Clinical Case Report

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The malposition of a central venous catheter through a sheath introducer via the left internal jugular vein

A case report

Jung A. Lim, MD, Chan hee Jee, MD, Kyung-Hwa Kwak, MD, PhD*

Abstract

Rationale: The misplacement of central venous catheter (CVC) can occur more often at the left jugular vein than the right side due to anatomic differences. And many of the previously reported cases are about catheter misplacement resulting from vessel penetration associated with guidewire. This case differs that the catheter itself through the sheath introducer can cause venous injury that may lead to the malposition of CVC particularly through an approach to the left internal jugular vein.

Patient concerns, diagnosis, interventions, and outcomes: We cannulated a large-bore CVC with a sheath introducer, namely mult-lumen access catheter (MAC) in the left jugular vein of patient under anesthesia using ultrasound and inserted the additional central venous oximetry catheter through the sheath introducer of MAC and confirmed aspiration of blood. However, the postoperative imaging study revealed malposition of the tip of the oximetry catheter in the mediastinum.

Main lesson: The insertion of additional catheter through the sheath introducer needs to be carried out as carefully as the insertion of guidewire and should be confirmed with imaging study after the procedure.

Abbreviations: CVC = central venous catheter, CVP = central venous pressure, MAC = multi-lumen access catheter.

Keywords: central venous catheter, left internal jugular vein, malposition, mediastinum

1. Introduction

Central vein catheterization is a common procedure to provide fluid and blood infusion, to administer drugs, and to monitor central venous pressure (CVP). It is an invasive procedure that may cause several complications, such as cannula malposition, arrhythmia, infection, artery perforation, pneumothorax, and hemothorax.[1] Although various aids such as ultrasound guidance increase the successful placement of catheters, considerable numbers of catheter malposition can still occur.[2] Generally, catheter malposition occurs most commonly when a left internal jugular vein or subclavian vein is cannulated due to anatomic differences. Here, we report the malposition of a central venous oximetry catheter that was inserted through the sheath introducer built in a large bore central catheter, multilumen access catheter (MAC) via the left internal jugular vein and was found out later to be erroneously placed into the mediastinum after performing a postoperative chest x-ray and computed tomography. This case suggests that the CVC itself could lead vein perforation and be mispositioned.

2. Case report

A 43-year-old man with dissection of abdominal aorta was scheduled for emergency aortic occlusion ballooning and primary closure. He also had interventricular hemorrhage, right multiple rib fractures with pneumothorax, and C2 odontoid fracture. When he arrived at the emergency department, he was in a drunken state and his initial systolic/diastolic blood pressure and pulse rate were 43/31 mm Hg and 91 beats per minute, respectively. The norepinephrine infusion applied 0.4 μg/kg/min with fluid resuscitation. He had no past medical history and his preoperative laboratory findings were hemoglobin (Hb) 7.3 g/dL, prothrombin time 20.7 seconds, partial thromboplastin time 75.6 seconds, international normalized ratio 1.85, Troponin I 0.263 ng/mL, and others appeared to be within normal range. A simple chest x-ray revealed right pneumothorax and electrocardiogram showed sinus tachycardia with 103 of heart beats.

The patient arrived in the operating room having a central line at the right subclavian vein and endotracheal intubation. He also had chest tube drainage on the right side. His systolic/diastolic blood pressure was 79/48 mm Hg, heart rate was 120 beats per minute, and oxygen saturation was 98%. After confirming the modified Allen test, the right radial artery was cannulated with 20-gauge catheter for continuous arterial blood pressure monitoring and arterial blood gas analysis. He was agitated and anesthesia was induced by using 2 mg midazolam, 50 mg

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Department of Anesthesiology and Pain Medicine, Kyungpook National University School of Medicine, Daegu, Korea.

* Correspondence: Kyung-Hwa Kwak, Department of Anesthesiology and Pain Medicine, Kyungpook National University School of Medicine, 130 Dongdeok-ro, Jung-gu, Daegu 41944, Korea (e-mail: kwakkh@knu.ac.kr).

