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Sterile v aseptic non-touch technique for needle-less connector care on central venous access devices in a bone marrow transplant population: A comparative study.

Keywords
Bone marrow transplant, bloodstream infection, central venous access device, catheter related bloodstream infection, aseptic non-touch technique, needleless connector.

Introduction

Central venous access devices (CVAD) are routinely used for haematology patients undergoing a bone marrow transplant (BMT) for the infusion of blood products, immunosuppression, lipids, antibiotics and various other medications (Green, 2008). The intravenous administration sets (IVAS) are prepared and connected using an aseptic non-touch technique (ANTT); however, in many hospitals, including the setting for this study, the needleless connector (NC) is changed using a sterile technique. Each time the NC or IVAS are replaced there is a risk of microbial contamination from the healthcare workers' hands or the patients' skin (Ingram & Murdoch, 2009; Scales, 2011). However, the degree to which connectors and connector care may contribute to catheter related bloodstream infection (CRBSI) has not been quantified. Nonetheless, decreasing the risk of microbial contamination of CVADs and attachments can reduce the risk of CRBSI and improved patient outcomes.

In view of the limited evidence in this domain, it seemed practical to assess the impact this change in practice actually had on the rate of reported blood cultures in this population.

Background

Tunnelled catheters, such as the Hickman catheter, are the most common device used for intravenous infusion in the BMT population. They are tunnelled under the skin and inserted into the superior vena cava sitting just above the entry into the heart (Wolf et al., 2008). The skin is a vital protective barrier but also a potential source of pathogens for CRBSI. BMT recipients are particularly vulnerable to infection due to the effect of neutropenia caused by their treatment (Green, 2008; Ingram & Murdoch, 2009) and are therefore at increased risk of morbidity and mortality from bacteraemia and fungaemia, including infections acquired through the use of the CVAD (Crump & Collignon, 2000).

The two most common causes of CRBSI are: the colonisation of the outer surface of the catheter from bacteria originating from the skin during insertion; and colonisation of the inner surface of the catheter through contamination of the hub, usually from poor ANTT practices by healthcare workers (Crump & Collignon, 2000; O'Grady et al., 2002). Typically, the focus of reducing CRBSI was on the insertion; however, care and maintenance of these devices has been acknowledged as a credible source of CRBSI. There are multiple factors that have been associated with CRBSI due to post insertion care; however, this study focused on the procedure of changing the needleless connector on the hub of a CVAD following a policy change from an ANTT to a sterile technique.

A literature reiew was undertaken, however no studies were located comparing a sterile versus ANTT when changing the needleless connector on the hub of a CVAD. The criteria was changed to exclude needleless connectors and revealed two studies comparing the sterile versus ANTT for changing intravenous fluid lines on CVADs. The first study by Maas et al (1998), a pre-test (control) post-test (experimental), was conducted in a neonatal intensive care unit with 182 participants (n=26 pre-test, n=156 post-test), and historical data for the pre-test phase. The primary outcome was CRBSI. Maas et al (1998) concluded that a sterile technique could contribute to lowering CRBSI. The second study was a randomised control trial by Larwood et al (2000), in an adult intensive care unit and medical ward, which included 79 participants (n=39 sterile group (control), n=40 ANTT group (experimental)). The

primary outcome was CRBSI and CVAD tip colonisation. Larwood et al (2000) recommended the use of ANTT as it did not increase CRBSI.

The key theme of the two studies was to minimise CRBSI however, whilst comparing similar techniques, sterile versus ANTT, they came to differing conclusions, which contributes to confusion over which method is most suitable. Methodological issues such as small sample sizes, and partial retrospective design with unequal time periods for the pre/post analysis may introduce bias. No other research has been published in this domain since these trials were conducted, yet many of the problems posed within these studies remain relevant today. Both studies were informative to local practice at the time, but are of limited use in current practice, nor do they address the issue of hub and NC decontamination and related risks. This review has highlighted the limited research available to demonstrate any benefit of a sterile versus an ANTT approach to needleless connector and consequent IVAS changes. Therefore, the aim of this study was to retrospectively examine a change in practice that may have been enacted without a clear evidence based rationale.

