

The mysterious pleural effusion

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Central venous catheter placement for long-term total parenteral nutrition is a well-established practice. Considering the number of placed lines, serious complications are rare but may be life threatening. We report the case of a 6-month-old infant on total parenteral nutrition since neonatal period, as a consequence of severe intestinal insufficiency secondary to extensive intestinal resection for necrotizing enterocolitis. The child was admitted to the ICU with respiratory failure due to bilateral milky pleural effusion 17 days after placement of a left internal saphenous line. Pleural effusion analysis was suggestive of chylothorax, with high triglyceride (722 mg/dl) and low cholesterol (<20 mg/dl). Persistence of pleural effusion, despite adequate treatment, drew attention to other diagnostic hypothesis. Considering that parenteral nutrition solution used is cholesterol free and the child complained of pain when administered bolus through the catheter, the hypothesis of misplacement of the central venous catheter became more likely. Computed tomography scan after contrast administration through the catheter revealed its presence in the epidural space and

the ascending route reaching the pleural space. When parenteral nutrition was stopped, the pleural effusion resolved. At the present time, with 2 years of follow-up, the child does not have any complication of this event. This is, to our knowledge, the first reported case of an infant developing bilateral pleural effusion secondary to misplacement of a left internal saphenous catheter. *Ann Pediatr Surg* 10:83–86 © 2014 Annals of Pediatric Surgery.

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Introduction

Central venous access for long-term total parenteral nutrition (TPN) is a standard practice in neonatology, and associated complications due to aberrant percutaneous central venous catheters (CVC) locations have been well documented [1]. Misplacement of CVC has been associated with problems of local toxicity, perforation, and venous thrombosis [2]. Femoral catheterization has a higher incidence of mechanical complications than other CVC locations, and some of them are unusual and potentially fatal [2]. We report a previously undocumented complication following the malpositioning of the CVC in the left ascending lumbar vein.

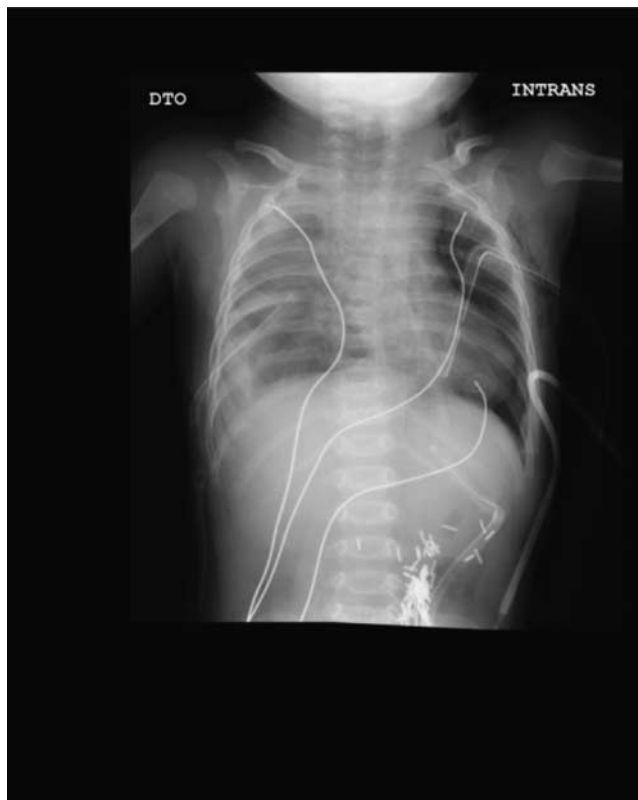
Case report

A 6-month-old infant, ex-preterm of 31 weeks with intestinal insufficiency secondary to necrotizing enterocolitis, under TPN at home, was admitted for placement of a new CVC. A 4.2 Fr Broviac (New Jersey, USA) catheter was easily placed into the left saphenous vein by the cutdown technique (neck and upper extremity veins had been used previously). The position of the catheter was verified, by abdominal anteroposterior radiograph, as being in the inferior vena cava at the level of the fourth lumbar vertebrae, and it was well functioning. Seventeen days after CVC placement, the infant developed irritability and progressive respiratory distress with bilateral decreased breath sounds, with no other accompanying signs and symptoms namely fever. Anteroposterior thoracic radiography and thoracic ultrasonography disclosed a bilateral pleural effusion (Fig. 1, right pleural effusion, bilateral

