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УХОД ЗА ПАЦИЕНТАМИ ХИРУРГИЧЕСКОГО ПРОФИЛЯ

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Рекомендовано Координационным советом по области образования «Здравоохранение и медицинские науки» в качестве учебно-методического пособия для использования в образовательных учреждениях, реализующих основные профессиональные образовательные программы высшего образования уровня специалитет по направлению подготовки 31.05.01 «Лечебное дело»

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STUDY GUIDE

CARE FOR SURGICAL PATIENTS

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CONTENTS

Chapter 2
GENERAL CONCEPTS OF ASEPTICS AND ANTISEPTICS

2.1. ASEPTICS

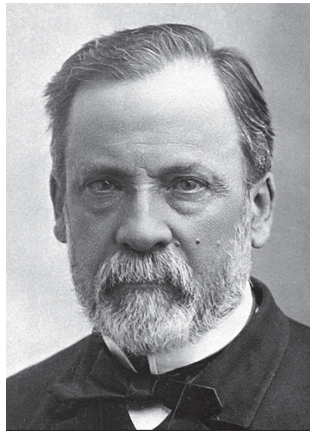
2.1.1. Founders of aseptics

Aseptics is the system of measures directed to the prevention of microbial contamination of the surgical wound and the patient's body.

In 1863, Louis Pasteur proved that the processes of fermentation and decay are associated with penetration, growth and development of microorganisms. The outstanding Russian surgeon N.I. Pirogov was one of the first who suggested the possibility of transmitting the infectious matter through the hands of the surgeon, surgery and bedclothes and also he used alcohol, silver nitrate and iodine for disinfection. In 1847 the Hungarian physician-obstetrician I. Semmelweis used 10% solution of chlorinated lime on his hands for the prevention of puerperal sepsis. In 1867 J. Lister explained postoperative wound infection by penetration and development of microbes in the wound. He introduced the method of treatment and prevention of suppurative processes based on the use of the carbolic acid solution. The surgical area, surgeon's hands, instruments were treated with 2–5% carbolic acid solution and the postoperative wound was closed with multilayer dressing soaked in 5% carbolic acid solution. In Russia, this method was first used by I.I. Burtsev in 1870. However, carbolic acid induced necrosis of tissues, dermatitis, led to the intoxication of patients and medical staff. In 1890, at the X International Congress of Surgeons in Berlin, the basic principle of aseptics was officially accepted: "everything that comes into contact with the wound should be sterile." In 1897, Zoege von Manteuffel suggested performing surgeries in sterile rubber gloves.

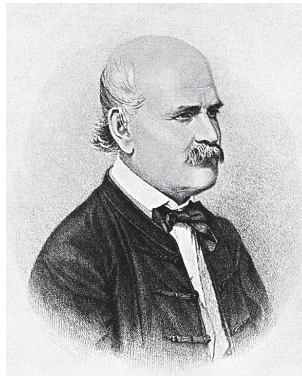
In 1885, Russian surgeon M. Subbotin was the first who equipped the surgery room where he worked with the sterile dressing material. T. Billroth introduced the uniform for doctors of surgical departments in the form of a white

gown and a cap. In subsequent years, E. Bergman developed specific methods of aseptics based on L. Pasteur discoveries and started the new directions of aseptics, some of which are used up to this day.



L. Pasteur

J. Lister



I. Semmelweis

M. Subbotin

Currently, two sources of infection are identified: exogenous and endogenous.

The endogenous source is the spread of microorganisms from the infection focal point in the body (upper respiratory tract infection, skin infection, hollow viscus perforation, with lymph and blood flow) which can enter in the infected spot via lymphatic and blood vessels and by contact way as well.

Exogenous source of infection is microbial contamination of the wound from the environment. In exogenous infection, the following ways of the spread of infection are distinguished as:

- air (airborne; air-dust) — pathogens enter the body from environmental air;
- contact — microorganisms enter the body through the subjects contacting with the wound during surgeries or other procedures;
- implantation — microorganisms enter the body with implantation substance (suture or dressing material, metal constructions, synthetic cardiac valve prostheses, etc.).