Method

Aim

The aim of this study was to determine whether a change in practice from an ANTT to a sterile technique when changing NC on a CVAD was associated with any change in CRBSI rates in the BMT population.

Research design

A two-group comparative study design without concurrent controls using a retrospective cohort was used (NHMRC, 2009). A chart review was conducted to examine patient characteristics and pathology results, to determine CRBSI rates in BMT recipients. The primary outcome was the rate of CRBSI, and secondary outcomes were laboratory confirmed bloodstream infection (LCBI) and mucosal barrier injury laboratory confirmed bloodstream infection (MBI-LCBI). The two techniques, sterile and ANTT, are outlined in Table 1. The key differences highlighted pertain to the type of gloves used and the creation of a sterile field.

Table 1: Aseptic Non-Touch Technique (ANTT) & sterile technique procedure

The definitions used for CRBSI, LCBI and MBI-LCBI have been taken form the CDC/National Healthcare Safety Network (CDC, 2014a; O'Grady & Healthcare Infection Control Practices Advisory Committee, 2011) as the MBI-LCBI directly relates to the population being studied (Table 2).

Table 2: Modified CDC/NHSN Bloodstream infection Surveillance Definition (CDC, 2014a)

Sample

The study was conducted at a large metropolitan teaching hospital in Australia. A list of BMT patients for the time period of September 2009 and October 2010 was requested and supplied by the BMT coordinator. Eligible patients were identified and included in the study upon meeting the inclusion criteria: 1) have a haematological malignancy, 2) have a Hickman catheter inserted for a BMT procedure, 3) age 18 or greater. Historical data was collected from September 2009 to March 2010 for the ANTT group, and from May 2010 to October 2010 for the sterile technique group. Data was not analysed in April 2010 during the practice transition period.

Procedure

A data extraction tool (Appendix 2) was developed based on key variables identified in the literature on CRBSI and CVADs, and was tested in the target population for face validity and practicality of use, requiring only minor modifications. A research nurse extracted the data, which was then cleaned and double entry of 10% of the data was performed. The research nurse was not blinded to the study aims; however pathology outcomes were reported independently. The data extraction tool was used to collect demographic, clinical and pathology-related data. Paper based medical records and electronic pathology results were reviewed and recorded in the data extraction tool. Once the patient had received the BMT, BC were collected at the first episode of a fever $\geq 38°C$. Peripheral and CVAD BC were collected, where possible, allowing for a diagnosis of CRBSI using differential time to positivity. Blood culture collection once the patient has commenced on intravenous antibiotics can interfere with bacterial growth (CDC, 2014b; Dellinger, 2008). Hence,

subsequent BCs were not analysed, as BMT patients are routinely commenced on broad spectrum intravenous antibiotics following the first BC collection, with targeted antibiotics commenced if the BC returns a positive result for a specific microorganism. For patients discharged with the CVAD insitu, the date of discharge was the census date for data collection.

Diagnosis of CRBSI, LCBI and MBI-LCBI were determined by the research nurse according to the CDC definitions (Table 2) and the independent laboratory blood culture reports. Results were then rechecked twice by the research nurse to confirm original diagnosis. If the strict criteria of CRBSI or MBI-LCBI were not met, a diagnosis of LCBI was then made.

Prior to commencement, ethical approval was sought and approved from the Royal Brisbane and Women's Hospital (HREC/12/QRBW/405) & Griffith University (NRS/43/12/HREC) Brisbane.

Data analysis

Data was analysed using Predictive Analytics Software version 19.0 (Statistical Package for the Social Sciences **(**SPSS) Inc, Chicago). Descriptive statistics were used to describe demographics and key variables. Non-parametric analysis was performed. Pearson's chi-square was used for measuring association between groups, with Fisher's Exact Test used when cell count in 2x2 table was low. Odds ratios were used to evaluate risk exposure between groups. Kaplan-Meier survival curves were used to compare rates of time until first CRBSI per patient between groups.

