Anaesth Intensive Care 2002; **30:** 338-340

Washing of Gloved Hands in Antiseptic Solution Prior to Central Venous Line Insertion Reduces Contamination

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SUMMARY

Glove contamination at the time a central venous catheter is handled is highly undesirable and likely to increase the risk of subsequent line infection. This study was designed to determine how frequently gloves become contaminated during central venous line insertion and to demonstrate the value of glove decontamination immediately prior to handling of the central venous catheter.

During twenty routine internal jugular catheter insertions the sterility of the operator's gloved fingertips (just prior to handling the intravenous catheter) was assessed by touching the fingertips onto blood agar plates. The gloved hands were then rinsed in chlorhexidine/alcohol and after drying were placed onto a further plate. Contamination was detected in 55% of the prewash plates but in none of the postwash plates. Procedures performed by less experienced resident staff had a higher contamination rate despite there being no evident breach of sterile technique.

It is likely that glove contamination results from the persistance of bacteria within the deeper layers of the skin, despite surface disinfection. These bacteria may be released by manipulation of the skin when identifying landmarks. This hypothesis was supported by a subsequent observation that gloves were more highly contaminated after firm touching of the skin rather than light touching.

Glove contamination during central line insertion is frequent. Catheter contamination rates could be reduced (without risk or additional cost) by rinsing gloved hands in a solution of chlorhexidine (0.5%) in alcohol (70%) prior to handling the catheter.

Key Words: CENTRAL VENOUS CATHETER: contamination, antiseptic

Although not widely recognized by clinicians, contamination of the operator's gloves from skin contact during surgical procedures is frequent.

A study by Levy et al[1], in which glove contamination during central line placement was assessed, showed that, despite standard aseptic technique, the anaesthetist's gloved finger tips were contaminated at the end of the procedure in 83% of cases.

Bacteria present on the fingertips are undesirable and are likely to be transferred to the catheter during insertion. For catheters that are in place for short periods, microbial migration down the outer surface of the device to the intravascular tip, predominates as a cause of device-related nosocomial infection. Where the catheter is contaminated at the time of insertion, this mechanism of infection is facilitated[2].

In recognition of this high incidence of glove contamination, practice at the Geelong Hospital has included the additional step of disinfecting the gloved hands by washing in chlorhexidine (0.5%) and alcohol (70%) just prior to picking up and handling any catheter.

This study was designed to reconfirm that glove contamination due to skin bacteria is frequent and to establish the benefit of glove decontamination during central venous catheterization.

METHODS

Twenty routine percutaneous catheter insertions were assessed for evidence of glove contamination. In each case, insertion was via the internal jugular route using a Seldinger technique.

Catheter insertion was undertaken as a non-urgent

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Accepted for publication on November 27, 2001.

sterile procedure on cooperative or sedated patients. Operators wore masks, commenced with a surgical scrub and used sterile gloves, gowns and drapes. The skin was disinfected with 0.5% chlorhexidine and 70% alcohol.

Once a sterile field was established, the operator proceeded with identification of the vein and insertion of the guidewire.

Operators were timed from the moment they first touched the patient's skin within the sterile field to identify the vein, to the point at which the operator was about to handle the catheter just prior to insertion (the wire having been placed into the vein). At this point the procedure was interrupted and the fingertips of both gloved hands were firmly touched onto a sterile blood agar culture plate which was labelled "PRE". The fingers of each gloved hand were then dipped into the previously used chlorhexidine/alcohol skin prep solution, the hands were rubbed together to distribute the antiseptic solution and the gloves were then allowed to dry completely.

Again the fingertips of both gloved hands were imprinted onto a sterile blood agar culture plate which was marked "POST". Once this was completed the intravascular catheter was inserted as usual. The plates were then incubated for 48 hours at 37°C and growth of bacterial colonies was recorded.

Statistical analysis was performed using GraphPad InStat (version 3.00 for Windows 95, GraphPad Software, San Diego California, U.S.A., www.graphpad.com). The presence or absence of contamination was compared using the two-sided Chi square test. Times for insertion and number of touches of the skin were compared using an unpaired t-test with Welch correction. The effect of repeated light and heavy skin touching was also evaluated using a t-test.

To elucidate the mechanism by which glove contamination occurs, a subsidiary study was undertaken that examined the impact of intensity of skin manipulation on bacterial culture rates. Twenty healthy volunteers were studied. The skin surface on the side of the neck of each volunteer was prepared with alcoholic chlorhexidine which was then allowed to dry. A sterile gloved finger was gently touched onto the skin ten times within a 25 mm^2 marked area of the skin. This finger was then touched onto a sterile blood agar culture plate. An adjacent 25 mm^2 marked skin area in the same sterile field was then separately firmly pressed (pressure the subject acknowledged was firm but not painful) ten times with a separate sterile gloved finger and plated onto a second blood agar plate. Both culture plates were then incubated at 37°C for 48 hours and a colony count undertaken.