2.1.2. Methods for prevention of airborne infection

Methods for prevention of airborne infection can include the following of personal hygiene rules (medical staff, patient, visitors), wearing of medical face masks, organisation of adequate ventilation and use of bactericidal lamps.

The medical face mask is the orthogonal dressing closing the nose and mouth, relatively loosely adhering to the face and aimed to decrease the elimination of secret drops from the nasopharynx and oral cavity in the environment during respiration.

Currently, filter-type masks are widely used. Reflective masks are not commonly used, in which produced condensation flows down into the special built-in containers. Disadvantages of this mask type, first of all, include its inconvenience.

There are several types of medical masks, depending on the filtration level for bacterial and submicrobial particles:

- 2-, 3-, 4- and multilayer masks;
- face respirators without relief valve (provide filtration efficacy of at least 95% and leakage below 8% of the air due to optimised form as well);
- face respirators with relief valve (leakage is below 2–8% of inlet air, 95–99% filtration efficacy for the particles with 100-nm diameter).

There are gauze, cellulose, etc., cloth and non-cloth masks depending on the materials from which they are made.

Classification of masks by purpose can also be used. Procedural and surgical face masks which are additionally equipped with the sweat-absorbing strip, fog proof strip or protective shield are also distinguished. Elastic or string masks, etc. are distinguished depending on the support system.

While getting wet from breath - the filtration ability of the mask is decreased, thus, e.g., 100% of 3-layered gauze face masks are very contaminated by the microbial flora 3 hours after the start of the use. Currently, some masks

not only block the penetration of microbes to the body but also neutralise their activity; therefore, in order to increase the efficacy of filter masks, the latter are soaked with antiseptic agents which prolongs their effectiveness by 1.5–2 times.

The masks should be worn by: medical staff in the surgery room, dressing room; in resuscitation department and intensive care units in some cases; during any invasive procedures (bandaging in patient rooms, injections, etc.); during flu epidemy.

2.1.3. Development of ventilation system

The organisation of the surgical inpatient department includes the adequate organisation of ventilation for surgery rooms with the following functions: a) prevention of bacterial transfer from the in-patient hospital; b) from one part of the operating room to other parts; c) elimination of air contamination by the staff and patients.

In old design operating rooms, the bacteria count per 1 m^3 of air was 1000 at the beginning of the surgery start and 4000 — at the end of the surgery. After the introduction of the air cleaning system, the bacterial contamination of the surgery room decreased to 30 and 100 bacteria per 1 m^3 respectively.

Modern ventilation system includes the use of gateways, inlet ventilation providing air input in larger volumes if compared to the outflow.

Gateways for the staff, patients, clothes, apparatus and equipment with tight bactericidal locks — are the additional barriers between the surgery rooms and the hospital.

Supply of sterile air under excessive pressure is recommended. The air should be supplied over the surgical table through ceiling panels. Surgery rooms with vertical airflow provide a lower risk of wound infection if compared to the horizontal one. In the climate control system the following conditions are considered as optimal: air changing at least once in 12–15 hours, positive pressure (+20 mm Hg), the temperature of 18.5–23.8 °C, the humidity of 50–55%, air recirculation with effective filtration up to 80%.

The modern model of the surgery room is the isolation unit housing the surgical team, patient and bacteria-free air which is supplied from downward. The surgical team wears tight air-proof surgical overalls in which the air is supplied, and exhaled air is sucked through flexible tubes.

Operating rooms with laminar airflow. In the operating rooms, the air is pumped continuously through the ceiling. As a result, smooth laminar airflow is sustained preventing the occurrence of turbulent flows elevating dust and microorganisms from non-sterile surfaces.

2.1.4. Prevention of implantation infection

Implantation infection is caused by non-sterile foreign subjects administered in tissues: suture material, prostheses, metal constructions for osteosynthesis, drugs. It can contribute to the development of an abscess, sepsis, osteomyelitis, hepatitis B infection, HIV infection. Prevention patterns:

- use of disposable materials and instruments;
- use of sterile suture material;
- use of sterile grafts;
- use of disposable sterile lining materials;
- control for medical device use;
- careful treatment of used material;
- non-disposable instruments are sterilized;
- observation of storage rules for sterile materials and instruments;
- sterilisation quality control.

