Unusual Position of a Peripherally Inserted Central Catheter in a Preterm Infant with a Persistent Left Superior Vena Cava

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Abstract

Peripherally inserted central catheter (PICC) placement is a routine procedure in the neonatal intensive care unit. However, PICC insertion and accurate tip positioning in neonates can be challenging, especially in cases of venous malpositions and anomalies. We report a preterm infant with a persistent left superior vena cava (PLSVC) which was identified following PICC placement. This case highlights the importance of recognizing thoracic venous anomalies in neonates, as well as the typical and atypical pathways of PICC to ensure safe venous access.

Keywords: Neonate; Peripherally Inserted Central Catheter (PICC); Neonatal ICU; Cardiac Anomaly; Persistent Left Superior Vena Cava (PLSVC); Oman

Introduction

Peripherally inserted central catheter (PICC) insertion is a common procedure in neonatal intensive care unit (NICU) for administration of fluids, medications, nutrition, especially total parenteral nutrition (TPN) for preterm and critically ill newborns.[1] Neonatal PICC insertions are considered safe, with high reported success rates.

The distal tip of a neonatal PICC should ideally lie within the superior vena cava (SVC) or inferior vena cava (IVC), but clearly outside the silhouette of the heart. For PICCs inserted into the scalp or upper limb veins, the tip should be positioned within the SVC above the level of the fourth thoracic vertebra (T4). On the other hand, PICCs inserted via the lower limb should be positioned to the right of the spinal column, inside the IVC but below the level of the ninth thoracic vertebra (T9).[1,2]

Malposition of neonatal PICC tip may increase the risk of potentially fatal complications, such as thrombosis, cardiac arrhythmia, pericardial effusion, and pericardial tamponade. Therefore, these are generally withdrawn and moved to a midline position.[2]

It can be difficult to place a PICC correctly in infants with abnormal venous anatomy such as persistent left superior vena cava (PLSVC). Those who regularly insert PICC lines should be familiar with venous malpositions and anatomic variants. In such patients, alternate pathways, including PLSVC can also be a relatively safe final tip position.

This report describes the radiologic findings and clinical significance of a PLSVC identified incidentally in a preterm infant during routine placement of a PICC line.

Case Report

A preterm male infant born at 31-weeks' gestation was delivered by an emergency lower segment cesarean section due to prolonged premature rupture of membranes and suspected chorioamnionitis. The mother, 35-year-old, gravida 6 para 5 abortus 1 (G6P5A1), had no medical illnesses. She had regular antenatal follow ups including scans, which were unremarkable.

At birth, the infant had a good cry and tone, with Apgar scores of 7 and 9 at 1 and 5 minutes respectively, but exhibited increased work of breathing, requiring noninvasive continuous positive airway pressure support (CPAP). No resuscitation was required. Birth anthropometric measurements included a weight of 1.54 kg (< 10th percentile), length of 39 cm (20th percentile), and a head circumference 28.5 cm (20th percentile).

He was admitted to the neonatal intensive care unit (NICU) and administered continuous positive airway pressure (CPAP). Upon improvement of respiratory status, he was initiated on preterm formula due to the unavailability of expressed breast milk.

On day 5 of life, he developed abdominal distension with melena. An abdominal X-ray showed features of necrotizing enterocolitis. Because of the need for bowel rest with nil per os (NPO) status, total parental nutrition, and intravenous (IV) medications, a PICC was inserted in the left upper limb. A chest X-ray taken to confirm the PICC position showed an abnormal catheter course [Figure 1] along the left side of the heart, extending toward the right atrium, raising suspicion of a venous anomaly.

A pediatric cardiologist was consulted, and echocardiography revealed a dilated coronary sinus with persistent left superior vena cava (PLSVC) draining into the coronary sinus [Figures 2–4]. Cardiac function was normal. The PICC was withdrawn from its deep positioning and repositioned at the level of PLSVC (at T4–T6). The infant stayed in the NICU for total 27 days and was discharged in good condition. After that, he was seen at pediatric cardiology and neonatology clinics in stable condition.

