

Challenges with Peripherally Inserted Central Catheter Migration in Neonates

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Abstract

The use of peripherally inserted central catheter in neonatal intensive care unit is a common practice, but it is associated with various complications. Catheter migration is the most common complication in neonates. The incidence of PICC migration in neonates ranges from 8% to 33%. The majority of the PICC migration is seen in first 3 days after PICC placement. Periodic imaging is strongly recommended to monitor the PICC tip position. X-Ray is still the standard method for evaluation of the PICC tip position, but supportive evidence of point of care ultrasound is increasing.

Keywords: Neonates; Complications; Migration

Introduction

The number of extremely low-birth-weight infants and the number of neonates requiring surgical procedures are increasing with continuing progress in clinical practices which enhances the importance of reliable lines to provide long-term parenteral nutrition to support their growth. Peripheral intravenous and umbilical catheters have a limited dwell time and increased risk of complications which limit their use. Surgically inserted central venous catheters have been successfully placed in neonates but are more costly when compared to other techniques. The use of Peripherally Inserted Catheters (PICC) is a safe and reliable technique for providing vascular access in neonates which was first described in 1973 by Shaw [1]. Although the use of PICC in the Neonatal Intensive Care Unit (NICU) is a common practice, it is associated with various complications including infection, thrombosis, dysrhythmias, pericardial effusion, pleural effusion, neurological complications and malposition of catheter [2-5]. Catheter migration is the most common complication in neonates [6]. Catheter migration occurs when the catheter tip location changes from a satisfactory documented post-insertion location to a different location after initial placement. According to the U.S. Food and Drug Administration (FDA), the tip of the PICC should reside in the superior vena cava for upper-body insertions and the thoracic inferior vena cava above the level of diaphragm for lower extremity insertions and recommended that 'the catheter tip should not be placed in or be allowed to migrate into the heart' [7,8]. The position for the superior vena cava has been described as the T3-T5 level, but varies depending on radiographic technique and infant anatomy. The lower one-half to one-third of the superior vena cava as the ideal top location for upper body insertions. Appropriate catheter tip placement in the inferior vena cava is between the right atrium and the diaphragm, described as T8-T10. Catheters whose tips reside outside the superior vena cava or inferior vena cava are associated with 3 to 8 times higher risk of a PICC-related complications [7-10].

The movement of PICCs within the body may occur spontaneously or as a result of extremity movement and position [11,12]. Consistent

patient positioning is very important to monitor PICC tip migration. Variations in the position of the extremity of the insertion site can lead to misinterpretation of the radiograph for catheter migration and subsequent unnecessary withdrawal or exchange of the catheter. The optimal patient position for radiographic monitoring is unclear. It has been recommended that radiographs should consistently be taken in a position tip location closest to right atrium to minimize the risk of the catheter moving further inward with patient movements [2]. Most research suggest that upper extremity adduction during placement confirmation radiographs results in PICC tips in the deepest central location, regardless of the specific vein cannulated [11-13].

Incidence and Timing

The incidence of PICC migration ranges from 8% to 33% in neonates [14-17]. There has been only one study that specifically investigated the timing of PICC migration in neonates. In this study, 83% of the migration was detected within 3 days after PICC placement [17]. Another study investigated the risk factors for PICC complications which reported 8.1% of line malposition overall with 4.1% occurring within the first 72 hours, and 4% after 72 hours [16]. Zaghoul et al. also has reported that PICC tip malposition rate decreases over time [18].

Risk Factors

Wen and colleagues reported that premature infants with birth weight >1500 gram were less likely to have PICC complication than infants with birth weight ≤ 1500 gram [19]. Pet and colleagues also reported that prematurity (gestational age at birth <37 weeks) was associated with an increased risk of malposition over time [16].

Some studies reported less migration in lower extremity PICCs than upper extremity PICCs in neonates [15,16,20].

In one study PICC migration was associated with difficulty advancing PICC at insertion and with dressing change [17].

Gnant colleagues reported that silicone PICCs move less than PICCs made of polyurethane in pediatric patients [21].

For neonates with prolonged PICC duration, growth can also effect catheter tip location, but it is challenging to assess the association between PICC migration and growth in neonates because the majority of PICCs are only needed for a short period of time, especially in premature infants.

Signs and Symptoms

Catheter migration may be asymptomatic. The symptoms of reported cases with PICC migration including; pain and irritability, erythema or edema, change in catheter function (difficulty flushing or withdrawing), change in visible measurable length of external catheter segment, symptoms specific to a particular complication (i.e., dysrhythmia, pericardial or pleural effusion) [22].

Monitoring

Radiographic monitoring and reconfirmation of the catheter tip location is invaluable in detecting migration and malposition of the catheter [17,23,24], but there is no uniform practice in the NICU for radiographic confirmation of the catheter tip location. X-Ray still is the standard method used for evaluation of the PICC tip position. Consistent positioning when X-rays are taken is very important, variations in the position can lead to misinterpretation for catheter migration. Several recent studies examining PICC tip location, performed in more than 400 neonates, demonstrated that concordance between X-ray and ultrasound was 59-94% [18,25-29]. Ultrasound has less turn-around time, no radiation exposure, also allows staff to immediately manipulate the line at the time of insertion to an appropriate position. One of the barriers to the widespread use of ultrasound is the highly operator-dependent nature of this technology. Catheter tips "within the liver", outside of the vena cava may cause diagnostic challenges [30], also hyper inflated lung, pneumothorax, and gaseous abdomens may obscure tip position location [26].

Prevention

Prevention of PICC migration is limited due to dynamic factors, such as tortuous course of vessels and movement of blood around PICC in the first couple of days after insertion. Every NICU needs to have PICC guidelines and monitor their complications closely. Current strategies that minimize the risk of migration include;

1. Maintaining the security of the catheter with intact dressing and secure device.
2. Verifying the catheter tip location upon insertion, 3rd day after PICC placement as most migration occurred within three days after insertion [17,22] and an ongoing basis.
3. Meticulous documentation of the external catheter length before and during dressing changes and obtaining imaging after dressing change if there is a change in measurement.
4. Consistent extremity positioning when imaging is performed [2,11-13].

Conclusion

PICC migration is the most common PICC related complication in neonates. Prevention of the PICC migration is limited, including maintaining the security of the catheter, documentation of the external length during dressing changes and monitoring PICC tip location

periodically. X-Ray is still the standard method for evaluation of the PICC tip position, but supportive evidence and use of point of care ultrasound is increasing. According to current literature we recommend to confirm the tip of PICC location at 12-24 hours, 3rd day after PICC placement and an ongoing basis per each NICU unit's protocols. More research is needed to determine the frequency of imaging to monitor PICC tip location and to investigate the risk factors associated with PICC migration in neonates.

Disclosure Statements

The author has no conflicts of interest relevant to this article.

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