pleural drainage). The infant was transferred to the Pediatric Intensive Care Unit where bilateral pleural drainage was placed. Pleural effusion analysis suggested chylothorax [lipemic, pH 8.0, density 1005, glucose concentration 122 mg/dl, protein 3.2 mg/dl, lactate dehydrogenase 168 U/l, triglyceride 722 mg/dl, cholesterol < 20 mg/dl, cells 2000/mm³ (neutrophils 20%, lymphocytes 9%, eosinophils 71%)]. Persistence of pleural effusion, despite adequate treatment (including octreotide), drew attention to other diagnostic hypothesis. We noticed the infant's complains of discomfort coincident with boluses of medication through the catheter. In addition, blood withdrawal was no longer possible. Furthermore, the lipid solution used does not have cholesterol in its composition; hence, it could be a part of pleural effusion. These facts raised the hypothesis of CVC misplacement, and the interruption of its use led to the rapid disappearance of pleural drainage. Eco-Doppler documented the intravascular location of the proximal catheter's portion. Computed tomography scan (Fig. 2) after administration of contrast through the catheter revealed the catheter tip at L5 level in the left ascending lumbar vein, the presence of contrast in the epidural space, epidural venous plexus, and venous plexus surrounding nerve roots, and the ascending route of contrast until it passes through the intervertebral foramen accompanying nerve roots and reaches the pleural space at the upper thoracic level. The infant was discharged from Pediatric Intensive Care Unit 8 days after catheter removal.

After 2½ years of follow-up, the child has a neurodevelopment adequate for age and does not have any complication related with this event.

Fig. 1



Thoracic radiograph: right pleural effusion, bilateral pleural drainage.

Discussion

This case report describes bilateral pleural effusion as a previously unreported complication of femoral CVC misplacement.

In the reviewed literature, there are at least 13 cases described of patients with lower extremity CVC malpositioning into the epidural venous plexus. Complications associated with catheter malposition into the epidural venous plexus include venous stasis and thrombosis, vasculitis, increased pressure in the spinal canal, spinal cord injury, and perforation into the subarachnoid space [3]. None describe pleural effusion as a complication. Usually, pleural effusion is a complication of subclavian catheterization [4].