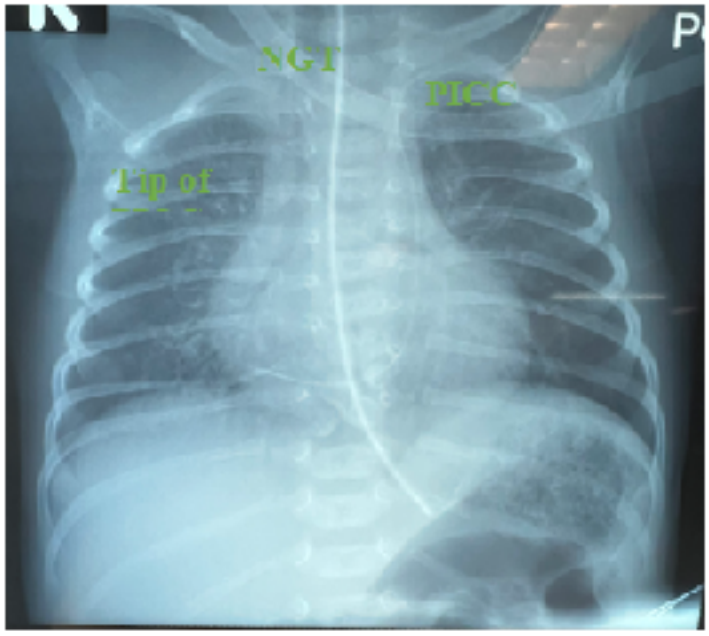

Figure 1: Chest and abdomen radiograph showing the peripherally inserted central catheter (PICC) coursing to the left side of the heart.

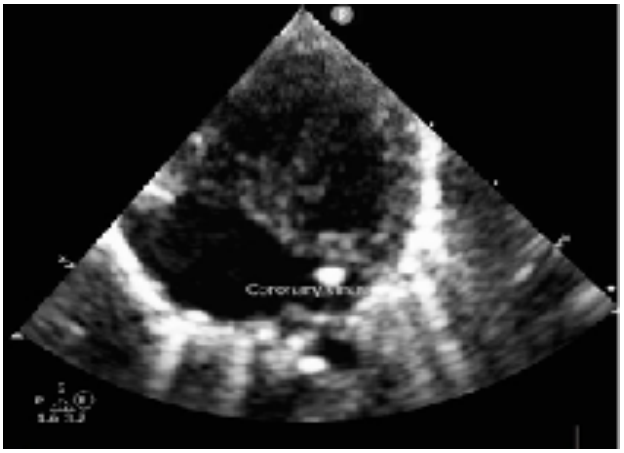

Figure 2: Transthoracic echocardiogram, showing a dilated coronary sinus in the subxiphoid short-axis (sagittal bicaval) view.

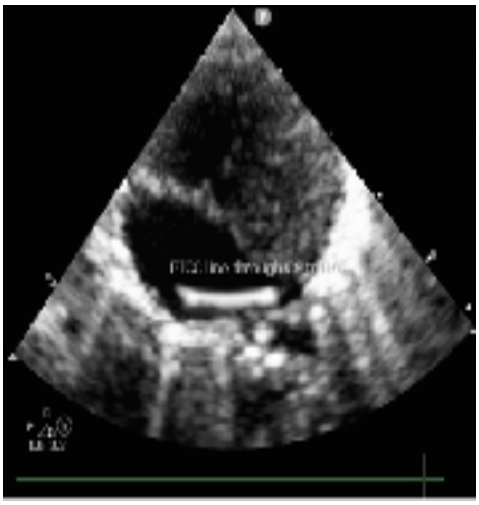

Figure 3: Apical four-chamber echocardiographic view demonstrating a dilated coronary sinus and a peripherally inserted central catheter entering the right atrium via the coronary sinus.

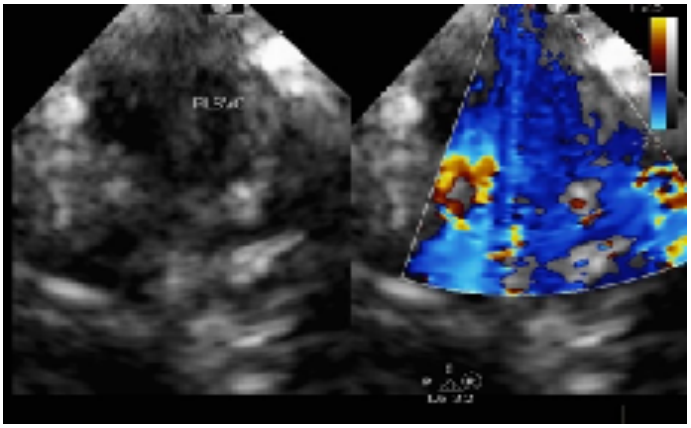

Figure 4: High parasternal (ductal) transthoracic echocardiographic view showing left superior vena cava (PLSVC). (A) Two-dimensional grayscale image showing PLSVC. (B) Color Doppler image demonstrating venous flow within PLSVC.

