneous graft (tissue) rejection is about 20-35 days therefore the risk of various complications development related to plasma loss, intoxication, complications development is high.

There are two ways of necrotic tissue removal a: 1) the tangential one – tissues are dissected before capillary bleeding, and then a surface layer is removed; 2) the single-stage one – immediately all tissues are excised to obviously viable tissue.

After necretomy, the wound defect is closed by sutures or with local tissue rearrangement.

Indications:

1) all skin thickness burn is no more than 10-20%;

2) burns in older persons

3) hand burn (to decrease the scar tissue formation).

A choice method in the deep burn treatment is the delayed dermal plasty.

This method is applied after the conservative treatment completed with a eschar rejection and wound infection suppression,

The dermal (skin) plasty is possibly when the wound is covered with granulation tissue and there is no pathogenic flora on its surface (usually in 2-4 weeks).

Now the following plasty types are applied:

1) local tissues plasty;

2) free skin (dermal) plasty:

a) full-thickness skin graft transplantation;

b) split-thickness skin graft transplantation;

c) Thiersch's method

Autodermoplasty is performed on the prepared granulation tissue by means of split-thickness skin graft, which is taken out from a healthy surface by a biopsy punch.

The choice of anesthesia depends on the patient general condition, the prepared transplantanting area and localization of donor surfaces.

The removed grafts can be applied to the granulations in the form of solid or perforated mesh flaps.

At critical loss of skin (over 30% of a body surface), burn dystrophy, deficiency of donor places, temporary closure by allogenic graft or heterograft is used.

Complex treatment of patients suffered from burns

Treatment of burn shock at a pre-hospital stage:

1) Rest, bandages,

2) antihistamine preparations and analgetics,

3) during transportation – Fentanyl, droperidol

4) fight against the general cooling,

5) plasma loss compensation (alkaline solutions, parenteral administration of liquids).

In a hospital – in antishock chamber. It is necessary to be aware that the greatest losses of liquid happen in the first 8-12 hours and lasting about 2 days.

For extensive burn, loss of plasma is to 6-8 liters per day. Daily protein losses – 70-80 g and more. There are various formulas for liquid calculation, but there are following basic provisions:

1) The volume of transfusional agents should not exceed 10% of the patient body weight.

2) In the first 8 hours after receiving a burn, 1/2 or 2/3 from the daily volume of liquid should be entered.

3) In 2 and 3 days the volume of the entered liquid makes no more than 5% of body weight.

Brock's formula:

1 ml ∙ body weight (in kg) ∙ the burn area (the III-IV St) (in %) + 2000 ml of 5% of glucose solution, and a half of daily volume pour is in the first 8 hours, and on the 2nd – 3rd days the volume of infusion is reduced by 2-3 times.

Control of a diuresis: constant catheter. Infusional therapy adequacy criteria is maintenance of CVD within 70-150 mm of a water column, an hourly diuresis of 2 ml on 1 kg an hour, a hematocrit within 38-42%.

After burn shock relief, treatment of a burn toxemia and septicotoxemia along with performing disintoxication therapy, it is necessary to make up for the loss of plasma, to perform the correction of hypo - and dysproteinemia and the secondary anemia; elimination of a metabolic acidosis; to prescribe antihistamine drugs, antibiotic treatment.

**Control questions:**

1. The treatment of patients with scalds.

2. First aid for burns.

3. The treatment of

-a burn shock;

-a toxemia period.

4. The prevention of a burn infection.

5. The initial d-bridement of burns.

6. When is it possible to exsect the necrotic tissue.

7. The methods of open and closed treatment. Advantages and disadvantages.

8. The Indications and contraindications of a distant flaps grafting.

**Tests on the topic: «Treatment of thermal burns»**

*Choose one correct answer*

1. MAIN CLINICAL SIGNS OF REMOVING THE PATIENT FROM BURN SHOCK IS

1) restoration of the patient's consciousness

2) relief of pain syndrome

3) restoration of diuresis

4) normalization of pulse rate

2. THE FOLLOWING MEANS ARE APPLIED TO ACCELERATE LYSIS AND REJECTION OF NECROTIZED TISSUES IN A BURN WOUND

1) proteolytic enzymes of animal and bacterial origin

2) mucolytic agents

3) fibrinolytic agents

4) bandage with water-soluble ointments

3. AUTODERMOPLASTY FOR CLOSING BURN WOUNDS IS CARRIED OUT BY THE FOLLOWING METHODS:

1) a split skin flap

2) the membranes of the embryo

3) closure of the wound with fibrin films

4) highly porous collagen polymer

4. ADVANTAGES OF THE CLOSED METHOD OF BURN TREATMENT ARE

1) prevention of secondary infection

2) the use of agents that suppress the growth of bacteria and promote wound epithelialization

3) the possibility of outpatient treatment

4) all of the above

5. DISADVANTAGES OF THE OPEN METHOD OF BURN TREATMENT ARE

1) transportation of the patient is facilitated

2) the need for special equipment of chambers

3) saving bandage material

4) rapid formation of dry scab

6. DISADVANTAGES OF THE CLOSED METHOD OF BURN TREATMENT ARE

1) the possibility of infection

2) soreness of bandaging

3) saving bandage material

4) all of the above

7. FREE SKIN PLASTIC IS

1) plastic with a flap on the nutritional pedicle

2) the use of cultured alloofibroblasts

3) temporary biological closure of the defect

4) transplant of a split skin graft

8. DURING LOCAL TREATMENT OF II DEGREE BURNS, LARGE UNRUPTED PUSTULES ARE

1) excised

2) left intact

3) undercut at the base and released the liquid

4) treated openly

9. THE EFFECTIVENESS OF INFUSION THERAPY IS CONTROLLED BY

1) heart rate

2) the level of the CVP

3) the level of blood pressure

4) all of the above

10. RATE OF HOURLY DIURESIS IN MILLILITTERS IS

1) 40-60

2) 20-30

3) 90-100

4) 100-120

11. FREE SKIN PLASTIC IS PERFORMED BY

a) a split skin graft

b) full-thickness skin graft

c) a flap on a permanent pedicle

d) a flap on a temporary pedicle

Choose the right combination of answers

1) a, b

2) b, c

3) b, d

4) a, d

12. DURING LOCAL TREATMENT OF II DEGREE BURNS, SMALL PUSTULES ARE

1) deleted

2) opened

3) saved

4) excised

**16. Acute purulent surgical infection**

Classification:

Depending on a clinical course and anatomicopathological changes in tissues, all types of surgical infection are divided into two groups.

1. Acute surgical infection:

A) specific (malignant anthrax, tetanus)

B) acute nonspecific infection (acute mastitis, abscess, phlegmon, furuncle, whitlow, erypsipelas)

the purulent

the putrefactive

the anaerobic

2. Chronic surgical infection:

A) specific (tuberculosis, actinomycosis)

B) chronic nonspecific infection (chr. mastitis, chr. abscess, chr. paraproctitis).

**Etiology**

Pyoinflammatory diseases have the infectious nature, caused by different types of agents: Gram-positive and Gram-negative, aerobic and anaerobic, spore forming and non-spore forming microorganisms.

Classification of soft tissues infections depending on lesion level

I. level – skin lesion - (a furuncle, an erypsipelas, streptococci, staphylococci)

II. level – lesion of subcutaneous adipose tissue (an anthrax, a hydroadenitis, a lymphadenitis, abscess, a cellulitis – staphilococci)

III. level – a lesion of superficial fascias, necrotic fascias (a polymicrobial etiology of S.aureus, E. coli, Pr. mirabilis, Enterobacter, non-clostridial anaerobes)

IV. level – a lesion of muscles and deep fascial structures – myonecrosis, myositis, B. Fragilis, Clostridium spp., S. Aureus

This is due to the fact that in most cases there is a clear connection between the level of the infectious lesion and a certain set of microorganisms, which makes it possible to choose certain drugs.

Distribution of the main pathogens of soft tissue infections depending on the lesion level:

Level I - Str. Pyogenes

Level II - Str. Pyogenes, St. aureus

Level III (mixed) - St. aureus, E. Coli, Pr. Mirab., Ps. Aerug., Enterobacter, anaerobic pathogens

Level IV (mixed) - B. Fragilis, Clostridium spp., St. aureus.

The etiology of staphylococcus (Staphilococcus aureus, S. epidermidis, S. saprophiticus) is still one of the most important and most frequent pathogens. They are widespread in the external environment, on the surface of the human body, in the nasopharynx and respiratory tract. The transmission of infection is carried out mainly by contact.

Streptococci. A - streptococcus (Streptococcus piogenes), β-hemolytic is carried mainly by contact, causes severe infections in newborns (sepsis with destruction of the lung and meningitis, osteomyelitis).

Streptococci can also cause specific forms of infection, such as erysipelas, wound scarlet fever, and bacterial endocarditis.

Pneumococci (Pneumococcus) live in the oral cavity, nasopharyngeal cavity and upper respiratory tract. They are the most common causative agents of pneumonia, mastoiditis, otitis media, meningitis, purulent arthritis.

E. coli (gram-negative enterobacteriaceae - Esherichia coli) is found in large quantities in the intestinal tract of humans and animals, can exist both in aerobic and anaerobic conditions. It plays a large role in the occurrence of purulent diseases of the abdominal organs. E. coli causes putrefactive decay of tissues.