Results

One hundred and sixty seven BMT were performed within the time period studied; 11 of these were conducted during the change of practice month of April 2010, and six patients had incomplete data, leaving 150 eligible for inclusion. No significant difference was observed in the key demographics between groups, with distribution of gender, BMT type, level of neutropenia and positive BC similar (Table 3).

Table 3: Participant demographics per group

To determine the rate of CRBSI, all positive BC results were assessed using the CDC criteria described previously. No significant difference was found in either the confirmed CRBSI rate (ANTT n=3 (4%), Sterile n=1 (2.7%), *p*=0.357 Fishers Exact Test, Odds Ratio 3.257 (95% CI 0.331 – 32.047) or suspected CRBSI rate (ANTT 17 (23%) vs Sterile 19 (25%), *p*=0.842) between groups. No significant difference was observed in the secondary variables of LCBI, MBI-LCBI between groups. When reported per 1000 catheter days the difference observed between groups was ANTT 1.2/1000 vs Sterile 0.46/1000; which was not statistically significant. The differences observed between groups for the other variables (LCBI and MBI-LCBI) were smaller and also non-significant. See Table 4 for details. Infection by skin contaminants were identified in a similar number of cases across both groups (ANTT n=9 (12.3%) vs Sterile n=6 (7.8%), *p*=0.355). A breakdown of the common skin contaminants found is provided in Table 5.

Figure 1: Kaplan-Meier analysis of survival from CRBSI per catheter days

A log rank test was performed to determine if there were differences in the survival between groups per catheter days. The survival distributions for the two groups were statistically significantly different, $\chi^2(1) = 16.987$, $p = 0.00$ (Figure 1), however beyond day 150 the cumulative survival is similar for both the ANTT and Sterile groups.

Table 4: Catheter Related Bloodstream Infection rates per group and per catheter days

Table 5: Number of episodes of common skin contaminants identified overall

Given the rate of skin contaminants and CVAD removal across groups and collectively, further investigation of these variables across the entire cohort was conducted. Ten percent (n=15/150) of the overall cohort had a positive BC due to a

skin contaminant, with nine (20%, n=9/46) in the ANTT group, and six (16%, n=6/38) in the sterile group, 36% (n=54/150) due to LCBI, and 7.3% (n=11/150) due to MBI-LCBI. Forty-five percent (n=68/150) of overall CVADs were removed during the relevant admission, with the most common reason for CVAD removal being suspected CRBSI (52%, 36/69). Of the 36 CVADs removed for suspected CRBSI, 10% (4/36) of the catheter tips were found to have a positive blood culture.

Discussion

The aim of this study was to evaluate the impact an ANTT versus a sterile technique had on CRBSI rates when performing the NC change. The comparative group analysis demonstrated no associated increase in CRBSI rates in the ANTT method compared to the sterile technique. Regardless of which technique was used, infection from skin contaminants was similar across groups and represented 10% of the root cause of pathogens across the entire cohort. This implied poor hand hygiene and connector care generally, and poor understanding of the principles of ANTT. Furthermore, 17% of CVADs with suspected CRBSI were potentially removed unnecessarily as they ultimately did not meet the CDC definition of a CRBSI. This means that already vulnerable patients experienced interruptions to therapy and risks associated with replacement catheter insertion. A majority of the patients studied had a neutropenic level of ≤ 0.5, leaving them at high risk of infection. Consequently, high standards of CVAD insertion, care and maintenance, and sound clinician understanding of asepsis, good ANTT and appropriate CRBSI definitions are paramount to good practice in this field.

Scrub the hub

This study set out to determine if a change in practice from an ANTT to a sterile technique would decrease CRBSI. However the study also showed a high proportion of known skin contaminants identified in each group (Table 5) which could not be overlooked. Nine (20%, n=9/46) skin contaminants were identified in the ANTT group, and six (16%, n=6/38) in the sterile group, with 10% (n=15/150) overall. Sixteen percent is high even after the sterile technique had been implemented, highlighting poor practices, possibly due to inadequate hub cleaning/decontamination prior to accessing the CVAD system, or potential contamination of IVAS when preparing equipment. A recently published study noted

that none of the participants adhered to the organisational recommendations of a 30 second drying time for hub decontamination, with a mean drying time of only 6 seconds in one group and 12 seconds in the other group (Keogh, et al., 2014). This also highlights poor techniques when accessing the intravenous device system.

