Antisepsis, Disinfection Sterilization - Methods Used in Dentistry

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The Pasteur principles regarding the cause of infection and the measures that need to be taken in order to prevent it have become a necessity of the first rank, representing, at the same time, the decisive factor of progress in modern dentistry. Nowadays, based on these principles, from the simplest bandage to the most complex surgery, these are carried out with the help of materials, dental hands and a surgery area where the pathogenic germs have been destroyed. These measures are based on asepsis and antisepsis, methods that perform the disinfection. Asepsis represents the prophylactic side of the disinfection and addresses all the moments that present the risk of contamination. It represents the set of measures by means of which the contact between germs and surgery or accidental plague is avoided. It is a prophylactic method. Antisepsis represents the totality of the means by which the destruction of the germs present in a plague, on the skin or in the environment is sought; it is a curative method. -The main mechanisms of action of antiseptics on microorganisms are: altered outer membrane, amino group blockage, tiolitic group blockage, inhibition of ergosterol synthesis, cytoplasmic membrane alteration, energy decoupling, intracytoplasmic clotting. The study comprises 135 sterilizations performed over a period of two years; 107 (79.26%) were done in autoclaves, 7 (5.18%) in ethylene oxide, and 21 (15.56%) in hydrogen peroxide. The use of an antiseptic for long periods of time must be avoided due to the fact that, in the case of those containing heavy metals in their structure, they can be cumulated in the human body, and when toxic concentrations are reached, various toxicities can be triggered.

Keywords: infection, disinfection, prophylactic method, curative method, sterilization, oral cavity

Louis Pasteur (1822–1895) is considered to be the father of modern sterility, other personalities whose names are related to this field being the Russian Elie Metchnikoff (1845 - 1916) and the Romanian Victor Babe' (1854 - 1926).

Antisepsis and disinfection have always played an important role in the fight against infectious diseases, especially since the 19th and 20th centuries, once with the development of chemistry, pharmacy and microbiology, which established the concepts and rules of using antiseptics and disinfectants in medicine and surgery.

The need imposed by medical ethics and by the legislator to fight vigorously against these infections mobilizes all resources, among which antisepsis and disinfection have a decisive role.

The oral cavity, considered the most contaminated natural cavity of the body, in near vicinity with other septic cavities of the face (nose, pharynx, paranasal sinuses).

Acute, chronic infectious lesions, make the patient see the doctor for the treatment of the non-specific infections (abscess, periodontitis, gingivitis, stomatitis), or even of the specific ones (syphilis, TBC); respectively patients can carry hepatic viruses (hepatitis B, C, D, E..F...), acquired human immunodeficiency (HIV).

Antisepsis and disinfection represent the necessary and inseparable elements of the disinfection process. Asepsis represents the prophylactic side of disinfection and addresses all the moments that present the risk of contamination of the surgical plague; it is done by a series of methods: disinfection of the dentist's hands and the protection with sterile gloves; disinfection of the surgery area; sterilization of the surgical instruments and of the soft material; aseptic gestures on the post-surgery plague.

Asepsis - without putrefaction – the set of measures by which the contact between germs and the surgical plague is avoided, being a prophylactic measure.

Infections in dentistry

The contact of the doctor's hands and the nurse's hands with saliva, blood, pus, contaminated tissues, dental device with dental units with polyethylene tubing that favours the contamination and colonization with microorganisms and their circulation from one patient to the other; the hand parts (right, elbow, turbine) difficult to sterilize, can circulate germs from one patient to the other by the contact with oral mucosa, saliva, blood, pus, respectively with the doctor's hands, hence the necessity of the existence of a larger number of hand parts, in order to be able to sterilize them from one patient to the other. There are also hand parts from plastic – parts of the scaling devices – that also do not allow the sterilisation, only the disinfection. We can add the very high speeds of the units, respectively the sprays of water and air, which favour the spreading of germs in the patient's oral cavity in the environment of the practice; from there, it is aspirated by the compressor, which, through the tubing of the dental unit, can pass it on to the following patients.

The destruction or removal of all forms of existence of microorganisms on an object or from an environment by using physical and chemical methods is called sterilisation.