Proteus (Proteus vulgaris, Pr. Morganii, Pr. Inconstans) are widespread in the external environment, as well as in the oral cavity and intestinal tract. Purulent processes caused by these pathogens are accompanied by putrefactive decay of soft tissues.

Pseudomonas aeruginosa is found on the skin, especially in places where there are many sweat glands - in the armpits, on the thighs, near the navel.

A characteristic sign of the presence of the pathogen is mucous discharge (dressings are stained greenish-blue). Most often found in burn departments and resuscitation and intensive care units.

**Pathogenesis**

The development of an acute-purulent-inflammatory process caused by a pyogenic flora is determined by three factors:

• dose, virulence and other biological properties of microbes that have entered the body.

• anatomical and physiological features of the focus of the introduction of microflora

• the state of the immunobiological forces of the macroorganism.

**Ways of spread of infection in the body**

1. Contact - on the intercellular, perivascular, cellular space. Protective role of fascia and aponeuroses (impermeability to pus and infection).

2. Through the lymphatic vessels into the bloodstream.

3. On the bloodstream - emboli, phlebitis.

Less than ± 105 bacteria per 1 g of tissue, as a rule, turns out to be insufficient for the development of severe wound infection, but the presence of blood, serum, dead tissue, suture material reduces the required number of bacteria for the development of wound infection.

**Anatomical and physiological features of the focus of infection**

The following factors contribute to the development of an acute purulent infection:

1) violation of the trophism of the skin in the area of the entrance gate (hemorrhage, necrosis)

2) polyinfection (synergistic effect of several types of microbial flora)

3) superinfection (introduction of new types of microbes, characterized by acute virulence)

**Reaction of macroorganism**

Not always a microbe trapped in the tissue leads to the development of a purulent process. To a greater extent, this is determined by the factors of the body's defense.

A) non-specific defense mechanisms:

1. Anatomical barriers - skin and mucous membranes. The skin has bactericidal properties due to the substances contained in the secretions of the sweat and sebaceous glands. On the surface of the mucous membranes there is a secret of the lacrimal and salivary glands, mucus, hydrochloric acid.

2. Normal microflora of biotopes.

3. Humoral factors

4. Cellular mechanisms of nonspecific defense are represented by an inflammatory response and phagocytosis.

Local organism reaction to infection penetration

Inflammation - the stereotypic protective reaction bound to a condition of all organism.

The clinical performance consists of local and general implications.

Clinical signs of local reaction: pain, an edema, temperature increase and malfunction of the struck part of a body or an organ, gloss of a skin, varicose veins

There are 2 phases of infectious inflammatory process:

Phase of an inflammable infiltrate

Phase of purulent fusion

This phase is characterized by the absence of pus, tissue necrosis is not acute. In this phase with the elimination of the pathogenic beginning by the forces of the body or together with treatment with antiseptics, all phenomena are reversible. This infiltrate is resolved and the inflammatory phenomena disappear without requiring surgical intervention. This phase is usually short-lived and usually lasts 1-2 days, then passing into the phase of purulent fusion.

The phase of purulent fusion: tissue necrosis, the accumulation of dead leukocytes and products of wound decay are noted.

Local complications of purulent processes.

Formation of necrosis (due to impaired microcirculation and influence of microorganisms)

Lymphangitis.

Lymphadenitis.

Thrombophlebitis.

All these signs are the beginning of the generalization of the infectious process.

Clinical manifestations of the general reaction of the body to purulent inflammation, manifested changes in temperature; heart rate changes are increased by 10 beats.

mental state - depression, weakness, lethargy, euphoria; enlargement of the spleen, liver.

**Diagnostics**

1.Changes in the clinical blood test (leukocytosis, shift of the leukoformula to the left, neutrophilia, an increase in the percentage of neutrophils, an increase in the normal level of stab leukocytes (more than 4-5%), the appearance of immature forms of leukocytes in the peripheral blood (young myelocytes), a decrease in the number of lymphocytes, monocytes , anemia.

2. Changes in blood biochemical parameters (creatinine, urea, bilirubin, hypoproteinemia)

3. To study the degree of intoxication, the leukocyte index of intoxication is calculated

4. Determination of the medium molecules level.

5. Bacteriological research.

**Treatment of a purulent surgical infection.**

Complex treatment also includes three main components:

1) Impact on a macroorganism

2) Impact on a microorganism

3) Treatment of the local center

Impact on macroorganisms

1) The fight against intoxication, the plan of which includes infusion therapy with elements of forced diuresis, the appointment of drugs with detoxification properties, active methods of detoxification: hemosorption, plasmaphoresis.

2) Maintaining and stimulating the body's immunobiological forces and, if necessary, correcting their violations.

3) Syndromic treatment includes all provisions of an intensive care.

Impact on microorganisms

It consists in conducting rational antibiotic therapy in compliance with the following rules:

• taking into account the sensitivity of the pathogen to the drug.

• In the presence of mixed flora, the use of two antibacterial drugs.

• Appointment in severe cases of maximum doses.

• strict adherence to the intervals between drug injections.

• Taking into account the routes of drug administration

• to carry out long courses of antibiotic therapy.

Treatment of phase I of an infectious inflammatory process is conservative (immobilization, dry heat, physiotherapy, antibiotics).

Treatment of phase II of purulent diseases (operative).

In the treatment of purulent foci, radical intervention is currently used.

1. All purulent foci undergo surgical treatment.

2. After surgical treatment of purulent foci, the wound should be drained with perforated tubes for the use of flow-through wound washing.

3. If all non-viable tissue around the wound has been excised, the wound is sutured (primary suture). If the primary suture is not applied immediately, then the wound is washed through the drainage, after the inflammation subsides, primary-delayed or secondary sutures are applied.

4. If you cannot close the wound, then you have to treat it under bandages with hypertonic solutions or ointments on a water-soluble basis or enzyme preparations.

**Control questions:**

1. The classification of surgical infection.

2. Total and the local reaction to the introduction of infection.

3. Functions of the local inflammatory focus. The phases of the local inflammatory focus.

4. Clinical signs of inflammation focus in the phase of infiltration and the purulent melting phase.

5. The treatment of septic diseases depending on the stage of the process.

6. The concept of

-furuncle and carbuncle;

-abscess and phlegmon;

- panaritium.

7. The clinic and the treatment.

8. The treatment of panaritiums. The technique of anesthesia. Types of cuts.

9. The concept of

- lymphangitis and lymphadenitis;

- mastitis;

- thrombophlebitis.

10. And also etiology, clinical features, treatment, prevention.

11. The closed treatment of purulent process of soft tissue.

**Tests on the topic: «Acute purulent surgical infection»**

*Choose one correct answer*

1. THE FIRST PHASE OF THE ACUTE INFLAMMATORY PROCESS

1) phase alteration

2) phase of inflammatory infiltration

3) phase of exudation

4) phase of purulent fusion

2. THE SECOND PHASE OF THE ACUTE INFLAMMATORY PROCESS

1) phase alteration

2) purulent melting phase

3) phase of healing

4) phase of inflammatory infiltration

3. A SYMPTOM INDICATING THE TRANSITION OF AN ACUTE INFLAMMATORY PROCESS TO PHASE II

1) fluctuation

2) hyperemia

3) the local temperature rise

4) edema

4. THE MOST INFORMATIVE DIAGNOSTIC TECHNIQUE THAT ALLOWS YOU TO DIFFERENTIATE THE PHASES OF THE ACUTE INFLAMMATORY PROCESS

1) body temperature measurement

2) puncture

3) palpation

4) general blood test

5. THE REVERSIBLE PHASE OF THE ACUTE INFLAMMATORY PROCESS IS

1) Phase I

2) Phase II

3) both phases

4) none of the phases

6. IN THE FIRST PHASE OF ACUTE PURULENT DISEASE, TREATMENT IS INDICATED

1) operational

2) conservative

3) first or second, depending on the doctor's qualifications

4) operational in combination with conservative

7. IN THE SECOND PHASE OF ACUTE PURULENT DISEASE, TREATMENT IS INDICATED

1) operational only

2) only conservative

3) first or second, depending on the doctor's qualifications

4) operational in combination with conservative

8. A SIGN THAT ALLOWS YOU TO JUDGE THE EXIT OF THE INFECTION BEYOND THE LOCAL PURULENT FOCUS IN THE BODY

1) increased pain

2) increased edema

3) lymphadenitis

4) increase in the area of hyperemia

9. WHAT CAUSES THE SYMPTOM OF FLUCTUATION

1) the presence of a seal in the area of the abscess

2) the presence of fluid in the abscess cavity

3) the presence of displacement of the abscess

4) the severity of edema above the abscess

10. DIAGNOSTIC METHOD THAT ALLOWS YOU TO ESTABLISH THE PHASE OF PURULENT DISEASE

1) radiography

2) Ultrasound

3) general blood test

4) body temperature measurement

11. IN THE PHASE OF INFLAMMATORY INFILTRATION, THE FOLLOWING PROCEDURES ARE PERFORMED:

1) incision, immobilization, prescribe antibiotics

2) excision, primary suture, prescribe antibiotics

3) immobilization, prescribe antibiotics

4) all of the above is possible

12. THE DISTINCTIVE FEATURE OF PURULENT INFECTION AT THE PRESENT STAGE

1) acute onset

2) a tendency to sluggish flow and chronization of the process

3) more often develops several purulent foci

4) the tendency to the most pronounced local reaction to the introduction of the pathogen

