

Bilateral Tension Hydrothorax and Pericardial Effusion in Correctly Placed Umbilical Venous Catheter: A Bolt From the Blue

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Abstract

Umbilical venous catheterization is used extensively in the neonatal intensive care unit. A majority of serious complications such as perforation of myocardium and pericardial effusions are described to be due to incorrect positioning of the umbilical venous catheter (UVC). This case report is presented to sensitize clinicians about considering the possibility of bilateral tension hydrothorax and pericardial effusions in any neonate with UVC in situ. These complications can happen even if UVC is in the correct position.

Key Words: Tension hydrothorax, umbilical venous catheter, infradiaphragmatic positioning, hemithorax opacification, ultrasonogram, pleurocentesis

Introduction

The first reported use of umbilical venous catheters (UVCs) was by Diamond in 1947, for exchange transfusion.¹ UVCs are now used extensively in neonatal intensive care units (NICUs). A majority of serious complications such as perforation of myocardium and pericardial effusion are described to be due to incorrect positioning of the UVC. The accepted correct position of the UVC is at the inferior vena cava (IVC) and right atrial junction corresponding to the eighth and ninth thoracic vertebrae.² This case report is presented to sensitize clinicians about the possibility of bilateral tension hydrothorax and pericardial effusions in any neonate with UVC in situ, in the event of sudden and unexplained clinical deterioration even when the UVC is in the correct position.

Case Description

A male preterm neonate was born at 29⁺⁴ weeks of gestation to a 29-year-old primigravida by lower segment cesarean section. The neonate required resuscitation at birth in the form of chest compression and intratracheal adrenalin; Apgar scores were 2, 5, and 7 at 1, 5, and 10 minutes, respectively. The neonate was transferred to the NICU with intermittent positive pressure respiration. At the NICU, the neonate was continued on mechanical ventilation to treat severe respiratory distress. UVC and umbilical arterial catheter (UAC) were tied and secured with a skin knot. X-ray imaging showed changes of grade IV respiratory distress syndrome and correct infradiaphragmatic positioning of UVC. The neonate required 3 doses of surfactant within 24 hours of admission for persistent respiratory distress and could be weaned to continuous positive airway pressure on day 3 of life. UAC was removed on day 3 of life and the neonate was started on trophic feeds. However, the neonate again developed sudden-onset respiratory distress on day 7 of life with features of early shock, which presented in the form of prolonged capillary refill time. The neonate was started on inotropic support (dopamine) and feeding was withheld. The performed chest X-ray revealed a right-sided hemithorax opacification (Figure). The neonate was electively reventilated

to increase distress and shock. A bedside ultrasonogram (USG) of the thorax confirmed the presence of bilateral tension hydrothorax (or pleural effusion; more in the right than the left cavity) and pericardial effusion along with mild ascites. UVC was reconfirmed to be in correct position at the IVC below the diaphragm and away from the myocardium. USG-guided pleurocentesis was performed immediately and 50 mL of clear fluid was drained from the right intercostal drain (ICD) and 40 mL of fluid was drained from the left ICD. The neonate's features of shock improved dramatically and respiratory support could be lowered immediately after pleurocentesis (FiO₂ reached 40% from 100% and PIP reached 12 from the earlier 18 cm H₂O). Pleural fluid analysis was acellular with high glucose (750 mg/dL). On ECG, there were no signs of pericardial tamponade. As features of shock improved substantially after pleurocentesis, pericardial effusion was managed conservatively. Pleural fluid culture was sterile. UVC was removed immediately. Pericardial effusion resolved in the next 4 days. The left ICD was removed in 24 hours



Figure. Chest X-ray Showing Right-Sided Hemithorax Opacification

and the right ICD was removed in the next 48 hours. There was no reaccumulation of fluid in the pleural and pericardial cavities. The neonate's further course in the NICU was uneventful and was discharged at 35 corrected weeks of gestation. The neonate was on breast-feeding at the time of discharge.