Antisepsis - without putrefaction – the set of measures by which the germs from a plague, from the skin or from the environment, being a curative method; it is a complex of curative and preventive measures, pertaining to the destruction of microorganisms in the plague. In turn, antisepsis is a component of chemotherapy acting on the infectious process, aimed at reducing and treating the infectious process. Two types of surgical infections can be distinguished between: *the endogenous source* is located inside the patient's body - *asepsis*; *the exogenous source* is located in the external environment - *antisepsis.*

Physics has the purpose of forming unfavourable conditions to develop bacteria and decrease the toxins in

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the plague, assuring the elimination of the toxic exudate in the plague in the bandage by using hydroscopic bandage. The properties were described in 1894 by the great scientist Preobrajenskii.

Antisepsis uses, for this purpose, antiseptic and disinfectant; antiseptics are chemical substances with bacteriostatic or bactericidal action of contact on the pathogenic germs on the teguments, mucosa and other live tissues; disinfectants are chemical substances that destroy or remove microbial agents from objects, medical instruments, excrete or other pathological materials.

Disinfection is the totality of the physical, chemical, biological and pharmacological means that try to remove, inactivate or destroy the pathological germs in the environment; it is prophylactic, the prevention of outburst and spread of illnesses with known point of start; current, at the patient's bed during the whole hospitalization period; and terminal, for all the objects used by the patient, furniture, room.

Sterilization, the most complex form of disinfection, able to destroy germs even in their spore form, comprises thus two components: asepsis and anti-sep-sis.

To be used in good conditions, an antiseptic substance must meet some conditions: have rapid and durable action; destroy as many germs as possible in low concentrations; not to have a toxic action on the tissues where it is applied and not to trouble the mechanisms of defence, thus favouring a bacterial infection; not to deteriorate surfaces, instruments or materials that are going to be disinfected; be easily soluble in water and once melted, to give a stable mixture (not to modify its properties in time); maintain its antiseptic properties in any environment.

According to the way of action, the antiseptics and disinfectants are classified as follows:

a) *Surface-active agents* – comprise surface substances, modifying the permeability of the bacterial cell wall and the wall of the cytoplasmic membrane, which becomes unable to retain anymore substances useful to the microbial cell, such as: amino acids, nucleotides, coenzymes, K and Mg. This group comprises phenols, soaps, detergents.

b) *Denaturing agents* of the protein substance of microbes, acting by physical and chemical modifications of the cytoplasmic colloids with breaking of enzymatic activity and coagulation or precipitation of the cellular proteins.

This category includes: acids, alkalis, alcohols, organic solvents.

c) *Substances that interfere with the active functional groups of the essential enzymes in the metabolism of the microbial cell.*

The following belong to this group: formaldehyde, salts of heavy metals, oxidising agents, isolated metallic ions, detergent. The chemical structure of the antiseptics and disinfectants can be inorganic or metallic-organic. The spectrum of activity of the antiseptics and disinfectants is wide, but variable from one product to the other, and in the same product according to the concentration. Their action can be bacteriostatic or bactericidal, fungicidal, sometimes with spores.

Characteristics of the antiseptic substance: bacterial capacity, without persistent unpleasant smell; easily soluble in water, acts in any environment, does not affect the tissues it is applied on.

The following are included among the *potentially lethal products*:

- Highly reactive chemical compounds that are characterized by a brutal, quick, temporary and often non-specific action (protoplasmic poison); this group can also include oxidants with hydrogen peroxide, halogens (chlorine, iodine), and ethylene oxide, acids and strong bases, aldehydes, phenol;

- Chemical components that are stable to more specific action, the group including quaternary ammonium, phenolic derivatives (other than phenol), chlorhexidine, hexaminide, hexetidine, dibrompropamidine.

- Non-lethal products, which nonetheless inhibit the multiplication of micro-organisms, especially contain metal (mercurial, copper, zinc, silver derivatives, etc).

In accordance with the nature and concentration used, the antiseptics and disinfectants have one or several targets; in most cases, the access to the target requires passing the cell wall is a physical or chemical obstacle.

