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Case report

Extravasation of TPN following central venous catheter migration

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ABSTRACT

Central venous catheterization is a preferred method for intensive care patients who require total parenteral nutrition (TPN). TPN can cause tissue damage due to osmotic effects and the presence of ions. We report a case of TPN extravasation into the pleural cavity due to a shift in position of a subclavian central vein catheter. In this report, we discuss the importance of serial follow up of chest X-ray examination in patients with central vein catheterization.

1. Introduction

Central venous catheterization (CVC) is a preferred method for critically ill patients who require total parenteral nutrition (TPN), high-volume fluid therapy, or cardiovascular monitoring. [1–4]. A study published in 1988 reported two cases of pleural extravasation of TPN administered through a subclavian vein catheterization, which is a less commonly used and more dangerous method [5]. TPN can cause tissue damage due to osmotic effects and the presence of ions. [6,7] Here, we report a case of TPN extravasation into the pleural cavity due to a shift in position of a subclavian central vein catheter.

2. Case

A 70-year-old woman underwent craniotomy and clipping of the right posterior communicating artery for incidental aneurysm formation. Preoperatively, a double-lumen CVC was inserted via the left subclavian vein for TPN. The post-procedure chest X-rays showed that the catheter was in the correct position in the superior vena cava (Fig. 1). She was given fluids and antibiotics via the subclavian CVC (see Fig. 2).

On postoperative day (POD) 7, she developed shortness of breath, hypoxia, and hypotension. Oxygen was supplied via a nasal cannula and her blood pressure was raised with inotropics. Chest X-ray showed a large left-sided pleural effusion (Fig. 4) and migration of the CVC. A pigtail catheter was inserted immediately to drain the effusion.

The drained pleural fluid was milky, and had triglyceride and glucose concentrations of 465 and 207 mg/dL, respectively; the serum glucose concentration was 98 mg/dL (Table 1). The pleural fluid to serum glucose ratio was >1.

Because the pleural fluid triglyceride concentration was high, we needed to distinguish between hydrothorax and chylothorax. Samples of the TPN fluid and serum were subsequently analyzed (Table 1), and the similarities of the triglyceride and glucose concentrations between the pleural and TPN fluid confirmed the diagnosis.

Comparing the chest X-rays on POD1 and POD7, migration of the CVC tip was seen (Figs. 1, 3 and 4). On discontinuing TPN and removing the CVC, her condition improved. After removing the pigtail catheter on POD 13, there was no recurrence of the pleural

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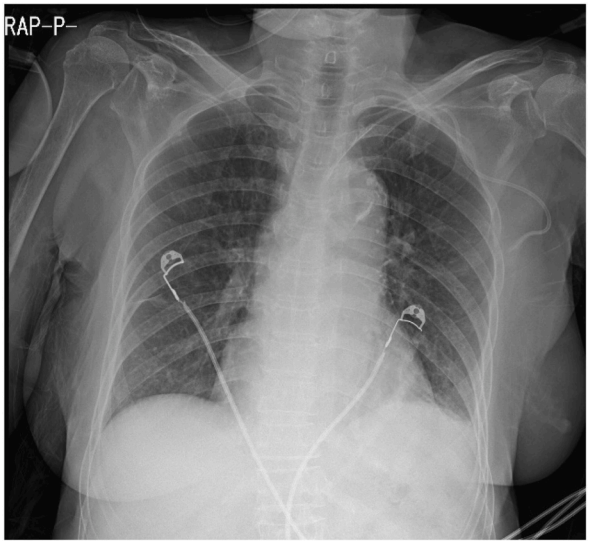

Fig. 1. Chest X-ray on POD1.

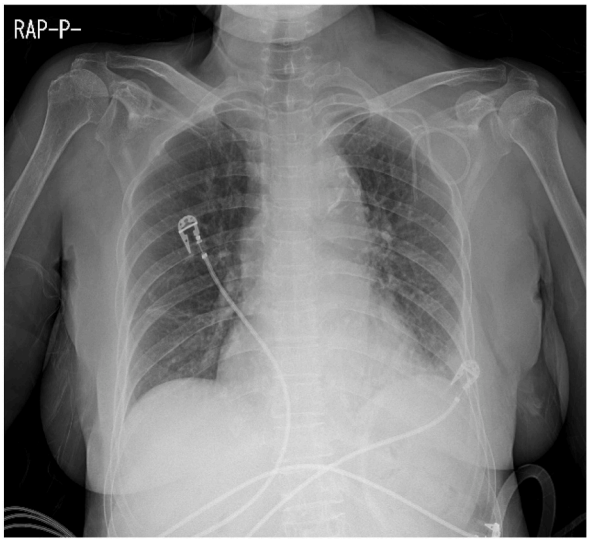

Fig. 2. Chest X-ray on POD6.

