

Case Report

Umbilical venous catheterization: a fatal complication in a term neonate

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Abstract

This case report describes a newborn with pulmonary hypertension who developed liver failure and multi organ failure due to extravasation through a malpositioned umbilical venous catheter. Although placement of an umbilical venous catheter is a commonly used technique, correct positioning is difficult, particularly since x-ray confirmation is often unreliable. Acceptance in suboptimal position, not at the junction of the inferior vena cava and the right atrium, can lead to serious morbidity and mortality. With this case report we want to raise awareness of the risk of complications following improper tip placement of an UVC and promote the use of ultrasound in confirming the catheter position.

Introduction

Insertion of an umbilical venous catheter (UVC) is a commonly used procedure to establish central venous access in neonates. It is widely used as a quick intravenous access to be able to administer intravenous fluids such as parenteral nutrition, medication and transfusions. However, caution is warranted as complications can occur, especially if placed in suboptimal position or if kept into place longer than a period of 7-14 days (1, 2). Catheter-related infection, thromboembolic events and complications due to malpositioning of the UVC such as cardiac arrhythmias and extravasation in the hepatic parenchyma are the most common complications. Complications related to the liver parenchyma are rare, but have a high rate of morbidity and mortality (3, 4).

The aim of this case report is to raise awareness of the risk of complications following improper tip placement of an UVC. Furthermore, we discuss how these complications can be prevented.

Case Report

A term neonate, born at 38 weeks and 4 days gestational age after a repeat caesarean section with a birthweight of 3445 grams, presented with respiratory distress within fifteen minutes postpartum. Initially, nasal CPAP was started and intravascular access was obtained through UVC and umbilical arterial catheter (UAC) placement. X-ray confirmed a correct position of the UAC and showed the tip of the UVC on the right side of the T11-12 vertebra on anteroposterior X-ray (figure 1). No profile X-ray was made. Although the tip position of the UVC was not correct, it was not repositioned. Because of respiratory deterioration, the neonate was intubated at day one of life and mechanically ventilated from then on. Hypertonic parenteral nutrition was started. Persistent pulmonary hypertension of the neonate (PPHN) was diagnosed by echocardiography. Inhaled NO and intravenous levosimendan were started as treatment. High doses of intravenous noradrenaline and dopamine were needed to treat severe hypotension. All intravenous medication was administered through the UVC. Although the initial clinical improvement and resolution of the PPHN on echocardiography, his clinical condition deteriorated rapidly on day 3 of life with development of

cardiorespiratory failure. On clinical examination at that time hepatomegaly and abdominal distension were noted. An abdominal ultrasound showed extensive multifocal lesions in the left liver lobe, suggestive of necrotic or haemorrhagic lesions, as well as free fluid in the abdominal cavity, suggestive of extravasation (figure 2). The UVC was visualised in the vena umbilicalis. The tip was suspected to be in the portal vein, although not clearly visualised on ultrasound. The UVC was removed after these findings and was replaced by a peripherally-inserted central catheter. Despite removal of the UVC, there was a rapid evolution to fulminant hepatic failure and secondary multiple organ failure with the need for haemodialysis. A cranial ultrasound showed an extensive subdural haemorrhage in the left frontotemporal lobe as well as an intraventricular haemorrhage causing midline shift and cerebral oedema. The haemorrhage was caused by extensive coagulopathy reflected biochemically by abnormal APTT and PT values as well as clinically by prolonged bleeding after procedures. After careful consideration of the severe clinical condition with poor prognosis, taking into account the opinion of the parents, the decision was made to withhold further intensive care. The patient died at day five postpartum. At post-mortem examination, there was diffuse ischaemic liver necrosis of more than 50 percent of the parenchyma, in both the left and right liver lobes (figure 3). Necrosis of the vena umbilicalis and ductus venosus was observed and there was diffuse intestinal transmural ischaemic necrosis with peritonitis. The kidneys showed signs of acute tubular necrosis. Lung pathology was consistent with congenital alveolar dysplasia, explaining the initial presentation of respiratory distress and PPHN. Although often a fatal condition, the congenital alveolar dysplasia did not explain the rapid clinical deterioration with multi organ failure as seen in our patient.

Discussion

Umbilical venous catheter placement is one of the most frequently used methods for obtaining an urgent venous access in neonates since it has been first described in 1947. The correct position of an UVC is at the junction of the inferior vena cava (IVC) and the right atrium, but is not always easy to achieve. Repeated manipulations should be avoided keeping in mind the clinical condition and

Figure 1 : Anteroposterior X-ray showing the position of the umbilical arterial catheter and the umbilical venous catheter, with the tip of the umbilical venous catheter on the right side of the T11-12 vertebra.



Figure 2 : Abdominal ultrasound showing heterogenous liver parenchyma, with wide spread necrotic and haemorrhagic zones (Blue arrow).

