

Audit of factors associated with the intactness of central venous catheter exit site dressings for northern Australian haemodialysis patients

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Abstract

Background

For people receiving haemodialysis (HD) via a central venous catheter (CVC), a secure dressing is essential to protect the exit site from infection and to stabilise the catheter. A literature review identified the lack of evidence to support the use of any one dressing type in a tropical setting. Renal nurses rely on clinical experience to select the dressing most suitable for the humid conditions in which renal out-patients often live and work.

Aim

To determine the percentage of opaque dressings currently used for CVC exit sites that remained intact between dialysis episodes, and to explore whether altered dressing integrity is associated with specific demographic or clinical characteristics.

Method

A prospective, observational design was used to audit the CVC exit sites of 34 patients at each dialysis presentation over a four-week period. Information about intactness of dressings in relationship to position and type of catheter and assessment of exit sites was collected. Demographics included age, home town and ethnicity.

Results

Of 273 presentations, 107 (39.2%) did not have a fully intact dressing. Non-intact dressings were associated with: position of catheter; presence of sutures; having a wet dressing; and permanent residence greater than 150 kilometres from the dialysis centre. During the four-week audit, five patients developed significant new exit site infections.

Conclusion

The high number of non-intact dressings indicates that further review of clinical practices and dressings used in the tropics is warranted. These findings have informed the design for a randomised controlled trial to compare dressing types.

Keywords

Central venous catheters, haemodialysis access, nursing, wound care, infection, renal.

Introduction

Central venous catheters (CVC) remain a frequent means for haemodialysis (HD) access despite current best practice being early referral for formation of arteriovenous fistula or insertion of peritoneal dialysis catheter (Polkinghorne, 2009). If CVCs must be used, it is important to identify an appropriate dressing that provides a barrier from infection while protecting the exit site from trauma and the line from dislodgment (Bennett *et al.*, 2005; Callahan & Wesorick, 1987). Nurses in a large regional renal service located in the Australian tropics perceived that dressings frequently lifted off between dialysis episodes, potentially exposing the patient to both local and systemic infection.

Background and literature review

Nurses in a busy regional renal service were aware that their protocols for dressing CVC exit sites using an opaque dressing did not comply with health department guidelines that recommended a transparent dressing be used to facilitate observation of CVC exit sites (CHRISP [Centre for Healthcare Related Infection Surveillance and Prevention], 2007).

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At that time there were no specific HD CVC exit site dressing guidelines. Several initiatives were undertaken to determine whether a change of practice was warranted. A literature review was conducted to ascertain CVC dressings appropriate for use in the tropics (McArdle & Gardner, 2009). This review of the literature confirmed that there was no consensus about whether transparent or opaque dressings should be used and identified that there was limited evidence to guide the selection of the most appropriate dressing for use in hot and humid climates. Further research was required to determine the most effective dressing type. While the literature review was being finalised, an audit of current practice was undertaken to determine the actual level of intactness of opaque dressings between dialysis episodes. It was becoming clear from the literature review that there was little evidence to support either transparent or opaque dressing selection and so a randomised controlled trial was needed. However, further information would be needed before embarking on such a trial. Firstly, the current level of security of dressings needed to be calculated and the perception that the dressings did not stay on needed to be verified. We also recognised that the link between non-intact dressings and the development of local or systemic infection would need to be empirically measured. An audit was planned to provide some of this information.

Dressings over CVC exit sites perform several functions. A dressing is required to keep the CVC line secure and to prevent possible mechanical damage that may be associated with the catheter displacement whilst avoiding pain and reducing the risk of infection. The literature about this topic has been well covered both in the Australian and international literature and so will not be described in detail (McArdle & Gardner, 2009; McCann & Moore, 2010; Mermel *et al.*, 2009).

At the time of the audit, the dressing used in the service was an adhesive non-woven opaque dressing (Primapore™) hereafter referred to as the dressing. This paper presents the results of an audit that determined the percentage of CVC exit site dressings remaining intact between dialysis episodes and explored whether altered intactness was associated with specific demographic or clinical characteristics. The incidence of significant catheter-related microbial infections was also calculated for the audit month.