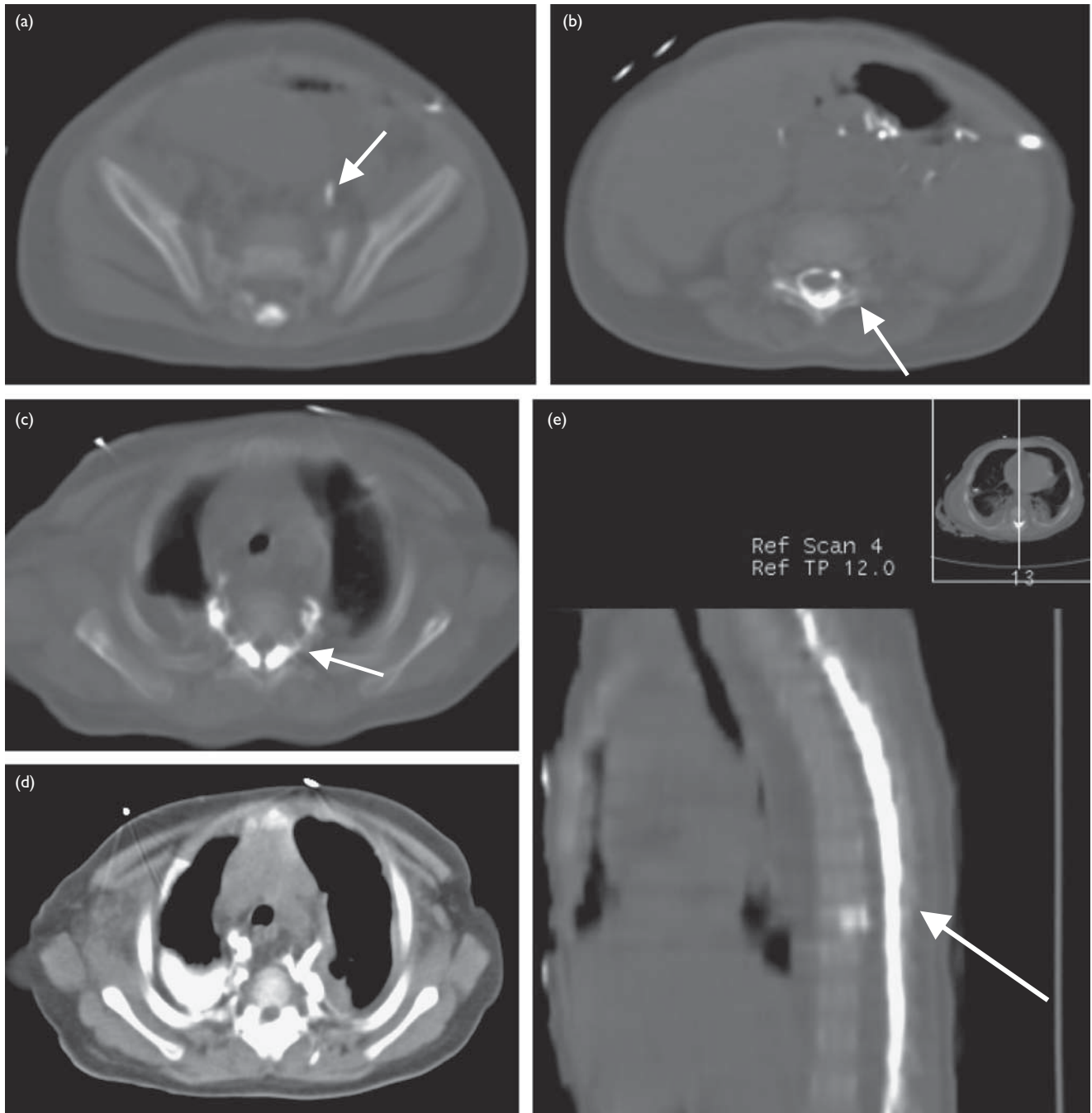
Rubin *et al.* [5] described a case of an infant who developed severe lung disease presumably as a consequence of perfusion of TPN directly into the lung parenchyma, as a consequence of malpositioning of a left brachial vein CVC. In our case, the child does not have any respiratory sequelae directly attributed to this intercurrent.

As described in the literature, this report demonstrates that, even with careful checking of catheter's position at the time of placement, displacement or migration can still occur, usually within the first 11 days [6,7]. Signs and symptoms can vary from nonspecific, suggestive of sepsis, difficult blood withdrawal, respiratory distress, neurological deficits due to elevated cerebrospinal protein, glucose, and lipid in a patient receiving central venous

hyperlimentation [1,7,8]. Our patient developed symptoms of respiratory distress and difficult blood withdrawal 17 days after placement. A high index of suspicion is needed to alert a physician to this rare type of complication [6]. Postprocedure films should be performed to check for complications and misplacement; however, congenital or acquired anatomic variations can make difficult the radiologic interpretation of the tip's location [2]. In our case, the infant had a postsurgical anatomic variation. Anteroposterior and lateral view roentgenograms are a useful means of diagnosing the malpositioning of CVC in the inferior vena cava [9,7]. When plain roentgenogram suggests an aberrant route (subtle lateral deviation of the catheter at the level of L4–L5 and catheter path directly over the vertebral column, rather than to the right of midline), a contrast study is indicated [7,10]. In our case, the anteroposterior roentgenogram and eco-Doppler were misleading. Contrast computed tomography was performed revealing the catheter tip at L5 level in the left ascending lumbar vein and contrast in the epidural space, epidural venous plexus, and venous plexus surrounding nerve roots. Contrast took an ascending route, passing through the intervertebral foramen accompanying nerve roots and reaching the pleural space at the upper thoracic level.