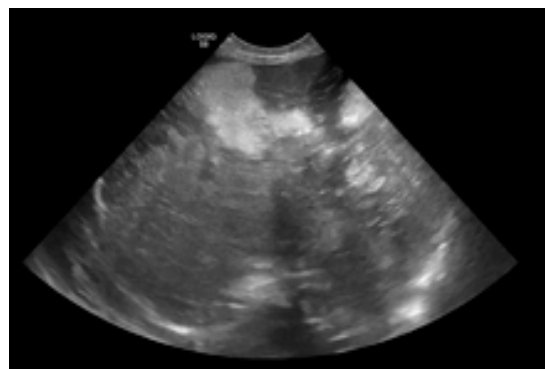
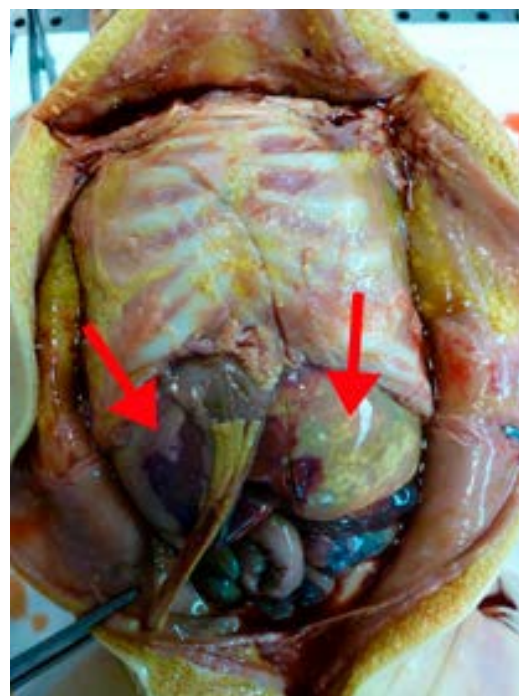


Figure 3 : Anteroposterior X-ray showing the position of the umbilical arterial catheter and the umbilical venous catheter, with the tip of the umbilical venous catheter on the right side of the T11-12 vertebra.



stability of the patient. In such a case a suboptimal position, i.e. downstream of the ductus venosus in the umbilical vein, is sometimes accepted (5). If so, the UVC needs to be handled as a peripheral catheter and no hypertonic parenteral nutrition nor hyperosmolar drugs should be administered through it.

Complications after UVC placement are not rare. Blood stream infections are the most frequently reported serious adverse events, although the reported incidence varies from 3 to 36% (6). Portal venous thrombosis (PVT) is slightly less common with a reported incidence between 2 and 43%, although probably underreported because of lack of symptoms (7). PVT should not be ignored because of the possible evolution to portal hypertension. Therapy is usually conservative since more than half of the cases show spontaneous resolution, although there is a tendency to treat large obstructive thrombi with low molecular weight heparin (8, 9). Furthermore as a complication of catheters with an atrial position, cardiac arrhythmias have been described and most often show resolution after repositioning of the UVC in the correct position (4, 6).

With this case report, we focus on the hepatic parenchyma complications related to UVC placement. Hepatic complications occur less often than other complications, with a reported incidence of 0.8%. (10). However, they are associated with higher morbidity and mortality than other complications. Furthermore there is a strong association between malpositioning of the catheter in the liver and subsequent extravasation of hypertonic fluids (3-5).

If hepatic injury occurs, abdominal distension or clinical deterioration and hypotension may arise (10). The diagnosis is made by abdominal ultrasound, showing heterogeneously echogenic intrahepatic lesions or cyst-like well-margined liver lesions with hyperechoic rims (10, 11). Fortunately in most cases, after removal of the umbilical catheter, follow-up ultrasounds show resolution of the hepatic lesions. However if persistent, these lesions can lead to portal hypertension, liver lobe atrophy and development of hepatic cavernoma (12). Some neonates even need laparotomy in case of perforation of the hepatic vessels and mortality due to liver failure and bleeding has been described (5, 10).

Considering the possible severe complications, correct tip positioning of the UVC is paramount. To assess the position of the UVC, antero-posterior chest-abdominal radiograph is the most widely used technique. There are two ways of assessing the correct position on the radiograph. Firstly, the vertebral body method in which the position of the tip relative to the vertebral bodies is assessed. Optimal

positioning would be on T8-T9. Secondly, the cardiac silhouette method in which the position of the tip relative to the supposedly cavo-atrial junction is assessed. Optimal positioning would be at the junction of the IVC with the right atrium (13). However, errors do occur when using chest-abdominal radiograph to determine the UVC position. Recent studies have shown the superiority of ultrasound to X-ray in detecting the actual catheter position. A study by Michel et al. showed a sensitivity of 93% and specificity of 95% concerning correct tip positioning when using ultrasound, compared to a sensitivity of 66% and specificity of 63% when using antero-posterior radiography. A more recent study of Grizelj et al. supports these data (10, 14). Besides being more reliable, it is also bedside available which allows frequent control of catheter position since even after initial correct placement, catheter tips seem to migrate in 50 to 90% of the cases (13, 15). Additionally, the use of ultrasound leads to less X-ray exposure and fewer manipulations of the catheter (3). Despite these advantages, ultrasound still is not widely used to analyse the location of the UVC tip. It is of great interest to train

neonatologists to use this technique seeing the great advantage it holds in correct positioning of the UVC and thereby reducing catheter related complications. (16)

Our case report illustrates severe morbidity with fatal outcome following acceptance of suboptimal position of an UVC. The placement of the UVC in the hepatic circulation and infusion of hypertonic and inotropic fluids caused extravasation in the hepatic parenchyma with extensive caustic and ischaemic necrosis as a result. This resulted in fulminant liver failure, evolving to multi organ failure with coagulopathy and subsequently intracranial haemorrhage.

This case report reminds us that umbilical venous catheterization cannot be considered harmless. It should be correctly placed, catheter tip position should be checked on a regular basis and the use of an UVC should be limited in time to a maximum of 7 to 14 days. Although not free of complications either, percutaneous central venous catheters are recommended whenever prolonged infusion is anticipated.

Conclusion

We presented a case of severe morbidity with fatal outcome after misplacement of an UVC. Awareness should be raised of the potentially severe complications when keeping an UVC in aberrant position. Verifying the tip position of the UVC by X-ray may be unreliable. Therefore, the use of ultrasound to determine the UVC position should be used on a regular basis, especially when there is doubt about the correct position on X-ray.

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