Method

Population and sample

At the time of the audit the renal unit totalled 25 dialysis chairs, used over two sessions a day and six days a week. This allowed an average capacity of 100 booked patients each two days: totalling approximately 300 sessions a week as well as emergency dialysis. During a four-week period from 24 November until 20 December 2008, 36 patients received HD via either a temporary or semi-permanent central vascular access. Two patients received only one session each and were excluded. The remaining 34 patients comprised the sample for the audit.

Design and tools

A prospective, observational audit design was used and two forms were developed to assist in the collection of relevant information. Location of home-town, age, gender, ethnicity, work and hobbies were recorded on a patient demographic form that was completed only once. Limited history was also recorded on this form and included: date the patient began dialysis; whether the patient was taking immunosuppressive medication; and if the patient was diabetic.

The second form was used to record data from each presentation for dialysis after the dressing was completed. One week of information was recorded per sheet,

usually comprising three dialysis episodes. The weekly audit tool was divided into three components.

Section 1 covered patient clinical assessment and catheter details on the day of dialysis. This included type of catheter: tunnelled (yes/no); catheter position (right or left jugular, right or left subclavian, and right or left femoral); and sutures present (yes/no). Patient clinical parameters collected included: whether a person was an in-patient (yes/no); pain at exit site (scale from 0 to 10); body temperature; and blood sugar level. Serum albumin level was recorded weekly.

Section 2 referred to the state of the dressing. The intactness of the CVC exit site dressing on the day of dialysis episode was recorded as; fully intact; one side/corner off; two sides/corners off; three sides/corners off; or no dressing present; if dressing was wet (yes/no); and if the patient had replaced the dressing between dialysis episodes (yes/no).

Section 3 allowed for documentation of exit site assessment. A modified Twardowski scale was used to standardise colour and scab/crust as an assessment of healed, healthy exit site, or whether trauma or infection was present at the exit site. The Twardowski chart was adapted from the Peritoneal Dialysis Catheter Site Classification Guide (Baxter Healthcare Corporation, 1997; Twardowski & Prowant, 1996). This scale allowed for consensus on colour change, especially within different patient skin tones. It is widely used in peritoneal dialysis as a standardised protocol for classifying the colour, scab, crust or discharge present around Tenckhoff exit sites for early detection and treatment of exit infection, although there are no published validation studies of its performance as an assessment tool for either peritoneal dialysis or central venous access sites. It has also been recommended for trial in CVC exit site assessment (Harwood *et al.*, 2008) but

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we could find no published evidence of this use. Here the Twardowski scale classification chart was used to classify colour as either 'A' perfect, 'B' good, 'C' equivocal could be infected depending on discharge, or 'D' infected. Crust and scab with or without discharge was classified as either 'A' good, 'B' equivocal, 'C' acute infection, or 'D' chronic infection. A footnote was added to the audit sheet with the definition of crust and scab as defined in the original Twardowski scale. An area for recording active bleeding or other complication such as 'cuff visible' was available. Colour charts were printed and laminated for use by nursing staff.

Limited pathology results were recorded for the audit. The nursing staff indicated on the audit tool if an exit site swab or blood culture was taken for investigation of microbial infection. There was no specific guide for when to swab the exit site; this was left to the clinical decision-making of the patient's primary nurse. Pathology results were recorded for all cultures obtained at the end of the four-week period as well as any treatment ordered, such as antibiotics or relocation of central line.

For the purposes of the audit, the definition of new exit site infection was where there was culture-positive wound swab with recognised pathogens such as *Staphylococcus aureus* (Auricht *et al.*, 2001). Several patients had existing infections when the audit commenced. All were being treated with antibiotics and some were still culture-positive during the audit. These existing infections were not included in the audit.

