

Sterilization, disinfection and sterile precaution

Sterilisation

Sterilisation by steam

Instruments can be sterilised by steam under pressure using autoclaves. Vegetative bacteria, including tuberculosis, and viruses such as hepatitis B, hepatitis C and human immunodeficiency virus (HIV) and heat-resistant spores, including *Clostridium tetani* and *Clostridium perfringens*, are killed. The combination of pressure, temperature and time with the moist heat is important:

- 134 C (30 lb/in.2) for a hold time of 3 minutes;
- 121 C (15 lb/in.2) for a hold time of 15 minutes;

Sterilisation by ethylene oxide

Ethylene oxide is a highly penetrative noncorrosive gas which has a broad-spectrum cidal action. It is utilised for heat-sensitive materials including electrical equipment. It is not recommended for ventilator respiratory equipment or soiled instruments because organic debris, including serum, has a marked adverse effect.

Sterilisation by hot air

This is inefficient compared with moist steam sterilisation, but it has the advantage in the ability to treat solid nonaqueous liquids grease/ointments and to process closed (airtight) containers. Lack of corrosion may be important, particularly with instruments with fine cutting edges such as ophthalmic instruments. It cannot be used for substances such as rubber, plastics and intravenous fluids which are denatured.

Sterilisation by low-temperature steam and formaldehyde

This uses a combination of dried saturated steam and formaldehyde, with the main advantage being that sterilisation is achieved at a low temperature (73 C) and the method is therefore suitable for heat-sensitive materials and items of equipment with integral plastic components. It is not recommended for sealed, oily items or those with retained air. Some plastics and fabrics absorb formaldehyde, releasing this in a delayed manner which may cause hypersensitivity to the users.

Sterilisation by irradiation

This technique employs gamma rays or accelerated electrons. It is an industrial process and is particularly appropriate to the sterilisation of large batches of similar products, such as syringes, catheters and intravenous cannulas. The delivery of an irradiation dose in excess of 25 kGy is accepted as providing adequate sterility assurance.

Disinfection

Cleaning of items is essential before disinfection is undertaken and the efficiency also depends on:

1. The nature of microorganisms;
2. The load of microorganisms;
3. The duration of exposure to the agent;
4. The temperature.

Disinfection with low-temperature steam

Typical conditions include exposure to dry saturated steam at a temperature of 73 C for a period of 20 minutes at a pressure below atmospheric. This is a useful process for dealing with dirty returns from the operating theatre or clinics which may be contaminated with protein from bodily secretions and microorganisms. Following this method of disinfection the instruments must be cleaned.

Disinfection with boiling water

This utilises soft water at 100C at normal pressure for 5minutes. Instruments must be thoroughly cleaned before being utilised.

Disinfection with formaldehyde

Formaldehyde gas is a broad-spectrum antimicrobial agent. This process utilises a cabinet which is airtight and circulates gaseous formaldehyde up to 50 C.

Disinfection with glutaraldehyde

A 2 per cent solution of glutaraldehyde is effective against most bacterial viruses, including hepatitis B and C and HIV, and is particularly useful for the decontamination of flexible endoscopes.

- Thorough cleansing is essential.
- The degree of decontamination is proportional to the time of immersion.
- It is a toxic substance and causes irritant, allergic reactions to the staff, particularly skin reactions, which limits its use.

Sterile precaution in the theatre

Bacterial infection

The presence of an infected skin lesion, such as a boil, paronychia or carbuncle, known carrier state, particularly in the nares and the presence of an acute bacterial infection, particularly an upper respiratory tract infection, must lead to the exclusion of such a person from the team.

Showering

Showering is preferable to bathing and the utilisation of a 4 per cent chlorhexidine gluconate soap by the surgical team is of benefit before the start of an operating list, and has been recommended for the operating surgeon between cases when the procedure is long.

Clothing and gowning

Desquamation principally occurs from the lower half of the body and the changing from normal clothes to clean linen reduces the bacterial count;

Caps are usually worn, although the amount of pathogenic bacteria dispersed is unlikely to be of any significance in general surgery, but may again be significant in implant surgery.

