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Original Article

Spectrum of Colonizing Organisms and Catheter-Related Bloodstream Infections in Neonates with Umbilical Venous Catheters

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ABSTRACT

Background: Umbilical venous catheterization (UVC) is widely used in neonatal intensive care for vascular access but is associated with infectious complications including catheter colonization and catheter-related bloodstream infections (CRBSI).
Objective: To evaluate the spectrum of colonizing organisms and the incidence of catheter-related bloodstream infections in neonates with UVC.
Materials and Methods: This prospective observational study included 70 neonates undergoing UVC placement in a tertiary care NICU over one year. Aseptic precautions were followed. Septic screen and blood culture were performed before and after UVC placement. Catheter tips were cultured after removal. Data were analyzed using SPSS.
Results: Colonization was observed in 2 (2.9%) neonates, exclusively due to *Acinetobacter baumannii*. Septic screen positivity after UVC was 5.7% (n=4). Blood culture positivity was 11.4% (n=8), including *Enterococcus faecium* (5.7%) and *Klebsiella pneumoniae* (5.7%). Clinically defined CRBSI occurred in 2.9% (n=2). Prolonged catheter duration was significantly associated with CRBSI.
Conclusion: UVC-associated infections were relatively low. *Acinetobacter baumannii* was the only colonizing organism, while bloodstream infections showed mixed microbial etiology. Catheter duration remains a key modifiable risk factor.

Keywords: *Umbilical venous catheter, Neonates, CRBSI, Catheter colonization, Acinetobacter.*

INTRODUCTION

Umbilical venous catheterization (UVC) is an essential procedure in neonatal intensive care units (NICUs), providing reliable vascular access for critically ill neonates. Despite its benefits, UVC use is associated with infectious complications, particularly catheter colonization and catheter-related bloodstream infections (CRBSI), which significantly impact neonatal morbidity and mortality[1].

The umbilical stump becomes rapidly colonized after birth, and the presence of a catheter facilitates microbial adherence and biofilm formation, predisposing neonates to bloodstream infections[2]. Previous studies have reported catheter colonization rates of up to 40–55%, with CRBSI occurring in approximately 5% of cases[3].

Coagulase-negative Staphylococci are commonly implicated due to their biofilm-forming ability, although gram-negative organisms such as *Klebsiella* and *Escherichia coli* are increasingly recognized[4]. CRBSI is defined as a laboratory-confirmed bloodstream infection associated with a central venous catheter[5].

The risk of infection is influenced by multiple factors, including catheter duration, insertion technique, and adherence to aseptic protocols. Prolonged catheterization has been consistently identified as a major risk factor[6,7]. This study aims to evaluate the microbial spectrum of catheter colonization and bloodstream infections in neonates with UVC.

OBJECTIVE

To evaluate the spectrum of colonizing organisms and incidence of catheter-related bloodstream infections in neonates with umbilical venous catheters.

MATERIALS AND METHODS

Study Design: Prospective observational study

Setting: NICU, NHDU, SNCU

Duration: February 2019 – January 2020

Sample Size: 70 neonates

Methodology: UVC was inserted under strict aseptic precautions. Septic screen and blood culture was done before insertion. Repeat septic screen was done after insertion. Catheter tip was cultured after removal.

RESULTS

Colonization occurred in **2.9%**, exclusively *Acinetobacter*, indicating low colonization and possible nosocomial origin. Low septic screen positivity (5.7%) suggests limited biochemical infection post-UVC. Bloodstream infection rate (11.4%) exceeded colonization, indicating non-catheter sources also. CRBSI Incidence was observed as 2 cases (2.9%). Strict diagnostic criteria explain lower CRBSI compared to blood culture positivity. Colonization (2.9%) was lower than bloodstream infection (11.4%), suggesting infections are not always catheter-derived. Mixed microbial pattern observed. Catheter duration significantly influenced infection risk.