Prior to commencement of the audit, copies of the draft audit tools were reviewed by staff. Opportunity to ask questions and make suggestions about the chart, other tools and information was provided. Minor changes were made based on this feedback.

Education sessions for all nursing staff were conducted by two senior clinical nurses during the week prior to commencement of the audit and were repeated at handover each day during the first week of the audit. Information included how and when to complete the audit and explanation about the use of the Twardowski scale. This ensured consistency and accuracy of the data collection. Throughout the four weeks senior staff involved with the collation of the audit were available to assist with completion of forms.

Audit process and data management

Data were collected over a four-week period with the information recorded on the audit tool each HD presentation. The CVC exit site dressing was changed every dialysis presentation; either two or three times per week depending on the patient's dialysis regimen. Audit sheets were collected at the end of each week and all data were entered into a purpose-designed database in SPSS (Statistical Package for the Social Sciences, version 15).

Statistical analysis

Statistical analysis first involved dichotomising the dependent variable on the intactness of the patient's CVC dressing into either "fully intact" or "has one or more side/edges off or rolled up". Other variables were also dichotomised, including: body temperature into normal or elevated ($>37^{\circ}\text{C}$); blood sugar level into normal or elevated ($>8\text{ mmol/L}$); serum albumin level (recorded for the first dialysis in each week so measured in patient weeks) into normal or low ($<33\text{ g/L}$); the distance of the patient's home town from the renal unit into less than or greater than 150 kilometres away (150 kilometres was chosen as the practical distance limit for patients to commute for dialysis); pain at exit site into "no pain" or "at least some pain"; colour classification into 'A' and 'B' versus 'C' and 'D'; and

crust and scab classification into 'A' versus 'B' versus 'C' and 'D'. The level of patient activity was summarised as high activity or not with "yes" to home duties, volunteer work, paid employment or active hobbies being categorised as "high activity". "Low activity" was recorded if all were categorised as "no". The bivariate relationships between the dependent variable (intactness of dressing) and independent variables for each episode such as clinical characteristics of the CVC exit site and observations of the CVC exit site were assessed by means of chi-squared tests, t-tests and non-parametric Wilcoxon tests, as appropriate. Statistical significance was set at less than 0.05. Not all patients had the same number of dialysis sessions and so cross tabulation of episode-level data with patient level characteristics was only conducted where distribution was proportionate.

Results

Demographic characteristics

Thirty-four HD patients attending the study sites within the period 24 November 2008 to 20 December 2008 and receiving HD using central venous access (rather than arteriovenous fistulae) participated in the study. The median age of patients was 63.5 years, ranging between 19 and 89 years old. Fifty-three per cent of patients were male and 44% described themselves as of Aboriginal or Torres Strait Islander (ATSI) descent. At the commencement of the audit, the median period of time that patients had received HD was six months with a range of one to 97 months. Demographic characteristics of the sample are presented in Table 1.

The majority of patients stated Townsville (primary location of the regional service) as their home town ($n=19$). Other stated home towns ranged from Mount Isa (approximately 900 km west) to Mackay (nearly 390 km south) and included Palm Island (65 km north-west by sea).

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This geographical distribution reflects the wide catchment of the Townsville-based renal service. For 10 of the patients, their stated home town was more than 150 km from Townsville. These patients were unable to commute to Townsville for HD and most were housed long-term away from their original homes in hostel or other shared accommodation in Townsville. There was a high percentage of people of ATSI origin in the group of relocated patients: half (seven of 14, 50%) compared with 17% (three of 18) of non-ATSI peoples and this difference was statistically significant ($\chi^2 4.07, p=0.044$). The stated home town was not recorded for two patients.

Clinical characteristics including infection

Most patients dialysed using tunnelled catheters as their vascular access ($n=25$, 73.5%). Four patients (11.8%) were taking immunosuppressing drugs and 23 patients (67.6%) were diagnosed as diabetic.

