


CASE REPORT

Pitfall of left sided triple-lumen catheter for continuous renal replacement therapy: A case report

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Abstract

We report a case of vascular injury caused by a multi-lumen catheter for CRRT inserted through left jugular vein. Diagnosis was delayed because CRRT could be continued. Clinicians should be aware of potential vascular complications associated with the wrong placement of multi-lumen catheters even if blood flow continues without difficulty.

KEYWORDS

blood purification, innominate vein, triple-lumen catheter

1 | INTRODUCTION

A multi-lumen catheter may be used for vascular access during the continuous renal replacement therapy (CRRT). While this is a commonplace procedure, it may be associated with serious and even fatal complications. We report here a case of vascular injury associated with the insertion of a triple-lumen catheter; diagnosis was delayed because CRRT could be continued despite this serious injury.

2 | CASE PRESENTATION

An 87-year-old woman was transported to our institute for evaluation and treatment of an acute disturbance of consciousness and right hemiplegia. Her medical history was notable for chronic renal failure due to diabetic nephropathy that required regular hemodialysis (HD). Upon admission, she was diagnosed with cerebral infarction by computed tomography (CT) and magnetic resonance image (MRI) that was treated via a thrombectomy. Given her clinical condition, we were

concerned that conventional HD would be associated with a high risk of disequilibrium syndrome; as such, CRRT was recommended. An initial effort was made to obtain central access via ultrasound-guided insertion of a triple-lumen catheter into the right internal jugular vein; this effort failed due to accidental arterial puncture.

On day 2, we inserted a triple-lumen catheter (Gentle Cath™ COVIDIEN) via the left internal jugular vein under fluoroscopic guidance by emergency physician who is a nonvascular expert (Figure 1). Although the catheter advanced easily into the central vein, it was too short (16 cm) to reach the right atrium. But a longer blood access catheter was not available in our institute. Therefore, we placed the catheter at the innominate vein without touching the superior vena cava (SVC) wall. The position of the tip of catheter was confirmed by X-ray, and smooth functioning of the catheter was confirmed by blood withdrawal and saline flush through all three of the catheter lumens. Then, it was secured with sutures. After initiation of CRRT with administration of Nafamostat mesylate, a chest radiograph taken on day 3 revealed an enlarged mediastinum, which was consistent with

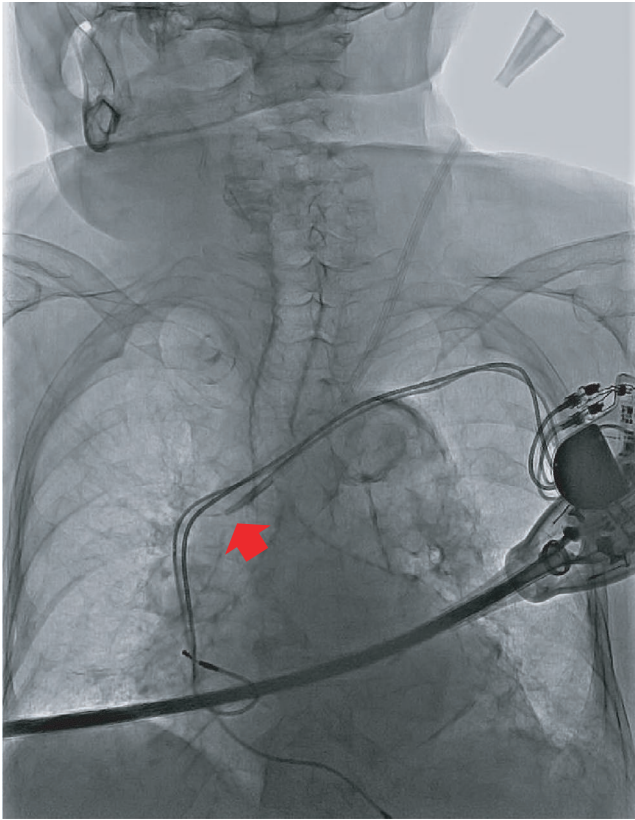


FIGURE 1 Perspective image after insertion of a triple-lumen catheter. Arrow indicates the catheter tip positioned at the superior vena cava