We can only speculate on the mechanisms of this rare complication. Properly placed CVC into the left saphenous vein ascends through the left iliac vein, impinging to the right midline at L4–L5 level, and ascends in the inferior vena cava [7]. However, the catheter can deviate posteriorly because of anatomic proximity of the ascending lumbar vein. Passive venous dilatation caused by decreased intra-abdominal and intrathoracic pressure can force the inadvertent deflection into this location [1,11]. Some authors relate this event to obstruction or thrombosis of the left saphenous vein or inferior vena cava, as it increases blood flow through the paravertebral plexus, which may displace the tip of the catheter from its proper place. Neither superior vena cava nor inferior vena cava obstruction was found in our patient; however, postsurgical anatomic variations may have caused a decrease in intra-abdominopelvic pressure and determine differences in venous drainage route. Significant predominance of the left-sided paravertebral catheter malposition (10:1) indicates that ascension into the ascending lumbar vein is more likely to occur on the left side [12]. The left ascending lumbar vein is longer and more oblique in direction compared with the right common iliac vein, which is shorter and almost vertical [8]. In addition, the angle formed by joining ascending lumbar vein is less acute on the left side, and consequently the left ascending lumbar vein is more prone to aberrant passage of an ascending catheter [8]. Ascending lumbar veins communicate with lumbar vertebral venous plexus through the intervertebral and lumbar veins [1,8]. The vertebral venous system parallels the caval system and during periods of increased intra-abdominopelvic pressure, blood flows through the vertebral plexus rather than through the inferior caval system [1], as occurred in our patient. The internal vertebral plexus forms a continuous network between the

Fig. 2



Computed tomography scan. (a) Lateral left deviation at L4–L5 level of catheter route. (b) Contrast in epidural space. (c) Contrast passing through the intervertebral foramen. (d) Contrast in pleural space. (e) Contrast in epidural space and vertebral plexus surrounding the vertebral body of a low thoracic vertebra. Arrow indicates signaling contrast.

dura mater and the walls of the vertebral canal [6]. As these vessels are so thin walled, it is likely that the catheter, having passed into the ascending lumbar veins, entered the intervertebral veins, ruptured its wall, thereby lodging in the epidural space [6]. Another explanation would be that, after a period of TPN infusion, endothelial damage and ultimately rupture would overcome, releasing TPN into the epidural space [8]. In our case, we could not determine for sure the exact mechanism, but we could document the presence of contrast in all length of epidural space. As

shown in Fig. 2, contrast passed from epidural space through the intervertebral foramen to pleural cavity at the upper thoracic level. With respect to the mechanism we can only speculate, the child may have a specific anatomic characteristic that, at this level, facilitates the passage of contrast to pleural cavity accompanying nerve roots.

At the present time, with 2½ years of follow-up, the child does not have nor had any complication related to this event.

Conclusion

Inadvertent placement of CVC into the ascending lumbar vein during cannulation of the inferior vena cava is a rare complication but much more likely to occur with a line placed through the left lower limb. Unrecognized misplacement of the catheter may be herald by a variety of unspecific symptoms. We describe, to our knowledge, the first case of a patient who developed bilateral pleural effusion secondary to misplacement of a left internal saphenous catheter. Early investigation is imperative if any doubt subsides regarding the CVC placement. Anteroposterior and lateral radiographs of the abdomen are useful means to ascertain catheter position. Every misplaced catheter should be replaced or removed immediately.

Acknowledgements

Conflicts of interest

There are no conflicts of interest.

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