A total of 21 swabs for microscopic culture and sensitivity were taken during the audit period, with five new infections confirmed by positive laboratory results. All infections arose in patients who had tunnelled catheters. The infections comprised one *Enterobacter cloacae* infection, two methicillin-sensitive *S. aureus* (MSSA) infections and two methicillin-resistant *S. aureus* (MRSA) infections. Infections were treated with vancomycin or gentamycin. One infection arose in week 2, two in week 3 and two in week 4 of the audit.

During the audit period, median attendance per week for HD was 2.7 episodes and data were recorded for 273 episodes. The remaining results relate to characteristics of each HD episode, referred to as dialysis episodes.

Descriptive analysis of dialysis episodes

In 87% of the 273 recorded dialysis episodes the patient was an out-patient.

Serum albumin level was recorded for the first dialysis in each week of the audit and for 56% of patient weeks this was low (less than 33 g/L). Elevated temperature only occurred in 4% of episodes ($>37.1^\circ\text{C}$) and in 61% of recorded episodes the patient had an elevated serum blood sugar level (>8 mmol/L prior to commencing dialysis). In 17% of dialysis episodes, patients reported experiencing some pain at the CVC exit site.

Overall, the most common catheter position used was the right subclavian (used in 45% of dialysis episodes), followed by right jugular (30%), right femoral (10%), left femoral (8%) and left subclavian (7%). A tunnelled catheter was used in 86% of dialysis episodes and sutures were present in 24% of dialysis episodes.

In 57% ($n=155$) of the 273 dialysis episodes the dressing was fully intact when the patient presented for dialysis, in 24% of episodes ($n=65$) one side or

Table 1. Demographic and clinical characteristics of sample ($n=34$).

Characteristic	Tunnelled catheter = 25 n (%)	Non-tunnelled catheter = 9 n (%)	Row total = 34 n (%)
Sex:			
Male	12 (66.7)	6 (33.3)	18 (52.9)
Female	13 (81.3)	3 (18.8)	16 (47.1)
Indigenous status:			
Aboriginal	6 (100)	0 (0)	6 (17.6)
Torres Strait Islander	3 (33.3)	6 (66.7)	9 (26.5)
Neither	16 (84.2)	3 (15.8)	19 (55.9)
High activity			
Yes	11 (84.6)	2 (15.4)	13 (38.2)
No	14 (66.7)	7 (33.3)	21 (61.8)
Distance from home town ($n=32$):			
Less than 150 km	18 (81.8)	4 (18.2)	22 (68.8)
150 km or more	7 (70.0)	3 (30.0)	10 (31.2)
Diabetic status			
Yes	10 (90.9)	1 (8.1)	11 (32.4)
No	15 (65.2)	8 (34.8)	23 (67.6)
Infection during audit			
Yes	5 (20)	0 (0)	5 (14.7)
No	20 (69.0)	9 (31.0)	29 (85.3)
Receiving immunosuppressive			
Yes	3 (75.0)	1 (25.0)	4 (11.8)
No	22 (73.3)	8 (26.7)	30 (88.2)

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edge was off, in 7% of episodes (n=19) two sides or corners were off, in 6% of episodes (n=17) three sides or corners were off, and in 6% of episodes (n=17) the dressing was completely absent.

In 58% of the 273 episodes the crust and scab around the CVC exit site was observed to be an 'A' classification using the Twardowski scale, and in 89% of recorded episodes the colour of the exit site was observed to be either an 'A' or 'B' classification. In 10% of recorded episodes, the dressing appeared wet and in 8% of episodes there was active bleeding around the exit site.

Factors associated with dressing with at least one edge off

Having a CVC exit dressing with at least one edge/side off or rolled up was significantly associated with a femoral catheter being used ($p=0.008$), a subclavian catheter not being used ($p=0.007$), a non-tunnelled catheter being used ($p=0.003$), sutures being present ($p=0.002$), the dressing appearing wet ($p=0.015$), the exit site being classified as having a 'B', 'C' or 'D' crust and scab classification ($p<0.001$), and the exit site being classified as having a 'C' or 'D' colour classification ($p=0.039$). A list of all the factors associated with dressing intactness is shown in Table 2.