13. THE ETIOLOGICAL FACTOR OF ERYSIPELAS IS

1) staphylococci

2) streptococci

3) E. coli

4) non-clostridial anaerobes

14. THE TERM "FURUNCULOSIS" MEANS

1) repeated development of boils during the year

2) simultaneous occurrence of several boils

3) both of the above situations are true

4) annual development of boils

15. ACUTE PURULENT PROCESS DEVELOPING ON THE BACK SURFACE OF THE FINGERS OF THE HAND

1) subcutaneous panaritium

2) boil

3) the tendon felon

4) any of these processes can develop

16. THE MOST DANGEROUS COMPLICATION OF BOILS LOCALIZED IN THE UPPER LIP AREA

1) development of purulent meningitis

2) transition to carbuncle

3) the appearance of phlebitis of the face

4) development of regional lymphadenitis

17. THE TERM "PANDECTIST" MEANS

1) purulent inflammation of all tissues of the finger

2) purulent inflammation of all soft tissues of the finger

3) inflammation of the periarticular roller

4) purulent inflammation of the bone tissue

18. THE PRESENCE OF RED STRIPES ON THE SKIN COMING FROM THE FOCUS OF PURULENT INFLAMMATION INDICATES

1) the development of lymphangitis

2) the spread of the purulent process through the cellular spaces

3) reactive inflammation around the purulent focus

4) good reactivity of the body

19. THE MOST DANGEROUS COMPLICATION OF ACUTE PURULENT LACTATION MASTITIS

1) sepsis

2) lymphadenitis

3) thrombophlebitis

4) milk fistula

20. AN ABSCESS IS

1) delineated accumulation of pus in various tissues and organs

2) delineated accumulation of pus in the natural cavities of the body

3) both of the above statements are true

4) acute diffuse purulent inflammation of the cellular spaces

21. PHLEGMON IS

1) acute diffuse inflammation of the cellular spaces

2) acute spilled inflammation of the natural cavities of the body

3) both of the above statements are true

4) acute diffuse inflammation of all layers of the skin with pronounced edema

22. HYDRADENITIS IS

1) inflammation of the sebaceous glands

2) inflammation of the sweat glands

3) inflammation of the hair sac

4) inflammation of the lymph node

**17. Hematogenous osteomyelitis.**

**The purpose of the study topic** is to form an idea of ​​the etiology, pathogenesis and hematogenous osteomyelitis classification. To know the diagnosis and treatment of acute and chronic hematogenous osteomyelitis.

Osteomyelitis is a purulent-necrotic inflammation of the bone, involving the bone marrow (osteomyelitis itself), the compact and cancellous part of the bone (osteitis), as well as the periosteum (periostitis). In the overwhelming majority of cases, the soft tissues surrounding the affected bone are also involved in the infectious and inflammatory process to one degree or another.

Purulent osteomyelitis is divided into two large groups, which differ significantly in the way infectious pathogens penetrate into the bone and in pathogenesis. If the infection enters the bone from the external environment, through a wound during surgery, open fractures or wounds, that is, exogenously, it means the traumatic or wound osteomyelitis. If the infection is transferred to the bone with the flow of blood or lymph from any existing purulent focus, that is, endogenously, it is customary to talk about hematogenous osteomyelitis.

**Acute hematogenous osteomyelitis.** Basically (80-90%) children get sick, and 62.5% of patients is at the age of 8-14 years, mainly boys and adolescents. The disease equally often affects the bones of the left and right half of the skeleton, but most often affects the femur, then the tibia and humerus. The longer the bone is, the more often it is susceptible to microbes settling in it and the development of an inflammatory process. The part that is involved in the growth of the limb in length is most often affected. These are the proximal and distal metaphyses of the femur.

Factors affecting the development of osteomyelitis:

1. Anatomical and physiological features of bone blood supply in children.

2. Biological and immunological characteristics of the organism.

3. Predisposing moments.

1) The emergence of a hematogenous focus of infection in the bone is associated with the structural features of the child's bone in the zone of its growth, identified by Lexer in 1824 - the embolic theory. These features are as follows:

a) In children, the metaphysis is on the border with the actively functioning epiphyseal cartilage has an abundant network of vessels, characterized by wide capillaries with slow blood flow.

b) The vasculature of the metaphysis does not communicate with the vasculature of the epiphyseal cartilage. The vessels of the diaphysis are mainly of the main type.

The diaphyseal part of the bone receives nutrition from the network of periosteal vessels, as well as from the a. nutricia, which, penetrating into the bone in the form of one or more trunks, forms a network of small branches heading towards the metaphysis. As a result, many vessels (arterioles) end blindly at the border with the growth cartilage and depart at an acute angle. All this contributes to the settling of microorganisms. Bacteria, developing in the vessels of the bone (metaphysis), cause thromboarteritis or thrombophlebitis, followed by the formation of a purulent focus - phlegmon of the bone marrow. This theory explained the selective localization of the inflammatory process in the long bones and the pathways for the infection to penetrate the bone. It has been proved that in adolescence, as the epiphyseal cartilage decreases, vascular connections are established between the pineal gland and the metaphysis, and this corresponds to a decrease in the probability of fixation of microorganisms.

2) The significance of the body's reaction in response to the introduction of the pathogen was proved in 1937 by S.M. Derizhanov, who created the theory of sensibilization.

The author caused sensibilization of rabbits with horse serum. Then he injected a permissive dose of serum into the bone marrow cavity, got allergic aseptic osteomyelitis.

In another series of experiments, he sensitized rabbits with horse serum with an insignificant amount of microbial bodies and injected the same mixture in the form of a resolving dose into the bone marrow cavity. There was a picture of purulent osteomyelitis in animals.

In the third series of experiments, preliminary tapping of the leg of an experimental animal sensitized with serum with a microbial suspension with a stick caused localization of the infection in the bone, followed by the development of purulent osteomyelitis, even with intravenous administration of a permissive dose. Based on this, Derizhanov believed that bacterial emboli play no role in the pathogenesis of osteomyelitis. The disease develops only on the basis of sensitization of the body and the occurrence of aseptic inflammation in the bone, which occurs from a variety of reasons. But later, when the experiments were repeated, not all animals developed experimental osteomyelitis. In addition, the allergic theory could not explain other features of this disease, the more frequent damage to children, the localization of the process.

3) Provoking and predisposing factors.

In the pathogenesis of hematogenous osteomyelitis, autogenous sources (exogenous) microflora (foci of latent dormant infection) are of great importance. Microorganisms in carious teeth, adenoids, constantly releasing toxin, contributing to the development of a delayed-type allergic reaction, create a predisposition, "readiness" of the body for the onset of the disease. In this situation, in a sensitized organism, nonspecific stimuli (trauma, overwork, hypothermia) play the role of a resolving factor and can cause aseptic inflammation in the bone. The latter, when microbes enter the bloodstream, is realized in acute hematogenous osteomyelitis.

An important feature of the inflammatory process is that it is closed by the rigid walls of the bone tube; this leads to compression of the veins, and then the arteries. An indirect proof of such an interpretation of the violation of blood circulation in the bone is pain, which is a consequence of hypertension in the medullary canal. The value of intraosseous pressure in acute osteomyelitis reaches 300-500 mm aq. Art. (at a rate of 60-100) in healthy children.

Pathological changes. The inflammatory process occurs within a day after penetration into the bone and begins in the form of limited serous changes in certain areas of the bone marrow, more often in the metaphysis of the tubular bone. In the focus of inflammation, hyperemia and edema occur. Then there is thrombophlebitis, thromboangitis, phlegmonous damage to the bone marrow, spreading in the direction of the diaphysis, because epiphyseal cartilage is resistant to infection. Bone marrow phlegmon is formed. If the osteomyelitis process is not diagnosed at the stage of inflammation within the marrow canal, then from 4-5 days from the onset of the disease, pus spreads along the bone (Haversian) canals and nutrient (Folkmann's) canals under the periosteum, gradually exfoliating it. At a later date (8-10 days and later), pus and decay products continue to flake off the periosteum, then pus breaks into soft tissues, forming intermuscular and subcutaneous phlegmon. The pain, as a rule, subsides with spontaneous opening of the subperiosteal abscess into the surrounding soft tissues, because the pressure in the bone tube decreases. With the involvement of the skin in the process, pus breaks out, forming fistulas.

A breakthrough of pus or operative drainage of a purulent focus ends the acute period, clinically manifested by severe intoxication.

Clinical presentation and diagnosis.

In accordance with the general clinical and local manifestations of the disease, 3 forms of acute hematogenous osteomyelitis are distinguished: toxic (fulminant), septic-pyemic and local (focal).

The clinically toxic (adynamic) form is extremely violent with symptoms of endotoxic shock. In this case, as a rule, there is a collaptoid state with loss of consciousness, delirium, high temperature (up to 40-41 °), sometimes convulsions, vomiting. Shortness of breath without a clearly defined picture of pneumonia is noted. In the study of the cardiovascular system, a violation of the central and peripheral blood circulation, a decrease in blood pressure are found, and soon heart failure and myocarditis phenomena occur.

The clinical manifestations of this form of acute osteomyelitis fit into the essence of septic shock, and the developing multiple organ failure (cardiovascular and respiratory) determine the severity of the process and high mortality.

The septic-pyemic form of acute hematogenous osteomyelitis occurs most often, in which septic phenomena predominate with the formation of metastatic abscesses in other organs. The onset of the disease is also acute, there is an increase in temperature up to 39-40 °, intoxication phenomena are increasing, the functions of vital organs and systems are disrupted. Confusion, delirium, euphoria are possible.

