SIX

SURGICAL ANTISEPSIS

KEY CONCEPTS you will learn in this chapter include:

- What the causes of wound infections are
- What the safest and most effective antiseptics are
- How to use antiseptics and perform surgical antisepsis
- How to prevent contamination of antiseptics

BACKGROUND

Although considerable progress has been made in understanding the cause and prevention of surgical site infections during the past 100 years, postoperative wound infections (incisional and deep) remain a leading cause of nosocomial (hospital-acquired) infections, especially in developing countries. The vast majority of postoperative incisional or superficial wound infections are caused by microorganisms (usually bacteria or sometimes fungi) normally found on the patient's skin or from mucous membranes adjacent to the surgical site, and less often from other sites (e.g., nose, mouth or respiratory tract in abdominal operations). By contrast, microorganisms from the hands of the surgeon or assistant are seldom the cause of incisional surgical site infections (Galle, Homesley and Rhyne 1978), nor are organisms present in the operating room or on other surgical staff.

Preoperative surgical antisepsis consists of three processes (hand hygiene and gloving of surgical team members combined with applying an antiseptic agent to the surgical site) designed to block transmission of infectious agents into the surgical wound. The effectiveness of handwashing followed by briefly applying a waterless, alcohol-based antiseptic handrub or antiseptic solution in reducing the number of bacteria and fungi on hands has been amply documented (Galle, Homesley and Rhyne 1978; Larson et al 2001). In fact, one large, 10-year prospective study found no postoperative wound infections after 141 operations during which the surgeon's glove was punctured (Cruse and Foord 1980). In addition, preoperative skin preparation using an antiseptic agent, when done correctly, has been shown to effectively reduce both transient and resident skin flora, as well as infection rates (Platt and Bucknall 1984).

Whether a postoperative infection occurs depends on several risk factors, the most important being:

- number of microorganisms entering the wound;
- type and virulence (ability to cause disease) of the bacteria;
- strength of the patient's defense mechanisms (e.g., status of the immune system); and
- external factors, such as the patient being in the hospital several days before the surgery or duration of the surgery (>4 hours).[1]

Thus surgical antisepsis, by limiting the type and number of microorganisms transferred into the wound during surgery, plays an important, but not necessarily major, role in preventing postoperative wound infections.

DEFINITIONS

- **Antiseptic** or **antimicrobial agent (terms used interchangeably)**. Chemicals that are applied to the skin or other living tissue to inhibit or kill microorganisms (both transient and resident) thereby reducing the total bacterial count. Examples include alcohols (ethyl and isopropyl), dilute iodine solutions, iodophors, chlorhexidine and triclosan. (See **Appendix B** for complete listing of uses, effectiveness, advantages and disadvantages.)
- **Antisepsis**. Process of reducing the number of microorganisms on skin, mucous membranes or other body tissue by applying an antimicrobial (antiseptic) agent.

SELECTION OF ANTISEPTICS

While plain soap and clean water physically remove dirt and other material as well as some **transient** microorganisms from the skin, antiseptic solutions kill or inhibit almost all transient and many **resident** microorganisms, including most vegetative bacteria and many viruses. Antiseptics are designed to remove as many microorganisms as possible without damaging or irritating the skin or mucous membrane on which they are used. In addition, some antiseptic solutions have a **residual effect**, meaning their killing action continues for a period of time after they have been applied to skin or mucous membranes.

Many chemicals qualify as safe antiseptics. **Table 6-1** lists several recommended antiseptic solutions, their microbiologic activity and their potential uses. (The grading system used in this table is excellent, good, fair, and none.) The most frequently used antiseptics are chlorhexidine gluconate, which is contained in Hibitane®, Hibiscrub®, and iodophors such as Betadine® and Wescodyne®. Not listed in **Table 6-1** is Savlon®, which contains chlorhexidine and is available throughout the world, because it is largely sold as concentrated solution that is then diluted with water. In many countries, the concentration used is less than 1%, which is too low to be effective.

[1] The factors responsible for postoperative wound infections are discussed in more detail in **Chapter 23**.