Discussion

Pericardial effusion is a rare but potentially lethal complication of CVC use and is described in 1% to 5% of cases.² Co-occurrence of pericardial effusion and tension hydrothorax is even rare and is reported in only 5% of cases with pericardial effusion.³ Catheter-associated effusion is seen more frequently with large catheters, UVCs made of stiff materials such as polyethylene, intracardiac tip position of the UVC, and also prematurity due to thin myocardium.^{3,4} Malposed UVC in the right atrium can perforate the endocardium and lead to hemopericardium or pericardial effusion. The mechanism of tension hydrothorax and pericardial effusion even with correct positioning of the UVC in the infracardiac IVC is not entirely understood. However, effusion is thought to be related to endothelial damage caused by hyperosmolar fluid and subsequent seepage of fluid into the perivascular space. As pericardial and pleural reflections extend up to a variable extent on blood vessels, it can lead to tension hydrothorax with or without pericardial effusion.^{3,5} Rapid accumulation of fluid in the pleural space can lead to positive pressure in the mediastinum and mediastinal shift, leading to impairment of venous return of the heart and shock, akin to tension pneumothorax. This condition is called tension hydrothorax. Mediastinal shift may be absent in bilateral hydrothorax.⁵ Pleural space is a large space and can accumulate large amount of fluid before cardiac compression and compromise can occur. However, a relatively small amount of rapidly accumulating fluid in the pleural or pericardial compartment can startlingly impair cardiac function. Rapid release of the pressure by tube drainage not only improves cardiac functioning but could also be life saving, as observed in this case. High glucose level in the pleural fluid was consistent with the leaked IV fluid from the UVC and therefore UVC was removed.

Features of shock showed remarkable improvement after pleurocentesis. As ECG did not show any features of tamponade, pericardiocentesis was withheld and the neonate was monitored. Pericardial tamponade per say has very high mortality (45%) if not detected and treated in time. Mortality is higher in patients who do not undergo pericardiocentesis than those who do (75% vs 8%).³ No reaccumulation of fluid was observed and pericardial effusion also resolved after 4 days.

We monitored the neonate for signs of clinical deterioration and/or tamponade and found that the neonate did not require pericardiocentesis, which is a risky procedure. Aspiration of fluid from the umbilical lines may not always be successful (because of thrombosis of the catheter or catheter impinging on the cardiac wall) and has shown variable success in adults.³ Immediate removal of CVCs is practiced in majority of the instances as done in this case; however, withdrawal from the inappropriate position and continued successful use of UVC are also described in literature.^{3,6} As we removed the source causing tension hydrothorax, that is, UVC, which had lead to cardiac dysfunction, the neonate made a swift recovery without reaccumulation of fluid.

In this case, the UVC tip was in the infradiaphragmatic position, which was confirmed by X-ray. Although X-ray is the most commonly used tool to locate the tip position of UVC, it has low sensitivity (only 50%–75%).⁷ USG-guided tip localization with the help of saline contrast is being used increasingly and is set to become the gold standard. However, this technique is observer dependent and lacks universal availability.⁷ Incorrect positioning of the UVC tip in cardiac silhouette is described in 93% of pericardial effusions, further emphasizing that extravasations of fluid can happen even with correct positioning of UVC in the remaining 7% of cases.^{3,8} Extracardiac positioning of the UVC tip decreases the risk of tension hydrothorax and pericardial effusion but does not completely eliminate it. However, at the same time, it increases the risk of extracardiac (pleural and peritoneal) effusion as observed in this case. Sudden cardiac collapse is described as a presentation in 61% of such cases and unexplained cardiac instability is observed in another 36% of the largest described series.^{3,8}

Conclusion

Bilateral tension hydrothorax with pericardial effusion is a very rare complication of a correctly positioned UVC. However, clinicians should be alert to the possibilities of bilateral tension hydrothorax and/or pericardial effusion in case of sudden unexplained deterioration, especially in neonates with correctly positioned UVC.

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