ASEPSIS AND ANTISEPSIS

General Information

Microorganisms are found everywhere. They constitute various types of flora: saprophytic, symbiotic, soil-borne, commensal... and there are also germs sought for their usefulness, such as lactobacilli and yeasts.

Unfortunately, there are also germs that are harmful due to their pathogenic effects. They can be combated by various means, but sometimes they are very resistant, thus refractory to any treatment, making them very dangerous and putting the patient's life at risk. This is particularly the case with "MRSA" (Methicillin-resistant *Staphylococcus aureus*).

Infections are very common and are the origin of all infectious pathologies. The entry points are numerous, and among them are wounds, regardless of their etiology, including surgical wounds from surgery. It is imperative to control them ; this is the goal of asepsis and antisepsis.

DEFINITION

Asepsis and antisepsis constitute the set of methods and techniques implemented to protect the body against microbial invasion, especially during surgical interventions.

They pursue the same goal but are different.

➢ a = without + sepsis = infection

➢ anti = against + sepsis = infection

Asepsis

Is a prophylactic method by which all germs are destroyed on everything that comes into contact with the surgical field. It uses chemical and physical means.

Antisepsis

Is a curative method that consists of combating an already established infection.

Historical

Until the mid-19th century, nothing was known about microbes, but suppurations and deaths from septicemia were observed without knowing the cause.

In 1840, Semmelweis noticed a very high mortality rate in delivery rooms, despite successful surgical interventions.

In 1850, Trelat limited himself to excisions of lipomas, which are simple surgical interventions, but saw all these patients die from infection following a more or less long postoperative period.

In 1857, Lister developed an antiseptic technique based on phenol, which he applied using a sprayer before, during, and after the surgical intervention. He sometimes had some patient deaths, but he significantly lowered the postoperative mortality rate.

In 1878, Pasteur recommended applying an aseptic program by which only sterile equipment should be used; the surgeon's hands must be sterile, the surgical field, and the atmosphere around the patient must be sterile. The application of this aseptic method gave extraordinary results. Infection was overcome.

In 1940, the first antibiotics appeared. Initially, postoperative infections and mortality were low, and asepsis began to be abandoned. Shortly after, surgical success and postoperative survival rates became low again with the emergence of antibiotic resistance.

We returned to asepsis and learned that asepsis should never be sacrificed for antisepsis, because it is better to prevent than to cure.

SURGICAL INFECTION

Microbes are very numerous and their pathogenicity is more or less strong; even the most common germs can be dangerous. They are to be feared because they can create favorable conditions for highly pathogenic germs.

Example: aerobic germs that multiply in an infectious focus consume all the oxygen, thus creating anaerobic conditions favorable to the development of anaerobic germs (*Clostridium*).

Some are pyogenic, others are toxigenic.

Source of infection

The two main sources of surgical infection come from the patient and the external environment. Thus, we distinguish the flora of the operated patient, the commensal or autogenous flora; and the flora of the external environment, the exogenous flora.

The autogenous flora of the operated patient is itself divided into two types of flora:

• Cutaneous flora: this is the flora found on the skin and mucous membranes. It is schematically divided into resident flora and transient flora.

• Endogenous flora: this is the flora found in the natural cavities of the body: digestive tract, respiratory tract, genitourinary tract. This flora is schematically composed of three categories of microbes:

Aerobic Gram - Non-sporulating strict anaerobes. Sporulating strict anaerobes.

Exogenous flora groups together three types of flora:

• Autogenous flora of the surgical staff: organized similarly to the operated patient's endogenous flora:

✓ cutaneous flora, particularly found on the hands.

✓ endogenous flora of cavities, especially that of the respiratory tract.

This flora can therefore be transmitted by direct contact or by sneezing, saliva droplets, sweat, etc.

• Flora of surgical equipment, carried by:

✓ surgical instruments, which come into direct contact with the wound.

✓ the medical-surgical equipment in the operating room, i.e., tables, IV poles, electrical wires, etc.

• Ambient air flora: ambient air is in close relation with surfaces, and it is through contact with them, particularly with dust, that air develops its microbial flora. It is therefore important to remember that: clean surfaces = clean air!

Obviously, for this, surfaces must be cleaned every day.

Surgical instruments and the surgeon's hands constitute sources of contamination. The atmosphere of the place where surgery is performed is also more or less polluted. The highest microbial load is encountered in livestock facilities and autopsy rooms. Outdoors, in the sun and sheltered from the wind, the concentration of germs is the lowest.

Natural resistance can be weakened by numerous causes :

In elderly subjects.

In cases of major diseases (diabetes, nephropathies).

