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# Delayed Vascular Perforation after Ultrasound-Guided Central Venous Catheter Insertion with Infraclavicular Approach: A Case Report

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**Abstract** | **Case Report**

Central venous catheter (CVC) insertion is essential for critically ill patients but entails risks, delayed venous perforation which is rare and can be fatal. This complication is difficult to detect early as clinical manifestations such as fever or dyspnea may appear late. We report a case of delayed venous perforation diagnosed by parenteral nutrition fluid drainage through a chest tube. A 72-year-old man underwent ultrasound-guided CVC insertion through the right subclavian vein with infraclavicular approach for scheduled right hepatectomy. A pneumothorax occurred during CVC insertion, for which a chest tube was placed. The chest radiograph obtained at that time demonstrated appropriate CVC position. On postoperative day 2, milky fluid drained from the chest tube after parenteral nutrition was started. A chest computed tomography confirmed the CVC tip had perforated the venous wall at the junction of Superior vena cava and innominate vein, extending into the mediastinum. The CVC was immediately removed, and the patient recovered uneventfully with antibiotics. Clinicians must maintain vigilance during follow-up. Any unexpected radiographic change in catheter tip position or failure to aspirate blood should prompt concern for delayed perforation and immediate preventive action.

**Keywords**: Central venous catheter complication, delayed venous perforation, superior vena cava perforation, mediastinitis.



## INTRODUCTION

Central venous catheter (CVC) insertion is an essential procedure for critically ill and surgical patients requiring fluid administration, blood transfusion, dialysis, parenteral nutrition, and reliable medication delivery. However, this procedure carries inherent risks and may result in various complications. Associated complications include arterial puncture, pneumothorax, hematoma, CVC-related infection, venous thrombosis, and delayed venous perforation [1]. Among these complications, delayed venous perforation has a relatively low incidence but can cause severe adverse events such as mediastinitis, pneumonia, and sepsis when it occurs. Moreover, early recognition remains challenging, as clinical manifestations such as fever and dyspnea may not appear until significant complications have developed [2]. We present a case of delayed venous perforation diagnosed by chest-tube drainage of parenteral nutrition fluid, with a review of related literature.

## CASE REPORT

The Institutional Review Board of Presbyterian Medical Center approved the study and determined that informed consent was not required, under which the patients' medical records were reviewed. (IRB no. PMC 2025-10-004).

A 72-year-old man (156 cm, 47 kg; Body mass index 19.3 kg/m²) was scheduled for right hepatectomy due to hepatocellular carcinoma. Previous medical history included hypertension and a previous cerebral infarction, resulting in mild residual hemiparesis but preserved independent ambulation. Antiplatelet therapy had been discontinued one week before surgery. Preoperative investigations, including electrocardiography, chest radiography, chest computed tomography (CT), and routine laboratory tests were unremarkable.

On the day of surgery, no premedication was administered and baseline vital signs were within normal limits. Following preoxygenation with 100% oxygen via a facial mask, anesthesia was induced with

remimazolam, rocuronium, and remifentanil, and endotracheal intubation was performed uneventfully. An arterial line was then placed in the right radial artery under ultrasound guidance. A 7-Fr triple-lumen catheter (Prime-S®, SungWon, Cheongju, Korea) was inserted through the right subclavian vein using an infraclavicular approach under ultrasound guidance. CVC was inseted as 13.5cm. Blood aspiration and saline flushing from all three lumens were achieved without resistance. Approximately four hours after induction, excessive elevation of the right diaphragm was noted. Intraoperative portable chest radiography revealed a right-sided pneumothorax (Figure 1A), and a chest tube was inserted immediately (Figure 1B).

