

Cardiac tamponade: a rare but preventable complication of central venous catheter in neonates

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SUMMARY

Pericardial effusion with cardiac tamponade is a rare and life-threatening complication of peripherally inserted central catheter (PICC) in a neonate. We report a 33-week preterm neonate who had sudden clinical deterioration at day seven of total parenteral nutrition regime via PICC. Recognition of pericardial effusion with cardiac tamponade in neonates with a PICC requires a high index of suspicion and steps in prevention include proper catheter tip placement and continuous monitoring of line position and function.

KEY WORDS:

Cardiac tamponade, peripherally inserted central venous catheter, neonates, total parenteral nutrition

INTRODUCTION

Survival of the very low birth weight and extremely low birth weight neonate due to advances in neonatal care has increased the need for a reliable and prolonged intravascular access for parenteral nutrition, administration of medications and fluids. Several methods are available including peripherally inserted intravascular and umbilical catheters but these catheters have limited dwell time. In 1973, a method of inserting a silicone intravenous catheter into the central vein of a neonate was introduced by Shaw and since then, the PICC has become a mainstay of vascular access in the care of premature neonates. The PICC offers the advantage of being able to be inserted at the bedside and remain in-situ for weeks or even months with proper line care. The common complications of a PICC include local haemorrhage and malpositioning of the catheter tip. Other complications include catheter migration, blood stream infections, occlusions, thrombophlebitis, catheter rupture and pleural or pericardial effusion. Pericardial effusion with cardiac tamponade is a rare but life-threatening complication. A high index of suspicion is paramount, especially in cases of acute clinical deterioration in neonates on a total parenteral nutrition regime via the PICC. Recognition and emergency pericardiocentesis reduce the mortality rate from 75% to 8%. Insertion by trained medical personnel, followed by proper post line insertion assessment and routine monitoring of line function are imperative in reducing the rate of PICC-related complications. We present a case of a preterm neonate who developed this life-threatening complication.

CASE REPORT

A preterm neonate was born at 33 weeks of gestation, via emergency lower segment caesarean section because of foetal distress, to a 28-year-old Gravida 3 Para 2 healthy mother. Her birth weight was 1.36 kg. The APGAR score was 5 and 8 at 1 and 5 minutes respectively. She required resuscitation for poor respiratory effort and subsequently nasal intermittent mandatory ventilation (IMV) for mild Respiratory Distress Syndrome.

Small volume feeds using expressed breast milk was started at day two of life. However, after two days, the patient had high non-bilious aspirates from the nasogastric tube and hence she was treated as suspected necrotising enterocolitis. She was subsequently kept nil by mouth and treated with broad spectrum antibiotics. A peripherally inserted central catheter (PICC) line was inserted via the right antecubital fossa for administration of total parenteral nutrition (TPN). An uncontrasted chest radiograph post-PICC line placement showed the tip of the PICC in the superior vena cava.

A week later whilst the patient was still on TPN, she was noted to have sudden desaturation (oxygen saturation between 30-40%) and bradycardia (heart rate between 40-50 beats/minute). It was preceded by a few brief episodes of apnoea with fluctuating oxygen saturation which needed increasing ventilatory support. Cardiac auscultation revealed muffled heart sounds. Active resuscitation was commenced for 20 minutes. An urgent bedside echocardiogram revealed a large pericardial effusion, consistent with cardiac tamponade, measuring 9 mm surrounding the heart with the catheter tip seen within the pericardial cavity. An emergency pericardiocentesis using a substernal approach yielded 25 ml of creamy white fluid with similar appearance to the lipid solution of the non-compounded TPN. She showed marked improvement after the procedure. Her heart rate increased to 130 beats/minute and oxygen saturation up to 93-94%.

Unfortunately, she developed severe hypoxic-ischemic encephalopathy and multiple organs failure as a result of the acute life-threatening event. She had multiple seizures that were controlled with phenobarbitone and phenytoin. There was also oliguria associated with symptomatic hyperkalaemia. Bedside ultrasound revealed cerebral oedema with bilateral hyperechoic kidneys. She succumbed to death at 14 days of life.

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DISCUSSION

Complications such as pleural or pericardial effusion and cardiac tamponade following PICC for TPN in neonates are rare. However, these catheter-related complications are life-threatening especially when the TPN infusate accumulates and causes a tamponade effect in the pleural and / or pericardial cavities. A high index of suspicion is important in neonates who have unexplained and acute clinical deterioration when they are still on a TPN regime. The only life-saving measure is early recognition and intervention.¹ The reported mortality rate was 8% in patients who underwent pericardiocentesis versus 75% in patients who did not.²

There are some preventive measures related to PICC insertion. Standardised central venous line insertion by well trained medical personnel, followed by proper assessment post line insertion and routine monitoring of line function are imperative. In the study noted, there was no significant difference in upper and lower limb site of central venous line insertion causing complications that necessitated PICC removal. However, non-central tips were found to be a statistically significant cause of complications in PICC inserted via the upper extremity. Hence, the insertion site of a PICC in neonates should take into consideration the skill of the inserter, the quality of accessible veins with the aim to achieve a centrally located tip.³

The preferred position of the PICC tip is in the lower $\frac{1}{2}$ to $\frac{1}{3}$ of the superior vena cava for upper-body insertions and the thoracic inferior vena cava for lower-extremity insertions.⁴ Studies showed that central venous catheter (CVC)-related pericardial effusion occurred in 80-90% of infants in whom the CVC tip was within the pericardial reflections on a chest radiograph.^{1,2} The contrast-enhanced chest radiograph after insertion of the catheter must be performed to ascertain a correct position of the tip. The use of radio-opaque contrast while taking radiographs for the localization of the CVC tip position does improve observer ability to clearly evaluate the tip position and reduces inter-observer variability.⁵

Apart from the assessment of post-catheter insertion, daily review of the catheter function is essential. Failure to detect catheter-related complications in a timely manner may lead to catastrophic events.¹ At any time, should a chest radiograph be performed for any clinical purpose, the CVC tip must be reviewed. Sudden increment in the cardiothoracic ratio may raise suspicion of possible pericardial effusion secondary to CVC insertion. A non-central catheter tip location is recognised as a modifiable risk factor for complications necessitating PICC removal.^{2,3} Catheter migration may not be preventable due to dynamic forces within the body. Some strategies to minimise the risk of migration include securing the catheter with intact dressing, verifying the head and extremity position on radiograph as this can alter the catheter tip position.⁴

In this case report, malposition of the catheter tip could be a contributing factor as an uncontrasted chest radiograph was performed to look for the CVC tip position though migration of the catheter needs to be considered as well. Pleural or cardiac tamponade must be suspected to all babies with CVC presenting with sudden deterioration. Early recognition and intervention of catheter-related complications are life-saving measures. Preventive measures are imperative in all cases with PICC.

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