RESULTS

Contamination of the gloves was observed in 55% (11/20) of cases prior to washing of hands in the antiseptic solution, but in no case after washing ($P<0.001$). The mean colony count on the prewash sample plates from contaminated gloves was 19±8 (mean±SD). Colonies growing where contaminated gloved finger tips were touched onto the agar plate are illustrated in Figure 1.

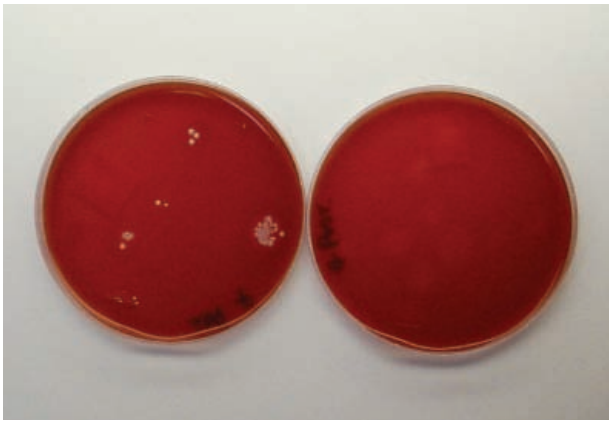

FIGURE 1. Blood agar plate with bacterial colonies growing where contaminated gloved fingertips were touched onto the plate (prior to disinfection) (left) and the effect of alcoholic chorhexidine washing (right).

When the cases performed by residents and specialists were analysed separately the residents had a greater incidence of glove contamination (70% vs 40%, NS), took more than three times as long to insert the guide wire (15.5±5.9 mins vs 4.7±1.5 mins, $P<0.001$) and touched the skin twice as much (30.2±9.1 times vs 14.1±5.7, $P<0.001$)(see Table 1).

TABLE 1

	Time taken (minutes)	Number of times skin touched by operator	Number of "pre-wash" plates growing organisms	Number of "post-wash" plates growing organisms
Residents (10)	15.5±5.9	30.2±9.1	7/10	0/10
Specialists (10)	4.7±1.5	14.1±5.7	4/10	0/10

Values are expressed as mean±SD.

The only bacteria cultured from the contaminated gloves were coagulase-negative staphyloccoccus.

Culture of gloved fingers following repeated (10 times) touching of the neck skin, with light pressure, produced a colony count of 14.8±8.2 (mean±SD). However there was greater growth following firm touching of the skin (25±12.6 (mean±SD) colonies), $P<0.05$.

DISCUSSION

This study confirms that despite proper use of standard aseptic technique, contamination of the gloved fingertips with skin commensal bacteria is common during central venous line insertion.

Standard skin preparation can only disinfect the skin surface and viable organisms remain in the crypts of the hair follicles and sweat glands. This concept is supported by the observation that bacteria can be cultured from 32.4% of excised skin specimens following skin disinfection with povidone-iodine and from 5.7% of the specimens disinfected with chlorhexidine[3].

Skin organisms surviving in skin crypts after surface disinfection are more likely to be released by prolonged and/or firm skin manipulation. The comparison of repeated gentle touching of the skin with repeated firm pressing on glove contamination supports this view. The observation that inexperienced operators touch the skin more frequently and more firmly when identifying anatomical landmarks during central line insertion may explain why their gloved fingers are more frequently contaminated.

The association of operator inexperience and subsequent line infection rates of intravenous catheters has been previously reported[4].

Glove perforations have been shown to be relatively frequent (7.1%) following surgical operations[5] and consequently bacteria from the operator's hand may also contribute to the observed glove contamination.

Whatever the explanation for the glove contamination, this study demonstrates that it can be easily eliminated by washing the gloved hand in antiseptic solution.

This study did not look for an association between glove contamination and subsequent catheter and systemic infection. Such a study would need to be much larger. It is doubtful that a study involving the insertion of a central venous catheter with a gloved hand, known to be bacterially contaminated, would be ethical. Consequently it remains (and probably will remain) unclear whether glove decontamination has an impact on the overall patient infection rate. However the described decontamination technique is employed in our unit which enjoys a catheter-related bacteraemia rate of 0.6 per 1000 device days. This is well below the accepted baseline rate and suggests that the technique may be valuable.

We advocate that this simple practice be implemented, not simply for central line placement, but for all invasive procedures in the intensive care unit. The benefit is likely to be greatest when a high proportion of catheters are inserted by inexperienced operators.

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