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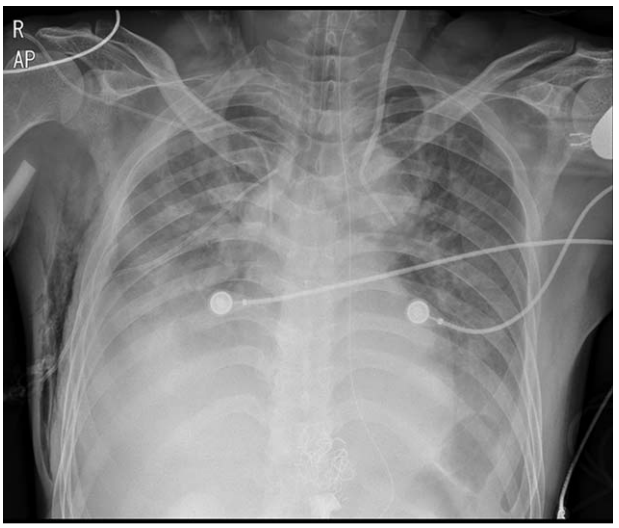

Figure 1. The left internal jugular catheter is not across the midline with catheter kinking shown on this chest x-ray.

rocuronium, and maintained with 2.5 L/min air, 1.5 L/min O_2, and 4 to 6 vol% desflurane.

Although he already had central vein catheter in the right subclavian vein, we decided to insert additional central catheter to prepare for an unexpected massive bleeding and to keep the infusion rate of norepinephrine. The patient was placed in the Trendelenberg position and the left internal jugular vein was punctured with an 18-gauge needle using ultrasound. The guidewire was inserted through needle without any resistance up to 20 cm and the needle was removed. After the incision on the skin, the large bore central catheter (MAC Two-lumen central venous access set; Arrow international, Reading, PA) accompanying dilator was pushed in along the guide wire. It has a sheath introducer built in as well as a 9 Fr and 12-gauge lines. The sheath introducer, namely hemostasis valve, gives access for the additional catheter. The insertion was made without resistance and we confirmed aspiration of blood through 2 lumens of the catheter and connected flow management system (FMS).

To measure central venous oxygen saturation ($ScvO_2$), we inserted additional 8.5 Fr central catheter (PreSep-oximetry catheter set: Edwards Lifesciences, Irvine, CA) through MAC's hemostasis valve without resistance and confirmed aspiration of venous blood in all three lumens. No noticeable resistance, arrhythmia, or changes in vital signs were observed during the insertion of the intravenous catheter. Intravenous fluids were uneventfully infused through this catheter. The proximal lumen was connected to pressure kit transducer for CVP monitoring and other 2 lumens were kept without fluid infusion. Intraoperative CVP was maintained at 6 to 10 mm Hg and there was no abnormal change of waveform. After end of operation, the patient was transferred to the intensive care unit keeping intubation with sedation.

Postoperative chest x-ray revealed that there was small amount of pleural effusion in both lower lung field and the catheter did not across the midline showing catheter kinking (Fig. 1). The further chest computed tomography showed that the MAC was located in the left innominate vein abutting the inferior wall of innominate vein and the central oximetry catheter was running through MAC and its distal tip protruded out of the proximal innominate vein into the mediastinum (Fig. 2). With a plan for balloon occlusion of the vessel perforation, the patient underwent catheter removal with balloon advancement to the left innominate vein and kept balloon tamponade for 5 minutes to limit bleeding. After balloon deflation, contrast leakage was not found in venography and did not require further treatment. Follow-up chest x-ray and arterial blood gas analysis showed normal finding and the patient was extubated after 3 days. He had additional C2 to C3 screw fixation for C2 odontoid fracture 21 days later discharged from hospital without complications.

Approval for the study by the local institutional review board was not required because it was a case report.