However, in patients of this group, bone lesions can be detected much earlier. From the first days of the disease, pain in the affected limb. Pain syndrome reaches significant intensity due to the development of intraosseous hypertension. In some cases, in the area of ​​the metaphysis of the limb, edema, a local increase in temperature appear, in patients the liver and an enlarged spleen are palpable. Often there are septic complications due to metastasis of purulent foci in various organs (lungs, heart, kidneys), as well as in other bones.

The local form of acute hematogenous osteomyelitis is characterized by the predominance of local symptoms of purulent inflammation over the general clinical manifestations of the disease. The onset of the disease is typically quite acute. Against the background of apparent well-being, a sharp pain in the limb appears. Usually, older children accurately indicate the place of greatest pain. The child tries to keep the affected limb in a certain position, since any movement increases the pain. If the focus is located close to the joint, then the ligamentous apparatus and periarticular tissues are involved in the process. This leads to a pronounced and persistent joint contracture. The temperature rises and further keeps at high numbers (39-40 °). The general condition of the child is rapidly deteriorating, appetite decreases, thirst increases, which indicates the development of intoxication. When examining a diseased limb, the first signs of an inflammatory process are revealed: swelling of the affected area, continuous tissue infiltration and an increase in the venous pattern of the skin. Among the permanent local signs of osteomyelitis, the main one is a pronounced local pain on palpation and especially with percussion over the lesion site. Swelling and soreness spreads to neighboring areas. Symptoms such as hyperemia of the skin and especially fluctuation in the affected area are late signs and indicate the neglect of osteomyelitis.

**Diagnostics**

1) The first X-ray symptoms of acute hematogenous osteomyelitis begin to appear only from the 10-14th day of the disease, due to these features of the rapidly progressing purulent process in the bone, the X-ray diagnosis is late, because changes in bone are already irreversible. An early radiological sign of long bone osteomyelitis is:

a) a symptom of detachment of the periosteum, which begins to produce bone substances - a thin linear shadow with a smooth outer and somewhat even inner contour;

b) in the metaphysis, X-ray data in the form of blurred bone structure, alternating areas of rarefaction and compaction;

2) Laboratory diagnostics: leukocytosis, decrease in hemoglobin level, shift of the formula to the left, changes in urine;

3) Thermography.

In doubtful cases, a diagnostic bone puncture is used, followed by a cytological examination of the punctate. In the early diagnosis of acute hematogenous osteomyelitis, the determination of intraosseous pressure is also important. Diagnostic puncture is crucial. Establishing the fact of intraosseous hypertension allows confirming this diagnosis even in the absence of pus under the periosteum or in the medullary canal.

**Complications of acute hematogenous osteomyelitis:**

1. Sepsis

2. Purulent arthritis

3. Deep phlegmon of the limb

4. Pathological fractures

**Treatment**

Currently, complex treatment of osteomyelitis is widely used, substantiated by T.B. Krasnobaev. It consists of three basic principles: 1) impact on the macroorganism, 2) direct impact on the causative agent of the disease, 3) timely and complete sanitation of the local focus.

The impact on the macroorganism should be aimed at eliminating severe intoxication and correcting disturbed homeostasis. Active detoxification therapy includes the introduction of a 10% glucose solution with insulin, hemodez, polyglucin, aminophylline, and native plasma. To desensitize the body and normalize vascular tissue permeability, calcium preparations, diphenhydramine, suprastin or pipolfen are administered. To increase the level of specific immunity in the acute period of osteomyelitis, passive immunization of the child's body is carried out. For this purpose, hyperimmune staphylococcal plasma and antistaphylococcal gamma globulin are administered. During intensive care, it is necessary to monitor electrolyte metabolism, acid-base state and the function of the urinary system. The course of treatment also includes stimulation of the body's defenses.

In severe forms of the disease, the function of the adrenal cortex is suppressed. Hormonal drugs (hydrocortisone or prednisolone) are administered in a short cycle (up to 7 days). The direct effect on the causative agent of the disease is carried out by prescribing broad-spectrum antibiotics. The most effective is a combination of intravenous and intraosseous administration. The effectiveness of antibiotic therapy is significantly increased when it is combined with proteolytic enzymes. For the next course, antibiotics with bone tropism (lincomycin) are prescribed in an age dosage for a period of 2-3 weeks. Antibiotics are canceled when the temperature is normalized, the inflammatory reaction in the focus disappears and the general blood test tends to normalize.

Timely and complete sanitation of the local hearth. Due to the fact that the development of severe forms of osteomyelitis in most cases is due to intraosseous hypertension, early surgical intervention - osteoperforation is of paramount importance. An incision is made in the soft tissues over the lesion at least 10-15 cm long and the periosteum is dissected longitudinally. On the border with healthy areas of the bone, 2-3 perforated holes with a diameter of 3-5 mm are applied. In this case, pus is usually released under pressure, and with a disease duration of 2-3 days, the contents of the medullary canal can be serous-purulent. In the later periods of admission of patients to the hospital (5-6 days), pus can also be found in the subperiosteal space (subperiosteal abscess).

Through the osteoperforation holes, the bone marrow canal is washed with a solution of furacillin 1: 5000 with antibiotics;

Puncture treatment - the needle is inserted into the cavity of greatest pain. This is in the early stages - in the first 2 days, when blood is obtained during puncture - the intraosseous pressure is immediately determined: antibiotics are administered, the method is considered shown in children 4-6 years old.

According to many authors, rational CSO therapy in the first 12 hours leads to recovery of 93.4%, within 1 day - 90%, within 2 days - only 73%, i.e. AHO (acute hematogenous osteomyelitis) treatment is most effective in the first 24 hours.

**Chronic hematogenous osteomyelitis**

Chronic osteomyelitis is a special phase of a purulent-necrotic disease of the skeletal system, which is necessarily preceded by an acute stage. The only exceptions are primary chronic forms of osteomyelitis. The transition of acute to chronic osteomyelitis occurs in the period from 3 weeks to 4 months from the onset of the disease. It is more correct to judge the transition to the chronic stage not by the time factor, but by the clinical manifestations and morphological changes in the bone. For a confident diagnosis, it is necessary to detect a triad of main signs: 1) purulent fistula, 2) bone sequestration, 3) recurrent course. The reasons for the transition of acute to chronic osteomyelitis are manifold:

1) Late appealability and delayed diagnosis;

2) Insufficient surgical treatment;

3) Inappropriate antibiotic therapy.

**Etiology and pathogenesis**

Due to purulent inflammation of the bone marrow, the involvement of a compact part of the bone in the process, detachment of the periosteum, the blood supply to the bone tissue is disrupted, which leads to bone necrosis and the formation of sequestration. Due to the mechanical and chemical properties of the bone, the dead part (sequestration) cannot quickly separate from the living tissue under the influence of pus enzymes. The sequestration process is slow - from 2 months or more, depending on the size of the rejected bone site. A dead piece of bone tissue not only supports suppuration, but also causes inflammatory and reparative processes due to the osteogenic tissue of the endosteum and periosteum, which form a capsule from the newly formed bone with a granulation lining inside. As a result, the sequestrum, which has lost its mechanical connection with the living bone, turns out to be walled up in a capsule from the newly formed bone (sequestral box). Sequestrum, being an infected foreign body, is very slowly resorbed and maintains a chronic purulent process for years. With all the diversity, the following types of sequestration are distinguished:

Cortical (cortical) - with necrotization of a thin bone plate under the periosteum.

Central - with necrosis of the endosteal surface of the bone.

Penetrating - with necrosis of the entire thickness of the compact layer in a bone area limited around the circumference.

Circular - with necrosis of the diaphysis along the entire circumference.

The wall of the sequestral capsule consists of heterogeneous bone tissue and contains many bone cells filled with pus and granulations; it has numerous openings through which pus enters the surrounding tissues. In the bone marrow, the ossifying process leads to a thickening of the beams and crossbars. Merging into one compact mass, the spongy layer finally disappears, and the medullary cavity is obliterated.

**Clinical picture**

Chronic osteomyelitis is characterized by a long course of remission and worsening. During remission, the fistula may close. With an exacerbation of the process, the temperature rises, soreness and intoxication increase. Fistulas begin to secrete pus again, sometimes in significant quantities. When examining the patient, it is possible to note swelling of soft tissues, sometimes thickening of the limb at the level of the lesion. A characteristic feature of chronic osteomyelitis are fistulas and scars at the site of former fistulas. Palpation of the limb is usually not painful and often reveals soft tissue atrophy and thickening of the bone. Pallor of the skin, reduced nutrition are also noted. The temperature is subfebrile, especially in the evening, sometimes rising to high numbers at the time of exacerbation.

**Diagnostics**

The main diagnosis is radiography, which determines:

- thickening of the bone;

- the presence of cavities and sequesters;

- the perifocal zone of osteosclerosis, due to which the bone marrow canal is narrowed or absent;

- alternation of areas of osteosclerosis and osteoporosis;

- thickening of the periosteum in the form of irregularities in the cortical layer.

Treatment.