"Scrub the hub" has become the mantra highlighting the importance of decontaminating the hub or NC prior to accessing the CVAD. There is still some confusion as to the amount of time needed for the scrub, with some studies showing the time required for decontamination to be from 10 to 30 seconds using friction and 70% isopropyl alcohol swab (Lockman, Heitmiller, Ascenzi, & Berkowitz, 2011; Simmons, Bryson, & Porter, 2011; Zack, 2008). An innovative technology using a continuous passive disinfection method provided by a cap, using either 70% isopropyl alcohol or chlorhexidine with 70% isopropyl alcohol, is proving to be very effective in reducing bacterial contamination (Menyhay & Maki, 2006, 2008) and CRBSI (Sweet, Cumpston, Briggs, Craig, & Hamadani, 2012; Wright et al., 2013). These NC and hub protectors are screwed into place and provide the decontamination process as the cap is twisted into position. The cap remains in place until the hub or NC is required to be accessed, providing continual protection from contamination. The cap is for single use only, with a new cap applied on completion of CVAD access (Sweet, Cumpston, Briggs, Craig, & Hamadani, 2012; Wright et al., 2013). While these results are helpful, further research is required in this area.

Many of the current guidelines recommend decontamination of the NC and hub prior to accessing the system. The Centre for Disease Control and Prevention (CDC) guidelines (O'Grady & Healthcare Infection Control Practices Advisory Committee, 2011), suggest disinfection with a chlorhexidine/alcohol preparation, but do not mention a specific time for this procedure, except to say that using a 70% alcohol solution for 3 to 5 seconds is not adequate. Epic3 guidelines recommend disinfecting for a minimum of 15 seconds with chlorhexidine gluconate in 70% isopropyl alcohol, then allowing it to dry prior to accessing the system (Loveday et al., 2014). Queensland Health I-Care Guideline for Tunnelled Central Venous Catheters states that all intravenous access ports should be meticulously cleaned with a single use 70% alcohol impregnated swab and allowed to dry, but does not detail a time frame for this procedure (Queensland Government, 2013). Since each guideline has

differing recommendations, it is confusing for clinicians as to which method will produce the best outcomes for patients.

Central venous access device removal, a difficult issue

Despite the overall CRBSI rate being low (2%, n=4/150), a significant number of CVADs were removed (ANTT n=28/73, Sterile n=41/77). Current definitions of management indicate that it may have been possible for some of these Hickman catheters to be retained (Mermel et al., 2009), as the removal of these devices has attendant risks, especially when the patient is pancytopenic (having reduced red cells, white cells and platelets), increasing the risk of infection or bleeding (Coyle, McMullan, Morris, Rooney, & Hedderwick, 2004). Once the device is removed, another central catheter, usually a peripherally inserted central catheter, will need to be placed. These devices are smaller in size/gauge, have only two lumens (in this study) and are more prone to occlusion (Skaff, Doucette, McDiarmid, Huebsch, & Sabloff, 2012), which causes interruptions to treatment, especially for the allogeneic BMT recipient, who routinely requires a triple lumen Hickman catheter for the multiple medications and treatments required.

In this study, 61 patients returned a positive BC, with 36 Hickman catheters removed for suspected CRBSI. There were 14 ICU admissions, of which 12 patients had their catheter removed for suspected CRBSI, leaving 24 patients with Hickman catheters having a positive BC managed effectively with IV antibiotic therapy in a ward environment. Although retaining these devices without harming patients would be the optimal outcome, in the absence of no other known cause of infection the CVAD becomes suspect, often leaving no alternative but to remove the device, especially when the patient is in septic shock (Dellinger et al., 2008; Mermel et al., 2009; O'Grady et al., 2002). Severe sepsis and septic shock has a mortality rate ranging from 10-53% (Angus et al., 2001; Regazzoni, Irrazabal, Luna, & Poderoso, 2004; Vandijck et al., 2008), therefore delaying until a diagnosis is laboratory confirmed may contribute to morbidity. The question of whether to retain the CVAD remains unclear and is beyond the scope of the study; however, previous studies have indicated that between 50-82% (Flynn, Shenep, Stokes, & Barrett, 1987; Kim et al., 2003; Simon & Suttorp, 1994) of Hickman catheters could be retained. On the other hand, another study suggested that if the patient is not pancytopenic, haematology

patients would be better served by removal of the device, on the grounds that therapy failure and increased morbidity may occur if the device is not removed (Coyle et al., 2004).