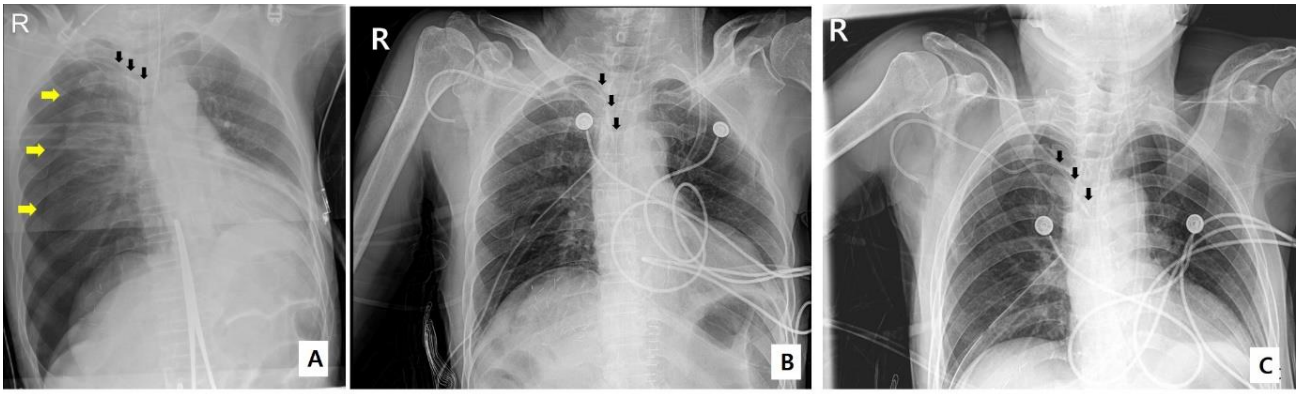


**Figure 1: Chest radiograph**
**(A): Intra-operative radiograph. Pneumothorax is present (Yellow arrows). Catheter tip is directed toward the aortic arch (black arrows), with the upper arm abducted at 90°**
**(B): Post-operative radiograph. Catheter tip is oriented parallel to the course of SVC (black arrows), with the upper arm adducted**
**(C): Chest radiograph at postoperative day 1. Catheter tip is not oriented parallel to the course of superior vena cava (black arrows), with the upper arm abducted**

At the end of surgery, neuromuscular blockade was reversed with sugammadex 200 mg. After recovery of spontaneous ventilation, the patient was extubated and exited the operating room uneventfully. The total duration of surgery was 6 hours 35 minutes, and anesthesia time was 7 hours 40 minutes. Intraoperatively, 3,000 mL of crystalloid and 500 mL of colloid were infused through the distal lumen of the CVC, and 700 mL of crystalloid and 500 mL of colloid through the proximal lumen of the CVC.

From postoperative day 0 to 2, the patient exhibited leukocytosis and a fever ranging from 37.5°C to 37.8°C. Enteral feeding through a nasogastric tube was initiated, and parenteral nutrition was administered through the distal lumen of the CVC. On postoperative day 2, milky fluid drainage was noted through the chest tube. The patient reported no additional complaints, except for mild discomfort at the chest tube site and surgical wound pain. Chest CT was performed to evaluate for chylothorax and to identify the source of fever. The CT revealed that the central venous catheter tip had perforated the venous wall at the junction of the innominate vein and the superior vena cava(SVC), extending into the mediastinum (Figure 2). Diffuse mediastinal fluid collection was observed, with additional fluid in the left pleural space, whereas the right pleural space was drained by the existing chest tube. CVC use was immediately discontinued, and it was removed under radiologic guidance. No active bleeding or acute complications occurred following removal. Post-removal, the patient's condition was closely monitored under continuous antibiotic therapy. By postoperative day 10, the white blood cell count and body temperature had normalized. Follow-up chest CT on postoperative day 24 showed minimal residual mediastinal and pleural fluid collections, and the chest tube was removed. The patient recovered uneventfully and was discharged without further complications.

