Do dressings with increased permeability reduce the incidence of central venous catheter related sepsis?

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The incidence of catheter-related sepsis associated with the use of Tegaderm® or Opsite IV3000® dressings on 100 critically ill patients with liver disease was studied. All the patients had central venous catheters in situ and they were randomly assigned to one of the two dressings. In this study the sites of insertion were assessed at each dressing change, together with any fluid under the dressing. No statistically significant difference between the two dressings was found in accumulation of fluid, skin microbial colonization, local infection or systemic infection of patients in our sample. There was no apparent advantage to using the more permeable Opsite IV3000® dressing.

INTRODUCTION

Comparatively recently, semi-permeable, transparent, polyurethane dressings such as Tegaderm® have become the standard dressings for central venous catheter (CVC) insertion sites. They anchor the CVC, protect the insertion site from external microbial contamination and allow visualization of any early signs of localized sepsis (Vasquez & Jarrard, 1984, Fincham Gee & Noble, 1990).

However, these dressings may have potential disadvantages. Fluid, including blood, sweat and exudate, may accumulate under the dressing (Fitchie 1992). This pooled fluid can be an excellent culture medium for organisms which may potentially proliferate and migrate down the external surface of the CVC, where they multiply resulting in sepsis. These organisms, including Staphylococcus epidermidis, often originate from the patient’s skin flora. Several studies have shown that fluid accumulation under a dressing is more likely to lead to identification of an increased number of microorganisms compared to a dry environment, and that positive CVC entry site cultures result in a greater incidence of CVC-related sepsis (Snydman et al, 1982, Maki et al, 1988, Cheesebrough et al, 1986, Mermel et al, 1991, Cercenado et al, 1990).

It would therefore be of value to have a dressing which would retain the acknowledged advantages of semi-permeable polyurethane dressings, whilst reducing their propensity to retain fluid. An example of such a dressing is Opsite IV3000®, which is up to 8 times more permeable than standard films such as Opsite® and Tegaderm® (Smith and Nephew Medical 1994). Opsite IV3000® is designed to prevent the accumulation of fluids, resulting in a less favourable environment for the potential pathogens.


It has been shown that the incidence of CVC-related sepsis is lower with the use of Opsite IV3000® than with conventional film dressings. However, this still remains to be fully evaluated. The current study assessed a group of patients with liver disease who are at high risk of infection. The incidence of CVC-related infection in these patients was compared when using either Opsite IV3000® or Tegaderm® to dress the CVC insertion site.

METHODS

The study was a prospective, randomised trial of 100 critically ill liver patients admitted into the Liver ITU, Queen Elizabeth Hospital,
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Birmingham. Ethics Committee approval was obtained for the study. The entry criteria determined that a CVC had to be inserted either in the Liver ITU or in the operating theatre. Each patient was randomly, sequentially assigned to receive either the Tegaderm® or the Opsite IV3000® dressing. The standard Unit protocol was used throughout to care for the CVC site and stated that dressings should be changed every 2 days, at which time the site would be cleaned with aqueous chlorhexidine gluconate 0.05% (Sterets®, Unisept, Oldham, UK). At each dressing change the surface area of any fluid accumulated under the dressing was determined by direct measurement, and the type of fluid recorded. The patient’s temperature was also noted.

Assessment of the number of organisms around the CVC insertion site and within the insertion wound

Prior to removal of the CVC a sterile swab moistened with Triton-X (0.1% in phosphate buffered saline (PBS)) was used to swab an area of 2cm² around the insertion site (Williamson & Kligman 1969). A second swab was then placed inside the insertion wound and rotated 180°, 5 times. The swabs were then transferred to 2ml of Stuart’s Transport medium containing lecithin (2%) and Tween (3%). The lecithin/Tween neutralized any chlorhexidine which may have been transferred with the swab (Chawner & Gilbert 1989). Triton-X (0.05%) was then added to the medium and the swabs were vortex mixed for 60 seconds. Serial dilutions of the medium were prepared and 100 microlitre aliquots were plated on to 7% blood agar. After a 48h incubation at 37°C in air any microorganisms isolated were identified by standard microbiological techniques.

Determination of the number of organisms on the CVC distal tip

The number of organisms contaminating the external surface of the CVC at the time of removal was determined by rolling the 5cm tip 5 times across the surface of a blood agar plate (Maki et al 1977). After a 48h incubation at 37°C in O₂/CO₂ any microorganisms isolated were identified.

Clinical assessment of infection

Each patient was assessed for the presence of signs and symptoms of CVC-related sepsis (Elhott et al 1994). Assessments were performed every 2 days and on removal of the catheter. The criteria for assessment of local and systemic infection are as follows.

