An audit of pre-operative skin preparative methods

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ABSTRACT

INTRODUCTION A study into how pre-operative skin preparation varies between surgical units and surgeons.

MATERIALS AND METHODS A postal audit of general, vascular and thoracic surgeons in Northern Ireland was conducted together with a literature review to establish best practice.

RESULTS Overall, 73 surgeons were contacted, and 63 (86.3%) responded. There was marked variation in shaving of the operative site. A wide range of solutions was used, and 14 different sequences were employed. All surgeons used a swab or sponge to apply the solutions. Several drying methods were employed.

CONCLUSIONS There is variation in the method of skin preparation employed between surgical units and surgeons. There is limited evidence-based research on this topic. Recommendations are made as to best practice.

KEYWORDS

Pre-operative methods – Skin preparation – Disinfection – Betadine

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Since Lister¹ first described the benefits of carbolic acid as a skin disinfectant in 1867, primarily in the treatment of infected wounds, pre-operative skin disinfection has become an established routine before every operative procedure. Although carbolic acid is no longer used, we have observed considerable variation in the solutions used and in which sequence. We wished to verify this by a postal survey of surgeons in Northern Ireland.

Whilst previous articles have looked at patient skin preparation, we believe they have failed to clarify an appropriate skin preparative method. Based on the current literature, we provide such recommendations.

Materials and Methods

An anonymous four-question questionnaire was mailed to all general, vascular and thoracic surgeons in Northern Ireland. The first question related to the timing of operative site shaving, *i.e.* night before, pre-operative/on the ward, in theatre or not at all. Question 2 asked which solutions were used and in which sequence. Four named solutions Savlon®, alcohol, Betadine® and chlorhexidine in aqueous or alcohol solution were offered and a space for any others was

available. Question 3 related to the method of application – swab, sponge or spray. The final question surveyed the method of drying – air-drying and for how long; swabbing after each or the last solution; or any other method.

Data from returned questionnaires was entered into Microsoft Excel spreadsheet for comparison.

Results

Of 73 surgeons contacted, 63 responded (86.3%). Eleven surgeons (17.5%) shaved the operative site the night before, 24 (38.1%) shaved on the ward, 27 (42.9%) shaved in theatre and 1 (1.6%) surgeon did not shave any patients.

The diversity of solutions used and in which sequence is shown in Table 1, with 14 different sequences employed. Savlon® was the most commonly used solution (65.1%) followed by Betadine® (60.3%), chlorhexidine (46.0%) and alcohol (20.6%). Eight surgeons (12.7%) applied only one solution, 41 surgeons (65.1%) applied two solutions and 14 surgeons (22.2%) applied three solutions (Table 1).

There was considerable variation in the solutions and sequences used within surgical units (Fig. 1). Greater concordance was seen in smaller hospitals (Fig. 1).

Seventeen surgeons (27%) used a swab and 46 surgeons (73%) used a sponge to apply the solutions. Spray application was not used routinely by any surgeons, but one stated the use of spray for varicose vein patients.

Air drying was the most common drying method (47 surgeons; 74.6%), with roughly equal numbers drying for < 1 min (31.9%), 1–2 min (31.9%), > 2 min (36.2%). When adhesive drapes were used, 5 surgeons who were 'air dryers' indicated they used a swab after the last solution. Of the surgeons who used a swab to dry, 1 surgeon (6.5%) did so after each application and 15 (93.8%) only after the last solution had been applied.

Discussion

We found significant variation in pre-operative skin preparative techniques throughout Northern Ireland.

There is good evidence that shaving of the operative site hours before surgery increases the rate of wound infections by causing small cuts and abrasions which bacteria can colonise.² It appears that more than 50% of surgeons questioned still carry out this practice. Hair should only be removed from the operative site if it interferes mechanically with accurate, anatomical approximation of the wound. It is questionable if hair itself contributes to wound infection rates.^{5,4}

The ideal antiseptic is: 'one that is rapidly lethal to all forms of bacteria and their spores, capable of bactericidal activity for a prolonged period, has no injurious effects on wound tissues or skin, delineates the operative site and is easily applied and removed'.⁵ The skin cannot be completely sterilised without damaging or destroying it⁶ as bacteria found deep in the skin rise to contaminate the prepared area following standard methods.⁷ Hence, eradication of the greatest number of pathogenic bacteria should be the goal of pre-operative skin preparation. Most wound infections in