2.1.5. Surgeon's hands' preparation for surgery

Surgeon's hands' treatment is a crucial stage of preparation for the upcoming surgery. In most cases, handwash includes three successive steps:

1) mechanical and chemical treatment (skin defatting) — hands washing from fingertips to the upper third of the forearm with water and soap (or liquid detergent);
2) antiseptic treatment with substances which should be not only antiseptic but harmless for skin and cost-effective for use in large volume as well;
3) skin tanning or use of film-forming antiseptic agents can be used to increase the duration of skin sterility.

During and after handwash performance, it is necessary not to contact untreated skin and subjects by treated parts of hands.

2.1.6. Preparation of the surgical area

Presurgical preparation (excluding urgent surgeries, at the patient's severe state) includes complete sanitary and hygienic treatment of the patient: washing in the shower, change of bed and underwear.

The surgery area on the surgical table is treated by skin antiseptic agents (iodine agents, alcohol solution of chlorhexidine, bigluconate, 70° ethanol, sterile adhesive films, etc.)

Principles of surgical area preparation:

- a full treatment of the area of future section and neighbouring areas for sterility provision if the unscheduled extension of the surgical access is required;
- treatment from suggested section area to the periphery;
- more contaminated parts are treated in the last order;
- observation of Filonchikov–Grosikh rules — multiple handwashing: Before limiting the surgical area with surgical drape; immediately before sectioning; by indications — during surgery; before and after skin sutures application.

2.1.7. Hygiene of medical staff

Hygiene of medical staff is an essential part of prevention and struggle against surgery infection. The department staff should be examined at least once in three months to reveal carriers of pathogenic microorganisms. If they are revealed, sanitation of the infection site should be performed. Even pustules, eczema, decayed teeth are considered as significant. The staff is accepted to fulfil professional duties only in the case of negative reaction. If nosocomial infections are found, the unscheduled examination of the department staff and bacteriological testing for carriage is performed. The crucial procedure to provide aseptics is the sanation of identified sites of infection in the medical staff. When sanation gives no results, the carriers shall be relocated for work beyond the surgery departments.

Use of special clothes is obligatory. The organisation of sanitary inspection rooms when staff have a hygienic shower and wears special clothes is optimal. In the surgical department, all employees should have replaceable shoes, medical caps and coats, surgical overalls (not necessarily white), which should be suitable for repeated washing. During dressing of patients who have ongoing infectious processes, the staff should use oilcloth aprons which are wiped with a disinfecting agent after every dressing. It is necessary to pay attention to medical staff appearance. Jewellery and cosmetics should be minimal. Persons participating in the surgery should have a hygienic shower, wear sterile surgical clothes (surgical overall, coat, shoes). The coat is taken off before entering the surgical hall. Overshoes, apron, face mask, are worn, and handwashing is performed. The sterile coat, gloves are worn just in the surgery room. The appearance of medical staff with hair down, outdoor footwear in the operating unit is strictly prohibited. The staff should not go out of the operating unit in special sterile clothes.

2.2. ANTISEPTICS

The term "antiseptic agent" was introduced in 1750 by English surgeon J. Pringle who described the antiseptic action of quinine. Before aseptics and antiseptics introduction, the statistics were unfavourable: each sixth patient died after performed surgery mainly due to septic complications. The situation changed when in 1865 English surgeon Joseph Lister used the dressing soaked in carbolic acid for treatment of the opened wound for the first time and further he developed the complex of antiseptic activities. N.I. Pirogov also used substances with antiseptic properties for wound treatment: camphor spirit, chlorinated lime, silver nitrate, etc. but he did not develop a complete doctrine on the use of antiseptic agents.

Antiseptics is a unique treatment and preventive complex of activities directed to decrease microbe count in the pathological focus, organs and tissues, decrease of their viability, risk of penetration into surrounding tissues and other body media, and to increase the immune and biological activity of the patient's body and its reactivity.

There are mechanical, physical, chemical, biological, and mixed antiseptics depending on the principle of action.

