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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

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ABSTRACT

Purpose: The aim of this study was to determine whether a variation in practice from an aseptic non-touch technique (ANTT) to a sterile technique when changing needleless connectors on central venous access devices (CVAD) was associated with any change in catheter related bloodstream infection (CRBSI) rates in the bone marrow transplant (BMT) population.
Methods: A two group comparative study without concurrent controls using a retrospective cohort was conducted in a large metropolitan hospital in Brisbane, Australia. Inclusion criteria: haematological malignancy, Hickman catheter inserted, age ≥18. A tool was developed to extract historical data from medical records and pathology results. Primary outcome: CRBSI. Secondary outcomes: laboratory confirmed bloodstream infection, mucosal barrier injury laboratory confirmed bloodstream infection and skin contaminants.
Results: One hundred and fifty patients were assessed, 73/150 (49%) in the ANTT group. Demographics: males 95/150 (63%), with 71/150 (47%) receiving an autologous BMT. No difference in CRBSI rates between groups was observed (ANTT n = 3 (4%) vs Sterile n = 1 (2.7%), p = 0.357 Fishers Exact Test). 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%)).
Conclusions: No causal effect can be deduced from this small study; nevertheless results imply that an ANTT was not associated with increased CRBSI. Poor hand hygiene and ANTT were perceived across both groups. Quality and consistent ANTT is a safe method for managing intravascular devices, however education and awareness of pathogen transfer from healthcare worker and patient to their device is required.

1. 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 and 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.

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2. Background

Tunnelled catheters, such as the Hickman catheter, are the most common devices 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 and 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 and 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 and 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 review 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.

3. Method

3.1. 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.

3.2. Research design

A two-group comparative study design without concurrent controls using a retrospective cohort was used (NHMRC, 2010). 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) mucosal barrier injury laboratory confirmed bloodstream infection (MBI-LCBI) and the presence of common skin contaminants. 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.

The definitions used for CRBSI, LCBI and MBI-LCBI have been taken from the CDC/National Healthcare Safety Network (CDC, 2015; O'Grady & Healthcare Infection Control Practices Advisory Committee, 2011) as the MBI-LCBI directly relates to the population being studied (Table 2). CRBSI and LCBI have existed in various forms for some time, however the MBI-LCBI is a relative newcomer, and was introduced to further categorise LCBIs that were thought to relate to a decreased immune system with an injured mucosa and therefore not related to the insertion or maintenance practice of central lines (CDC, 2013). As BMT recipients experience prolonged periods of neutropenia and mucositis, this definition seemed relevant. The MBI-LCBI is only useful in this specific population, and need not be reported, however it allows reporters of bloodstream infection a greater insight into the potential causes of LCBI (CDC, 2013). The additionally category of skin contaminants was also included. When a common skin contaminant such as Bacillus spp., Propionibacterium spp., coagulase-negative staphylococci (including Staphylococcus epidermidis), and Micrococcus spp. is identified in a blood culture it is only considered to be a LCBI if two or more cultures taken return the same organism (CDC, 2015), therefore if only one bacteria such as Staphylococcus epidermis, is returned from any BC taken, it can be considered a contaminant.

3.3. 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 change transition period.

3.4. Procedure

A data extraction tool (Appendix 1) was developed based on key variables identified in the literature on CRBSI and CVADs, and was tested in 5% of 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