Salton described five stages in the action of the antimicrobial agents:

1. adsorption on the cell followed by penetration in the wall;
2. complex reactions with the cytoplasmic membrane leading to its disorganization;
3. light molecular components leaving the cytoplasm;
4. degradation of proteins and nucleic acids;
5. link to walls caused by the autolytic enzymes.

According to their chemical nature, the common antiseptics and disinfectants are part of:

The group of halogens and halogenated compounds

Hypochlorite – Substances with disinfecting action by releasing O_2 and active chlorine. Used in disinfecting the laundry, bandages in watery solutions of 0.5-1.25% active chlorine.

Chloramines – Derived chlorinated of some organic substances, less toxic than hypochlorite. Active on germ gram positive, gram negative and Koch bacillus.

Chloramines B – presented in form of pills of 0.5 g (containing 25-29% active chlorine). It is used in antisepsis of plagues or of hands in concentration of 0.2-1%. For the disinfection of laundry and instruments, the solution is more concentrated, 2-5%.

Chlorhexidine, active mainly on germs gram negative. It does not have spore action. It has good local tolerance. It is used in the antisepsis of the plagues and the burnt surfaces in solution of 0.05% in distilled water and the antisepsis of the hands and teguments, solution 0.5% in ethyl alcohol of 70 or solution 1% in isopropyl alcohol; disinfection of surgical instruments, solution 0.5% in ethyl alcohol 70 for rapid disinfection (2 minutes); solution 0.02% in water (with added sodium nitrite to avoid corrosion), when 2-6 hours are necessary. Chlorhexidine is an efficient substance also in biological environment (blood, saliva, pus). Well tolerated by mucosa, with agreeable taste. It is used in watery or alcoholic solution 0.5%. It is also found in form of spray for teguments and plagues (accidental or surgical). The solution of 0.2% is used for mouth wash (frequently in Periodontics, Implantology surgery – for the mouth hygiene after surgery); alcoholic solution of 5% is used for instruments.

Hexachlorophene, chlorinated phenolic compound, resistant to the incorporation in soaps. It is active mainly on bacteria gram positive and negative. It is a very valuable antiseptic used in the antisepsis of the teguments, baths and laundry.

Substances based on iodine - bactericides and fungicides, have the capacity to penetrate in the pores of glands; antiseptic universal iodine, bactericide and fungicide; used as antiseptic of the healthy teguments, is corrosive for mucosa. Solutions: *Tincture of iodine*, hydro-alcoholic solution containing 2% iodine and 2% sodium iodide. By aging, it produces iodide acid, toxic, irritating. It

is also used in form of iodized gasoline (iodine 1‰). It causes phenomena of intolerance to patients sensitive to iodine.

Iodoform, antiseptic in form of cream to apply on the skin; in form of crystals, it is applied on wounds with antiseptic and deodorant action. *Iodophore* are antiseptic solutions containing molecular iodine in variable concentrations from 1.75-5%. They have bactericide action higher than the hydro-alcoholic solutions, are not irritable, do not stain, do not smell, and lack toxicity.

Oxidising antiseptic – the group comprises antiseptic that acts by releasing O_2.

Hydrogen peroxide (oxygen peroxide) presents itself in form of solution, concentration 30%. The *perhydrol* that dilutes extemporaneously until the concentration 3% or in form of *Perogen* pills (1g peroxide of urea), which is soluble in proportion of 8-10cp/100 mL distilled water. The action of hydrogen peroxide applied on plague is oxidising, cytophylactic, slightly hemostatic; by the foam action, it makes it easier to remove mechanically the necrotic remains in the suppurated plagues.

Detergent compounds – are surface-active antiseptics that act in very big dilutions, with antiseptic and detergent action. To this group belong soaps and synthetic detergents. According to the active part of the molecule, they are classified into:

a) *Anionic detergents* - solutions: *lauryl sulfate of sodium* with weak bacteriostatic action and only on the germs gram positive. The powders of *Alba* or *Perlan* are used to clean the glassware in the laboratory. They frequently give contact dermatitis.

b) C*ationic detergents* – comprise quaternary salts of ammonium. They are substances without smell, insipid, stable with acids and alkalis with bacteriostatic properties, bactericide, fungicide. They are efficient in the disinfection the teguments, hands, burnt surfaces, the preparation of the surgical area, the medical instruments, the laundry.

