



BRIEF COMMUNICATION

# Association between thrombosis and bloodstream infection in neonates with peripherally inserted catheters

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## KEYWORDS

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## Abstract

**Introduction:** Peripherally inserted catheters are essential for infants in the neonatal intensive care nursery for administration of medications, parenteral nutrition and blood transfusions. We hypothesized that there is an association between catheter associated thrombosis and catheter associated blood stream infection. The primary objective of this study was to determine the association between catheter associated blood stream infection (CABSI) and catheter-related thrombosis in the Neonatal Intensive Care Unit.

**Materials and methods:** We performed a cohort study of the 1540 peripherally inserted catheters placed in 882 infants from August 2002 until November 2005 in the Duke University Medical Center Neonatal Intensive Care Unit.

**Results:** 212 peripherally inserted catheters were removed because of thrombosis. We identified 142 cases of CABSI. There was a positive association between thrombosis and infection in infants who did not have lines removed for infection,  $p < 0.05$ .

**Conclusions:** Further study is warranted to determine the pathophysiology between the association between thrombosis and infection and to determine if interventions may decrease the risk of these potentially life-threatening complications.

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**Abbreviations:** PICs, Peripherally inserted catheters; NICU, neonatal intensive care unit; TPN, total parenteral nutrition; VTE, Venous thromboembolism; CVCs, central venous catheters; CABSI, catheter associated thrombosis and catheter associated blood stream infection; DUMC, Duke University Medical Center.

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Peripherally inserted catheters (PICs) have been utilized in the neonatal intensive care unit (NICU) since the 1980's. They are essential for critically ill premature and full-term infants, and they are becoming part of the admission process for extremely low birth weight infants (infants <1000 grams birth weight). They provide a means to provide long-term access for antibiotics, blood products, intravenous fluids, and total parenteral nutrition (TPN). They also decrease the number of painful procedures to which infants are exposed [1]. However, PICs are associated with a number of significant complications including mechanical complications, infection, and thrombosis [2]. Venous thromboembolism (VTE) is a common complication of central venous catheters (CVCs) including PICs and catheter associated thrombosis is the most common type of VTE in children [3]. Neonates are at particularly high risk for catheter thrombosis due to the large bore of the catheter relative to the size of the blood vessel which leads to obstruction to blood flow and damage to the vein, physiologic differences in the neonatal hemostatic system and acquired prothrombotic risk factors such as dehydration and polycythemia. Neonates are also at risk for catheter associated blood stream infection (CABSI). Prior studies have suggested that lower birthweight, TPN administration, colonization with *Staphylococcus epidermidis* and duration of catheter increase the risk of infection [4].

There is some evidence that there is an association between catheter associated thrombosis and CABSI. This is likely a bidirectional relationship. The presence of catheter thrombus serves as a nidus of infection. For example, the plastic CVC surface promotes platelet activation and thrombus formation, and the thrombus and its ligands promote adherence of local bacteria [5]. Alternatively, an infection and the associated inflammation can trigger thrombus formation.

We sought to better define this relationship in infants as both infection and thrombosis can be life-threatening in this age group. If a relationship is determined, screening and prevention strategies can be implemented to reduce these catheter

**Table 2** Reasons for PIC removal

Reason for removal	N	%
No longer needed	549	38.5
Line malfunction	260	18.2
Thrombosis	212	14.9
Infection	61	4.3
Line broken or in wrong position	58	4
Death	45	3.2
Replaced	7	0.5
Other	18	1.3
Transferred with line	218	15.3

complications. This study was undertaken to determine the association between CABSI and catheter associated thrombosis and to describe the epidemiology of PICs in the NICU at Duke University Medical Center (DUMC).

## Materials and methods

We performed a retrospective cohort study of the 1540 PICs placed in 882 infants from August 2002 until November 2005 in the DUMC NICU. A CABSI was defined as a positive blood culture which was documented >24 h after PIC placement or within 72 h of catheter removal. Positive cultures were ignored if the same organism was cultured in the week prior to catheter insertion. Evidence of thrombus included cord, phlebitis, extremity edema, extremity perfusion, and inability to draw or flush the catheter as previously described [6]. A relevant thrombus was defined as a thrombus leading to PIC removal; this was recorded in a PIC log by nurses trained in the care of neonatal PICs under the supervision of a neonatologist. Additional data including reason for PIC removal were collected from an electronic medical record and PIC log in electronic and written formats. The DUMC Institutional Review Board approved this study.

All PICs were placed by using sterile technique by a member of the neonatal PIC team under sterile conditions using povidone-iodine, gowns, caps, masks, and sterile gloves. All PICs were 24 or 28 gauge single lumen catheters. Twenty-eight gauge PICs were never hepllocked. Infants received continuous infusions of intravenous fluids with 0.5–1 units of heparin /mL or TPN with 0.5–1 units of heparin/mL at a minimum rate of 0.5–1 cm<sup>3</sup>/h. Twenty-four gauge PICs that were hepllocked were flushed every 4 h with IVF containing 1 unit of heparin/mL.

Data were analyzed using STATA 9.0 (College Station, TX). Descriptive statistics were used to describe baseline characteristics. The association between thrombosis and CABSI was determined by logistic regression adjusting for PIC position and gestational age at insertion. If removal of the PIC prevented thrombus formation then the association between CABSI and thrombosis may be obscured. Therefore, the data were analyzed to compare rates of infection in infants whose PICs were removed for thrombosis versus infants whose PICs were removed for a reason other than presumed or documented infection. Rates of CABSI and thrombosis were calculated per 1000 PIC days.

## Results

We analyzed 1540 PIC insertions in 882 infants. Baseline characteristics are shown in Table 1. The majority of PICs were placed in the arm (N=572), foot (N=488) and hand (N=326). Other locations included leg, scalp, axilla, neck and groin veins.

**Table 1** Baseline characteristics of the study population

	Mean	Range
Gestational age at birth (weeks)	31.1±5	23–42
Gestational age at PIC insertion (weeks)	32.8±5.9	24–66
Gestational age at PIC removal (weeks)	34.4±5.9	24.7–66.4
Birth weight (grams)	1749±1033	484–6160
Weight at PIC Insertion (grams)	1623±1014	469–5815

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