Discussion

PLSVC is estimated to be present in 0.3% to 0.5% of the general population.[3] It may occur in isolation or in association with congenital heart disease in up to 10% of cases. Reported associations include heterotaxy (left and right isomerism), dextrocardia, double-outlet right ventricle, atrioventricular septal defect, coarctation of the aorta, ventricular septal defect, bicuspid aortic valves, tetralogy of Fallot, and double aortic arch.[3] Also, PLSVC cases have been described in association with several genetic and chromosomal abnormalities including VACTERL (vertebral defects, anal atresia, cardiac defects, tracheoesophageal fistula, esophageal atresia, renal anomalies, and limb abnormalities), CHARGE syndrome (coloboma, heart defects, atresia choanae, retarded growth and development, genital anomalies, and ear anomalies), and Opitz G syndrome. PSLVC is also associated with chromosomal abnormalities such as trisomy 21, Turner syndrome, and microdeletion 22q11.2.[3]

Isolated PLSVC is typically asymptomatic with few or no clinical features, and are frequently discovered incidentally. The importance of PLSVC in neonatal care lies in its possible association with chromosomal or congenital heart defects and (as in the present case) how it impacts upon central line placement when using the left arm. Thus, the finding of a PLSVC should alert the clinician to these potential associations and the need for appropriate evaluations including echocardiography and investigating for associated congenital defects.

In the early stages of embryonic development, around 3 to 4 weeks into gestation, blood from the arms and head returns to the right atrium via the right and left anterior cardinal veins. By the 8th week of gestation, the left anterior cardinal vein normally regresses. Failure of this regression results in PLSVC.[3,4]

The presence of PLSVC can complicate catheter placement on the right side of the heart when using a left subclavian approach for vascular access, during the insertion of percutaneous central venous catheters in newborns from the right upper limb, or when placing pacemakers or defibrillators for arrhythmia treatment. Sometimes PLSVS can be unexpectedly found during cardiac or thoracic surgical procedures.

PLSVC can present in various anatomical forms. In 80% to 90% of cases, it drains into the right atrium through the coronary sinus. [Figure 5] The coronary sinus may dilate as a result, which could lead to two outcomes: (1) cardiac arrhythmia due to stretching of the atrioventricular node or bundle of His; and (2) obstruction of the left atrioventricular flow due to partial occlusion of the mitral valve.[5] In10% to 20% of cases, PLSVC may drain directly into the left atrium, resulting in right to left shunt with possible cyanosis.[6]

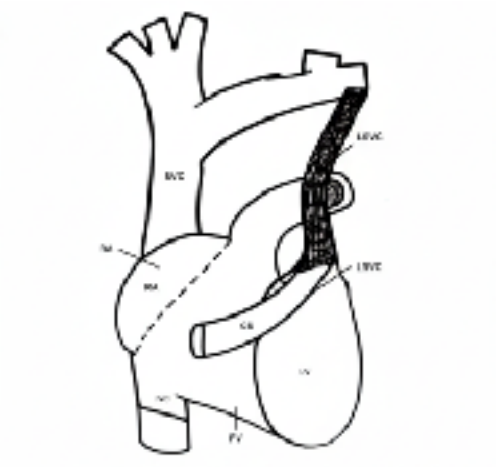

Figure 5: Schematic illustration of a persistent left superior vena cava (PLSVC) draining into the coronary sinus, and subsequently into the right atrium (RA). (Image generated by authors.)

Note. *SVC: Superior vena cava; IVC: Inferior vena cava; LV: Left ventricle (LV); CS: Coronary sinus.*

Implications for PICC placement

PICC placement in neonates with PLSVC can be challenging. Often, the anomaly is first revealed on post-catheterization imaging, as in the present case. A PICC located along the left mediastinal border may lie within the PLSVC, but also could also take alternate positions such as the descending aorta, internal thoracic vein, superior intercostal vein, pericardiophrenic vein, pleura, pericardium, or mediastinum. Therefore, when a PICC follows an unexpected trajectory, clinicians should suspect PLSVC rather than attempt repeated catheter insertion. A chest X-ray may not suffice for diagnosing PLSVC and typically requires echocardiography, as in our patient. For more complex cases, other modalities such as fluoroscopy, computed tomography, or magnetic resonance imaging may be considered.

Conclusion

A persistent left superior vena cava is a common venous anomaly that is typically asymptomatic but has important procedural implications. Awareness of such variants may help avoid unnecessary reinsertion of PICC, and opt for echocardiographic evaluation to trace the catheter route and assess associated anomalies. This case highlights the importance of recognizing common thoracic venous variants such as PLSVC in neonatal practice.

Disclosure

The authors declare no conflicts of interest. Informed consent was obtained from the patient's mother.

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