Solutions: *Cetrimoniumbromid or Bromocet*, in form of hydro-alcoholic solution 10 and 20%. As antiseptic, it is used in watery solutions of 0.1-1%.

c) *Ampholytic detergents* – have a bactericide, fungicide and detergent effect; they are not toxic. Solutions: *Tego* and *Tagonin* - in solution of 1% are used for skin antisepsis, disinfection of the dentistry instruments and furniture, laundry.

d) *Un-ionic detergents*, products based on superior alcohols in the class of polymers of ethylene oxide. They have bactericide activity on the germs gram positive and negative.

Acids and bases

Antiseptics that act by modification of *p*H and specific antimicrobial activity: *hydrochloric acid* (solution 1.6%), *mandelic acid, hydroxide of Na* (solution 1-4%).

Alcohols and phenols

Ethyl alcohol is used as antiseptic in concentration of 70; it has a wide antibacterial range; it does not have spore action; it is bactericide, inactive on Koch bacillus; it is used only in the disinfection of the teguments, hands. It does not apply on humid wound or teguments. It does not have secondary effects.

The phenol discovered by Rouge in 1834 and introduced in surgery by Lister in 1867 in form of carbolic acid 2.5-5%. Active on germs gram positive and less on those gram negative. Being irritating and caustic, it is used only for the disinfection of the objects, excretions, etc. *Cresols* have bacteriostatic, bactericide, fungicide action.

Aldehydes

Formaldehyde is present in form of watery solution (formalin) that contains 29% formaldehyde. It is used as surface disinfectant of objects, probes, instruments. Vapours are irritating for the eyes and airways. It has bactericide, spore action and does not cause resistance. *Glutaraldehyde,* disinfectant with wide bactericide and spore range. It is active in alkaline environment.

Metallic compounds and salts of heavy metals

They comprise antiseptic that acts on the microbial enzymatic systems or by precipitation of bacterial proteins.

a)Silver solutions: *Silver nitrate* is used in solutions of 0.005-0.2% for the antisepsis of the plagues and burnings. In concentration of 0.5-1-2%, it is used in instillations.

b) Mercury solutions: In 1850, mercury salts with hypochlorite phenol and iodine completed the antimicrobial drugs that were available to the physician. Mercury chloride was used and assessed by Robert Koch and Geppert. Nowadays, the use of mercury in medicine is low, even though a number of mercury organic derivatives are used as bacteriostatic and fungistatic agents, as well as preservatives and bactericides in parenteral products. Following a disaster that took place in Japan which resulted in the dispersal of mercury into the environment, worldwide disagreement over its use in any field arose, due to the fact that it constituted a major pollution factor.

Modern conception currently tries to diminish the spread of germs in the room environment to the maximum, by: locating the compressor in a separate room – in order not to aspirate – eliminates the contaminated air; starting the water, liquid soap – with pedals, photo-sensitive cells; replacing the textile towel – with use-and-throw paper tissues or devices of warm air; using gloves, glasses, syringes, cannulas for saliva aspiration, containment fields, etc – all disposable; replacing large cassolettes containing all sterilized instruments – with individual sterile kits for each patient; disinfection of the dental chair several times per day (ideally - after each patient) - especially the headrest, arms, table, buttons - with disinfectant spray, with a sponge soaked in alcohol; spittoons - cleaned and disinfected after each patient - with alcohol.

Chlorhexidine, disinfectant sprays; indoor air – frequent aeration, UV lamp - several times per day during working hours with patients; disinfection with formaldehyde at the end of the working hours; furniture (wardrobes, tables), doorknobs - disinfected several times per day with a sponge soaked in alcohol, disinfectant sprays; walls - disinfected once with the indoor air with the UV lamp; later with formaldehyde at the end the working schedule.