1. Surgical treatment involves excision of all fistulas, trepanation of the bone with the opening of the osteomyelitic cavity, sequestrectomy, removal of infected granulations and pus from the cavity, the inner walls of the cavity to unaffected bone tissue, cavity plastics using autogenous, homogeneous tissues and alloplastic materials (muscles, bone, chondroplasty, antibiotics added to the blood clot);

2. Antimicrobial therapy;

3. Immunotherapy (staphylococcal toxoid)

4. Blood substitutes.

**Atypical forms of chronic osteomyelitis**

These are primary chronic forms, characterized by a sluggish course from the onset of the disease. The reason for the development of these forms is the low virulence of microbes with a high reactivity of the organism.

Atypical forms: 1. Brody's abscess. 2. Ollier's albuminous osteomyelitis. 3. Sclerosing osteomyelitis Garre.

Brodie's abscess (1828) - a long asymptomatic history, there is no pronounced clinical picture. It begins at an early age and manifests itself after many years. The external manifestations of the disease are scarce, only pain is found with bone percussion, there are no changes in the analyzes, only the radiograph shows a focus of enlightenment, localized in the metaphysis or epiphysis of the tibia, femur or humerus. The shape of the focus is round, along the edge there is a clear sclerotic border, there is pus in the cavity, there is no periosteal reaction. Treatment is bone trepanation and drainage.

Ollier's albuminous osteomyelitis (1984). The cause of the disease is that the weakened flora cannot turn the protein-rich exudate present in the inflammation cavity into pus; more often adolescents are ill. The process is more often in the distal part of the thigh, with the development of destruction, it is accompanied by aan acute exudative reaction in the paraosal tissues. The focus of inflammation is located in the internal sections with the formation of central sequesters. Complaints of constant pain in the hip, then there is a swelling that grows within 1-2 months, redness of the skin rarely appears. On the roentgenogram, there are regular and irregular cavities with periossal layers. At puncture - a light opalescent liquid. Treatment is surgical.

Sclerosing osteomyelitis Garre (1893) - the disease begins subacutely; characterized by pain at night, subfebrile condition; patients are treated for a long time for bruising, myositis, the process goes on for a long time with remissions and exacerbations. On the roentgenogram, a sharp fusiform thickening of the diaphysis of the bone, bone sclerosis. Treatment is usually conservative.

**Features of the course of hematogenous osteomyelitis in children**

When clarifying the anamnesis, it is possible to establish such predisposing factors as a contusion of a limb or hypothermia, angina transferred in the past, purulent pharyngitis, the presence of carious teeth, purulent processes (boils, panaritium, infected abrasions, etc.), all this can be a source of infection with hematogenous osteomyelitis.

When examining the patient, signs of general purulent intoxication are established: lethargy, weakness, lethargy, sticky sweat, pallor of the skin, rapid breathing, tachycardia up to 120 beats. per minute, heart sounds become muffled, systolic murmur appears. , heart sounds become muffled, systolic murmur appears. Often, an increase in the spleen and liver is determined, vomiting, intestinal paresis, pain in the kidney area with a positive Pasternatsky symptom is noted.

On the first day of the disease, when examining the patient, attention is drawn to the forced (bent) position of the affected limb. Active and passive movements in the joint closest to the focus are sharply limited due to increasing pain. To establish a focus of osteomyelitis, careful tapping over the bone is necessary. Beating in the area of ​​the calcaneus causes a painful focus along the axis of the limb. In the later stages of the disease, over the affected part of the limb, the skin becomes tense, infiltrated, and then hyperemic. On palpation, soft tissue infiltration, soreness and local hyperemia are determined. With a comparative measurement, an increase in the circumference of the affected limb is determined, due to the growing focus. To measure the circumference of the limb, it is necessary to do this at equal distances from certain identification points (the lower pole of the patella for the lower leg, the upper pole for the thigh, etc.).

With advanced hematogenous osteomyelitis, signs of phlegmon are determined: swelling, skin hyperemia and fluctuation. Sometimes patients come with already spontaneously opened phlegmon and the presence of a purulent fistula. With especially unfavorable developing osteomyelitis, 3-4 weeks after the onset of the disease, a symptom of pathological limb mobility may appear, which indicates a pathological fracture that has occurred in connection with osteonecrosis.

When the focus is localized in the metaepiphyseal zone, the adjacent joint is often involved in the inflammatory process. In this case, typical signs of purulent arthritis appear: smoothing of the contours of the joint, a symptom of fluctuation, limitation of movement, soreness, detection of purulent effusion during diagnostic puncture of the joint. Usually, these symptoms are sufficient to establish a diagnosis of acute hematogenous osteomyelitis. Difficulty in diagnosis arises when patients are admitted early, before the development of soft tissue inflammation. In these cases, a diagnostic bone puncture (osteoperforation) is indicated with a special needle in the area of ​​the corresponding metaphysis. If, during aspiration, pus or a cloudy ichor with an admixture of fibrin appears in the syringe, this indicates osteomyelitis. Puncture of the medullary canal in patients with acute osteomyelitis reveals an increase in intraosseous pressure up to 300-400 mm water column (with 50 mm water column normal).

**X-ray diagnostics**

Reliable X-ray signs appear no earlier than 10-14 days after the disease. It is possible to establish a thickening of the periosteum, "erosion" of the architectonics of the bone structure, followed by the formation of bone cavities. The earliest, but not permanent radiological sign of osteomyelitis is a thickening of the shadow of the soft tissues adjacent to the affected bone. Chronic osteomyelitis is characterized by the presence of sequesters, osteomyelic cavities of osteosclerosis, and the absence of a bone marrow canal. With fistulography, it is possible to identify the direction of the fistulous course, its connection with the bone cavity.

**Laboratory data**

Acute hematogenous osteomyelitis is characterized by leukocytosis up to 20 \* 10 / l with an increase in the number of neutrophils, ESR is always accelerated. There is a moderate decrease in hemoglobin levels. At the same time, dysproteinemia occurs - a decrease in albumin, an increase in the level of globulins. Changes in urine: traces of protein, leukocytes in sediment, casts. With septicopyemic form of osteomyelitis, bacteriuria is often determined.

**Control questions:**

1. The concept of osteomyelitis and the its classification
2. Features of the structure and blood supply of children bones and its role in osteomyelitis occurrence.
3. The sources of infection.
4. Sensitization as a role for osteomyelitis occurrence.
5. Pathologic anatomy of acute phase of hematogenous osteomyelitis.
6. The mechanism of a sequestration and the types of sequestrums.
7. The clinical characteristic of osteomyelitis. General and local symptoms.
8. X-ray diagnosis of hematogenous osteomyelitis. Possible complications.
9. The chronic phase of hematogenous osteomyelitis. Local symptoms. The concept of fistulography.
10. The treatment of different phase of hematogenous osteomyelitis. Indications for surgical operation.
11. The atypical form of the disease: sclerosing (Garré's disease and others).

**Tests on the topic: «Hematogenous osteomyelitis»**

***Choose one correct answer***

1. ACUTE HEMATOGENOUS OSTEOMYELITIS IS MORE LIKELY TO OCCUR AT THE AGE OF

1) 1-2 years

2) 3-4 years old

3) 8-14 years old

4) 16-20 years old

2. TWO WEEKS AFTER THE ONSET OF OSTEOMYELITIS, AN X-RAY REVEALS

1) the presence of sequesters

2) blurring of the bone pattern

3) osteosclerosis

4) osteoporosis

3. SEQUESTRATION IS

1) a section of new bone tissue

2) purulent cavity

3) necrotic bone area

4) rejected section of dead tissue

4. IN CHRONIC HEMATOGENOUS OSTEOMYELITIS, SURGICAL TREATMENT IS INDICATED

1) if there is a sequester

2) in the presence of periostitis

3) after the formation of the sequestral box

4) when conservative treatment is ineffective

5. IN ACUTE HEMATOGENOUS OSTEOMYELITIS, X-RAY EXAMINATION WILL BE INFORMATIVE

1) on the first day after the onset of the disease

2) on the 2nd-3rd day from the beginning of the disease

3) on the 5th-7th day from the beginning of the disease

4) on the 10th-14th day from the beginning of the disease

6. THERE ARE SEQUESTERS

1) circulating

2) penetrating

3) local

4) pointed

7. OSTEOMYELITIS IS AN ACUTE PURULENT-INFLAMMATORY PROCESS THAT IS LOCALIZED

1) in the bone marrow, bone, periosteum and surrounding soft tissues

2) in the bone marrow, bone and periosteum

3) in the bone marrow, bones

4) in the bone marrow

8. CHARACTERISTIC RADIOLOGICAL SIGN OF CHRONIC HEMATOGENOUS OSTEOMYELITIS IS

1) sequester and sequestral box

2) multilayered periostitis

3) osteosclerosis

4) everything is correct

9. IN CHRONIC HEMATOGENOUS OSTEOMYELITIS, THE SEQUESTER ON THE X-RAY LOOKS LIKE A SECTION OF

1) rarefaction (enlightenment)

2) darkening with a rim of illumination around

3) osteosclerosis

4) clearances with a darkening rim around

10. THE PRINCIPLE OF SURGICAL TREATMENT OF ACUTE HEMATOGENOUS OSTEOMYELITIS IS

1) drainage of intermuscular phlegmon

2) early decompressive osteoperforation

3) sequestrectomy

4) amputation

11. RADICAL TREATMENT OF CHRONIC HEMATOGENOUS OSTEOMYELITIS IS

1) elimination of purulent-necrotic focus

2) opening of the subcostal abscess

3) removing the sequester

4) drainage of intermuscular phlegmon

12. THE SEQUESTRAL BOX IS

1) a section of dead bone

2) newly formed bone tissue around the sequester

3) unchanged bone tissue around the sequester

4) the plot of the periosteum

13. ACUTE HEMATOGENOUS OSTEOMYELITIS IS MORE OFTEN LOCALIZED IN

1) the diaphysis

2) metadiabase

3) metaphysics

4) the pineal gland

14. FISTULAS ARE A CHARACTERISTIC FEATURE OF

1) acute hematogenous osteomyelitis

2) chronic hematogenous osteomyelitis

3) primary-chronic osteomyelitis

4) can occur in any form of osteomyelitis

**Osteoarticular tuberculosis**

The causative agent of tuberculosis is mycobacterium tuberculosis bacteria, which may be straight or curved (discovered by Robert Koch in 1882). Mycobacterium tuberculosis is extremely resistant to various chemical and physical influences. They tolerate cold, drying, stay alive in street dirt for up to 2 weeks, on the pages of books - up to 3 months, keep well in dark damp places, but do not tolerate direct sunlight.