3. Discussion

The CVC-induced intrathoracic vein injury and its malposition are not rare. Several potential mechanisms of intrathoracic vein injury have been proposed. One possible explanation includes forced manipulation of the dilators or guide wires against resistance. One may infer that a guidewire alone might perforate a vein. However, there is very little evidence that this actually happens with flexible spring guide wires. The most likely mechanism of injury is that a guidewire becomes strapped against the wall of a vein by a stiff dilator, sheath, or catheter that is being advanced over the guide wire, and the vein is perforated or torn.

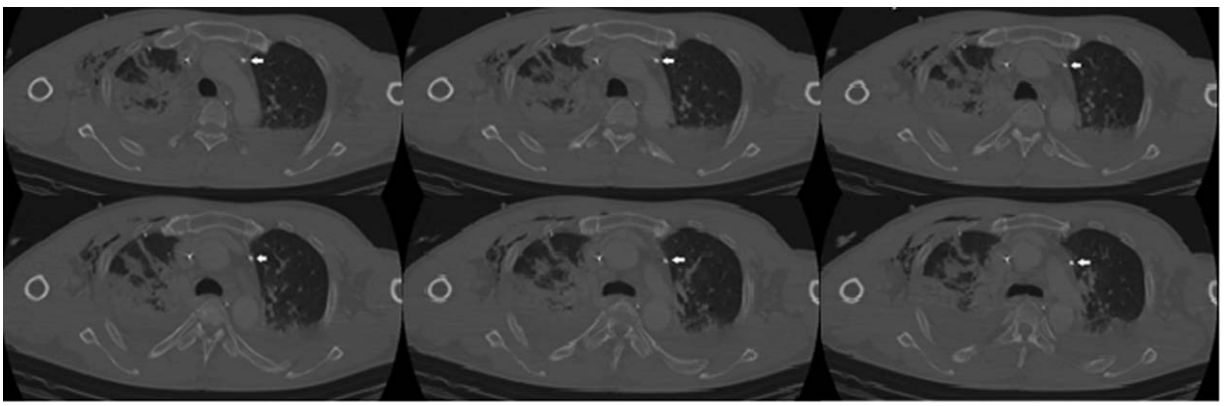

Figure 2. Chest computed tomography shows that the central oxymetry catheter is inserted and protruded out of the left innominate vein and the arrow indicates that the catheter proceeds toward mediastinum.

This problem probably is more likely to occur with the left side internal jugular vein approach, than the right internal jugular vein approach because the left innominate vein, in particular, is anatomically different from the right innominate vein and this discrepancy makes it difficult to place catheter in correct site. The inferior wall of the left innominate vein is at a relatively acute angle to the path of the left internal jugular vein. Thus, the guide wire can make a relatively acute right-hand bend as it enters the innominate vein from the left internal jugular vein, and the guide wire can be trapped at that point when the introducer sheath, dilator, or CVC is advanced.[3]

The current case differs from the previously reported examples in that successful positioning of an additional CVC through the stiff sheath introducer largely depends on the location of prepositioned stiff sheath inducer in left-sided internal jugular vein puncture approaches. In our case, as 10 cm length stiff large bore MAC was already placed at the acute angle between the left internal jugular vein and left innominate vein, facing and abutting the wall of the left innominate vein, there was very limited room between the tip of the MAC and the wall of the innominate vein for subsequent 8.5-Fr catheter that came through the MAC. Thus, we assume that this condition may increase the risk for the additional catheter to abut and injure the wall of the innominate vein. The final perforation of the vessel and malposition of catheter may occur in either way; the catheter may perforate the vessel wall directly during the insertion or its tip may wear the vessel wall and later migrate through the wall. It has been shown in the laboratory that an angle of the CVC tip to vessel wall of greater than 40° is more likely to lead to vessel wall perforation.[4]