Microbial sensitivity and resistance are relative notions based on the multitude of responses of different species to antimicrobial substances. The responses are determined under precise conditions regarding the parameters that interfere with the activity of production. These conditions include *p*H, temperature, the presence of organic substances or ions, microorganism growth, which can strongly alter the activity of antiseptics and disinfectants. Two levels of intensity of bacterial resistance are considered: low and high levels of resistance. Two types of microbial resistance to antimicrobials are distinguished: intrinsic resistance, which is an internal characteristic of the cell belonging to a microbial species or to group of species, and intrinsic microbial resistance, which is predictable. It is a stable characteristic of certain microbial species or groups vis-α-vis an antimicrobial.

The intrinsic or natural resistance to antiseptics and disinfectants is an important phenomenon that depends on the microorganism and on the type of molecules.

The resistance acquired is due to an unforeseeable event inside a microbial species with a homogeneous sensitivity to an antimicrobial. It results in the appearance of a strain of this species with a diminished sensitivity. In antimicrobials, it is due to genetic variations produced in rare strains in the microbial population constituting a single species.

Antiseptics and disinfectants are exposed to the phenomenon of acquired resistance.

The conditions of use of the products must avoid the selection of resistant bacteria. In certain cases, there are risks that must not be overlooked as regards the selection of resistant bacteria. These risks become more and more important when it comes to antibiotic multi-resistant bacteria due to autotransferrable plasmids carrying antiseptic and disinfectant resistance genes.

Some mercury and silver derivatives and some copper and zinc salts still occupy a place that cannot be neglected in carrying out antisepsis and disinfection.

Study of the number of sterilizations performed in the dental office

The study was carried out with the purpose of highlighting the advantage of each type of sterilization and their importance in the good development of the medical activity.

The main purpose of a high-quality sterilization program is to reduce the potential for the outbreaks of nosocomial infections caused by use of non-sterile products. The monitorization of the effectiveness of sterilization is the process by which a load is monitored and released on the basis of the results provided by the biological indicator.

The chemical indicator does not prove that the material processed is sterile, but only that the sterilization process was carried out in compliance with the optimum parameters; the chemical indicators must be used together with the biological indicators during the sterilization process.

The sterilization methods are classified into:

- Moist heat sterilization;
- Dry heat sterilization;
- Radiation sterilization;
- Gas sterilization, disinfection;
- Chemical substance sterilization, disinfection.

Preparing the tools in view of sterilisation – before the sterilisation, all the equipment is cleaned by organic remaining, blood, pus, dentine, bone; they are washed and dried, manually and with ultrasound.

Physical methods of sterilisation - Heat, in its dry or humid form represents the most used method in view of sterilisation, which is done by the coagulation of the microbe proteins. The vegetative forms of some pathogenic germs die at 50-60 within 30 min, or in 5-10 min at temperature of 70. Spores (forms of microbial resistance) are destroyed only at temperatures of over 120 within 15 minutes, depending on the thickness of their protective membrane and the state of dehydration.

Experimental part

Material and method

This study comprises a number of 135 sterilizations in the period from 2014 until 2016.

Both descriptive and analytical models have been used in the statistical analysis.

After collecting the data in an accesible form in order to ensure their informational character, they were processed.

The confidence intervals at 95% materiality were used in presenting the data; moreover, χ^2 and t-Student were used to test differences.

The primary processing, data systematization through centralization and grouping, respectively, lead to obtaining the primary indicators, which are presented as absolute values. Based on the primary indicators, through various statistical methods for comparison, abstraction and generalization, derived indicators were obtained. The data were centralized in Excel and SPSS 13.0 databases and processed with the related statistical functions.

Results and discussions

A number of 135 sterilizations were performed. Among them, 107 (79.26%) were done in autoclaves, 7 (5.18%) in ethylene oxide, and 21 (15.56%) in hydrogen peroxide.

