Central venous catheter dressing durability: an evaluation

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Abstract

Background: Skin organisms at the insertion site are frequently implicated in central venous catheter blood stream infections (CVC BSIs) yet few studies have compared the durability of CVC dressings in critically ill patients.

Aims: To undertake an evaluation of the durability and associated costs of different CVC dressings.

Methods: Dressing duration was captured prospectively using a pro forma on four different dressings on five critical care units over a 12-month period. Staff received training on CVC dressing evidence-based practices and a 'how to guide' was implemented.

Findings: A total of 1229 CVC dressings were observed from 590 CVCs. One dressing had a median (IQR) duration of 68.5 h (range, 32–105 h) compared to a median duration of 43.5, 46.0 and 40.5 h for the other dressings ($P < 0.001$). The mean time to change a CVC dressing was 13.5 min and the cost of a dressing change was in the range of £1.97–4.97. During the 12-month study period we observed a downward trend in CVC BSIs.

Discussion: Despite few dressings remaining adherent for 7 days, the low rates of CVC BSI observed suggests good dressing practices.

Conclusions: One dressing appeared more durable than the others, although it was still below the recommended standard and more expensive.

Keywords

Blood stream infections, central venous catheters, dressing techniques

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Background

Preventing central venous catheter blood stream infections (CVC BSIs) is an important patient safety issue and a number of initiatives aimed at decreasing CVC BSIs have been implemented at an international, national and local level. The Department of Health (DOH) Saving Lives Campaign focused on CVC insertion and ongoing care to reduce CVC-BSIs through the use of high impact interventions (DOH, 2007). Between 2009 and 2011 the National Patient Safety Agency (NPSA) led the 'Matching Michigan' patient safety initiative (Bion et al., 2013). This introduced technical and

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non-technical interventions which had previously been shown to reduce ICU CVC-BSIs (Pronovost et al., 2006). Since the Matching Michigan initiative, we have maintained a system to continuously monitor CVC BSIs in adult and paediatric critical care, allowing ongoing evaluation of our practice.

One unresolved issue identified locally and supported by audit data from 151 CVCs in a study in Birmingham (Shapey, 2009) is that of CVC dressing durability. Audit work in our Trust had shown that CVC dressings remained in place for an average of 2 days. Non-adherence seemed a particular problem when patients were febrile, had clammy skin, or when more than one CVC was used in the same insertion site.

Current national guidelines (Loveday et al., 2014) recommend that 'Transparent, semi-permeable polyurethane dressings should be changed every 7 days, or sooner, if they are no longer intact or if moisture collects under the dressing'. In our experience, it was rare for dressings to last 7 days and many were changed much more frequently. As skin organisms at the insertion site are frequently implicated in CVC BSIs (Mermell, 2011), decreasing bacterial colonisation at the insertion site by improving dressing adherence may decrease the risk of CVC BSIs.

At a local level CVC usage was high, each year approximately 2800–3000 CVCs were inserted within the five critical care units and operating departments. The local approach to CVC dressing use was very variable, with wide practice variation in both the type of dressing and method of application. We therefore set out to prospectively evaluate the durability of various commercially available dressings and the optimum dressing technique, including an evaluation of costs.

CVC dressing literature review

We searched the published literature for studies evaluating the optimum CVC dressing or application technique in critically ill patients and found few to guide practice. Vokurka et al. (2009) compared once-weekly versus twice-weekly dressing change on non-tunnelled CVCs in oncology patients. The once-weekly group achieved a mean duration of 5.4 days due to problems with soiled dressings or bleeding. Keene et al. (2009) tested CVC dressings and techniques on Hickman lines, including different types of semi-permeable dressings and various fixation techniques (described as loop-line, sandwich loop-line and a bridge technique). The study was undertaken in a laboratory setting with dressings applied to a hairless part of an arm and weights added until the dressing peeled off. The greatest skin adherence was with a combination of a semi-permeable dressing (Tegaderm®) and a non-woven polyester adhesive fabric strip (Mefix®) using a bridge technique. We tried the bridge technique in clinical practice and modified it to a 'window' technique with four strips of a similar

adherent fabric strip (Hypafix®) applied like a window frame around the dressing.

Aims

To undertake an evaluation of the durability of CVC dressings and the associated costs. The specific objectives were to evaluate:

- Four different commercially available, sterile, transparent, semi-permeable polyurethane dressings against the 7-day standard (Loveday et al., 2014).
- A 'window' technique to improve durability of a CVC dressing.
- Costs of the various CVC dressings and techniques.

Methods

A small central strategy team was set up to direct and facilitate the evaluation. This strategy team consisted of a nursing project lead and a medical consultant in critical care. The proposal to undertake a CVC dressing durability evaluation was highlighted to the critical care units in the local healthcare organisation and five critical care units agreed to participate. This included one paediatric and four adult units, each unit identified one or two experienced project nurses to participate in the evaluation. This approach was to support local responsibility and ownership of the evaluation within their clinical area.