During specific therapies (prolonged corticosteroid therapy, anti-rejection therapy for transplants like cyclosporines).

Surgical shock, which is a factor depressing the body's defenses.

Trauma : can be an inoculator and disseminator.

ASEPSIS

It is indicated whenever an intervention is performed on an organism; it must be done with germ-free equipment (catheterization, injections, endoscopies), on a healthy and disinfected integumentary surface. This asepsis must be applied before, during, and after the intervention.

Preoperative Asepsis

1- Atmosphere:

➢Large animals:

- The best for large animals is to operate outdoors in full sun, sheltered from the wind.

- If the animal must be laid down, the tarp covering the straw bed should be moistened with an antiseptic solution.

- In operating rooms (disinfection with terpineol or formalin every 2 years), UV lamps are not very effective.

2- Equipment: Absolute sterility must be achieved; the best possible conditions must be gathered:

- Instruments should be simple and easy to clean.

- Sterilization is done by physical and chemical means, with a predominant place for heat.

Sterilization takes place in several steps: pre-disinfection, washing, packaging in an appropriate container, and sterilization.

1. Pre-disinfection

This involves immersing the equipment for at least fifteen minutes in a detergent-based solution to eliminate most of the organic matter present on the tools (especially grease). Ultrasound can also be used: vibrations will make it even easier to detach organic elements.

2. Washing

Washing is essential: << YOU CAN ONLY STERILIZE WHAT IS CLEAN ».

Washing can be done:

- Manually by an operator with a soft brush if the surgical volume is low (few instruments). This is very acceptable if done correctly.

- With a washing machine in case of high surgical volume.

Drying is mandatory.

3. Packaging and Sterilization There are two main categories of sterilization: by physical means (dry or moist heat); by chemical means.

Packaging is necessary to preserve sterility by placing sterilized objects in packaging that does not allow microorganisms to pass through.

Physical Means

DRY HEAT

A**Poupinel** oven is used. It is a chamber in which air is heated by electrical resistors. It provides uniform heat throughout the oven.

Clean and dry equipment is placed in appropriate containers resistant to heat: metal boxes or sleeves cut to the desired dimensions and then welded.

Furthermore, only heat-resistant equipment can be sterilized this way, i.e., only metals and glassware (plastics and textiles are obviously to be avoided).

In the hot air sterilizer, the Poupinel, the oxygen in the air is brought to a high temperature, which causes denaturation of bacterial proteins by oxidation. It usually takes 2 to 3 hours at 160°C for the temperature to be reached at the core of the load, with the time counted from the moment the temperature reaches the thermal plateau. It is a simple and inexpensive process.

145°C for 45 minutes for soft tissue surgical instruments.

145°C for 90 minutes for orthopedic surgical instruments.

➢ For orthopedic surgical instruments (bone, etc.), it is necessary to sterilize the equipment in two cycles of 145°C and 45 minutes each.

➢ For ophthalmic surgical equipment, sterilization is done at 120°C in two or three cycles of 45 minutes each, because the equipment is very fine and is easily damaged at high temperatures.

The use of dry heat can only be applied to metal or glass instruments. For other materials, moist heat or antiseptic solutions are used.

The Poupinel or dry heat sterilizer is now completely outdated in terms of effectiveness. In particular, it is inactive against prions (degeneration of the central nervous system).

Steam sterilization in an autoclave is now the recognized standard.

MOIST HEAT

This is the most widespread sterilization method. It is the only recognized procedure in human medicine (required by ISO, AFNOR standards, etc.). It meets the strictest sterilization standards and can even destroy prions.

It is carried out using an autoclave, i.e., a hermetic chamber in which sterilization is done with steam, in the absence of air, at high temperature (132°C) and pressure above atmospheric pressure (2 bars).

The simplest is boiling water; instruments are sterilized for 20 minutes at 100°C.

Hot water steam can also be used.

This sterilization method is useful for metal instruments, glass instruments, and polyethylene.

It is an easy method to apply that can be done anywhere, but it is advisable to add a few drops of acetic acid to the boiling water to prevent limescale deposits on the instruments.

The steam autoclave appeared in 1881. It is the reference method commonly used in hospitals for:

- recyclable textiles (surgical drapes, surgical clothing)

- dressings (woven and non-woven)

- stainless steel surgical instruments

- glassware

- rubber

- polymers and elastomers

➢ Drums are metal boxes equipped with perforations at the bottom and on the lid. These openings can be closed by a rotating guillotine system. Drums are mainly used for sterilizing textiles (drapes, gauze, gowns, etc.). They are non-hermetic containers that maintain sterility for 24 to 48 hours depending on whether adhesive tape is added around them or not. Beyond this time, they must be put back in the autoclave to be used.