Implications for Practice and Research

The findings of this study have implications for CVAD care and maintenance practice. Healthcare practitioners have a responsibility to their patients to deliver the best possible care available, with hand hygiene and NC care being two simple and effective methods for contributing to the process. Regardless of the method used, sterile or ANTT, LCBI remained high, with skin contaminants at 10% overall in this study. Healthcare practitioners need to be educated on the potential consequences of poor hand hygiene and connector care so that they appreciate why these methods have been incorporated into practice.

CVAD education for healthcare practitioners needs to include post-insertion care, which includes NC care, hand hygiene prior to accessing the CVAD system, inspection of the site, dressing changes, and the use of an ANTT. Each individual step is significant in CVAD care, however when grouped together as a 'bundle' may have a greater capacity to effect CRBSI rates, as the care bundle could become the best way to engage clinicians in the 'holistic management' of a patient with a CVAD device (Royer, 2010). Good quality research clarifying best practice related hub and connector care is urgently required.

Limitations

No causal effect can be deduced for this small comparative study. In addition the study was conducted on a single site, limiting the generalizability of the results. Nonetheless, the results of this study add to the limited body of knowledge within this area, and most importantly inform the protocol development for future RCTs to test the impact of these two techniques on clinical and organisational outcomes.

Summary

It is likely that CRBSI will always occur in the BMT population due to prolonged neutropenia, and with the addition of a CVAD, the patient's risk of infection increases further, due to the frequency with which healthcare workers access the

connected system. Given the mortality rate from severe sepsis and septic shock ranges from 10-53%, it is vital to minimise the risk of CVAD and related attachment contamination.

No firm conclusions can be drawn from this small study, however results did suggest that an ANTT was not associated with increased CRBSI. Regardless of which technique was used, infection from skin contaminants was similar; potentially as a result of poor hand hygiene and connector care. Particular emphasis needs to be given to connector decontamination, including NC replacement, and IVAS and medication preparation. Rigorous research clarifying best practice related to hub and connector care is urgently required. Following this, the introduction of an evidence based CVAD maintenance bundle, continued education on the real risks posed by suboptimal practice, and support and monitoring of practice is warranted whenever CVADs are used in patient care.

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Manuscript Tables and Figures

Table 1: aseptic Non-Touch Technique (ANTT) & sterile technique procedure

ANTT	**Sterile technique**
Equipment (for *one* lumen):	**Equipment (for *one* lumen):**
Non-sterile gloves*	**Sterile gloves**
Plastic apron	**Sterile dressing pack**
2 x 10ml luer lock syringes	Plastic apron
2 x 10ml ampoules 0.9% sodium chloride	2 x 10ml luer lock syringes
3 x 70% alcohol impregnated swabs	2 x 10ml ampoules 0.9% sodium chloride
1 x needleless connector	3 x 70% alcohol impregnated swabs
	1 x needleless connector
Disposable tray	**Dressing trolley (disinfected prior to use)**
Procedure:	**Procedure:**
Hand hygiene, don apron	Hand hygiene, don apron
Prepare equipment	**Set up sterile field, prepare equipment**
Hand hygiene, don **non-sterile** gloves	Hand hygiene, **don sterile gloves**
Remove connector, clean hub	Place **sterile field** under CVAD
Attach new connector, clean new connector	**Using gauze square hold lumen with non-dominant hand**
Flush with 20 mls 0.9% sodium chloride	Remove connector, clean hub
Clamp CVAD	Attach new connector, clean new connector
Disconnect syringe	Flush with 20 mls 0.9% sodium chloride
	Clamp CVAD
	Disconnect syringe

*Bold items highlight main differences between groups. CVAD: central venous access device.