Table 6-1. Antiseptics: Microbiologic Activities and Potential Uses

GROUP	ACTIVITY AGAINST BACTERIA							POTENTIAL USES			
	Gram-Positive	Most Gram-Negative	TB	Viruses	Fungi	Endospores	Relative Speed of Action	Affected by Organic Matter	Surgical Scrub	Skin Preparation	Comments
Alcohols (60–90% ethyl or isopropyl)	Excellent	Excellent	Excellent	Excellent	Excellent	None	Fast	Moderate	Yes	Yes	Not for use on mucous membranes Not good for physical cleaning of skin, no persistent activity
Chlorhexidine (2–4%) (Hibitane, Hibiscrub)	Excellent	Good	Fair	Excellent	Fair	None	Intermediate	Slight	Yes	Yes	Has good persistent effect Toxicity to ears and eyes
Iodine preparations (3%)	Excellent	Excellent	Excellent	Excellent	Good	Fair	Intermediate	Marked	No	Yes	Not for use on mucous membranes Can burn skin so remove after several minutes
Iodophors (7.5–10%) (Betadine)	Excellent	Excellent	Fair	Good	Good	None	Intermediate	Moderate	Yes	Yes	Can be used on mucous membranes
Para-chloro-metaxylenol (PCMX) (0.5–4%)	Good	Excellent	Fair	Good	Fair	Unknown	Slow	Minimal	No	Yes	Penetrates the skin and should not be used on newborns
Triclosan (0.2–2%)	Excellent	Good	Fair	Excellent	None	Unknown	Intermediate	Minimal	Yes	No	Acceptability on hands varies

Adapted from: Boyce and Pittet 2002; Olmsted 1996.

Although antiseptics are sometimes used as disinfectants (e.g., Savlon or Dettol®) for processing instruments and other inanimate objects, they are not designed for this use. They do not have the same killing power as chemical disinfectants (e.g., glutaraldehydes, hypochlorite and peroxides) and should not be used for this purpose (Rutala 1996).

Additional information, including advantages and disadvantages of commonly used antiseptics, is presented in **Appendix B**.

USE OF ANTISEPTICS

Hand Hygiene

Antimicrobial soaps or detergents are no more effective than plain soap and clean water in reducing the risk of infection when used for routine handwashing, provided the water quality is satisfactory (Pereira, Lee and Wade 1997). Water that contains large amounts of particulate matter (makes the water cloudy) or is contaminated (high bacteria count) should not be used for performing a surgical handscrub[2]. In addition, antimicrobial soaps are costly and are more irritating to the skin than plain soap. Detailed instructions for performing a surgical handscrub using either an antiseptic solution or antiseptic handrub are presented in **Chapter 3** and **Appendix A**.

Skin Preparation Prior to Surgical Procedures

Although skin cannot be sterilized, applying an antiseptic solution minimizes the number of microorganisms around the surgical wound that may contaminate and cause infection.

Instructions

STEP 1: **Do not shave hair** around the operative site. Shaving increases the risk of infection 5–10 fold because the tiny nicks in the skin provide an ideal setting for microorganisms to grow and multiply (Nichols 1991; Seropian and Reynolds 1971). If hair must be cut, **trim** the hair close to the skin surface with scissors immediately before surgery.

STEP 2: Ask the patient about **allergic reactions** (e.g., to iodine preparations) before selecting an antiseptic solution.

STEP 3: If the skin or external genital area is visibly soiled, gently wash it with soap and clean water and dry the area before applying the antiseptic.

Select the antiseptic solution from the following recommended products:

- Alcohol-based solutions (tinctures) of iodine or chlorhexidine
- Alcohols (60–90% ethyl, isopropyl or "methylated spirit") (see **Appendix B**)

[2] If tap water is cloudy, most particulates (debris and organic material) can be removed by filtering through four layers of moderately woven cotton cloth, such as cheese cloth or old sari material, before boiling or treating with dilute chlorine (sodium hypochlorite) solution (Colwell et al 2003; Huq et al 1996).

- Chlorhexidine gluconate (2–4%) (e.g., Hibitane, Hibiscrub, Hibiclens®)
- Chlorhexidine gluconate and cetrimide, various concentrations at least 2% (e.g., Savlon)
- Iodine (3%); aqueous iodine and alcohol-containing (tincture of iodine) products
- Iodophors (7.5–10%), various other concentrations (e.g., Betadine)
- Chloroxylenol (Para-chloro-metaxylenol or PCMX) (0.5–3.75%), various other concentrations (e.g., Dettol)

Note: **Do not allow the antiseptic to pool** underneath the client's body; this can irritate the skin.