When sterilizing with moist heat, the equipment must be placed in appropriate containers permeable to steam:

➢ Drums are metal boxes equipped with perforations at the bottom and on the lid. These openings can be closed by a rotating guillotine system.

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➢ Plastic sleeves or pouches have two different faces. These pouches maintain sterility for 2 weeks.

➢ Double wrapping with crepe paper allows the benefits of sterilization to be preserved for 3 months. A non-sterile person removes the first pouch, and the sterile person opens the second pouch.

It is now accepted that this sterilization method is the most effective, the most controllable, causes little damage to equipment, and can be used on a large number of different materials (metal, linen, rubber, certain plastics). This process should be used as a first intention.

After sterilization, there are various control devices to verify that it took place correctly:

✓ Strips of green/blue adhesive paper before sterilization that turn brown once sterilized. Placed around boxes, they have the advantage of ensuring a filtering function and increasing tightness.

✓ For moist heat, autoclaves are equipped with a control device that prints pressure and temperature curves on a disc. The parallelism between the two curves and the plateau during which the temperature is maintained are observed. The appearance of the two curves indicates whether the device functioned correctly. Time is indicated on the x-axis, so it is known if the temperature was maintained long enough.

✓ It is also possible to use Browne tubes, which are sealed glass tubes containing a liquid and crystals. Before use, the red liquid and green crystals are separate, each at one end of the tube. All crystals have melted when the desired temperature has been reached for a sufficient time; the liquid then becomes green, and there are no more crystals at the other end. The advantage is information on the temperature/duration combination.

✓ There are other methods based on a color change, like this yellow plate before use that becomes completely blue after. If yellow patches persist, the temperature was not reached, or not maintained long enough.

Sterilization by Ionizing Radiation

The ionizing radiations used for surgical sterilization are gamma rays and UV.

Gamma rays: are used industrially for sterilizing single-use surgical equipment (probes, syringes, etc.).

UV rays: are used for their DNA-destroying properties. Short UV rays must be used, with a wavelength between 2500 and 3500 Angstroms, produced by low-pressure mercury vapor lamps in quartz; these lamps are used to sterilize premises, they are different from lamps intended for tanning.

➢ Use of vapors: Formalin: equipment is placed in a chamber called a (formalin oven). Equipment should not be stacked to allow formalin vapors to circulate freely. These vapors are very effective for disinfecting equipment and premises.

➢ Formalin vapors ("Formic Aldehyde") are obtained from tablets or crystals of "Trioxymethylene" by sublimation.

➢ These same vapors can be obtained by bringing commercial formalin solutions to a boil.

➢ These vapors are very effective against germs for disinfecting equipment and premises, but the equipment used directly is irritating to tissues; therefore, it must be rinsed with sterile distilled water before use to remove formalin deposits on its surface.

Note

Urinary catheters must be rinsed with sterile physiological saline before use to avoid irritating mucous membranes.

➢ **Use of antiseptic solutions:**

- 60% alcohol is effective on very clean metal equipment.

- Mercuric chloride in a 0.2% solution is very effective for disinfecting rubber objects, but it is corrosive to metals.

- Formic aldehyde solutions can sterilize all materials.

- Quaternary ammonium compounds have a detergent and antiseptic effect.

- Oxidizing agents (potassium permanganate, sodium hypochlorite) are mainly used for disinfecting rubber equipment.

CONDITIONS OF APPLICATION IN VETERINARY MEDICINE

The concept of surgical asepsis is a way of behaving before, during, and after the surgical act so that neither the surgeon, nor the assistants, nor the instruments, nor the surgical field become contaminating or disseminating factors of pathogens into the surgical wound, which is the entry point for infection.

To achieve this, asepsis must be systematically applied in the operating room and to everything that may come into contact with the operated patient.

1- Preparation of premises and materials

➢The Operating Block: The operating room must be strictly reserved for surgical use and especially must not receive animals with a contagious infectious disease. Operating rooms must be separated into:

- Septic Room

- Aseptic Room

- Hyper-aseptic Room

- Septic Rooms: These are where surgical interventions that release septic fluids take place, such as abscess drainage, gangrene curettage, and dressing changes.

- Aseptic Rooms: These are where the operated patient is exposed to infection during surgery that includes a septic phase.

Example: digestive surgery where the septic phase involves opening an organ containing flora (rumen, intestines, colon), urinary surgery (bladder), obstetric surgery (uterus and lower tracts).

Surgeries on the kidney are completely aseptic.