Data were collected prospectively using a pro forma which had been designed and tested to ensure it was simple, clear and unambiguous. The data collection form captured the following items:

1. Name of unit
2. Type of dressing
3. Date and time this dressing was applied
4. CVC insertion date
5. CVC insertion site (e.g. internal jugular, sub-clavian, femoral)
6. CVC type (e.g. 4-lumen CVC, Vas-Cath, pulmonary artery catheter sheath, other)
7. Date and time this dressing was removed
8. Reason for why this dressing removed: line removed; routine dressing change at 7 days; dressing no longer adhering to skin; clammy skin; bleeding under dressing; and other
9. Any general comments about the dressing or technique used

We undertook the CVC dressing evaluation in five critical care units (4 adult and 1 paediatric) between December 2012 and December 2013. Data were collected on dressings applied to CVCs while in critical care. We did not

Table 1. Phases of the continuous evaluation of CVC dressing durability.

Phase	Months	CVC dressing evaluated	Other securement techniques
One	1–4	Standard dressings: sterile, transparent, semi-permeable polyurethane dressings (Opsite IV 3000 and 3M Tegaderm®)	None
Two	5–8	3M Tegaderm® IV Advanced: sterile, transparent, semi-permeable polyurethane dressings	Dressing with an integrated border around the dressing. Separate Hyperfix® border applied to create a further secure 'window' around the edge of the dressing
Three	9–12	Sorbaview®: sterile, transparent, semi-permeable polyurethane dressings	Integrated two piece dressing, one part for the site with a wide border and second part with a wide supporting bridge

include dressings applied to CVCs inserted outside of the ICU, for example those inserted in theatre or the radiology department. As this evaluation was of routine clinical practice we evaluated the new dressings and techniques in three phases (Table 1).

Evaluation of time and costs associated with CVC dressings

In a subset of dressing changes in this study ($n = 20$), the project nurses from each critical care unit recorded the time it took for them to change a CVC dressing as part of their routine CVC care. Four steps in the procedure were timed: assembling the trolley; preparing self and patient; dressing change; and disposal of waste and equipment. The dressing and material costs were obtained from the hospital supplies department.

Staff training

As this evaluation took place within routine clinical practice it was important that the clinical team were trained in the various dressing techniques and shown how to accurately complete the data collection forms. Training was provided to the clinical teams at the beginning of each phase of the evaluation including unit-based and one-to-one teaching sessions, 'how to guide' posters, and discussion at critical care nursing meetings. The educational content included: current clinical evidence and guidelines for CVC dressings; dressing design (permeability, adhesiveness); dressing technique; and how and when to change a CVC dressing.

Analysis

The primary outcome measure was the average duration in hours that a CVC dressing remained in place, this included dressings which were removed because the CVC was removed. We also performed a secondary analysis excluding CVC dressings which had been changed because the

CVC was removed or because the dressing had been in place for 7 days, or 'other'. This sub group then included dressings which had been changed because of non-adherence, clammy skin or bleeding under dressing. We excluded from the analysis any pro forma returned without the type of dressing being recorded. As the distribution of the data for dressing duration was not normally distributed these data are presented as median (interquartile range). We compared median duration of CVC dressing using the Kruskal-Wallis test, a nonparametric alternative to the one-way analysis of variance. Descriptive statistics are used to present the results of the evaluation of time and costs.

Ethics

This service evaluation was primarily intended to improve local care, not provide generalizable knowledge in a field of inquiry, and as such did not require review by a research ethics committee. Confidentiality was maintained as no patient identifiable data was shared outwith the clinical team.

Findings

During the 12 month period, 1229 dressing changes were recorded from 590 CVCs. The numbers of CVCs and the numbers of CVC dressing changes observed for each unit are shown in Table 2. The durability of the three CVC dressings evaluated during the three phases of the study is shown in Table 3. Of the 1229 dressing changes 304 (24.7%) did not have the type of dressing recorded so were excluded from the analysis. One dressing (Sorbaview) had a median [IQR] duration of 68.5 [32–105] hours compared to 43.5, 46.0 and 40.5 hours for the other three dressings ($P < 0.001$). There was no significant difference in the median dressing duration between the other three dressings ($p = 0.74$).

The reasons for removal of the CVC dressings are shown in Figure 1. The most common reason for removal of the

Table 2. Numbers of CVCs and dressing changes by unit.

Unit number (type)	CVCs Observed, n	Dressing changes recorded, n (%)
1 (adult general)	191	387 (31%)
2 (adult cardiothoracic)	107	206 (17%)
3 (adult general)	88	183 (15%)
4 (adult general)	126	252 (21%)
5 (paediatric cardiothoracic)	78	201 (16%)
Total	590	1229

dressing was that the CVC was also being removed (34%). The second most common reason was non-adherence. Only 3% of CVC dressing removals was due to the dressing remaining intact for 7 days.

A secondary analysis identified 630 dressing changes for non-adherence, clammy skin or bleeding under dressing; of these 163 (25.8%) had no dressing type recorded and were excluded from the analysis. Findings were similar with one dressing (Sorbaview) having a longer durability than the other dressings, median [IQR] 53 [30-95] hours compared to 36.0, 45.5 and 32.0 hours for the other dressings ($P=0.002$).