The source of infection is a person with tuberculosis, as well as sick animals (cattle, goats, sheep, poultry). About 1% of those infected with tuberculosis fall ill. This is due to the fact that a strong, healthy body has a natural resistance to tuberculosis. The disease develops in cases when the body's defense is weakened as a result of other diseases, harmful actions (for example, alcoholism). Tuberculosis is a social disease, a disease of basements and slums (dirt, cold, dark damp places).

Mycobacterium tuberculosis enter the body in the following ways:

1. Through respiratory tract by inhalation of air containing bacteria and dust.
2. Through digestivetract when taking milk, meat containing tuberculosis pathogens.
3. Possibly through the skin and mucous membranes if damaged.

In relation to the total number of tuberculosis, osteoarticular type of TB accounts for 5-10%.

Tuberculosis of bones and joints develops through hematogenous way from the primary site of disease in other organs. Most often, the source of hematogenous spread of Koch's mycobacteria is a primary tuberculosis complex in the lung: lung tissue → pneumonic focus; lymphatic pathways of the affected lung; lymph nodes of pulmonary roots with caseous changes in them. More often, the primary complex proceeds without complications and along with proper antibacterial treatment, ends favorably (resorption, calcification of the focus), but in case of complicated course of disease, lymphohematogenous dissemination to the other organs may occur.

The main localization of tuberculosis in case of bone damage is a spine (spondylitis - 40%), and joints, the most common are a knee joint (gonitis - 20%), a pelvis joint (coxitis - 20%).

60% of all patients with osteoarticular tuberculosis are children under 10 years of age and 72% - children under 15 years of age.

Such high disease incidence in children is explained by the characteristics of a child's body:

1. It has been established that tuberculosis infection is localized mainly in those bones that are rich with spongy substance (vertebrae, metaphyses of long bones), well supplied with blood vessels, where the blood flow is slowed down. In children, bones are especially rich in blood vessels; in adults, the vascular tree of bones is much less developed.

2. The second factor is the increasing load on one or another part of the skeleton. This explains that spondylitis begins more often at the age of 2 or 3 years, during the period of increasing load on the spine.

**Pathological anatomy**

As a rule, Mycobacterium tuberculosis in case of hematogenous dissemination from the primary focus is placed in red bone marrow. In the place where mycobacteria (Koch's bacillus) settle, a tubercle or granuloma of the size of millet seeds develops. This is how primary ostitis or tuberculous osteomyelitis is formed. In the center of the tubercle, a focus of homogeneous caseous necrosis is formed, along the edges of epithelioid and giant cells. The tubercles undergo caseous necrosis, new tubercles are formed around them, which merge with the first, the conglomerate undergoes necrosis along with the formation of granulation tissue around it, which is also necrotic. The spread of necrosis leads to complete separation of necrotic bone tissue from the adjacent bone - a sequestrum is formed.

The development of specific granulation tissue leads to lacunar resorption of the epiphysis bone tissue, with the formation of small caverns containing caseous abscess of tissues with bone sequestra, similar to pieces of ‘melting sugar’.

The further spread of the process and its transition to a joint occurs gradually. The closer the focus is to the cortical layer of a bone, the faster its transition to the joint is possible.

The progressive development of tuberculosis inflammation focus spreads to the joint with the formation of tubercles in joint capsule tissues, followed by caseous necrosis and destruction of articular cartilage and adjacent areas of bone tissue. Only in 5% of cases there is a primary lesion of synovial membranes (tuberculous synovitis). In such cases, prognosis is favorable, without destruction of epiphyses.

One of the most important pathogenetic features of osteoarticular tuberculosis is pronounced dystrophic changes of the tissues surrounding the tuberculosis focus: vasculature reduction, osteoporosis and muscle atrophy develop, which are found not only in the affected joint, but also throughout all limbs.

Depending on the localization of tuberculosis, the pathological and clinical manifestations have some differences.

Bone tuberculosis. Disease begins with the metaphysis damage, where tuberculous osteomyelitis (primary ostitis) develops. Clinical manifestations are usually associated with dysfunction of an adjacent joint, where reactive inflammation of synovial membrane develops with the formation of joint effusion. The subsequent development of the focus in metaphysis can lead to tuberculous arthritis.

P.G. Kornev distinguishes the following phases of osteoarticular tuberculosis:

1. Pre-arthritic phase - primary ostitis

2. Arthritic phase - secondary arthritis

3. Post-arthritic phase – consequences of postponed arthritis

Only in rare cases (5%) the disease doesn’t have three phases, but it develops according to the two-phase type, starting from a primary lesion of the joint itself, its synovial membrane, primary synovitis, which is the source of subsequent infection of joints and development of "secondary arthritis", very rarely the process starts from the synovial membrane.

There are a) synovial; b) fungous; c) bone forms of tuberculosis.

*Synovial form*. Due to the formation of tubercles and specific granulation tissue, a serous exudate is formed in the joint, an articular cartilage stays undamaged for a long time, due to the presence of fluid in the joint and muscle atrophy above and below the affected joint, the latter is spindle-shaped.

*Fungous form*. It develops with the predominance of productive processes over exudation. It is characterized by the development of granulation tissue in the affected joint. Granulation, as it grows, fills the entire joint, destroys cartilage, bone, joint capsule and surrounding soft tissues, which causes the joint to grow (‘white tumor’).

*Bone form* of osteoarticular tuberculosis is characterized by Koch's bacillus brought into the pineal gland which leads to the primary focus of tuberculosis (osteitis) with the formation of a cavity filled with sequestra, then the joint is damaged, tuberculous joint empyema develops (articular surfaces are destroyed, purulent fistulas are formed).

**Clinic**

The *pre-arthritic phase* is manifested by the syndrome of general tuberculous intoxication: children are naughty, get tired quickly, show loss of appetite, local symptoms are unclear and unexpressed.

*Arthritic phase*. There are signs of synovial membrane damage: pain, limitation of motion, muscle atrophy, manner of walking is changed, slight lameness, incomplete extension of a joint, sometimes limb elongation; Aleksandrov's symptom – because of edema and sclerosis of cellular tissue thickening of a skin fold occurs; on the affected side, smoothness ofjoint contour is found due to the accumulation of fluid; after that contracture of the joint appears, at first reflex contracture is noted, in 2 weeks it turns to myogenic, in 2 weeks turns to desmogenous and in 2 weeks more to arthritic, the joint increases in volume, the skin is edematous, pale. Skin dystrophy (hypertrichosis) and hyperhidrosis develop.

Diagnostics of tuberculous lesions of bones and joints includes specific tests, bacteriological and morphological research methods, ultrasound, CT and MRI. However, the leading role in diagnostics belongs to polypositional radiography.

*Pre-arthritic phase*. In the area of ​​epiphysial cartilage, primary ostitis is found. The developing tuberculous process destroys bone tissue, which can be seen in the image as a bone defect, an area with a lack of bone structure is a focus of enlightenment. Sometimes in the center of the focus there is a sequestration in the form of dark tissue. Primary lesions are often solitary and are always located in the cancellous bone, that is, in the area of ​​epiphysial cartilage. The tuberculous process is also characterized by the absent zone of bone sclerosis around the focus and, as a rule, porosity and atrophy of a bone are noted. As a rule, there is no thickening of the periosteum (periostitis is absent). The signs of caseous decay in the lesion focus and pronounced osteoporosis can be seen.

*Arthritic phase*. X-ray examination at this stage reveals: osteoporosis of joint area, expansion of joint space due to hypertrophy of the articular cartilage, destructive changes in ​​epiphysial cartilage area.

When inflammation moves to the joint, osteoporosis becomes more pronounced, contact destructive changes in the articular parts of bones increase. There is sharp narrowing of the joint space because ofcartilage destruction, increasing displacement of the bones that form the joint. In neglected cases, subluxations, pathological fractures, sequesters can be noted.

*Post-arthritic phase*. The initial radiological signs of remission are manifested by the appearance of signs of delimitation of bone destruction and decline of osteoporosis, the bone structure becomes visible. During the later period of remission, new trabeculars of bone appear (manifestations of osteoporosis). However, bone atrophy remains. A new joint is being formed. Capabilities of the damaged joint is highly limited. In 10-15% of patients, the process ends with bone ankylosis.

Complex *conservative treatment* includes administration of antimicrobial drugs, strengthening the immunological forces of the body.

In case of*surgical treatment* of osteoarticular tuberculosis, the following types of surgical operations are used: medical puncture, opening and excision of the primary purulent focus (necretomy), joint resection, osteoplasty and endoprosthesis replacement.

