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Research Article

Efficacy of Central Line Bundle Compliance on Central Line Associated Blood Stream Infections (CLABSI) among Neonatal Patients of An Intensive Care Unit

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Abstract

Background and Aim: Nosocomial infections pose an important threat to patient safety and recovery. The present study aimed to evaluate the effect of central line bundle compliance on central line associated blood stream infections in neonatal intensive care units.

Methods: The six components of bundle compliance were Hand hygiene, adherence to aseptic techniques including sterile gloves, gown, surgical cap and mask, preparing skin with 2% Chlorhexidine in 70% alcohol, optimal catheter site selection (Internal jugular or subclavian vein), standardized tubing change and daily review of catheter necessity. Compliance of CL bundle and CLABSIs were measured in the neonatal ICU from January 2019 to December 2019.

Results: A total of 2 CLABSI were reported of the patients who completed CL bundles. The major causes of central line infection included contamination, suboptimal environment of care, improper documentation and evaluation of central venous catheter dressing integrity, issues with equipment and suppliers and lack of knowledge.

Conclusion: This study provides evidence that CL bundle compliance is essential in preventing CLABSI in intensive care units. This could largely avoid neonatal deaths associated with infections.

Keywords: *Central Venous Catheters; Catheter-Related Infections; Intensive Avoid; Neonatal; Central Line Bundle*

Introduction

Hospital acquired or nosocomial infection is that infection acquired because of interaction with a hospital setting or a health care facility, that was not present at the time of admission. They usually surface 48 hours after admission to a health care facility [1]. The most commonly acquired hospital infections include central line associated blood stream infections (CLABSI), urinary tract infections associated with catheters, surgical site infections, pneumonia and Clostridium associated infections [1].

Infection occurs when a susceptible patient comes in contact with a pathogen as a result of invasive procedures, surgeries and indwelling prosthetic devices. The etiology could be bacterial, viral or fungal [2].

Healthcare associated infections are the most common adverse events reported from a healthcare setting that compromise patient safety. They cause morbidity, mortality, multi drug resistance, long term hospitalization as well as significant financial burden on patients, their families and health care systems [3,4].

A study had shown earlier that risk of Nosocomial infection acquisition was high among Intensive care unit patients and neonate nurseries [5]. The burden of healthcare associated infection was also found to be higher in developing countries. A systematic review and meta analysis by Allegranzi B., *et al*. (2011) observed a prevalence of 15.5% in developing countries most of which were neonatal infections in intensive care settings or pneumonia [6].

CLABSI occurs in the setting of a central venous line. It is the most preventable type of nosocomial infection [2] but ironically, is associated with high morbidity and deaths worldwide [7]. This has thus drawn attention of medical practitioners and researchers alike while making efforts to improve patient safety.

CLABSI occurs when bacteria on the skin grow rapidly along the catheter's external surface towards the intravascular part. Other ways of occurrence of CLABSI include contamination of the CVC during insertion or manipulation process or by hematogenous seeding. Bacteria and fungal pathogens responsible for CLABSI involve in biofilm production, which increases adherence on external devices [8]. The most common pathogens causing CLABSI in hospital settings include *S. aureus* (23%), *Candida* species (13%), coagulase-negative *Staphylococcus* (12%), *Enterococcus* species (12%), *Streptococcus* species (12%), *E. coli* (8%) and *Bacteroides* species (6%). Among these pathogens, antimicrobial resistance is a serious problem [9].

It was Provonost., *et al*. (2006) [10] who first showed that conformance to "bundle", a set of practices associated with central venous catheter placement in an intensive care unit could reduce the rate of hospital acquired infections and deaths in adults. This was later researched in children as well [11-13] and the results obtained were observed to be in concurrence with the above-mentioned study.

Newborns in the neonatal intensive care unit are premature with weak immune systems, and so are highly susceptible to acquire pathogens and develop infections from a health care facility. It is thus imperative to take into consideration guidelines and strict protocols to prevent development of nosocomial infections in the population.

Aim of the Study

The aim of this study was to evaluate the effect of CL bundle compliance on CLABSI rates in an NICU. In addition, we also aimed to identify the probable causes behind CLABSI incidences in the neonates.

Methods

Study population and setting: The study was carried out in a neonatal Intensive care unit, which was 20 bedded. Data were collected over a period of 1 year from January 2019 to December 2019 from patients who underwent CVC insertions. Only neonates were included in the present study.