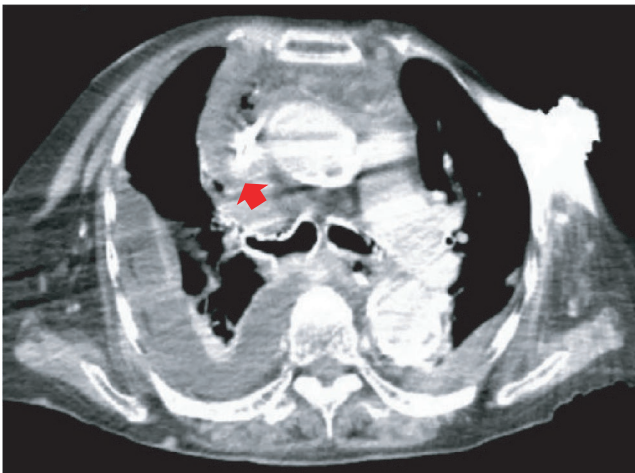


FIGURE 2 Enhanced CT scan revealed a fluid collection and air in the mediastinum. Arrows indicate catheter placed at the superior vena cava

mediastinitis; at that time, vital signs remained stable except for low-grade fever, and laboratory data showed an elevated white blood cell count ($90 \times 10^3/\mu\text{L}$) and C-reactive protein value (10.7 mg/dl). CRRT could be continued without difficulty (blood flow in the circuit: 80 ml/min, drainage pressure: 70–80 mmHg, and infusion pressure: 100–120 mmHg).

With respect to fever, laboratory data, and CT findings, we misdiagnosed them as mediastinitis associated with the first puncture. Since those inflammatory indices were gradually worsening, CT was performed on day 6, which suggested vascular injury (Figure 2). On day 7, transcatheter angiography revealed extravasation of the contrast media from the proximal lumen, confirming with vascular injury (Figure 3); therefore, an emergency thoracotomy was performed. During the procedure, we determined that the infusion port of the catheter had penetrated one wall of SVC; both drainage and return ports remained inside vessel (Figure 4). No fistula was identified. The catheter was removed, and the site of perforation was sutured. The patient's postoperative course was uneventful, and she was transferred to a rehabilitation hospital on 20 day after surgery.

3 | DISCUSSION

Central venous catheters (CVCs) are frequently associated with complications. The common immediate complications include arterial puncture, hematoma, pneumothorax, and hemothorax. Furthermore, the delayed complications include infection, venous thrombosis, and catheter migration. Among delayed vascular complications, delayed vascular perforation is a rare but life-threatening complication, especially when placed on the patient's left side.^{1–5}

Abdelkefi et al³ reported that the catheter tip is often positioned so that it is in direct contact with the lateral wall

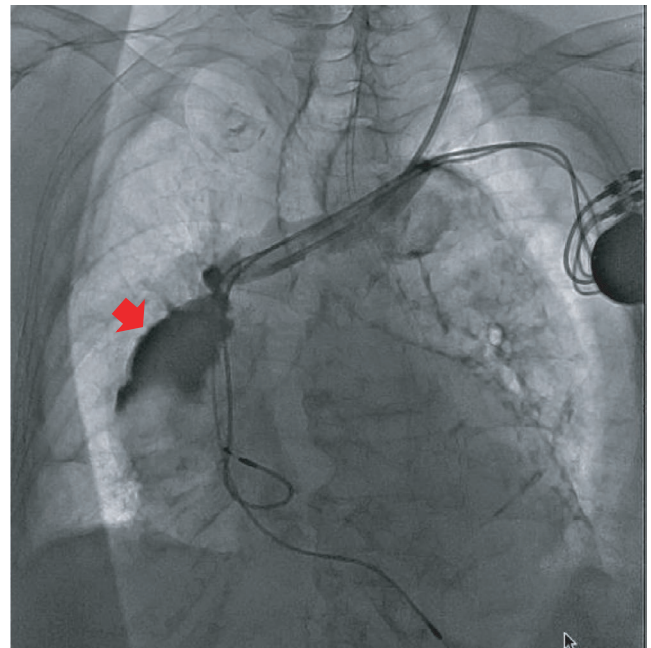
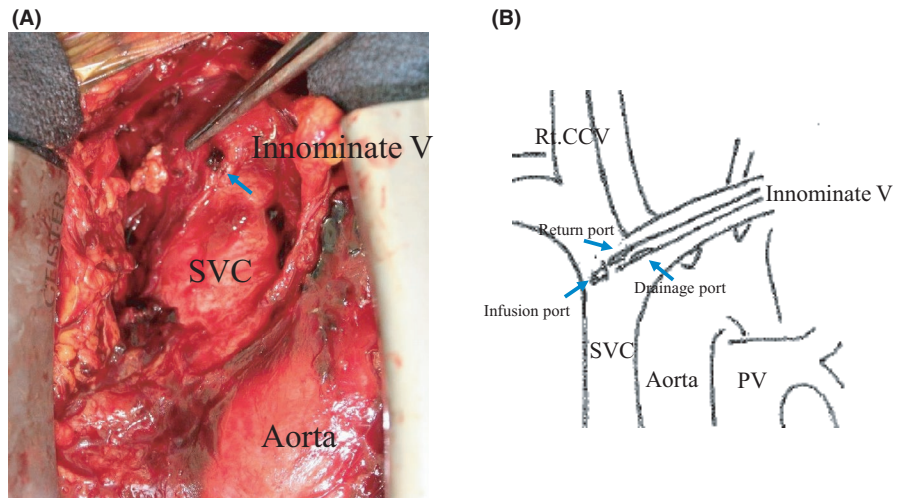


