Guideline 1

Surgical Skin Antisepsis in Operating Theatres

1 Purpose

This guideline provides recommendations regarding best practice for surgical skin antisepsis in Queensland Health Operating Theatres.

Accompanying Policy and Standard:
- Queensland Health Prevention and Control of Healthcare Associated Infection (HAI) Policy
- Queensland Health Prevention and Control of Healthcare Associated Infection (HAI) Standard

2 Introduction

Superficial surgical site infection (SSI) and early post-operative infection of deep tissue spaces and implantable prosthetic material is usually caused by bacteria found on the patient’s skin at the operative site. For this reason Staphylococcus aureus is the most frequently encountered organism, although Streptococci, Gram negative bacteria and, for prosthetic material, coagulase negative staphylococci and other skin flora may also cause infection. Prevention of surgical site infection relies on addressing a number of different variables, of which patient skin antisepsis is but one.

3 Background

It is not possible to sterilise the skin; skin antisepsis aims to reduce the number of viable resident organisms on or in the skin and to destroy pathogenic organisms that may be on the skin as transients.

It is important to reduce bacteria on the skin of the surgeon’s hands, the operating theatre staff, and the patient, particularly at the site of surgical incision. Some operations such as cardiac bypass grafting; have more than one site of incision (usually sternum and leg).

Several antiseptic agents are available for preoperative preparation of skin at the incision site. The common agents for preoperative skin antisepsis are iodophors (eg. povidone-iodine), alcohol-containing products, and chlorhexidine. However Mangram et al (1999) concluded that “no studies have adequately assessed the comparative effects of these preoperative skin antiseptics on surgical site infection risk in well-controlled, operation-specific studies.” A Cochrane review authored by Edwards et al (2004) of preoperative skin antiseptic agents concluded that there is insufficient evidence from randomised trials to support the use of one antiseptic over another.

In the absence of data on SSI rates, other information can be looked at such as ability to decrease skin flora, residual effect, effect of antiseptic on central catheter infection rates
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Alcohols have an important role in skin disinfection, either as the sole bactericide or in combination with chlorhexidine or povidone-iodine. In 1960 Lilly and Lowbury (cited in Woodhead et al, 2002) “showed that 1% iodine in 70% alcohol and 0.5% chlorhexidine in 70% alcohol were the two most effective skin antiseptics for preoperative hand decontamination by the surgeon and ‘scrub’ nurse.” These two antiseptics have become popular for the skin preparation of the patient.

Davies et al in 1978 (cited in Gardner & Peel, 1998) found that 70 per cent v/v ethyl alcohol, 0.5% w/v chlorhexidine in water or ethyl alcohol or alcoholic povidone-iodine (1 per cent available iodine) reduced the bacterial flora of the skin of the abdomen by 99 per cent within 5 minutes.

Gilliam & Nelson (1990) also identified benefits with an iodophor-in-alcohol solution including improved drape adhesion, more convenient, easier to apply, less time consuming and potentially less expensive.

A proposal by Segal and Anderson (2002) aimed at optimising preoperative skin preparation of patients undergoing heart surgery compared aqueous povidone-iodine paint and iodophor/alcohol water insoluble film as a skin preparation. A higher rate of infection was found in the aqueous iodine group. The authors reported multiple benefits including reduced patient SSI rates, improved clinical competency through standardisation of skin preparations, lower pricing through higher volumes of one product, inventory, and routine distribution.

4 Recommendation

The use of alcohol solutions (preferably 70% by v/v) in combination with agents that provide residual activity is recommended for skin preparation at operation due to their greater efficacy at killing bacteria.

4.1 Procedure

1. Before skin preparation of a patient is initiated, the skin should be free of gross contamination (i.e. dirt, soil, or any other debris).
2. The patient’s skin is prepared by applying an antiseptic in concentric circles, beginning in the area of the proposed incision.
3. The prepared area should be large enough to extend the incision or create new incisions or drain sites, if necessary.
4. The application of the skin preparation may need to be modified, depending on the condition of the skin (e.g. burns) or location of the incision site (e.g. face).

4.2 Epidural insertion procedure

1. Before skin preparation of a patient is initiated, the skin should be free of gross contamination (i.e. dirt, soil, or any other debris).
2. Prepare the patient’s skin using the chosen alcohol containing antiseptic solution in concentric circles beginning in the area of the proposed site. Allow the skin to dry.
   - Due to the potential risk of neurotoxicity from inadvertent contamination, antiseptic solutions with concentrations greater than 0.5% chlorhexidine gluconate should not be used for epidural insertions.

3. Remove the antiseptic fluid container and associated swabs from the sterile field.
4. Continue with the epidural insertion.

4.3 Hazard precautions

There should be no hazard if alcoholic preparations are used correctly:
- the amount used should be adequate to keep the site wet for the recommended time;
- sufficient time must be allowed for alcohol-based skin preparations to dry thoroughly before commencing the procedure to ensure that all combustible ingredients have evaporated;
- the preparation should be allowed to evaporate completely before electrocautery/diathermy or laser instruments are switched on; and
- pooling of excess liquid below the patient should not be allowed to occur.