Table 2: Modified CDC/NHSN Bloodstream infection Surveillance Definition (CDC, 2014a)

CRBSI definition:

Criteria 1: same organism grown from at least one percutaneous blood culture and from the catheter tip (CDC, 2014a), OR

Criteria 2: two blood cultures taken, one from the CVAD hub and one from a peripheral vein, with the CVAD culture positivity >2 hours versus the peripheral culture (CDC, 2014a).

LCBI definition:

LCBI 1: Patient has a recognised pathogen cultured from one or more blood cultures AND the organism cultured is not related to an infection in another area of the body (CDC, 2014a), OR

LCBI 2: Patient has at least one of the following signs or symptoms – fever, chills or hypotension, AND a positive cultured organism that is not related to an infection in another area of the body, AND the same common contaminant is cultured from two or more blood cultures drawn on separate occasions (CDC, 2014a).

MBI-LCBI definition:

MBI-LCBI 1: Patient of any age meets criterion 1 for LCBI with at least one blood culture growing any of the following intestinal organisms with no other organisms isolated: *Bacteroides spp., Candida spp., Clostridium spp., Enterococcus spp., Fusobacterium spp ., Peptostreptococcus spp., Prevotella spp., Veillonella spp., or Enterobacteriaceae (CDC, 2014a)* OR

MBI-LCBI 2: Patient of any age meets criterion 2 for LCBI when the blood cultures are growing only viridans group streptococci with no other organisms isolated (CDC, 2014a).

MBI-LCBI 1 & 2 also needs to meet one of the following:

- Is an a allogeneic hematopoietic stem cell transplant recipient within the past year with one of the following documented during same hospitalisation as positive blood culture:
    - Grade III or IV gastrointestinal graft versus host disease
    - ≥1 litre diarrhoea in a 24 hour period (CDC, 2014a)
- Is neutropenic, with absolute neutrophil count or total white blood cell count <500 cells/mm (CDC, 2014a).

CVAD: central venous access, CRBSI: catheter related bloodstream infection, LCBI: laboratory confirmed bloodstream infection, MBI-LCBI: mucosal barrier injury LCBI.

Table 3: Participant demographic and clinical information

		ANTT n=73	Sterile n=77	*p* value*
Gender:	**Male**	43 (59%)	52 (67.5%)	
	Female	30 (41%)	25 (32.5%)	
Age (years):		54 (48-61)[#]	54 (42-62) [#]	
BMT type:	**Autologous**	35 (48%)	36 (47%)	
	Allogeneic	38 (52%)	41 (53%)	
Neutropenia (≤ 0.5) at time of first BC		49 (67%)	51 (66%)	0.232
Febrile at time of first BC		60 (82%)	64 (85%)	0.474
Positive BC identified		32 (44%)	29 (36%)	0.695
CVAD removed		27 (37%)	41 (53%)	0.092

BMT: bone marrow transplant, BC: blood culture, CVAD: central venous access device. *Pearson Chi Square. [#]Median (25%-75% interquartile range).

Table 4: Bloodstream infection rates per group, including rate per catheter days

	ANTT n=73	Sterile n=77	*p* value
Infection rate per group			
CRBSI[&]	**3 (4%)**	**1 (2.7%)**	**0.357**[$]
LCBI[&]	30 (41.1%)	24 (31.2%)	0.206[%]
MBI-LCBI[&]	4 (5.5%)	7 (9.1%)	0.396[%]
Skin contaminants[#&]	9 (12.3%)	6 (7.8%)	0.355[%]
Total catheter days per group:	2501	2182	
Infection rate per 1000 catheter days			
CRBSI[&]	**1.2/1000***	**0.46/1000***	
LCBI[&]	11.99/1000*	10.99/1000*	
MBI-LCBI[&]	1.59/1000*	3.21/1000*	
Why removed			
Suspected CRBSI	**17** (23%)	**19** (25%)	0.842[%]

[#]Only one blood culture positive for a known skin contaminant e.g. Staphylococcus epidermis, CRBSI: catheter related bloodstream infection, LCBI: laboratory confirmed bloodstream infection, MBI-LCBI: mucosal barrier injury LCBI. * Bloodstream infection rate per 1000 catheter days. [&]Each positive blood culture has been allocated to one bloodstream infection group only; e.g. a skin contaminant cannot also be included as a LCBI and vice versa. [$]Fishers Exact Test. [%]Pearson's Chi Square.