- Hyper-aseptic Rooms: These are where all interventions that do not involve any septic phase are performed (osteoarticular, neurological, and cardiac surgery).

This strict separation of operating rooms greatly reduces the risk of infection.

➢**Preparation of the Operating Room:**

Regardless of the operating room, it must be kept in a state of perfect cleanliness.

The floor and walls must be covered with a material that withstands washing and disinfection. The floor must be non-slip and slightly sloped for water drainage.

Washing is done after each intervention before germs multiply in organic debris.

Washing must be done in two steps:

• Detergent cleaning: done with hot soapy water and an effective detergent added, such as quaternary ammonium compounds. All surfaces must be brushed vigorously, then rinsed with clean water.

• Disinfection: done with a second rinse. The water must have an effective antiseptic added, such as "sodium hypochlorite" or "terpineol".

☐ Remove dust two or three times a week. The actual surgical furniture (operating table, side tables, anesthesia equipment) must be carefully maintained.

☐ Containers receiving liquids and organic debris, used soiled compresses, various waste, and used surgical linen must be removed immediately after the intervention.

IN RURAL SETTINGS

It is not advisable to operate in livestock buildings because the germ content is often considerable, creating a very high risk of infection, the most serious of which are anaerobes.

The most suitable location is outdoors, away from where animals stay, in the sun and sheltered from the wind.

The operating table is replaced by straw bales covered with a tarp moistened with bleach or creosote solution to prevent dust from rising and ensure disinfection.

Preparation of Surgical Equipment

1- Cleaning
2- 2- Packaging
3- 3- Sterilization

1. Cleaning: It must be thorough and meticulous, paying particular attention to joints and grooves where organic debris, especially blood clots, can easily accumulate. Cleaning is done first with cold water and brushing to allow hemolysis of red blood cells and mechanical removal of organic debris with the brush. Then they are washed with hot water and a detergent using a brush or hydrojets. They are then rinsed with clean water, drained, dried, and finally a drop of silicone oil is applied to the joints.

2.Packaging:

It is done in metal boxes by special surgical set.

Instruments are carefully arranged in metal boxes, with a clean surgical drape placed at the bottom. They are arranged in a specific order: the heaviest instruments at the bottom, lighter ones above, and finally the lightest.

The instruments are covered with another clean surgical drape. The box is closed, and an "indicator adhesive" tape is placed on the lid, which changes color after sterilization, indicating that the instruments inside are sterilized.

After sterilization, the sterile equipment is stored in a cabinet separate from the one containing clean equipment.

Preparation of the Surgeon and Assistants

In veterinary practice, it is essential not to perform autopsies, deliver placentas, or drain abscesses in the days preceding the intervention.

Hand Washing:

There are several types of hand washing. The choice depends on the situation and the infectious risk.

• Simple hand washing, commonly called simple wash, hand wash, hospital wash, or social wash (40-60 sec)

• Hygienic hand washing, also called antiseptic hand wash, hygienic wash, or disinfecting wash (20-30 sec)

• Surgical hand washing

Surgical hand washing (2 -5 min)

• Wash hands with soap up to mid-forearm.

• Rinse with clean water.

• A second wash with an antiseptic foaming agent and brushing of the hands on the palm and back, paying attention to the nails.

• Rinse a second time: keep hands higher than elbows to prevent water from running from soiled areas towards the hands.

• After washing, a first disinfection is done with 60° to 70° alcohol, then the fingertips are dipped in iodinated alcohol.

• Hands are dried with a sterile surgical drape or with an electric hand dryer.

Gowning:

It involves putting on a gown, a cap, and a mask; assistants do the same. If the surgeon is working alone, they should put on the sterile gown last.

Mask and Cap They are non-sterile and must be put on first.

The mask prevents direct projection of liquid droplets onto the operative area but does not prevent contamination of the ambient air (non-hermetic).

The head covering prevents hair from falling. This can be:

☐ a surgical cap, but the disadvantage is that it stops at ear level, leaving some hair exposed.

☐ a bouffant cap, which has the advantage of covering all the hair and is cheaper than the surgical cap.

✓ It is reusable or single-use.

✓ It is folded so that it is handled only from the inside.

✓ Never touch the outside of the gown, which must remain sterile.

• Put on the first sleeve by grasping the gown from the inside.

• Keep the hand inside the sleeve, which allows grasping the second sleeve without contaminating it.

• An assistant ties the gown at the back.

Sterile Surgical Gloves

• Again, do not touch the outside of the gloves with an ungloved hand.

• The cuff of single-use sterile gloves allows the glove to be grasped by the inner surface.

