

Cardiac tamponade secondary to perforation of innominate vein following central line insertion in a neonate

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ABSTRACT

Cardiac tamponade following central line in a neonate is rare and an uncommon situation; however, it is potentially reversible when it is diagnosed in time. We report a case of cardiac tamponade following central line insertion. A 10-day-old 2.2 kg girl operated for obstructed total anomalous pulmonary venous connections had neckline slipped out during extubation. Attempted cannulations of right femoral vein were unsuccessful. At the end of the left internal jugular vein cannulation, there was a sudden cardiorespiratory arrest. Immediate transthoracic echocardiogram showed left pleural and pericardial collection. Chest was opened and the catheter tip was seen in the thoracic cavity after puncturing the innominate vein. The catheter was removed and the vent was repaired.

Key words: Cardiac tamponade, central line, great vessels, neonate, perforation

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INTRODUCTION

Cardiac tamponade secondary to the use of central venous catheter is a rare complication. This complication occurs in up to 3% of the newborn cases with central venous access.^[1] We report a case of cardiac tamponade following central venous cannulation that was diagnosed using a transthoracic echocardiography, managed by urgent surgical pericardial drainage. Complications with central line insertion in neonates occur most likely with guide wire aided insertion, with blind needling of a chest vein and with dilators. The risk appears to be greatest when the end of the catheter creates an acute angle to the vessel or cardiac wall.^[2]

CASE REPORT

A 10-day-old 2.2 kg female child was operated for obstructed total anomalous pulmonary venous connections (TAPVC) [Figure 1]. Right internal jugular vein was cannulated for central venous pressure

monitoring. Intra-operatively right upper lobe vein was not traceable, left upper and lower pulmonary veins were well seen. Rerouting of the three pulmonary veins to the left atrium, ligation of vertical vein and patch closure of atrial septal defect was done [Figure 1]. Child was extubated on the 3rd post-operative day. While positioning after extubation, the central line slipped out. Nitroglycerin, dobutamine, milrinone and noradrenaline infusions were on flow, when the line slipped out.

Attempted cannulations of right femoral vein were unsuccessful. Child had a respiratory distress and was intubated immediately. Left internal jugular vein was cannulated with 4F triple lumen catheter. In two lumens, the blood was aspirated freely and the aspiration of blood in the other lumen was negative. At the end of the procedure, there was a sudden cardiac arrest. Cardiopulmonary resuscitation was started. Bolus of fluid volume and inotropes in the central vein caused further deterioration. Blood was seen oozing out of the wound, when sternal compression

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was given. Immediate transthoracic echocardiogram showed left pleural and pericardial collection. Chest was opened and 40 ml of blood was seen in the mediastinum. Central vein catheter tip was seen in the thoracic cavity after puncturing the innominate vein [Figure 2]. The catheter was removed and the vent was repaired. Chest was closed after adequate haemostasis. Haemodynamics gradually picked up and later right internal jugular vein was cannulated with 4F triple lumen catheter.

DISCUSSION

Most serious complications of central lines in neonates are typically mechanical and occur early and a delay in diagnosis can be catastrophic. Careful insertion techniques, as well as continued vigilance in the correct position and function of central venous catheters are imperative to help prevent serious complications.^[3] When a suspicion of a serious mechanical complication arises, the infusion should be immediately discontinued and adequate interventions such as pericardial or pleural drainage

should be performed immediately.^[1] In our patient, the acute cardiorespiratory distress necessitated a bedside sternotomy and the patient was found to have a relatively complex injury of catheter coming through the innominate vein and tip lying in the thoracic cavity. The cardiac arrest was immediate as the rent in innominate vein was big and the amount of saline used to flush all three lumen was enough in 2.4 kg baby to cause immediate tamponade; roughly 5 ml of saline plus and the blood loss caused by innominate vein perforation could have triggered the arrest. Furthermore, as it was a state of post-operative obstructive TAPVC, any acute insult would be poorly tolerated.

Complications of perforation from central venous catheters in neonates include cardiac tamponade with catheter tips in the right atrium, right ventricle, superior vena cava and myocardial infiltration in the right atrium. Pleural effusion and ascites can occur due to the tip in the inferior vena cava and pericarditis can occur due to the tip in the superior vena cava. Rare complications include diaphragmatic paralysis, paraplegia and myoclonus due to tip in ascending lumbar vein and venous sinus thrombosis due to tip in the jugular vein. Another rare complication is the erosion of the catheter tip into pulmonary vessels.^[4]

As a general rule, direct vessel perforation from malposition occurs immediately as happened in our case, whereas osmotic erosion is more likely to occur days to weeks after catheter positioning.^[5] In our patient, urgent pericardiocentesis was lifesaving. There was no significant difference between survivors and non-survivors relative to gestational age at birth, birth weight and days to pericardial effusion diagnosis. However, mortality was significantly less in patients who underwent immediate pericardiocentesis. Therefore, emergent drainage of a pericardial effusion must be considered in any patient with a central vein catheter with sudden cardiorespiratory instability. The coexistence of acute pericardial and bilateral pleural effusions from central line perforation remains a very uncommon finding,^[6] which was present in our case. After subsequent pleural fluid drainage and central line removal, there was a rapid and complete recovery of the cardiorespiratory status.