CVC-BSI rates were monitored routinely during the 12 months before and the 12 months during the dressing evaluation project (Figure 2).

Associated time and costs

Twenty individual dressing changes were timed by nurses on the ICU. The mean (range) time taken for all dressings was 13.5 (10 to 19) minutes. The CVC dressing and material costs were calculated and varied from £1.97 to £4.97 (Table 4).

Figure 1. Reasons for dressing removal, all CVC (n=590).

Staff Feedback on CVC dressing preferences

Throughout the evaluation period the critical care project nurses collected feedback from ICU nurses on the practicalities of each CVC dressing. The consensus was that cutting separate borders of Hyperfix® for the “window” was not practical and too time consuming. Some reported that the “window” looked messy and they didn’t like this look when providing caring for their patients.

The Sorbaview® Integrated two piece dressing was viewed as easy to apply and was seen as a supportive dressing, adding strength with the weight of the CVC lumens on internal jugular insertion sites, as this was part of the CVC dressing which could drag the dressing off the skin.

Heightened awareness with the importance of CVC dressing durability was observed by the project nurses on their critical care units. Particular awareness was noted with the important aspect of saving nursing time with the number of CVC dressing changes, ensuring a cost effective use of CVC dressings and the importance of thorough on-going care with the CVC site.

Table 3. CVC dressing duration in the 4 dressing types.

Dressing Type	Dressings removed for any reason, n=1229			Dressings removed for non-adherence, clammy skin, or bleeding under dressing n=630		
	Number of dressings observed	Dressing duration (hrs) median [IQR]	z value*	Number of dressings observed	Dressing duration (hrs) median [IQR]	z value**
Opsite IV 3000	310	43.5 [21–78]	−1.79	160	36.0 [15–67.5]	−1.21
Tegaderm	237	46.0 [22–85]	−0.33	122	45.5 [22–73.8]	1.17
IV Advanced	262	40.5 [20–85]	−1.12	143	32.0 [14–69.5]	−1.98
Sorbaview	116	68.5 [32–105]	4.51	42	53.0 [30–95]	3.39
Unrecorded	304			163		

IQR, inter quartile range; * $P < 0.001$ and ** $P = 0.002$ for at least one difference between dressings.

Table 4. CVC Dressing and Material Costs.

	Opsite IV 3000	Tegaderm	IV Advanced with Hypafix window	Sorbaview
Sterile dressing pack including sterile gloves, clinell wipes, apron and non-sterile gloves	£0.53	£0.53	£0.53	£0.53
CVC Dressing	£1.44	£1.67	£1.48	£4.44
Total costs	£1.97	£2.20	£2.01	£4.97

Figure 2. CVC BSI Surveillance across all five critical care units.

Discussion

This evaluation found that few CVC dressings remained adherent to 7 days. One dressing (Sorbaview®) appeared to be significantly more durable, lasting on average a day longer than the other dressings. The “window” technique was not popular with nursing staff who preferred the two-piece CVC dressings. The Sorbaview dressing tended to perform better compared to other dressings. We identified the costs associated with a CVC dressing change and found that the CVC dressing was the most expensive part, with some variation in costs between dressings.

Our findings are in keeping with those of (Shapey, 2009) who found that CVC dressings were not kept intact on 158 of 1000 catheter days. These findings are also in line with the study by Timsit et al (2012) who found CVC dressings

became detached in 64% to 72% of cases. Taken together it would appear that CVC dressing adherence in an unresolved issue worthy of further development.

Despite poor dressing adherence and frequent need for dressing changes the rates of CVC BSIs observed during the study period were low. Although the rates of CVC BSIs were falling in the months prior to the study period, this project may have contributed to the on-going fall in infection rates. The education and awareness programme regarding CVC dressing care which ran alongside this evaluation emphasised to staff the importance of meticulous care of the CVC insertion site with early identification and replacement of a displaced dressing. This would be in keeping with previous studies which have shown that staff education, used in conjunction with audit and feedback, are an effective way of reducing CVC-BSIs (Loveday et al, 2014).

The act of monitoring CVC dressing duration may also have influenced practice (Hawthorne effect) and improved the overall standard of CVC care.

This project evaluated prospective data from a continuous period of 12 months including a large numbers of CVC dressings from four adult ICUs and a paediatric ICU meaning the findings should be generalizable to other units. Despite these strengths, some limitations require acknowledgement. Firstly the CVC dressings were allocated in phases of four months rather than randomly and nurses were still able to use standard dressings throughout all three phases; raising the possibility of allocation bias. Secondly, the data collection was patchy at times and required regular motivation of staff to continue data collection. Lastly, the reason why dressings were removed required a judgement by the nurse and some variability between nurses is likely.

Conclusions

In conclusion, our evaluation found that the commercially available CVC dressings performed similarly with few dressings remaining adherent for 7 days. One dressing (Sorbaview) appeared to last longer than the other dressings but was still below the recommended standard and at increased cost. Staff tended to prefer the two-piece design over other dressings. Despite frequent dressing changes low rates of CVC BSI infection were possible in this context, reinforcing the importance of meticulous care of the CVC insertion site through staff education and awareness-raising.

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