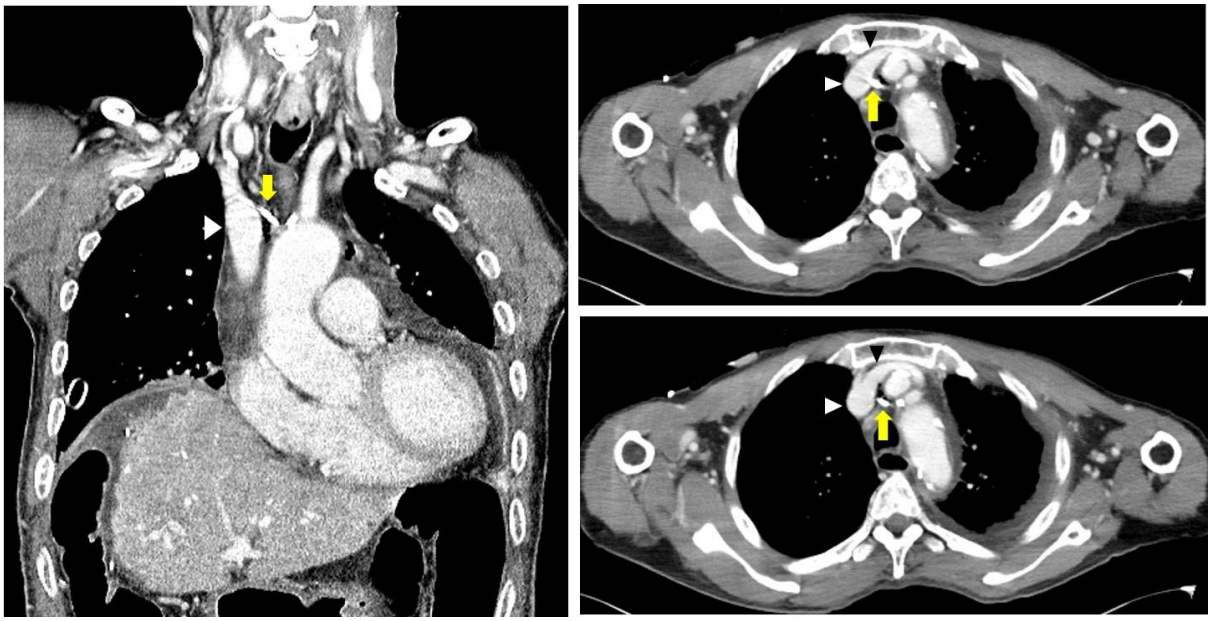

**Figure 2: Chest Computed tomography**
**Central venous catheter (yellow arrows) perforated junction of left innominate vein (black arrowheads) and superior vena cava (white arrowheads)**

## DISCUSSION

The prevention of CVC-related complications depends on careful use of ultrasound guided insertion, proper determination of insertion depth, radiographic verification of catheter placement, and confirmation of free aspiration and smooth irrigation. Among these, ultrasound-guided insertion has been shown to reduce complications such as hematoma, pneumothorax, arterial puncture, and nerve injury [3]. However, catheter malposition after insertion cannot be detected by ultrasound at the insertion site and may lead to critical complications. Two principal strategies are recommended to reduce this risk. First, verification of free aspiration of blood from all lumens without resistance, and second, radiographic confirmation of appropriate catheter length and location of catheter tip [4].

In this case, blood aspiration was confirmed from all three lumens without resistance. Chest radiographs after chest tube insertion demonstrated the catheter tip pointing toward the aortic arch while the ipsilateral upper limb was abducted to 90° (Figure 1A). After surgery, chest radiographs revealed the catheter tip oriented parallel to the course of the SVC, with the upper limb in adduction. (Figure 1B). However, one day later, chest radiographs showed the catheter tip no longer aligned with the course of SVC, with the upper limb in abduction. (Figure 1C). It is thought that CVC migration occurred postoperatively as the awake patient moved his upper limb or changed position, resulting in vein wall injury. Previous report has similarly implicated positional changes in CVC-induced venous perforation [5]. CVC was considered to remain correctly positioned within a vein throughout the surgery, because despite the intraoperative infusion of 5,200 mL through it, neither intraoperative imaging nor chest-tube drainage demonstrated fluid extravasation. Therefore, even if catheter length and angle are considered appropriate immediately after insertion, radiograph or repeated aspiration checks of each lumen should be performed to detect subsequent malposition and reduce venous perforation risk.

Optimal catheter length selection is also important for preventing complication. This is because if the inserted length is too short, the catheter tip may be located above the superior vena cava and cause venous perforation [6]. As discussed below, ultrasound-guided insertion may result in a more lateral puncture site, leading to an unexpectedly insufficient catheter length. Peres *et al.*, previously suggested that an appropriate catheter length for infraclavicular CVC insertion using the landmark technique is (height/10 – 2 cm) [7]. However, Zarskus *et al.*, reported that, with ultrasound-guided infraclavicular insertion, an additional 1.5 cm beyond the landmark technique is required to achieve optimal tip position [8]. This discrepancy is due first to clavicular shadowing that limits ultrasound visualization of the subclavian vein and second, particularly in the in-plane approach, to lateral displacement of the puncture site by the ultrasound probe [8]. Oh *et al.*, further noted that, during ultrasound-guided insertion, the vein puncture point often lies lateral to the subclavian vein at the axillary vein or its junction [9]. In the present case, a CVC insertion depth of 13.5 cm was selected based on patient height; however, this length appeared to be slightly insufficient.

Finally, an infraclavicular approach was used for this patient, which may also have contributed to vascular perforation. There have been reports that

infraclavicular access carries a higher risk of catheter malposition than the supraclavicular approach [10]. However, given the rarity of delayed vascular perforation, further research into risk factors specific to each apporach is necessary.

## CONCLUSION

CVC, as a critical procedure, carries inherent risks of complications. While some complications are recognized immediately, delayed vascular perforation, although rare, may not be apparent at the time of insertion and can result in life-threatening consequences. To mitigate this risk, clinicians should maintain vigilance not only immediately post-procedure but also during subsequent follow up. Any changes in catheter tip position or orientation on radiographs, failure to aspirate blood, or other unexpected findings should prompt consideration of delayed perforation and appropriate preventive measures.

### SUBMISSION DECLARATION

We confirm that this manuscript is original and not plagiarized, has not been submitted elsewhere, and will not be submitted to another journal during the review process. All authors agree to abide by the publication requirements and policies of SAS Publishers.

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