Table 1 Solutions used and in which sequence (e.g. 4 surgeons used only one application of Betadine; 8 surgeons used Savlon® followed by alcohol and then Betadine)

Solution and sequence	No. of surgeons	%
Betadine	4	6.3
Chlorhexidine	4	6.3
Betadine, alcohol	1	1.6
Betadine, Betadine	2	3.2
Betadine, chlorhexidine	1	1.6
Chlorhexidine, alcohol	1	1.6
Chlorhexidine, Betadine	3	4.8
Chlorhexidine, chlorhexidine	5	7.9
Savlon®, Betadine	16	25.4
Savlon®, chlorhexidine	12	19.0
Chlorhexidine, chlorhexidine, alcohol	1	1.6
Savlon®, alcohol, Betadine	8	12.7
Savlon®, alcohol, chlorhexidine	2	3.2
Savlon®, Savlon®, Betadine	3	4.8

clean surgical procedures are the result of skin bacteria invading the incision site,⁶ but room-air fallout was also shown to be a significant source of contamination.⁸

The sequence of solutions used is as dependent on the unit in which the surgeon works, as much as personal preference. There is variation even within and between surgical units. There appears to be a degree of standardisation within smaller units, but not within larger units. Of the 15 units contacted, in 9 (60.0%) units more than 50% of the surgeons used the same solutions and sequence (Fig. 1).

Figure 1 Variation within each of the 15 units from which responses were obtained. Surgical units are arranged according to unit size, those numbered 1–8 being the smaller units. Each coloured block refers to a separate skin preparation sequence, not necessarily the same sequence.

Iodine has been used as a skin disinfectant since 1905.⁹ It is known to kill bacteria, fungi, viruses and spores.⁹ The Iodophors (iodine complexed with a polymer, *e.g.* Betadine®, Povidone-Iodine) were synthesised in an attempt to reduce the incidence of skin sensitisation which occurs with free iodine in about 15% of patients. Interestingly, 60.3% (38) of surgeons questioned used Betadine® at some stage; however, 2 of these indicated they used chlorhexidine in patients who were iodine-sensitive. The bactericidal benefits alone, with the ability to verify the area covered by the solution, may account for its wide-spread use.

Chlorhexidine was introduced in 1954 and has been widely used in Europe since then. It combines the broad-spectrum antibacterial activity of the Iodophors, with a more prolonged action and no known sensitivity.¹⁰

Alcohol is effective against most pathogenic bacteria except dried spores but is of limited use against fungi.¹⁰ Alcohol, however, enhances the activity of other antiseptic solutions (*e.g.* Povidone-Iodine).¹¹ The dangers of using alcohol, which is flammable, in conjunction with electrosurgery are well described, especially under occlusive drapes where pooling can occur.¹²

Cetrimide, a constituent of Savlon®, along with chlorhexidine, has a strong bacteriostatic activity.⁶ As cetrimide is not bactericidal, it should take the place of soap and water for mechanical cleansing of the skin before application of the chosen antiseptic.⁶

Various studies have shown the virtual disinfection effect of various solutions to occur after just 20 s,^{7,15} and prolonged application was only marginally better.¹⁴ Hence, single application is all that is required. Special consideration should be given to the umbilicus.¹⁵

Friction is important in de-germing the skin and factors that lessen surface tension play a vital role in the efficacy of germicidal solutions.^{4,14,16} Spraying is also an effective method for antiseptic application.^{17,18} The abrasive nature of shaving increases wound infection rates and further research is needed to establish if vigorous antiseptic application methods are similarly detrimental.

Air drying is considered more effective,¹⁵ but Kutarski *et al.*¹⁹ showed no apparent deleterious effect on the action of aqueous Povidone-Iodine by wiping dry after 30 s. Of respondents, 4 (6.3%) pointed out that they used a swab/towel to dry, if adhesive drapes were to be applied.

Conclusions

We have shown wide variation in the practice of pre-operative skin preparation among 'general' surgeons in Northern Ireland. Given the universal acceptance of the practice of skin preparation with a limited evidence base, we would recommend the following:

- Shave the patient in theatre, if required, preferably with disposable electric clippers

- Savlon®, initially, as a detergent if required, followed by either aqueous chlorhexidine or an Iodophor. Given the possible sensitivity when using iodine, chlorhexidine would be preferred
- Either painting or spraying are effective application methods
- Optimal effect is achieved by 30 s, so swab drying after this time is acceptable.

Acknowledgement

We would like to thank all surgeons who completed this survey.

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