5 Discussion

Like many chemical disinfectants, alcohols are generally considered to be non-specific antimicrobials because of a multiplicity of toxic effect mechanisms. The predominant mode of action appears to stem from protein coagulation/denaturation. Alcohols must be diluted with sufficient water to facilitate their antimicrobial action, in the absence of water, proteins are not denatured as readily as when water is present.

Alcohol is readily obtainable, inexpensive, relatively non-toxic with topical application, and remains the most effective and rapid-acting skin antiseptic. Alcoholic solutions are seen as more effective than aqueous solutions of the same antimicrobial agents. This applies whether the alcohol is used as the sole disinfectant or as the solvent in a preparation of a non-volatile bactericide. Ethyl alcohol is generally used at 70-80 percent v/v and isopropyl alcohol as 60-70 percent v/v. Aqueous 70% to 92% alcohol solutions have germicidal activity against bacteria, fungi, and viruses, but spores can be resistant. The low surface tension of alcohol-water mixtures confers wetting ability and they penetrate well into crevices of the human skin.

The activity of alcohols alone is lost on evaporation (they evaporate at room temperature) and they exert no residual (persistent) effect (there is no residual activity after the alcohol has completely evaporated). The lack of residual activity is significantly improved by combination with other agents, in particular chlorhexidine.

Both chlorhexidine gluconate and iodophors have broad spectra of antimicrobial activity. In some comparisons of the two antiseptics when used as preoperative hand scrubs, chlorhexidine gluconate achieved greater reductions in skin microflora than did povidone-iodine and also had greater residual activity after a single application. Further, chlorhexidine gluconate is not inactivated by blood or serum proteins. Iodophors maybe
inactivated by blood or serum proteins, but exert a bacteriostatic effect as long as they are present on the skin.

6 Conclusion

Although numerous studies have been done in these areas some conclusions can be offered:

1. alcohol is the most microbiologically active agent in producing the largest and most rapid inactivation of vegetative bacteria (it is less active against spores);
2. alcohol lacks a sustained residual effect on the skin but this is significantly improved by combination with other agents, in particular chlorhexidine;
3. iodophors eg. povidone-iodine have a minimal residual effect;
4. alcohol-based handwash products are more efficacious than soaps or antimicrobial agents without alcohol in reducing both resident and transient hand flora;
5. chlorhexidine at a concentration of 2% is considered superior to povidone-iodine in preventing central line catheter sepsis; and
6. alcoholic preparations are generally less expensive, less time consuming, and more acceptable to users.

7 Issues

- Iodine preparations are not recommended in neonates, particularly preterm infants.
- Povidone-iodine may be toxic to tissues, however a half strength (5%) aqueous solution is available for ophthalmic surgery.
- Allergy to both iodine and chlorhexidine can occur, however incidence and severity of hypersensitivity reactions is greatly reduced with iodophors over the solutions of free iodine.
- Alcohols are irritant and toxic to tissue cells and are generally unsuitable for application to mucous membranes.
- 2% chlorhexidine gluconate in 70% alcohol is available for use in the preparation of skin for insertion and subsequent management of central venous access devices, however it is not indicated for surgical skin preparation.
- The problem of precipitation may be encountered when colouring agents are added by the user to identify the concentration or to distinguish between aqueous and alcoholic solutions.
- There have been some studies published on the use of microbial skin sealants to prevent SSI but to date there is insufficient evidence to warrant recommending these products.

Resistance

Resistance is not a significant issue with alcohols, especially at use-level concentrations employed for antisepsis and disinfection.
Flammability
All alcohol preparations are flammable. It is imperative that when used in a medical setting that all preparation has been allowed to evaporate and specifically that there are no areas where solution has been allowed to pool before exposure to potential ignition sources such as diathermy. Even lower concentrations of alcohol containing solution (eg. povidone-iodine containing 30% alcohol) carry a moderate flammability risk with a documented flash point of 34°C. The lower explosive limit (%) is not recorded on the material safety data sheet.

Expiry dates
Skin disinfectants should be labelled with the date when first opened and the expiry date which must be adhered to:
- aqueous solutions must be discarded after 24 hours;
- aqueous povidone-iodine expires one month after opening;
- alcoholic solutions must be discarded six (6) months after opening.

Regulation
The Therapeutic Goods Act 1989, Regulations and Orders set out the requirements for inclusion of therapeutic goods in the Australian Register of Therapeutic Goods (ARTG), including advertising, labelling, product appearance and appeal guidelines. Therapeutic goods include prescription and non-prescription (including over-the-counter and complementary medicines), as well as medical devices (including some sterilants and disinfectants). Any product for which therapeutic claims are made must be entered in the ARTG before the product can be supplied in Australia. Antiseptic applications of alcohols are recorded in ARTG.

8 References and recommended reading