30 - 45% of the total number of patients with osteoarticular tuberculosis have***tuberculosis of the spine***. This disease occurs mainly during the first five years of a child's life. Mostly at the age of 3. The most susceptible is thoracolumbar region. In 74% children 3 or more vertebrae can be affected. Combined lesions are observed in 10-15%. Most often, tuberculous spondylitis is observed in combination with a lesion of pelvis joint. In adults, spinal lesions are often combined with active tuberculosis of lungs and kidneys (10%).

Pathological anatomy. On the basis of tuberculous dissemination, primary ostitis arises in the vertebrae - a source ofspondylitis development. Localization of the primary focus in the vertebral body is closely connected with the peculiarities of blood supply and the patient's age. The most vascularized parts of the vertebra are often affected. In young children, these are the central parts of the vertebra, and in older children, peripheral ones, as by the age of 5-6 years, the process of ossification develops in so-called epiphyseal parts of vertebral bodies. Vertebra arches and processes are rarely affected.

There are various ways of tuberculosis spread from the primary focus: through the anterior, posterior and lateral surfaces of the vertebral body (non-disc path), as well as through the intervertebral disc (trans-disc path). The nature of neurological disorders is determined byprocess localization. The process, spreading by the non-disc pathway, leads to extensive destruction of the vertebrae, breaking through the anterior surface, pus exfoliates the anterior longitudinal ligament, forming a prevertebral abscess and causes contact damage to the bodies of the adjacent vertebrae (superficial caries). In case of breaking through the posterior longitudinal ligament, neurological disorders usually occur because ofspinal cord edema, spinal cord compression with pus, sequesters, thickening of the meninges due topachymeningitis development. Destruction of vertebral bodies is accompanied by their wedge-shaped deformation, which leads to wedge-shaped curvature of the spine (kyphosis), especially when localized in the thoracic spine. Because of kyphosis, the entire chest is deformed, the vessels and organs are compressed,pulmonary and heart failure develops. With lateral destruction of the vertebral bodies, scoliosis is formed (this is typical for the lumbar spine).

In *pre-spondylitic phase*(tuberculosis process is localized in one vertebra), there are signs characteristic of the initial stages of tuberculosis of any localization (weakness, subfebrile condition, autonomic disorders), local changes are not observed. The clinic is determined by intoxication, the patient's behavior changes: children becomenaughty, restless, less mobile, lose weight.

X-ray examination determines the focus of osteoporosis in the vertebral body; tomographic examination reveals the focus of destruction of 0.3-0.5 cm.

The *spondylitic phase*(the vertebra body is destroyed, tuberculosis process moves to intervertebral discs and surrounding tissues), in addition to the general manifestations of tuberculous intoxication, is characterized by the appearance of pain when trunkbending and"proud gait" posture, connected with a lack of movement, spine andtrunk rigidity, which creates physiological fixation of the spine. Curvature of the spine, hunchback and Kornev's sign are determined: when tapping on the back with a hammer, hypertension of muscle bundles appears, going in both directions to the shoulder blades from the affected vertebra. Congestive abscesses can be determined. In the middle thoracic spine there are prevertebral abscesses, retropharyngeal abscesses. If the lumbar vertebrae affected, congestive abscesses in rare cases remain near the vertebral bodies, but in most cases they penetrate into the sheath of greater teres muscle of the lower back, originating from these vertebrae and spread along the muscles downward, forming clusters in the iliac regions. Then, penetrating under the fallopian arch, they can go down through the muscular lacuna to the thigh, forming congestive abscesses.

Congestive abscess is a sacculated granuloma of soft tissues, the primary focus of which is located in the vertebra.

X-ray shows widespread destruction of the affected vertebra and contact involvement of two adjacent vertebrae that leads to angular kyphosis. The process can also involve other vertebrae with varying degrees of destruction.

In the *post-spondylitic phase*, pain is caused by radicular syndrome due to deformation and instability of the spine. In children, the affected vertebrae lag behind in growth, which aggravates the imbalance between the trunk and limbs, pachymeningitis develops due to narrowing of the spinal canal and formation of adhesions and scars. Paraparesis develops and it leads to trophic disorders. Congestive abscesses and fistulas may remain.

*Treatment of spine tuberculosis* includes the use of a plaster jacket, puncture of congestive abscesses and specific anti-tuberculosis chemotherapy. In case of pronounced destructive processes in the spine, necrectomy is performed (removal of tuberculosis foci from the vertebral bodies); spinal fusion –a surgical procedure during which several vertebrae are joined with bone grafts or metal structures.

**Self-study questions:**

1. A distinctive feature of the causative agent of tuberculosis.

2. Pathogenesis and pathology of osteoarticular tuberculosis. Mechanisms of bone destruction. Cold abscesses.

3. Clinical course of osteoarticular tuberculosis. Phase dynamics of general and local symptoms.

4. Clinical picture and diagnosis of spondylitis, gonitis, coxitis.

5. X-ray diagnostics of osteoarticular tuberculosis

6. Laboratory data of osteoarticular tuberculosis.

7. General principles of treatment of osteoarticular tuberculosis. Sanitary and orthopedic method. Local and general treatment: etiological, pathogenetic, nosotropic. The boundaries of conservative treatment.

8. Surgical treatment. Types of intervention depending on the phase and stage of disease.

9. Prognosis, outcome of the disease and employment of patients.

**Test on the topic «Osteoarticular tuberculosis»**

***Choose one correct answer***

1. PATIENT K., 46 YEARS OLD, IS REGISTERED IN A TUBERCULOSIS DISPENSARY. EXAMINATION DATA - GIBUS. DETERMINE THE PHASE OF THE DISEASE:

1) pre-spondylitic

2) post-spondylitic

3) spondylitic

4) other tests are required

2. TYPICAL INPUT GATE OF INFECTION IN OSTEOARTICULAR TUBERCULOSIS:

1) respiratory tract

2) skeletal system

3) skin

4) gastrointestinal tract

3. THE MOST FREQUENT LOCALIZATION OF THE TUBERCULOSIS PROCESS IN SPONDILITIS:

1) cervical vertebrae

2) upper thoracic vertebrae

3) coccygeal vertebrae

4) lumbar and lower thoracic vertebrae

4. CHARACTERISTIC X-RAY SIGNS OF ACTIVE OSTEOARTICULAR TUBERCULOSIS:

1) periostitis

2) sclerosis

3) osteoporosis

4) paraosseous bone formation

5. THE MOST FREQUENT LOCALIZATION OF THE TUBERCULOSIS PROCESS IN THE SPINE DURING PRE-SPONDYLYTIC PHASE:

1) vertebral body

2) spinous process of the vertebra

3) transverse process of the vertebra

4) intervertebral disc

6. THE MOST FREQUENT VERTEBRAL DISEASE IN CHILDREN WITH OSTEOARTICULAR TUBERCULOSIS:

1) one vertebra

2) two vertebrae

3) three or more vertebrae

4) spinous processes of the vertebrae

7. CHARACTERISTIC X-RAY SIGNS IN THE PRE-ARTHRITIC PHASE OF OSTEOARTICULAR TUBERCULOSIS:

1) osteosclerosis

2) osteoporosis

3) the formation of the sequestral capsule

4) large focal sequestrum

8. TACTICS OF THE DOCTOR AFTER DIAGNOSING THE COLD ABSCESS OF THE UPPER THIGH:

1) local conservative treatment

2) operation - incision

3) puncture

4) additional examination methods

9. PATHOLOGICAL PROCESS IN THE SUBCUTANEOUS FAT CELL, CHARACTERISTIC FOR OSTEOARTICULAR TUBERCULOSIS:

1) atrophy

2) sclerosis

3) inflammation

4) necrosis

10. NAME MORPHOLOGICAL MANIFESTATIONS AT THE BEGINNING OF THE DISEASE TYPICAL FOR OSTEOARTICULAR TUBERCULOSIS:

1) primary osteitis

2) secondary arthritis

3) primary arthritis

4) periarthritis

11. THE BIGGEST PERCENTAGE OF PRIMARY OSTEOARTICULAR TUBERCULOSIS DISEASE BY AGE GROUP:

1) from 10 to 20 years old

2) up to 10 years

3) from 20 to 30 years old

4) from 40 to 50 years old

12. KOCH’S BACILLA:

1) has an acid-resistant shell

2) releases endotoxin

3) develops in tissues with good blood supply

4) all of above mentioned is true

13. KOCH’S BACILLA IS:

1) Gram-negative aerobic

2) Gram-positive aerobic

3) Gram-negative anaerobic

4) Gram-positive anaerobic

14. FOR THE TUBERCULE IS SPECIFICALLY AVAILABLE:

1) Ashkenazi cells

2) Langhans cells

3) spindle cells

4) Osteoblasts

15. SYMPTOMS OF TUBERCULOUS ABSCESS:

1) Hyperemic lesion

2) Painful lesion

3) Solid, painless swelling

4) All of above mentioned is true

**Answer key**

**«Asepsis - antisepsis. Sterilization of surgeon armarium and suture material»**

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| 1-1 | 8-1 | 15-3 | 22-3 | 29-1 |
| 2-3 | 9-2 | 16-2 | 23-3 | 30-3 |
| 3-1 | 10-1 | 17-2 | 24-3 | 31-4 |
| 4-2 | 11-3 | 18-3 | 25-2 | 32-2 |
| 5-1 | 12-2 | 19-4 | 26-2 | 33-2 |
| 6-1 | 13-1 | 20-2 | 27-4 | 34-3 |
| 7-3 | 14-4 | 21-1 | 28-3 | 35-1 |