Table 1
The biochemistry of pleural fluid analysis.

	1st Pleural fluid analysis (After percutaneous catheter drainage insertion)	2nd Pleural fluid analysis (12 hours later)	Serum
Appearance	Turbid	Cloudy	
glucose (g/dl)	207	121	98
LDH (U/L)	40	90	216
Triglycerides (mg/dl)	465	418	
ADA (U/L)	15.1	1.4	
Protein (mg/dl)	629	1056	5000

effusion or complications.

3. Discussion

Parenteral nutrition is widely used in cases with gastrointestinal tract disease, to address malnourishment and prevent

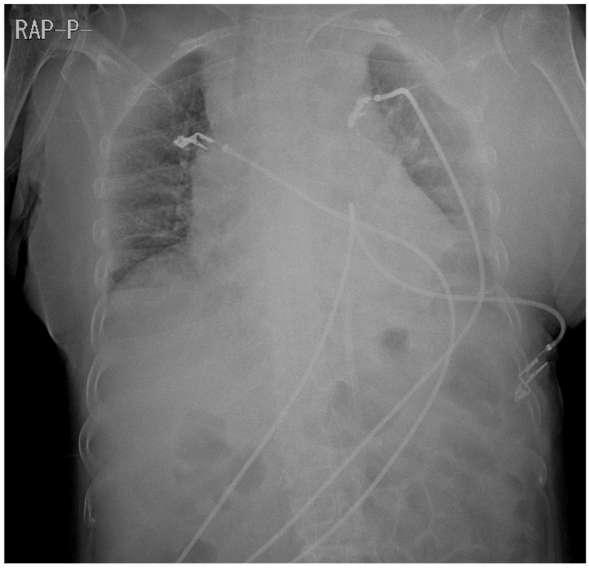

Fig. 3. Chest X-ray on POD7 (event day morning).

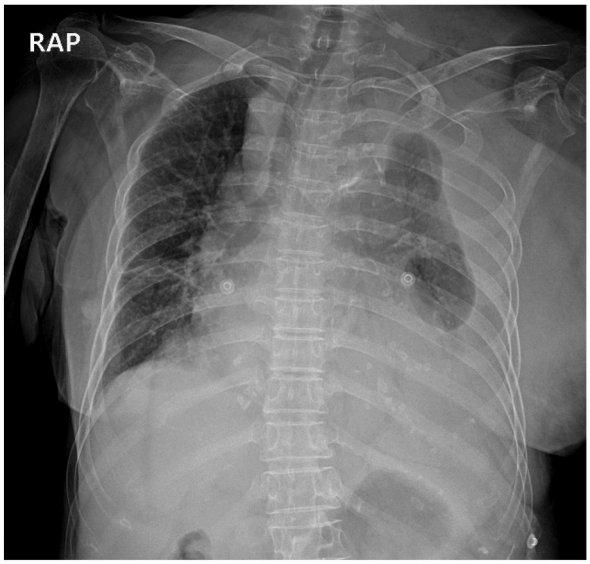

Fig. 4. Chest X-ray on POD7 (event day night).

malnutrition, but there are potential problems including infection, catheter malposition, and metabolic complications (hyperglycemia, hyperlipidemia, hypercapnia, acid–base disturbance, liver complications, and metabolic bone disease) [8]. The differential diagnoses of a turbid or milky pleural effusion include chylothorax, pseudo-chylothorax (cholesterol pleurisy), and empyema [9]. Empyema is differentiated by centrifugation, which results in a clear supernatant, along with other biochemical and microbiological investigations. Pseudo-chylothorax arises when fluid has been present in the pleural space for a protracted period, especially in cases of pleural fibrosis [9]. Chylothorax and pseudo-chylothorax can be discriminated by measuring lipids in the fluid. Chylothorax is typically associated with a high pleural fluid triglyceride concentration ($>$1.24 mmol/L), and can usually be excluded if the triglyceride concentration is $\leq$ 0.56 mmol/L [10]. The literature on the utility of the cholesterol level for differentiating chylothorax and pseudo-chylothorax is conflicting. While some authors state that a high cholesterol concentration (5.2 mmol/L) indicates pseudo-chylothorax [9], others have found no difference in cholesterol concentration between the two entities [14]. In our case, the pleural fluid cholesterol concentration was 3.2 mmol/L. Clinicians should be aware of this rare complication of parenteral nutrition (PN), especially when there is a sudden deterioration in respiratory function with no obvious cause.