• Once the first hand is gloved, it must not touch the cuff of the second glove.

• Then slide the hand between the cuff and the outer surface of the glove.

Preparation of the Patient

It is linked to three requirements:

➢ Destroy germs located on the skin or mucous membranes of the intervention site.

➢ Protect the surgical field against intraoperative contamination.

➢ Avoid complications linked to germs already present in the patient's internal environment.

Clipping

• It is performed in the preparation room with a surgical clipper.

• It is necessary to clip a sufficiently large area to have a significant safety margin and to anticipate a possible extension of the incision.

• The bulk of the hair is removed by hand and then vacuumed.

• Avoid creating micro-lesions on the skin to prevent the occurrence of infections.

• Example: for a femur operation, clip the limb and the pelvis beyond the midline.

Shaving is not necessary. If it is unavoidable, it should be done just before the operation and certainly not the day before. Indeed, shaving always causes micro-cuts that become infection sites within a few hours.

Washing

• Start antisepsis with a surgical wash of the area, i.e., a wash with an antiseptic soap.

• Be careful, the antiseptic is only effective if there is sufficient contact time between the microorganisms and the active ingredient.

• That is why 3 to 5 wash/rinse sequences are performed, each lasting at least 1.5 min (ideally 3 min).

• At least three washes for a low-risk operation.

• Five washes or more if necessary (for an orthopedic operation where an infectious contamination would be catastrophic, or on a dirty animal, for example).

✓ Ensure to stay within the same product range for the washing product and the antiseptic.

✓ Do not use the commercial solution undiluted; dilute it before use.

✓ Rinsing: Between each wash, include a rinse step with 70% alcohol.

• Use Vétédine solution or chlorhexidine. Application is done using a spray bottle to avoid touching the animal. Otherwise, the surgeon uses a sterile compress for application, just before the operation.

• Respect the contact time.

• The antiseptic solution must contain the same active ingredient as the soap to avoid incompatibilities that would compromise the effectiveness of the antisepsis.

Draping

• This is the action of placing surgical drapes around the operative area to protect it from contamination from the peripheral environment.

• Textile drapes are applied first. Be careful, a textile drape wet from contact with hair allows microorganisms to move by capillarity. Hence the expression: wet drape = soiled drape.

Disinfection of the operative site:

This disinfection of the skin or mucous membranes involves several steps:

• Clip the hair very widely.

• Clean the skin to remove scales, detached hairs, etc.

• Soaping then disinfection.

➢ A first application by swabbing the surgical field from front to back.

➢ A second application by swabbing the surgical field in a centrifugal manner, starting from the center.

Protection against microbial germs: Two cases must be distinguished: the patient has an infectious disease, or the intervention involves opening a septic organ (digestive tract, urinary tract). In all cases where the operation is not an emergency, the operated patient's temperature curve should be monitored for four to five days. Postpone the intervention for subjects incubating infectious diseases.

When operations involve opening a septic organ, a specific protocol helps prevent contamination of the patient by the flora of the septic organ.

✓ A double set of surgical drapes, gloves, and instruments is needed, along with an antiseptic solution that can be applied to mucous membranes and another that effectively disinfects the integuments.

✓ At the end of the septic phase, this disinfection is performed, and then the drapes, gloves, and instruments are changed.

Conduct to Follow During the Intervention

➢ During the intervention, the surgeon and assistants must only touch sterile items.

➢ Plan for an assistant for the septic phases who opens instrument boxes, opens single-use equipment, and provides antiseptics and antibiotics.

➢ The intervention should only begin when everything is ready: operated patient, assistants, clinician, instruments, and disinfection equipment.

- Be as atraumatic as possible, notably to avoid devitalizing tissues, creating lesions, or clots; in general, to avoid infectious complications (devitalized tissues and clots are breeding grounds for microbes).

- Perform regular irrigation of tissues with warm physiological saline: this eliminates microorganisms mechanically and prevents drying.

- An instrument remains sterile as long as it has not come into contact with a non-sterile surface. Any instrument that accidentally touches the IV stand, anesthesia machine, etc., must be replaced.

REPEATED INTRAOPERATIVE IRRIGATION

Continuous irrigation of wounds with physiological saline.

Broad-spectrum postoperative antibiotic therapy is very often used but is useless! Moreover, it promotes bacterial resistance. What matters is pre- and intraoperative asepsis. Antibiotic prophylaxis can still be used for high-risk operations. The antibiotic is then injected intravenously just before the start of the operation.

It is always essential to remember that asepsis remains the essential doctrine of surgery; without it, the surgical act is no longer a rational therapy but exposes the patient's life to serious risk.