**«Asepsis - antisepsis. Surgical disinfection of hands and disinfection of surgical area. Sterilization of surgical garb and dressing material»**

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| 1-3 | 9-2 | 17-4 | 25-2 | 33-1 |
| 2-2 | 10-3 | 18-3 | 26-4 | 34-3 |
| 3-1 | 11-1 | 19-1 | 27-1 | 35-4 |
| 4-4 | 12-1 | 20-4 | 28-4 | 36-2 |
| 5-2 | 13-3 | 21-2 | 29-4 | 37-2 |
| 6-3 | 14-4 | 22-1 | 30-1 |  |
| 7-1 | 15-2 | 23-2 | 31-3 |  |
| 8-2 | 16-4 | 24-2 | 32-4 |  |

**«Bleeding and methods of its control»**

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| 1 – 3 | 6 – 3 | 11 – 1 | 16 – 1 | 21 – 1 |
| 2 – 1 | 7 – 4 | 12 – 2 | 17 – 4 | 22 – 2 |
| 3 – 1 | 8 – 3 | 13 – 1 | 18 – 3 | 23 – 1 |
| 4 – 1 | 9 – 2 | 14 – 1 | 19 – 3 | 24 – 2 |
| 5 – 3 | 10 – 3 | 15 – 2 | 20 – 3 | 25 – 1 |

**«Determination of blood type»**

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| 1 – 2 | 8 – 3 | 15 – 1 | 22 – 3 | 29 – 3 |
| 2 – 3 | 9 – 1 | 16 – 2 | 23 – 2 | 30 – 2 |
| 3 – 2 | 10 – 1 | 17 – 1 | 24 – 3 | 31 – 4 |
| 4 – 1 | 11 – 2 | 18 – 4 | 25 – 2 | 32 – 4 |
| 5 – 4 | 12 – 1 | 19 – 2 | 26 – 1 | 33 – 2 |
| 6 – 3 | 13 – 3 | 20 – 4 | 27 – 3 | 34 – 2 |
| 7 – 3 | 14 – 3 | 21 – 2 | 28 – 1 | 35 – 1 |

**«Blood transfusion»**

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| 1 – 2 | 11 – 2 | 21 – 3 | 31 – 2 | 41 – 2 |
| 2 – 1 | 12 – 2 | 22 – 1 | 32 – 2 | 42 – 1 |
| 3 – 1 | 13 – 2 | 23 – 1 | 33 – 3 | 43 – 3 |
| 4 – 4 | 14 – 3 | 24 – 2 | 34 – 4 |  |
| 5 – 3 | 15 – 3 | 25 – 4 | 35 – 1 |  |
| 6 – 4 | 16 – 2 | 26 – 2 | 36 – 3 |  |
| 7 – 3 | 17 – 1 | 27 – 2 | 37 – 4 |  |
| 8 – 3 | 18 – 1 | 28 – 2 | 38 – 1 |  |
| 9 – 3 | 19 – 1 | 29 – 4 | 39 – 2 |  |
| 10 – 4 | 20 – 3 | 30 – 1 | 40 – 4 |  |

**«Local anesthesia»**

|  |  |  |  |
| --- | --- | --- | --- |
| 1 – 1 | 4 – 1 | 7 – 4 | 10 – 2 |
| 2 – 3 | 5 – 2 | 8 – 3 | 11 – 1 |
| 3 – 3 | 6 – 4 | 9 – 2 |  |

**«General anesthesia»**

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| 1 – 2 | 6 – 2 | 11 – 2 | 16 – 4 | 21 – 2 |
| 2 – 4 | 7 – 3 | 12 – 2 | 17 – 3 | 22 – 4 |
| 3 – 1 | 8 – 1 | 13 – 3 | 18 – 4 | 23 – 3 |
| 4 – 2 | 9 – 4 | 14 – 2 | 19 – 4 | 24 – 4 |
| 5 – 2 | 10 – 1 | 15 – 3 | 20 – 1 | 25 – 2 |

**«Surgery. Pre- and postoperative period»**

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| 1 – 2 | 6 – 2 | 11 – 3 | 16 – 3 | 21 – 2 |
| 2 – 4 | 7 – 4 | 12 – 4 | 17 – 2 | 22 – 3 |
| 3 – 3 | 8 – 4 | 13 – 2 | 18 – 3 | 23 – 1 |
| 4 – 2 | 9 – 2 | 14 – 1 | 19 – 2 |  |
| 5 – 1 | 10 – 1 | 15 – 1 | 20 – 1 |  |

**«Tumors. Classification, clinic, diagnosis, treatment»**

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| 1 – 4 | 6 – 1 | 11 – 4 | 16 – 2 | 21 – 2 |
| 2 – 1 | 7 – 3 | 12 – 3 | 17 – 1 | 22 – 3 |
| 3 – 1 | 8 –1 | 13 – 3 | 18 – 2 | 23 – 3 |
| 4 – 1 | 9 – 3 | 14 – 2 | 19 – 4 | 24 – 3 |
| 5 – 2 | 10 – 3 | 15 – 4 | 20 – 2 | 25 – 4 |

**«Purulent wounds»**

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| 1 – 1 | 7 – 2 | 13 – 3 | 19 – 3 | 25 – 2 |
| 2 – 3 | 8 – 3 | 14 – 2 | 20 – 1 |  |
| 3 – 2 | 9 – 3 | 15 – 2 | 21 – 3 |  |
| 4 – 1 | 10 – 2 | 16 – 1 | 22 – 3 |  |
| 5 – 2 | 11 – 1 | 17 – 3 | 23 – 4 |  |
| 6 – 1 | 12 – 2 | 18 – 4 | 24 – 4 |  |

**«Aseptic and infected wounds»**

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| 1 – 2 | 4 – 1 | 7 – 1 | 10 – 1 | 13 – 2 |
| 2 – 4 | 5 – 2 | 8 – 3 | 11 – 1 | 14 – 2 |
| 3 – 3 | 6 – 2 | 9 – 3 | 12 – 1 |  |

**«Clinic and diagnostics of fractures of long tubular bones»**

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| 1 – 3 | 5 – 1 | 9 – 1 | 13 – 2 | 17 – 3 |
| 2 – 1 | 6 – 2 | 10 – 4 | 14 – 2 | 18 – 3 |
| 3 – 2 | 7 – 3 | 11 – 1 | 15 – 1 |  |
| 4 – 3 | 8 – 4 | 12 – 2 | 16 – 1 |  |

**«Treatment of fractures of long tubular bones»**

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| 1 – 2 | 7 – 3 | 13 – 2 | 19 – 2 | 25 – 3 |
| 2 – 3 | 8 – 2 | 14 – 2 | 20 – 4 | 26 – 2 |
| 3 – 4 | 9 – 3 | 15 – 3 | 21 – 1 | 27 – 1 |
| 4 – 1 | 10 – 4 | 16 – 3 | 22 – 3 |  |
| 5 – 1 | 11 – 3 | 17 – 2 | 23 – 3 |  |
| 6 – 2 | 12 – 1 | 18 – 1 | 24 – 3 |  |

**«Etiology, pathogenesis, clinical picture of thermal burns»**

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| 1 – 3 | 6 – 2 | 11 – 2 | 16 – 2 | 21 – 3 |
| 2 – 2 | 7 – 1 | 12 – 2 | 17 – 1 | 22 – 2 |
| 3 – 3 | 8 – 1 | 13 – 3 | 18 – 3 |  |
| 4 – 3 | 9 – 3 | 14 – 1 | 19 – 3 |  |
| 5 – 1 | 10 – 2 | 15 – 3 | 20 – 3 |  |

**«Treatment of thermal burns»**

|  |  |  |  |
| --- | --- | --- | --- |
| 1 – 3 | 4 – 4 | 7 – 4 | 10 – 1 |
| 2 – 1 | 5 – 2 | 8 – 3 | 11 – 1 |
| 3 – 1 | 6 – 2 | 9 – 2 | 12 – 3 |

**«Acute purulent surgical infection»**

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| 1 – 2 | 5 - 1 | 9 - 2 | 13 - 2 | 17 - 1 | 21 - 1 |
| 2 – 2 | 6 - 2 | 10 - 2 | 14 - 3 | 18 - 1 | 22 - 2 |
| 3 – 1 | 7 - 4 | 11 - 3 | 15 - 2 | 19 - 1 |  |
| 4 - 2 | 8 - 3 | 12 - 2 | 16 - 1 | 20 - 1 |  |

**«Hematogenous osteomyelitis»**

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| 1 – 3 | 4 – 3 | 7 – 1 | 10 – 2 | 13 – 2 |
| 2 – 2 | 5 – 4 | 8 – 4 | 11 – 1 | 14 – 2 |
| 3 – 4 | 6 – 2 | 9 – 2 | 12 – 2 |  |

**«Osteoarticular tuberculosis»**

|  |  |  |  |
| --- | --- | --- | --- |
| 1 - 2 | 5 - 1 | 9 - 2 | 13 - 1 |
| 2 - 1 | 6 - 3 | 10 - 1 | 14 - 2 |
| 3 - 4 | 7 - 2 | 11 - 2 | 15 - 3 |
| 4 - 3 | 8 - 4 | 12 - 4 |  |