The incidence for central line associated symptomatic perforation is 3% and fatal perforations are 1%, despite a policy of careful placement. The data also indicate that perforation complications occur regardless of

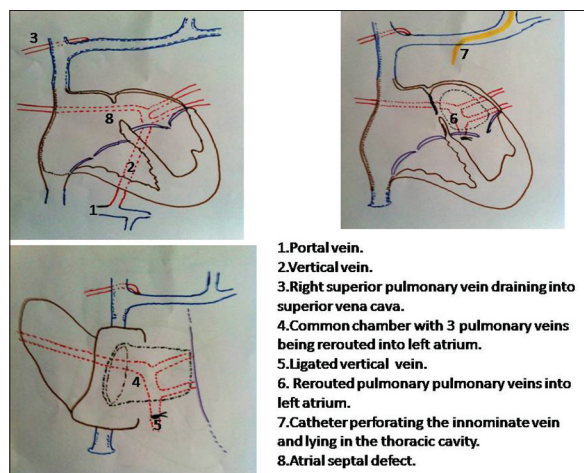


Figure 1: Schematic representation of pre-operative diagnosis, procedure done and the catheter piercing the innominate vein

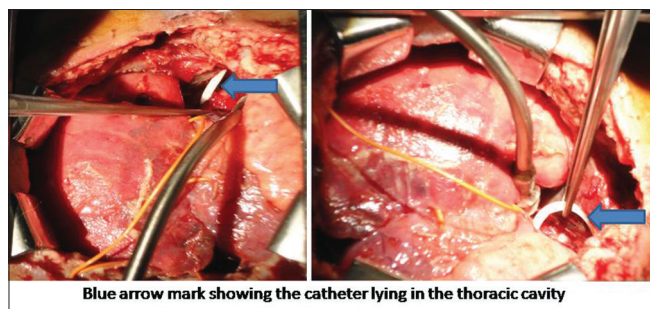


Figure 2: Intra-operative picture showing the catheter tip in the thoracic cavity

the size, material, location of the catheter tip and the access route. With regard to size of the catheter, there is an inverse relationship between size and mean days to pericardial effusion.^[5] Certainly, it is logical to expect that larger catheters may have a higher propensity to cause trauma to vascular or cardiac tissue, and thus, the smallest catheter required should always be used. However, catheter size is generally standardised and somewhat difficult to alter, and therefore, no definitive relationship is shown between size and development of cardiac tamponade.^[5]

The recent technical advancement like development of thin silastic and polyurethane catheters has not eliminated the perforation of the great veins of the heart and cardiac tamponade. This is most likely due to two practical problems; first, because of the difficulty in visualising the course of central line and second, because of the migration of the catheter after insertion.^[7] The speed and the amount of volume infused during cardiopulmonary resuscitation as it happened in our case may also be a contributing factor for perforation. Smaller children, haemodialysis central line catheter and the team's learning curve can also be risk factors for perforation.^[8]

There is no significant difference in pericardial effusion or mortality between various access routes. However, there is considerable debate regarding the correct tip placement of a catheter. Studies *in vitro* and in adults suggest that an increased angle of incidence between the catheter tip and the cardiac/vessel wall increases the likelihood of perforation. The tip of the catheter is not fixed and lateral neck flexion or arm movement may cause perforation, with arm movement causing greater catheter tip movement than neck movement.^[9] In response to reports of death from cardiac tamponade, some catheters now bear a manufacturer's recommendation that they should not be placed with the tip in the right atrium.^[6] However, catastrophic cardiac tamponade was reported even when the catheter tip was outside the right atrium^[10] as happened in our case.

CONCLUSION

Perforation following central line placement is a rare complication. Although isolated cases have been

reported in adults, a search of our entire paediatric database showed nil occurrence of catheter coming through the innominate vein into the thoracic cavity. It remains uncertain whether catheter insertion site, location of the catheter tip, material or size play any associated role in the development of this complication. Most important to us are restricting operators to experienced personnel, to ensure that blood can be readily and repeatedly withdrawn from all lumens of the catheter, where it is fixed at the completion of insertion, and also to ensure that it is in a large vessel and is not lodged against a vessel or cardiac chamber wall. When a suspicion of a serious mechanical complication arises, the infusions should be immediately discontinued and adequate interventions such as pericardial or pleural drainage should be performed immediately.

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