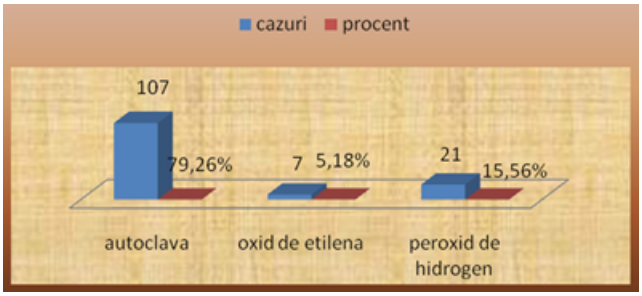

Fig.1.Number of sterilizations per sterilization method

The largest number of sterilizations was done using autoclaves, followed at great length by sterilizations using ethylene oxide and hydrogen peroxide. The main reason is that, in the sterilization station, autoclaves are the most commonly used sterilization method, given that they are used to sterilize a significant part of the sanitary materials, the duration of a sterilization cycle with autoclaves (30min.-50min) being incomparably lower than the duration of a sterilization cycle using ethylene oxide (60 min. for sterilization and an additional mandatory 12 h for desorption); the cost of a sterilization cycle using an autoclave is much lower than the cost of a sterilization cycle using ethylene oxide or hydrogen peroxide. Another reason why the autoclave is the sterilization method of choice for sterilizing sanitary materials is that the sanitary material that supports autoclaving is much larger quantitatively speaking than the sanitary material sterilized through other methods.

When it comes to the choice between ethylene oxide and plasma, ethylene oxide is preferred due to the fact that sterilization using ethylene oxide does not take the composition of the material into account, its complete dryness being unnecessary; sterilization with ethylene oxide is less expensive than the one using peroxide hydrogen.

The instruments examined (mirror, clamp and dental probe) for extraction and the surgical one is sterilized using autoclaves; drills, endodontic needles, the active part of scaling instruments - autoclave sterilization.

There are also handpieces that can be sterilized using the autoclave, using silicone oils. However, usually, they are sterilized by heat – only the removable metal sheath, the rest of the instrument is disinfected with various sprays (e.g. Gigasept). Formaldehyde vapors can also be used to sterilize handpieces. Fields, gowns, dressings, tents can be sterilizes by autoclaving and stored in cassolettes; or they can be disposable.

Suture material, needles, textile yarn (thread, silk) - autoclave sterilization, or disposable.

Rubber material, sterilization with formaldehyde vapors or ethylene oxide.

Water, for surgical scrubbing before interventions - autoclave sterilization at 2 atm, 30 minutes.

Dental unit tubing, water, air syringe - disinfection by the circulation of various solutions through the entire circuit of the apparatus; introducing lubricating oils later.

Currently, there are bactericide, fungicide, virucide solutions which ensure the sterilization of instruments, drills, etc. and are mostly used in dental offices.

Control of sterilization. The control of sterilization is usually done by monitoring the manometer and thermometer during the functioning of autoclave.

But the quality of sterilization can also be controlled by testing the temperature in the box of materials, placing among them at various levels tubes of control that contain fine powder of some chemical substances (benzoic acid, phthalic, picric, heliantine) whose melting point is at 120°C.

The most correct control is the bacteriologic one, by regular sampling of some fragments or traces of the materials used.

Chemical methods of sterilization

Sterilization in atmosphere of formalin of some devices that are made of some material that does not support high temperatures. The time for sterilization can be shortened if the temperature inside the sterilizer is raised, by its heating.

The atmosphere of the practice, the instruments and soft material used, the dental team present different possible sources of infection.

In the dental office, it is important to have all the conditions that tend to suppress the possibility of introducing, retaining or mobilizing the pathogenic germs. The sterilization of the atmosphere in the cabinet requires air conditioning that, filtrated, will be purified and practically aseptic. Conditioning the atmosphere in the cabinet supposes its constant renewal and the air conditioning that must remain at a constant temperature (2°C) and hygrometric state (50%).

Soft material: overall, caps, bandages, etc., are sterilized by autoclave.

Instruments made of metal, knives, pliers, scissors, tweezers, needles, etc., are usually sterilized by boiling under pressure in autoclave for instruments where the temperature rises to 110°C.

Instruments made of rubber can be sterilized either by boiling, protected between bandages of gauze, or by vapours of formalin.

The rubber gloves are also usually sterilized by autoclave under pressure of one atmosphere, for 20 min.

Sterilizing the water, element of first and permanent necessity, requires special attention, on taking into consideration the easiness of contamination and spreading of germs, following its diffusion.