A pleural fluid glucose concentration of 3.3 mmol/L is found in exudative pleural effusions secondary to empyema, rheumatoid disease, lupus, tuberculosis, malignancy, and esophageal rupture. The glucose concentrations are lowest in rheumatoid effusions and

empyema [9]. By contrast, a high pleural glucose concentration is rare. There have been case reports on TPN fluid leakage [11], esophageal perforation [12] and peritoneal dialysis [13], leading to elevated glucose in pleural fluid. When chylous fluid is suspected in patients receiving PN, triglyceride and cholesterol concentrations should be measured, as well as glucose and osmolality, to prevent misdiagnosis and further unnecessary investigations. In our two cases, the PN included dextrose, as well as calcium, potassium, and other ions, and its osmolarity was clearly higher than that of human serum osmolarity (281–289 mOsm/L) [6]. The hyperosmolarity and presence of these ions contributed to the extensive inflammatory reaction seen immediately after extravasation in both patients. Hyperosmolarity is thought to disrupt the transport mechanism of the cell membrane, resulting in cell death due to fluid imbibition. The presence of calcium and potassium ions in extravasated fluid is especially hazardous for tissues, and can cause prolonged ischemia leading to necrosis [15]. Elevated triglyceride, glucose, and potassium levels strongly suggested TPN fluid rather than chyle.

The diagnosis of chylothorax is based on the lipid profile of pleural fluid, i.e., a high triglyceride concentration in the presence of chylomicrons together with a low cholesterol concentration [9,14,16]. Chylothorax can be triggered by trauma, malignancies, liver cirrhosis and heart failure; it can also be congenital [9,17–21]. Diagnosis is based on the lipid composition of the fluid (high triglycerides, the presence of chylomicrons and a low cholesterol level), which differentiates chylothorax from pseudo-chylothorax; the latter fluid has a chyle-like appearance but is not associated with lymphatic vessels, and contains very high concentrations of cholesterol without triglycerides or chylomicrons. Pseudo-chylothorax can develop when fluid is present in the pleural space or a fibrotic pleura for a protracted period [9,14,16].

On the chest x-ray, the tip of the peripherally inserted CVC had migrated to the medial direction of the right subclavian vein. (31,32) Timely diagnosis and management are critical for preventing morbidity and mortality. Echocardiography did not show heart failure in our patient, and there was no evidence of kidney dysfunction. Although the CVC was inserted in the proper position, it had migrated, as shown by the chest X-ray. Malpositioning of the CVC causes TPN or other fluids to leak into the chest cavity or mediastinum, causing hydrothorax and hydromediastinum, respectively. This can lead to hypoxia, sepsis, and cardiovascular collapse, so the location of the catheter in the chest X-ray should be checked carefully.

The hypertonicity of TPN may trigger rapid vascular erosion. In an autopsy reported in 1998, the presence of TPN in the pleural space was detected based on high glucose and potassium levels.

The extravasation of irritants can cause an inflammatory reaction, accompanied by warmth, erythema, and tenderness in the extravasated area [22,23]. Extravasation of TPN is most commonly reported in newborns in the intensive care setting [24]; there are few adult case reports and the vast majority of reports were published more than a decade ago [6,15,24–27]. TPN is a complex mixture of amino acids, dextrose, lipids, vitamins, electrolytes, and trace elements [4]. The solution is often hyperosmolar (>1000 mOsm/L) to the serum (285 mOsm/L) [22]. Although the exact mechanism underlying the tissue toxicity caused by extravasated TPN is not clear, it has been suggested that it is related to the hyperosmolarity, acidic pH, and ion content of the PN [6,22,23]. Treatment should ideally include early recognition of TPN extravasation, with immediate discontinuation of the infusion [6,22,23]. When extravasation does occur, it is important to recognize and treat it promptly [22,23,25]. Lipoprotein electrophoresis (chylomicron) is the gold standard for detecting chyle, but it is expensive, laborious, and rarely available [3]. Analysis of triglyceride levels is the best option for detecting chyle when lipoprotein electrophoresis is unavailable and the measurement of cholesterol is regarded as unnecessary [3]. In our case, on the assumption that the fluid was chyle, we analyzed the triglyceride levels, which were increased. However, high triglyceride levels can be present in both chyle and TPN fluid; therefore, the glucose and potassium levels were also checked [4]. The high potassium and glucose levels led to the diagnosis of TPN leakage.

Fixation of CVC by suture is important management in the prevention of CVC migration. And also frequent checking of suture site whether the knot is tied well or not is helpful to prevent CVC migration. Careful checking of the position of the CVC on X-ray might have allowed for early diagnosis and immediate management, thus reducing complications [29,30].

4. Conclusion

In most case reports, iatrogenic chylothorax is caused by complications arising immediately after CVC insertion. There have been no reports of catheter migration 7 days after catheter insertion, aside from this case.

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Declaration of competing interest

The authors declare that they have no competing financial interests or personal relationships.

List of abbreviation

TPN	Total parenteral nutrition
CVC	Central venous catheterization
POD	Postoperative day

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