The CLABSI prevention bundle:

It is a collection of care bundles and comprises of the following components:

a) Hand hygiene.

b) Adherence to aseptic techniques including sterile gloves, gown, surgical cap and mask.

c) Preparing skin with 2% Chlorhexidine in 70% alcohol.

d) Optimal catheter site selection peripheral vein, internal jugular or subclavian vein).

e) Standardized tubing change.

f) Daily review of catheter necessity.

Component 1: Hand hygiene

A training on the maintenance of hand hygiene throughout the process was given to all health care workers associated with the neonatal ICU by an expert. There were five moments of hand hygiene involved in bundle compliance: 1. Before touching a patient 2. Before aseptic procedures 3. After body fluid exposure 4. After touching a patient 5. After touching patient surroundings.

Component 2: Adherence to aseptic techniques

The operator should adhere to strict aseptic techniques and use only sterile gloves, gown, mask and head cap.

Component 3: Preparation of skin

Prepare skin with 2% chlorhexidine in 70% alcohol using swabs and a friction scrub for 30 seconds. Allow the area to dry completely before skin puncture. If the area is moist, the preparation should be done for 2 min.

Component 4: Optimal catheter site selection

The subclavian and internal jugular are preferred sites as they reduce the risk of CLABSI in patients. Sterile single use jelly should be utilized during insertion.

Component 5: Standardized tubing change

Intravenous medication administration tubing should be changed according to local organization policies.

Component 6: Daily review of catheter necessity

Daily review of central lines should be conducted to decide if the lines are actually necessary or not. Unnecessary lines have to be removed.

Intervention

The study consisted of a multidisciplinary team of physicians, nurses, infection control practitioners and QI professionals. The whole team was involved in comprehensive review of cases to identify CLABSI and reduce infection rates in the neonatal ICU.

Step 1: An audit checklist was prepared and tested. It consisted of insertion and maintenance components and data was collected daily. Weekly compliance was also calculated by a special task force.

Step 2: Training was conducted on hand hygiene for all the staff working in the NICU. Compliance with hand hygiene practices was ensured through observers. Patient rooms were equipped with soap or alcohol based hand washes and sterile gloves to serve as a reminder for the NICU staff.

Step 3: Well prepared bundle kits were provided to front line health workers to ensure easy flow of work. All the necessary consumable items were given in a single pack.

Step 4: Proper use of personal protective equipments and chlorhexidine based skin antiseptics was reinforced at repeated intervals. A back and forth friction scrub was recommended for application of chlorhexidine accompanied by a recommended duration of 30 seconds. The area was advised to be allowed to dry for a minimum of 2 minutes.

Step 5: Training was provided to physicians regarding central line insertions through simulation techniques.

Step 6: Regular inspection was carried out to ensure bundle compliance and detect occurrence of infections.

The data of this research was collected through two different study designs. A prospective design was utilized to observe the occurrence of infections and a cross sectional design was employed to assess compliance to bundle instructions by hospital staff.

Data analysis: CLABSI rate was calculated as the number of CLABSI events per 1000 CL days. Bundle compliance rate was calculated as total number of compliant days divided by total number of those examined for compliance.

Results

Only two CLABSI cases were reported during the entire duration of the research. The major causes for central line infection were observed to be contamination, suboptimal environment of care, improper documentation and evaluation of central venous catheter dressing integrity, issues with equipment and suppliers and lack of knowledge.

Discussion

The World Health Organization has reported a CLABSI rate of 3.5 in high income countries and 12.2 in low and middle income countries [6]. This huge difference in infection rates necessitates that we understand central line associated infections and take steps to prevent them in future.

Though many studies were found to assess the rate of occurrence of CLABSI in adult ICU units [14-18], studies involving Neonatal ICU units have been meagre. Few studies have also shown that strict adherence to bundle protocol largely decreased infection incidence rate [19-21]. Neonates are highly vulnerable to developing infections from hospital settings [22-25]. This study thus aimed to assess the effectiveness of bundle compliance in reducing the incidence of infections in patients admitted to an NICU.

The overall CL bundle compliance was more than 95% in the current research. This clearly reflected in the number of patients developing infections which was a mere 2 in 1000 CL bundle compliant patients. This was in contrast to the study done by Ratna A., *et al*. (2016) [26] in Saudi Arabia as the overall compliance rate was less than 95% in the study.

The presence of other risk factors such as type of feeding and co morbidity was not included in the present study. The data is also associated with limited generalisability as it was conducted in only one centre. The follow up duration of the study was also small.

Conclusion

The overall CL bundle compliance was found to be well above the targeted rate and the reported infections were only 2 per 1000.

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