To reduce complications and assure appropriate placement of the catheter, several techniques such as use of imaging guidance during insertion have been suggested. Although there is no doubt that ultrasound guided insertion improves the safety of CVC insertion, they may not prevent subsequent malposition or vascular perforation. Resistance during central venous catheter insertion, poor blood aspiration after insertion, excessively high CVP, and abnormal waveform may be indicative of catheter malpositioning. In our case, we used ultrasound to avoid artery puncture and experienced no technical difficulties during initial MAC and subsequent oximetry catheter insertion such as bending of the guidewire, resistance to wire or catheters on insertion, and typical blood draw as well as CVP trace monitoring. But, postoperative imaging studies revealed the catheter tip malposition into the left mediastinum. Barrowcliffe[5] reported a case when the catheter tip lies between the vein and the pleural cavity, the blood aspiration is feasible, and fluid administration cause pleural effusion because fluids run into the pleural cavity easily due to negative pressure. One intriguing thing to note is that we could measure CVP properly. This may be possible because side pores of each lumen are located in different site, not all in the catheter tip. The pore of the CVP lumen is located in the distal portion of MAC, which is in the innominate vein and it enables to measure the CVP somehow. The CVP monitoring is even possible because the intrathoracic pressure that was delivered to the mediastinum may mimic the waveform of CVP even though the catheter tip was found in the mediastinum.[6] Kanter and Connelly[7] reported a case of CVC malposition entering the left internal mammary vein, which catheter through the hemostatic valve. In their discussion, the existence of CVP waveform is more important than CVP value to confirm the correct position of catheter and it is better to take chest x-ray soon after catheterization. Oropello et al[3] suggested that fluoroscopy is probably the most useful tool for avoiding venous wall injury during the course of the guidewire, dilator, or catheter, and can be observed in real time as they are advanced. However, fluoroscopy is hardly available in emergent anesthesia practice.

There are many cases reported about complications due to mediastinal catheter malposition. The innominate–SVC junction is close to the pericardium and pleural cavity. These anatomical characteristics make acute cardiac tamponade [8] and mediastinal hematoma [9] when the CVC perforates these organs. And delayed hydrothorax is often found and the long-term use catheter results in vessel erosion. But we removed catheters without consequences and no further complication was found because it is just as well that there was nearly no fluid administration via 8.5-Fr catheter, although we could not take a chest x-ray immediately in emergent situation at midnight; therefore, the misplacement of catheter was later found.

In summary, we found that a CVC through the stiff sheath introducer itself caused venous perforation and was malpositioned into mediastinum. Thus, it is important to note that the need for radiographic confirmation of appropriate CVC placement should be considered even if the insertion proceeded smoothly without apparent complications particularly in case of insertion of catheter through the sheath introducer with the left-sided internal jugular vein puncture approaches.

References

[1] McGee DC, Gould MK. Preventing complications of central venous catheterization. N Engl J Med 2003;348:1123–33.
[2] Carlos JR, Linda P. Central venous catheter intravascular malpositioning: causes, prevention, diagnosis, and correction. West J Emerg Med 2015; 16:658–64.
[3] Oropello JM, Leibowitz AB, Manasia A, et al. Dilator-associated complications of central vein catheter insertion: possible mechanisms of injury and suggestions for prevention. J Cardiothorac Vasc Anesth 1996;10:634–7.
[4] Stonelake PA, Bodenham AR. The carina as a radiological landmark for central venous catheter tip position. Br J Anaesth 2006;96:335–40.
[5] Barrowcliffe MP. Catheter erosion of vessel walls. Br J Anaesth 1988; 60:350–1.
[6] Lee TS, Chen BJ. Hydromediastinum following insertion of a central venous pressure line via the right external jugular vein. J Clin Anesth 1993;5:436–8.
[7] Kanter G, Connelly NR. Unusual positioning of a central venous catheter. J Clin Anesth 2005;17:293–5.
[8] Chabanier A, Dany F, Brutus P, et al. Iatrogenic cardiac tamponade after central venous catheter. Clin Cardiol 1988;11:91–9.
[9] Biswas S, Sidani M, Abrol S. Emergent median sternotomy for mediastinal hematoma: a rare complication following internal jugular vein catheterization for chemoport insertion. Case Rep Anesthesiol 2014; 2014:190172.