2.2.1. Mechanical antiseptics

Mechanical antiseptics is the system of antiseptic activities based on the mechanical removal of microorganisms with devitalized tissues serving as the culture medium for infection. Knife (scalpel), scissors, forceps, swab, etc. are used for mechanical antiseptics.

Methods of mechanical antiseptics

1. *Wound toilet* — enables to decrease the bacteria count in the wound by 70–80%; performed during any dressing. Wound toilet includes the following stages:

- dressing removal;
- cleaning of the skin around the wound:
  - defatting and cleaning;
  - disinfection and tanning.
- cleaning of the wound surface:
  - effusion and blood clots removal with gauze sponges;
  - wound flushing with antiseptic solution (solutions of chlorhexidine, sodium hypochlorite, hydrogen peroxide, etc.);
  - removal of necrotic tissues and foreign bodies using surgical instruments.
- applying of aseptic dressing.

2. *Initial surgical treatment* — one-step radical surgery which is directed to the prevention of infectious process in the wound and creation of conditions for effective wound healing and thus is performed with the observation of all principles of aseptics and antiseptics. Includes carving of wound edges and devitalized tissues and removal of foreign bodies.

Indications — the presence of accidental wound without infection signs and not more than 24 hours should pass after injury occurrence.

Initial surgical debridement starts from the wound dissection. Then the skin and subcutaneous fat are dissected around the wound by edging section of 0.5–1 cm in width. The skin section is prolonged along the extremity axis in order to examine all nooks and resect devitalized tissues. Further fascia and aponeurosis are dissected along the skin section. Scraps of clothing, blood clots, loosely lying foreign bodies are removed, and surgeons proceed to the excision of crushed and contaminated tissues. If damaged vessels, nerves, tendons are found, their integrity is restored and contaminated tissues are removed carefully from their surface. Small bone fragments in the wound are removed; bone fragments protruding into the wound ends are cut with forceps. Careful bleeding arrest is a necessity during wound treatment. If during surgical treatment of the wound devitalized tissues and foreign bodies are entirely removed, then the wound is sutured.

3. *Secondary surgical debridement of the wound* is performed following the same rules that the initial debridement is, but if there are any signs of purulence, it includes the wound cleaning, removal of foreign bodies and necrotising tissues, the opening of leakages, nooks, provision of wound discharge outflow. As a rule, excision of tissues is not carried out due to the risk of infection generalisation.

4. *Opening* of abscesses or *puncture* of encapsulated purulent foci.

5. *Sanation* is the system of activities directed to reveal functional and pathological changes of organs and their removal (sanation of abdominal, pleural cavities, abscess cavity).

6. *Ectomy* or *extirpation* is a complete removal of the organ or a specific anatomic part of the body, including in purulo-necrotic processes (appendectomy, mastectomy, cholecystectomy, pneumonectomy, hysterectomy).

2.2.2. Primary surgical debridement

Indications — presence of an accidental wound without signs of ingress of infection into it. No more than 24 hours should elapse since the moment of getting injured to admission to the hospital.

Primary surgical debridement (PSD) starts with wound discission. Then, the skin and the subcutaneous tissue around the wound are dissected with a 0.5–1 cm wide befringing discission. The skin discission is protracted along the extremity axis to make it possible to examine all the blind nooks and excise the devitalized tissues. Then, along the skin discission a fascia and aponeuroses are incised. Patches of clothes, blood clots, loose-lying debrides are removed, and then exsection of smashed and polluted tissues is started. On detection of lesions to vessels, nerves, and tendons, their integrity is restored, with polluted tissues carefully removed from their surface. Fine bone fragments loose-lying in the wound are removed, with the ends of bone fragments protruding into the wound bitten off with pliers. While cleaning the wound, a thorough bleeding control is necessary. If during the PSD of the wound devitalized tissues and debrides are completely removed, the wound is sewn up.