STEP 4: Using dry, high-level disinfected forceps and new cotton or gauze squares soaked in antiseptic, thoroughly cleanse the skin.[3] Work from the operative site outward for several centimeters. (A circular motion from the center out helps to prevent recontamination of the operative site with local skin bacteria.)

STEP 5: Allow the antiseptic enough time to be effective before beginning the procedure. For example, when an iodophor is used, allow 2 minutes or wait until the skin is visibly dry before proceeding, because free iodine, the active agent, is only released slowly (see **Appendix B**).

INSTRUCTIONS FOR CERVICAL OR VAGINAL PREPARATION

For **cervical** and **vaginal antisepsis**, prior to inserting a uterine elevator for minilaparotomy or doing an endometrial biopsy, select an aqueous (water-based) antiseptic such as an iodophor (povidone-iodine) or 2–4% chlorhexidine gluconate (e.g., Hibiclens or Savlon if properly prepared). **Do not use alcohols or alcohol-containing preparations**, such as Dettol. Alcohols burn, and they also dry and irritate mucous membranes that in turn promote the growth of microorganisms. In addition, hexachlorophene (pHisoHex®) is neurotoxic (Larson 1988) and should not be used on mucous membranes, such as the vaginal mucosa, because it is readily absorbed (Larson 1995).

STEP 1: Ask the patient about **allergic reactions** (e.g., to iodine preparations) before selecting an antiseptic solution.

STEP 2: If the external genital area is visibly soiled, gently wash it with soap and clean water and dry the area before applying the antiseptic.

STEP 3: After inserting the speculum, apply antiseptic solution liberally to the cervix and vagina (two times). It is not necessary to prep the external genital area with antiseptic solution if it appears clean.

STEP 4: If an iodophor is used, allow time (2 minutes) before proceeding.

[3] The cotton or gauze swabs or pads do not need to be made up from sterile items. Clean, new (not reprocessed) cotton or gauze swabs can be used, because they do not contain harmful organisms and will be touching only noncritical (intact skin) and semicritical (mucous) membranes (Spaulding 1968).

Skin Preparation for Injections

According to WHO and its Safe Injection Global Network (SIGN), "swabbing of clean skin—with an antiseptic solution—prior to giving an injection is unnecessary," because in controlled trials no infections were noted. In addition, a review of microbiologic studies did not suggest that wiping the skin with an antiseptic before giving an intradermal, subcutaneous or intramuscular injection reduced the risk of infection (Hutin et al 2001).

> If the injection site is visibly soiled, wash the site with soap and water and dry with a clean towel, and then give the injection.[4]

STORING AND DISPENSING OF ANTISEPTICS

Contamination of **every** antiseptic agent has been documented. Microorganisms contaminating antiseptic solutions include *Staphylococcus epidermidis* and *aureus*, gram-negative bacilli, *Pseudomonas aeruginosa,* and some endospores. Contaminated antiseptics can cause subsequent infection when used for handwashing or preparing a client's skin. The following can prevent contamination of antiseptic solutions:

- Unless supplied commercially in small quantities, pour the antiseptic into a small, reusable container for daily use. This prevents evaporation and contamination. Make sure the correct name of the solution is on the container each time you refill it. **Do not store gauze or cotton wool in antiseptics because this promotes contamination.**
- Establish a routine schedule for preparing new solutions and cleaning reusable containers. (Solutions are at increased risk of becoming contaminated after 1 week of storage.) **Do not "top off" antiseptic dispensers.**
- **Wash** reusable containers thoroughly with soap and clean water, rinse with boiled water if available and **drip dry** before refilling.
- Label reusable containers with the date each time they are washed, dried and refilled.
- Concentrated antiseptic solutions should be stored in a cool, dark area. Never store them in direct sunlight or in excessive heat (e.g., upper shelves in a tin-roofed building).

[4] Patients receiving injections regularly (e.g., using DMPA for contraception) should be taught to wash the injection site (arm or buttocks) with soap and clean water just prior to coming to the clinic or receiving the injection at their home.

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