Having the CVC exit dressing with at least one edge/side off or rolled up was also significantly associated with the patient being of ATSI descent ($p<0.001$). There was also a non-significant trend of the patient's original home town being a distance of 150 kilometres or more from the renal unit ($p=0.053$) suggesting that those who were living in a hostel or other shared accommodation were more likely to have a non-intact dressing when presenting for dialysis.

There was no identified relationship between infection and intactness of dressing. Two of the five infections were diagnosed from swabs taken

Table 2. Association of intactness of CVC exit site dressing with clinical characteristics of exit site each dialysis episode.

Characteristic	CVC dressing fully intact at presentation for dialysis (n=155; 57% of episodes)	CVC dressing had at least one side/edge off or rolled up (n=118; 43% of episodes)	Chi-squared test (p-value)
Patient characteristic			
Out-patient on day of dialysis treatment (271)	136 (88%)	99 (85%)	0.78 (0.375)
High activity Yes	60 (38.7)	56 (47.5)	2.10 (0.147)
Clinical characteristics of catheter exit site			
Type of catheter used			
<i>Femoral catheter</i>	19 (12%)	29 (25%)	7.02 (0.008)
<i>Subclavian catheter</i>	91 (59%)	50 (42%)	7.16 (0.007)
Non-tunnelled catheter (270)	13 (9%)	25 (21%)	8.77 (0.003)
Patient experiencing at least some pain at exit site (269)	21 (14%)	25 (21%)	2.66 (0.103)
Observation of the catheter exit site			
Sutures were present (269)	26 (17%)	39 (33%)	9.50 (0.002)
Dressing appeared wet (267)	10 (7%)	18 (16%)	5.96 (0.015)
Colour classification 'C' or 'D' (259)	12 (8%)	18 (16%)	4.27 (0.039)
Crust and scab classification 'B', 'C' or 'D' (233)	42 (32%)	56 (56%)	13.97 (<0.001)
Active bleeding present around exit site (249)	10 (7%)	10 (9%)	0.49 (0.483)

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when dressings were intact. Having a laboratory-confirmed microbial infection was associated with a 'C' or 'D' colour classification of the CVC site ($n=5$, Fishers exact $p < 0.001$). There were no other statistically significant relationships with new infection.

Discussion

The present study is the first prospective audit of the intactness of CVC dressings on primary HD out-patients in the tropics. The finding of 43% of CVC dressings not being fully intact at the next dialysis episode was alarming, given that the purpose of the dressing was to protect the exit site from infection and to stabilise the catheter. We could find no other similar audits for comparison, either in Australia or overseas.

Several factors were associated with a non-intact dressing. Whilst it is not possible to say that these factors were causally related, it is useful to consider possible explanations for these associations. ATSI status was associated with a non-intact dressing. A non-intact dressing also almost reached statistical significance when associated with patients whose home town was greater than 150 km from the nearest dialysis centre. These two characteristics, Indigenous status and distance from the dialysis centre are highly correlated as many patients who identified as being of ATSI descent stated that their home town was more than 150 km from the dialysis centre. These patients had to leave their communities and were housed in Townsville in hostel-like accommodation with shared facilities and often without air-conditioning.

The association between femoral access and loss of dressing intactness is not surprising. The significant loss of dressing can be attributed to the position and mobility of the groin as well as the difficulty of placement of the dressing due to hair growth. The risk is also recognised through guidelines

which suggest patients with femoral access should remain as in-patients until other access is established (CHRISP [Centre for Healthcare Related Infection Surveillance and Prevention], 2009a). This requirement needs to be balanced with other considerations such as promoting self-care skills and independence in anticipation of home therapies. This demonstrates the importance of early referral for establishment of permanent access whether arteriovenous fistula or Tenckhoff catheter.