2.2.3. Physical antiseptics

Physical antiseptics — the system of antiseptic activities based on the creation of unfavourable conditions for vital activity of microorganisms using methods of physical exposure. Physical antiseptics include:

1) *drainage* which can be active (by aspiration using vacuum-suction, etc.), passive (based on the natural flow of effusion); flow-flashing drainage (cavity flashing and evacuation of administered solution) is performed;
2) *absorbent properties of dressings* ensuring liquid outflow into the dressing; the effect significantly increases at its soaking with hypertonic solutions (10% sodium chloride, 25% magnesium sulphate);
3) *drying and different temperature* exposures;
4) *light and ultraviolet irradiation*, the use of which accelerates wound dehydration, stimulates regenerative processes. *Lasers* also produce a significant antimicrobial effect. Moderately defocused laser beam evaporates, and focused laser beam dissects the necrotised tissues;
5) *ultrasonic cavitation* is based on the use of liquid oscillation effect accompanied by necrotised tissue breakdown, bactericidal effects;
6) *electrophoresis and sinusoidal modulated current* the effect of which is based on the improvement of microcirculation and resorption of infiltrates;
7) *methods of intra- and extracorporal detoxication* (sorbents, hemosorption, lymphosorption, plasmapheresis) which removes toxins, microbes, etc. from the human body using physical methods of exposure.

2.2.4. Chemical antiseptics

Chemical antiseptics is the system of antiseptic activities based on the microorganism elimination with chemical substances (antiseptic agents). Currently, more than 30 thousands of antiseptic agents are known.

The antiseptic agent is the chemical agent eliminating or suppressing the growth of microorganisms, but it is non-toxic for skin and mucous membranes and can be used for wound treatment or body cavities.

There are the following groups of antiseptic agents:

1) halogens;
2) oxidising agents;
3) metal salts;
4) acids;
5) alcohols;
6) alkalis;
7) phenols;
8) aldehydes;
9) dyes;
10) detergents;
11) sulfonamides;
12) quinoxaline derivatives;
13) preparations of nitrofuran;
14) derivatives of 8-hydroxyquinoline;
15) derivatives of nitroimidazole;
16) herbal preparations;
17) tar and resins.

2.2.5. Biological antiseptics

Biological antiseptics is the system of antiseptic activities based on microorganisms elimination with the help of biological agents acting directly on the microorganisms and indirectly by stimulation of protective mechanisms of the organism struggling against infection.

Biological antiseptics of direct action include the use of:

- antibiotics;
- agents for passive immunisation of the body (therapeutic sera, bacteriophages, hyperimmune plasma, antitoxins, etc.);
- enzymes, proteolytic enzymes;
- of animal origin (trypsin, plasmin, chymotrypsin, chymopsin, ribonuclease);

- of vegetable-based origin (papain, debricin, terralitin), microbial enzymes (streptokinase, streptodornase, collagenase);
- methods of extracorporal detoxication.

Biological antiseptics of indirect action includes the use of preparations and methods stimulating:

- specific immunity (vaccines, anatoxins);
- nonspecific immunity (interleukins, interferons, lysozyme, levamisole, thymus agents/thymalin, T-activin, prodigiosin, sodium nucleinate, etc.);
- non-specific resistance of the macroorganism (ultraviolet irradiation and transfusion of blood products, laser therapy, vitamin therapy, etc.).

2.2.6. Mixed antiseptics

Mixed antiseptics is the usage of the combination of different methods of antiseptics on the micro- and macroorganism. In the clinical practice, mixed antiseptics are used most frequently because there is the necessity of obtaining the maximal antiseptic effect. For example, the modern management for patients with any surgical infection: surgical treatment (physical, chemical and mechanical antiseptics) is supplemented by the prescription of antibiotics (biological antiseptics).

Self-control questions

1. What is aseptics? What are the main stages of aseptics formation?
2. Methods for prevention of airborne infection?
3. The role of hygiene of medical staff?
4. Surgery handwashing?
5. Principles of surgical area preparation?
6. Methods of prevention from implantation infection?
7. What is antiseptics? List types of antiseptics.
8. What methods relate to mechanical antiseptic? What is initial and secondary surgical debridement?
9. What is physical antiseptics? What methods of physical exposure are widely used in clinical practice?
10. What does chemical antiseptics include?
11. What does biological antiseptics include? Which classifications of biological antiseptics do you know?
12. What is mixed antiseptics?