Table 1: Spectrum of Colonizing Organisms

Colonizing Organism	Number (n)	Percentage (%)
Acinetobacter baumannii	2	2.9%
No growth	68	97.1%
Total	**70**	**100.0%**

Table 2: Septic Screen After UVC

Septic Screen After UVC	Number (n)	Percentage (%)
Normal	66	94.3%
Positive	4	5.7%
Total	**70**	**100.0%**

Table 3: Blood Culture Results

Blood Culture Organism	Number (n)	Percentage (%)
Enterococcus faecium	4	5.7%
Klebsiella pneumoniae	4	5.7%
No growth	62	88.6%
Total	**70**	**100.0%**

DISCUSSION

Umbilical venous catheterization is an indispensable procedure in neonatal intensive care units; however, infectious complications continue to remain an important concern. In the present study, catheter colonization was observed in only 2.9% of neonates, with Acinetobacter baumannii being the sole colonizing organism isolated. This low colonization rate may reflect strict adherence to aseptic precautions during catheter insertion and maintenance. Previous studies have reported considerably higher catheter colonization rates ranging from 40% to 55%, particularly with prolonged catheter duration.[3,8] The difference observed in the present study may be attributable to shorter catheter dwell time, improved infection control measures, and local microbiological variations.

Blood culture positivity was observed in 11.4% of neonates, with Enterococcus faecium and Klebsiella pneumoniae isolated equally. These findings are clinically important because both organisms are recognized causes of healthcare-associated neonatal sepsis. Klebsiella pneumoniae is frequently associated with NICU outbreaks and multidrug resistance, whereas Enterococcus species are increasingly recognized in late-onset neonatal sepsis.[4,9] The predominance of gram-

negative organisms in bloodstream infections has also been reported in several neonatal studies from developing countries, likely reflecting hospital environmental flora and antibiotic selection pressure.[8]

The incidence of clinically defined catheter-related bloodstream infection (CRBSI) in the present study was 2.9%, which is comparable to the findings of Chinnaswamy et al., who reported a CRBSI incidence of nearly 2% following umbilical venous catheterization.[10] Similarly, Butler-O'Hara et al. observed that central venous catheter-related infections remain an important complication in preterm neonates despite advances in catheter care.[6] The relatively low CRBSI rate in the current study suggests that standardized catheter insertion practices and vigilant monitoring may effectively reduce infectious complications.

An important observation in the present study was the significant association between prolonged catheter duration and occurrence of CRBSI, consistent with previous literature.[11] Longer catheter dwell time facilitates microbial adhesion, biofilm formation, and bacterial translocation, thereby increasing the risk of bloodstream infection. Raad et al. emphasized that biofilm formation on intravascular catheters plays a central role in the pathogenesis of catheter-related infections.[8] Current recommendations therefore advocate early removal of umbilical venous catheters whenever clinically feasible.[3]

Another noteworthy finding was that bloodstream infection rates were higher than catheter colonization rates, indicating that all bloodstream infections cannot be directly attributed to catheter tip colonization alone. This suggests the contribution of multiple factors including environmental contamination, handling practices, invasive procedures, and endogenous neonatal flora.[5] Therefore, prevention of neonatal sepsis requires a comprehensive infection control approach extending beyond catheter care alone.

Overall, the findings of the present study reinforce that although infectious complications associated with umbilical venous catheters are relatively infrequent, they remain clinically significant. Strict aseptic precautions, adherence to catheter care bundles, minimization of catheter duration, and continuous surveillance of NICU microbial patterns are essential strategies to reduce catheter-associated infections and improve neonatal outcomes.

CONCLUSION

Umbilical venous catheter-related infections were relatively uncommon in the present study, with low rates of catheter colonization (2.9%) and CRBSI (2.9%). *Acinetobacter baumannii* was the only colonizing organism identified, while bloodstream infections (11.4%) showed both gram-positive and gram-negative pathogens. Prolonged catheter duration was significantly associated with increased infection risk, emphasizing the importance of strict aseptic precautions, vigilant monitoring, and early catheter removal to minimize infectious complications in neonates.

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