We are unsure what factor influenced non-intactness of dressing in association with non-tunnelled catheters. Non-tunnelled catheters were either femoral or internal jugular sites. In addition to the discussion above about the risks of femoral placement, it may be that the placement of the catheter in the internal jugular vein meant the catheter was running up the side of the neck and finishing in the hair line, which made dressing the exit site difficult and potentially pulling on the hair, making it uncomfortable for the patient. Since the completion of the audit, devices for securement of the CVC are now being used more commonly. This may reduce problems with movement of non-tunnelled catheters in particular.

Sutures at the exit site were present in 32% of non-intact dressings. The implication of this is unclear but a reasonable assumption may be that discomfort and itchiness as the exit site healed may have caused the patient to scratch and move the dressing.

Following product information for the dressing of choice (Primapore™), adhesive, non-woven wound dressings should be kept dry to provide a secure dressing fixation. By changing the dressing environment, for example, by showering or otherwise wetting the dressing, the adhesiveness of the dressing is compromised. Currently patients do not receive specific education about care of the exit site and dressing

management. Development of a set of simple guidelines might improve the outcome for the dressing and more importantly the wound (CHRISP [Centre for Healthcare Related Infection Surveillance and Prevention], 2009b; McCann & Moore, 2010). Given the high percentage of patients whose first language is not English and whose literacy levels are unknown, culturally appropriate materials would need to be developed.

Early indication of trauma or infection is often a change in colour of the skin surrounding a wound. When attempting to discern if a non-intact dressing influences any clinical outcomes for the patient, we decided to see if any variance in the appearance of the exit site was associated with dressing intactness. Using parts of the Twardowski scale for classification of peritoneal catheter exit sites allowed staff to consistently record appearance of erythema and other early indications of infection. This audit demonstrated that the modified Twardowski scale is very suitable for reliably recording appearance of CVC exits sites. The scale is now being used in a larger pilot study to examine the relationship between several dressing types and intactness between dialysis episodes.

The overall prevalence of exit site infection for the four-week audit period was 14.7%, giving a rate of 4.76 exit site infections per 1000 catheter days. This rate compares favourably with other reported rates as summarised in the systematic review by McCann and Moore (2010).

The present study had several limitations. In particular, there was anecdotal evidence that some staff were categorising a CVC dressing as fully intact, when it was not. This would have the effect of over-reporting intactness of dressings, making the real rate even lower than calculated. The audit also highlighted the need for better

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documentation of risk factors for and early signs of infection in our unit. The problematic quality of documentation has also been highlighted in other renal units (Lau *et al.*, 2010).

The chart audit identified that a number of patients were receiving antibiotic treatment without documented evidence of microbial infection from the pathology department. In this high-risk group, infection is often treated on clinical evidence only; thus there may have been more patients who had an infection than this audit would indicate. The length of time the CVC had been in place may have been associated with the pain and other local symptoms but it was not possible to accurately track this at the time of the audit.

Recommendations

Several recommendations were developed as a result of the audit. These were that:

- There is sufficient justification for a study to find the most suitable dressing for CVC exit sites in tropical regions, given the high level of detachment of dressings highlighted. A randomised controlled trial design would allow more sophisticated statistical analysis and identification of characteristics associated with dressing loss.
- Consideration is given to the development of education material for patients regarding care of exit sites between dialysis episodes.
- There is a need for increased recognition of risk factors and documentation of early signs of infection by staff.

Conclusion

In summary, this audit explored those factors that may be associated with the intactness of CVC exit site dressings

between HD episodes and described the incidence of significant catheter-related microbial infections in a population of 34 patients receiving HD. The audit confirmed the relatively high level of non-intactness of CVC dressings between episodes of HD and supported the need for further research. The audit also provided information to inform a randomised controlled trial comparing the effectiveness of selected dressing types for use on CVC exit sites in patients receiving HD and this trial is now under way. The audit also confirmed the efficacy of the Twardowski scale, previously used for peritoneal dialysis exit site observations, for documentation of erythema and crusting at CVC exit sites and provided other audit tools that could be easily adapted for use in a clinical trial.

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