The disinfection of the doctor's hands – washing with sterile water and soap represents the most used method of sterilization. Mechanical washing with water and soap removes the superficial corneous layer that keeps the pathogenic germs, but the holes of the sweat glands and peripilos sheaths can remain incompletely disinfected. It has been noted that after washing, the cultures remain sterile in a percentage of 90%, 10 min after at 70%, and 20 min after only 50%. After wearing gloves, the appearance of microbes on the surface of the hands is even more rapid because of sweating, which brings pathogenic germs from the bottom of the gland sack. Even if, as it can be seen, the method cannot be considered perfect, the danger of infection is practically inexistent, because the majority of germs in cause are saprophyte.

In order to correct the imperfections of the disinfection by mechanical washing with water and soap, it is used also the chemical disinfection, by cleansing the hands after washing with alcohol, with iodinated alcohol, or oxides of mercury 1-2‰.

The danger of infection of the surgical plague with microbial strains from the level of operator's skin is as high as that at the level of the dentist's hands or the materials used during surgery. The skin always presents microbial germs on its surface, on the hairs, in the depth of the wrinkles and glandular openings.

The technique of skin disinfection comprises the washing with water and soap of that tegument, respectively widely shaving the hairs in the area, after that bandage with ether and alcohol to remove the oil in the area.

The bacteriological samples proved that disinfection with tincture of iodine last for one hour and a half, enough time even for any intervention.

So, asepsis uses a set of methods having as purpose the work in sterile environment. It comprises the set of measures that eliminate the microbial agents from everything that will come in contact with the plague, in order not to contaminate it. It is thus a preventive method that is done by sterilizing the materials and disinfection of the dentist's hands, and of the tegument in the plague area.

Conclusions

Antiseptics and disinfectants are necessary substances for the control of the multiplication of microorganisms, both in vivo as well as in vitro.

The use of antiseptics for long periods of time must be avoided due to the fact that, in the case they contain heavy metals, they can be cumulated in the human body, and when toxic concentrations are reached, various toxicities can be triggered.

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25.***The Order of the Minister of Health no. 386/07 April 2004 on approving the Norms of the application of Patients' Rights Law no. 46/ 2003, published in the Official Gazette of Romania, part I, no. 356 of 22 April 2004, as amended and supplemented.
26.***The Order of the President of the National Commission for Nuclear Activities Control no. 293/30 August 2004 for amending and supplementing the Norms for radiological safety in radiotherapy practice, approved by the Order of the President of the National Commission for Nuclear Activities Control no. 94/2004, published in the Official Gazette of Romania, Part I, no. 1253 of 24 December 2004;
27.***The Order of the Minister of Public Health no. 916/2006 on the approval of the Norms of surveillance, prevention and control of hospital-acquired infections, published in the Official Gazette of Romania, part I, no. 759 of 6 September 2006;
28.***Government Emergency Ordinance no. 144/28.10.2008 on the profession of registered general care nurse, on the profession of midwife and on the professional of nurse, as well as the organization and functioning of the Nursing and Midwifery Council of Romania, published in the Official Gazette of Romania, part I , no. 785 of 24.11.2008, approved by Law 53/2014, as amended and supplemented;
29.***The Code of Ethics and Deontology of the Registered General Care Nurse, Midwife and Nurse in Romania, adopted by the Decision of the National General Assembly of the Nursing and Midwifery Council of Romania no. 2/9 July 2009 published in the Official Gazette of Romania, part I, no. 560 of 12 August 2009;
30. ***The Order of the Minister of Health no. 1226/03 December 2012 for the approval of the Technical norms on the management of medical waste and of the Methodology of data collection for the national database on waste resulting from medical activities, published in the Official Gazette of Romania, part I no. 855 of 18 December 2012;
31. ***The Order of the Minister of Health no. 961/19 August 2016 approving the Technical norms on cleaning, disinfection and sterilization in public and private hospitals, work techniques and interpretation for tests assessing the effectiveness of the cleaning and disinfection procedure, procedures recommended for hand disinfection, based on the level of risk, chemical disinfectant application methods based on the support to be treated and the methods of assessing the development and effectiveness of the sterilization process

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