FIGURE 3 Transcatheter angiography through the triple-lumen catheter revealed extravasation of the contrast agent. Arrow indicates extravasation of contrast agent detected outside of the SVC within the mediastinum

FIGURE 4 A, Operative findings show the perforation of superior vena cava (arrow). Catheter was already removed. B, This schema is an imaginary drawing in this case. The catheter perforated the SVC wall, but both drainage and return port were placed inside of the vessel. Only infusion port was out of the SVC. CCV, common carotid vein; SVC, superior vena cava; PV, pulmonary vein



of the SVC where the innominate vein is at a right angle to the SVC. Several mechanisms of vascular injury due to insertion of CVCs have been reported, including (1) direct trauma during insertion of the guide wire or catheter, (2) movement of the catheter tip after insertion due to changes in arm, neck, and/or head position, (3) continuous contact of the catheter tip with vascular wall associated with the heartbeat, and (4) vascular endothelial damage due to infusion of a hyperosmolar solution through the distal port.⁶⁻⁹

In this case, we speculate that the catheter perforated the vessel wall due to continuous contact of the tip with the vessel and movement associated with a change in neck and head position. The perforation was unlikely to have occurred during insertion; positioning of the catheter was confirmed at that time by evaluation of blood regurgitation and saline flushes through all three lumens. Moreover, only crystalloid fluids were introduced via distal port; as such, the perforation was not likely to be related to infusion of hyperosmolar solutions.

A chest radiograph performed on the following day after initiation of CRRT revealed an enlarged mediastinum. At that time, as CRRT continued with no difficulties, we misdiagnosed it as mediastinitis associated with the first unsuccessful attempt at catheter insertion. Although this finding suggested the possibility of vascular injury in a retrospect, we were not aware that vascular injury should be excluded. It caused a delay in definitive care. Although SVC injury was diagnosed by enhanced CT, surgical repair following angiography was performed the next day, because the patient was hemodynamically stable and there were no findings indicating active bleeding.

Ultimately, we determined that both the drainage and return ports had remained within the vessel. We speculate that the cause of this complication was the placement of the catheter at an inappropriate position that is the innominate vein. To prevent complications, we did the best under the existing conditions by placing the catheter tip in the right atrium. The catheter that we used was too short (16 cm) to place on SVC/

RA junction. In fact, the only available longer catheter for the CRRT was 25 cm long for the femoral vein in our institute. A catheter with adequate length (20 cm) was rarely required, because of a small physique of Japanese, and infrequent approach to the left internal jugular vein.

To our knowledge, this is the first documented case of the vascular injury associated with multi-lumen catheters in which hemodialysis continued. Clearly, a check to determine appropriate blood regurgitation from the infusion port would have led to an earlier diagnosis of this condition.

4 | CONCLUSION

When using a multi-lumen catheter for central access during CRRT, clinicians should be careful not to miss the possibility of vascular injury in case of inappropriate placement of a vascular access catheter even if blood flow through an extracorporeal circuit could be maintained. A thorough understanding of the structure of the CVC may prevent similar delayed diagnoses. The placement of catheter tip at the appropriate position is very important.

ACKNOWLEDGMENT

Published with written consent of the patient.

CONFLICT OF INTEREST

The authors declare no conflict of interest.

AUTHOR CONTRIBUTIONS

S. Ijuin: was involved in main work, data collection, and manuscript writing; MF, DF, MS, SK, AI, SM, TK, and SN: was involved in data collection and manuscript revision; S. Ishihara: was involved in final revision.

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How to cite this article: Ijuin S, Ishihara S, Fukushima M, et al. Pitfall of left sided triple-lumen catheter for continuous renal replacement therapy: A case report. *Clin Case Rep.* 2021;9:105–108. <https://doi.org/10.1002/ccr3.3463>