Masks

The oropharynx is a low-level source of bacteria (36 bacteria per 100 words spoken are generated), the number of bacteria that settle on culture plates is not affected by wearing a mask and several studies exist to show that the wearing of masks in general surgery does not affect the wound infection rate, although the wearing of masks in implant surgery is appropriate as their use has been shown to decrease the number of bacteria detected at the operating site.

- Their use is indicated in implant and orthopaedic surgery.
- They offer protection to the wearer.
- Reduction of speech at the operating table is important.

Gloving

Although gloving or double gloving is widely practised there is little evidence that wound infection is related to glove puncture. This would suggest that disinfection of the hands is important in keeping the incidences of wound infection low.

Scrubbing up

Brushes should only be used for cleaning finger nails. A scrub-up time of 3—5 minutes with chlorhexidine soap or povidone iodine soap is utilised; the former is a broad-spectrum rapidly active agent with persistent activity, whereas the latter has a relatively short duration. The technique should include thorough washing of the hands to the elbows, with removal of the soap in the direction hand to elbow.

Adequate drying is again essential, the preferred technique using paper towels in the direction hand to elbow. Jewellery should be removed

The operation

Preoperative preparation of patient

Factors to be taken into account include the following.

- **Preoperative showering** with hexachlorophane is widely used in Sweden but not elsewhere; subjects shower twice on the day before and once on the day of surgery. This has been shown to reduce the incidence of wound infection.
- **A short preoperative hospital stay** is important; this reduces both the presence of pathogenic bacteria on the skin and the incidence of nasal carrier state (*Staphylococcus aureus*) among patients on the ward.
- **Shaving** — the trauma of shaving undoubtedly results in lacerations to the skin, which can increase infection rate; it is preferable to use either clippers or, ideally, depilation cream but the latter is expensive..

Skin preparation

Before arrival in theatres the skin of the operation site should be washed with detergent-impregnated soap. This cleans the skin. In the operating theatre antiseptic solutions, usually of an alcohol-based detergent such as chlorhexidine or povidone iodine, give optimal disinfection. The solution should be allowed to dry to maximise the reduction of bacteria, and pools of residual alcoholic solution, such as occur at the umbilicus or in the perineum, must be dried off completely, otherwise there is a danger of burning with the use of diathermy. The vagina and perineum should be cleaned with aqueous chlorhexidine and cetrimide solution.

High-risk infection procedures

Again, there should be careful protocols for the handling of blood and body fluids in order to reduce the risk of auto-infection and cross-infection, for hepatitis B and C viruses, HIV and cytomegalovirus; such precautions are of particular importance in patients who have pre-existing infection or who are immunosuppressed.

The procedure

High standards of asepsis in the operating theatre demand clear protocols or guidelines with regard to the conduct of surgery, and must be monitored by the theatre manager. The proper performance of surgery ensures safety for the patient, surgeon and staff.

General measures include:

- Education of staff so that they are fully aware that there is a full vaccination programme for hepatitis B;
- The availability of advice for staff in the event of injury.

practical measures include:

- identifying high-risk patients on the operating list;
- Reduction of the number of staff in the theatres to cover essential roles only;
- Removal of all extr equipment from the theatre;
- Staff should avoid contact with contaminated body fluids, especially blood, and in this respect abrasions should be covered. If the member suffers from eczema, he or she should be excluded from the theatres and if contamination does occur rapid washing should be undertaken.
- When handling potentially contaminated blood or body fluids, scrub staff should use nonpermeable gowns and masks with eye protection and should double glove. Circulating personnel should use plastic aprons and wear gloves.
- Spills should be dealt with by staff wearing gloves and using absorbent disposable clothes; hypochlorite 1 per cent solution may be applied to blood spilt on the floor.
- Particular care should be taken with the handling of sharps, which should always be kept in receivers.
- Swabs should be counted but not left exposed, as for routine operations on a spike rack, they should be placed in deep 'swab pockets' on plastic racks.
- Disposable equipment should be placed in yellow bags at the earliest possible time, then sealed and double bagged with a hazard label attached.
- Instruments must be handled in such a way as to avoid injury to the patient and staff..
- Instruments should not be left on drapes where they can directly injure the patient or damage the drapes, breaching asepsis.
- Instruments should be well maintained so that no body fluid remains on the instruments after washing.

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