Localised infection
The patient had 2 or more of the following signs and symptoms: oedema, erythema, exudate or thrombophlebitis.

Systemic infection
The patient had 2 or more of the following: a low grade pyrexia which was unresponsive to broad spectrum antibiotics, pyrexia following intermittent line-flushing, no other obvious source for infection, evidence of localised infection.

RESULTS

One hundred patients were entered into the trial (59 women, 41 men). Their mean age was 47 years (range 16–73). The mean duration of the CVC remaining in situ was 5.6 days (range 1–15 days). Of the CVC used 64 were Deltacath™ (Becton Dickinson, Utah, USA) and 36 were Burton™ (Burton Medical Inc., Pennsylvania, USA).

Assessment of fluid under the dressing

Measurements of blood or exudate under the dressing were taken from 47 patients who had Tegaderm® dressings and 47 with Opsite IV3000®. Of the 47 patients who had Tegaderm® dressings 33 (70%) had blood present whilst the CVC was in situ. In comparison, in the group which had Opsite IV3000® 28 (60%) had blood present. There was no significant difference in the amount of blood collected under each dressing (P>0.01, unpaired t test). Exudate was present in 15 of the 47 patients with Opsite IV3000® (32%) compared to 11 of the 47 Tegaderm® patients (23%) (P>0.1). Similarly, the total area of exudate was equal in both groups.

Microbiological analysis

Microbiological analysis of the skin around the entry site wound, the entry site, and the CVC tip was performed on 75 patients. Of these patients 36 had Tegaderm® and 39 had IV3000®. Of the 47 patients who received Tegaderm® dressings, 23 (64%) had microorganisms isolated from the insertion site, Similarly, of the 39 patients who had Opsite IV3000® dressings 21 (54%) had positive cultures. There was no significant difference between these two rates of contamination (P>0.1).

The number of microorganisms isolated from the skin under the two dressings was not significantly different (Table 1, P>0.1).
Number of organisms | 3.2 × 10⁴ ± 5.2 × 10⁴ | 4.1 × 10⁴ ± 8.6 × 10⁴
Types of organisms | Coagulase negative staphylococci | Staphylococcus aureus | Enterococcus spp. | Diptheroid bacilli

Insertion site wound swab cultures (taken from the CVC insertion site itself) yielded similar results. Again there was no significant difference between the two dressings with regard to the number of organisms isolated from the wound ($P>0.1$).

Microorganisms (>15 cfu) were isolated from the surface of the distal tips of 24 CVC on removal. A similar range of microorganisms was isolated to that found on skin. There was no significant difference in the rates of contamination of the CVC between the two dressing regimes.

**Evidence of local and systemic infection**

Three patients had evidence of systemic infection associated with the CVC, all had Opsite IV3000® dressings. Eight patients had local infections at the CVC insertion site. Of the patients with local infection four received Tegaderm® dressings and four Opsite IV3000®.

**DISCUSSION**

The patients who were entered into the trial were all critically ill liver patients, the majority of whom had just undergone liver transplantation. These patients are prone to CVC-related sepsis for two predominant reasons. Firstly, owing to clotting abnormalities associated with liver disease, these patients tend to bleed more readily around their CVC entry sites. Secondly, all the patients are immunosuppressed due to drugs or to liver failure. This makes these patients more vulnerable to infection.

The current study investigated two areas. Firstly, the amount of fluid which collected below either Opsite IV3000® or Tegaderm® dressings. Secondly, the effect of either dressing on the presence of microorganisms on the underlying skin and the CVC insertion site. The results showed there was no statistically significant difference in the amount of fluid accumulated under either dressing. Similarly, no difference was found in the number of organisms present on the skin or within the insertion site.

These results are in contrast to early reports of studies by Richardson (1991), Kobayashi (1991), Joyeux (1991) and Kennlyside (1993) which detected less moisture under Opsite IV3000® than under a competitive dressing. In addition, Maki et al (1991) reported heavy growth of organisms under Tegaderm® as compared to Opsite IV3000®. These differences from the present study findings may reflect different clinical practices including the application and type of skin antisepsics as well as the frequency of dressing changes.

The results of the current study suggest that Opsite IV3000® and Tegaderm® have comparable amounts of moisture collection and that microbial growth under each is similar when using this dressing protocol. There was also no apparent difference in colonization rates of the distal tips of venous catheters in the two groups. Tegaderm® dressings continue to be the dressing of choice in our unit.

**ACKNOWLEDGEMENTS**

The authors would like to thank the following people for their assistance in performing this research: Ms D Bright, Mr V Powells, Mr I Morrison, Ms A Fisher, Mr W K Liu, Mr P Ashcroft, Mr A Poole, Mr R Breakwell, Mr M Robinson, Ms A Turner.

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