Table 5: Number of episodes of common skin contaminants identified overall

Organism		**ANTT**	**Sterile**
Staphylococcus epidermis	4	2	
Staphylococcus haemolyticus	3	1	
Micrococcus luteus	1	1	
Micrococcus sp.	1		
Staphylococcus hominis		1	
Propioni bacterium		1	
Totals	**9**	**6**	

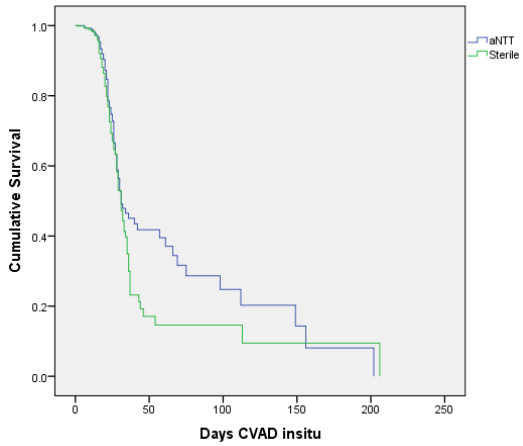

Figure 1: Kaplan-Meier analysis of survival from CRBSI per catheter days

Appendix 1: Data extraction tool

Was this device removed during current admission	Yes □ No □ If yes, date of removal: ___/___/20___
Was the central line tip sent for culture?	Yes □ No □ If yes, attach results to this form.
Where any organisms detected?	Yes □ No □ If Yes, attach results to form.
Why was the line removed?	Suspected blood stream infection □ Fractured □ Painful □ Blocked □ Accidental removal □ Completed therapy □ Deceased □
Did the patient have more than one device during their bone marrow transplant admission?	Yes □ No □ If Yes: Date of insertion/removal: ___/___/20___ Why removed: If blood cultures collected, organisms cultured: _____ _____
Has patient had previous central line infection prior to this admission	Yes □ No □ If yes, collect AusCare/AusLab data and attach to this form
Has the same organism been cultured in another site in the body?	Yes □ No □ If yes, list locations: _____
Patient admitted to ICU this admission?	Yes □ No □ If Yes: Days spent in ICU: _____
Is patient alive?	Yes □ No □ If no, Date deceased : ___/___/_____ Death in current admission: Yes □ No □
Was cause of death from a catheter related blood stream infection	Yes □ No □ Unsure □

Type of Bone Marrow Transplant:	Allo □ Auto □
Immunosuppression used:	CSA □ Tacro □ MTX □ MMF □ Steroids □
WCC less than 1.0 on date of admission?	Yes □ No □
WCC less than 1.0 when blood cultures collected?	Yes □ No □
Type of Hickman device inserted this admission: Date of insertion:	Double Lumen □ Triple lumen □ ___/___/20___
Any other device insitu?	PIVC □ POC □ IDC □ Other □ _____
Where blood cultures collected while central line insitu?	Yes □ No □
Why was the blood culture collected?	Patient febrile □ Routine (i.e. patient on steroids) □ Painful red entry site □ Other □ _____
Was patient already on IVABs?	Yes □ No □ If Yes, Why _____
Where any blood cultures positive? If yes, collected from:	Yes □ No □ Peripheral □ Central □ Time between CVAD and peripheral blood cultures: _____
Was the same organism cultured in another part of the body? (*Collect any positive blood, wound, or urine cultures from Aus Care/AusLab and attach to this form*)	Yes □ No □
Catheter related blood stream infection definition	Peripheral culture positive □ Central line culture positive □ Other site excluded □ If all three correct, most likely cause CRBSI