

Life-threatening hemothorax resulting from right brachiocephalic vein perforation during right internal jugular vein catheterization

YASUSHI INNAMI, TOMOKO OYAIZU, TAKASHI OUCHI, NAOJI UMEMURA, and TOSHIYA KOITABASHI

Department of Anesthesiology, Ichikawa General Hospital, Tokyo Dental College, 5-11-13 Sugano, Ichikawa, Chiba 272-8513, Japan

Abstract

We present a life-threatening case of hemothorax resulting from right brachiocephalic vein perforation during right internal jugular vein catheterization. We considered that the guidewire had punctured the right brachiocephalic vein extraluminally and the catheter inserted over the guidewire had enlarged the size of the perforation. Despite the use of proper technique, an angle-tip guidewire may perforate the venous wall. Therefore, when there is negative aspiration after central venous catheterization, it is important to perform an emergency chest radiograph before proceeding with surgery; it is also important not to use an angle-tip guidewire.

Key words Central venous catheterization · Guidewire · Hemothorax

Introduction

Central venous catheters may be associated with serious complications. The American Society of Anesthesiologists (ASA) Closed Claims Project revealed that for central catheter claims there was a high severity of injury, with a higher mortality rate (47%) compared to other claims (29%) [1]. With regard to hemothorax, 15 claims were reported in 110 central vascular catheterization-related complications [1]. Notably, a higher mortality rate (93%) occurred in claims for hemothorax compared with other central catheter injuries combined. We present a life-threatening case of hemothorax resulting from right brachiocephalic vein perforation during right internal jugular vein catheterization.

Case report

A 78-year-old man presented for Y-graft replacement of an abdominal aortic aneurysm. Following induction, three initial attempts to cannulate the right internal jugular vein performed by a skilled staff anesthesiologist were unsuccessful, although the character of the patient's neck was normal. During these attempts there was no arterial puncture or air aspiration. Finally, the vein was successfully punctured with a 22-gauge "finder" needle at the angle formed by the two bellies of the sternocleidomastoid muscle near the level of the cricoid cartilage. The vessel was cannulated with an 18-gauge straight introducer needle to a depth of 3 cm and the blood flowing from the needle was dark in color and nonpulsatile. An angle-tip guidewire (only this type of guidewire was included in the catheter kit) was threaded through the needle without difficulty. A dilator, which was 12 cm in length, was advanced 3–4 cm without apparent resistance over the guidewire and then removed. A 12-gauge double-lumen catheter (Argyle; Nihon Sherwood, Tokyo, Japan) was inserted over the wire and the guidewire was withdrawn without any resistance. Even though the catheter was inserted smoothly, blood could not be aspirated from either the proximal or distal ports, so the catheter was removed. Finally, with the same technique, a double-lumen catheter was successfully placed at the left internal jugular vein.

Three hours after beginning surgery, the blood loss increased. Despite adequate administration of fluids and transfusion, the patient exhibited worsening clinical signs of blood loss and increased airway pressure. At that time, physical examination revealed decreased breath sounds over the right hemithorax to auscultation. An emergency chest radiograph (CXR) showed a significant hemothorax (Fig. 1). Immediately, a 28-French chest tube was inserted into the right chest, and 1000 ml of blood was drained. An urgent right thoracos-

tomy was performed to identify the source of the bleeding, and finally, continuous extensive bleeding was found from a catheter-sized hole in the right brachiocephalic vein. Following the surgeon's repair of the vein, the patient recovered and became hemodynamically stable. The patient was transferred to an intensive care unit and the trachea was extubated 2 days later. Two weeks later, the patient was discharged.

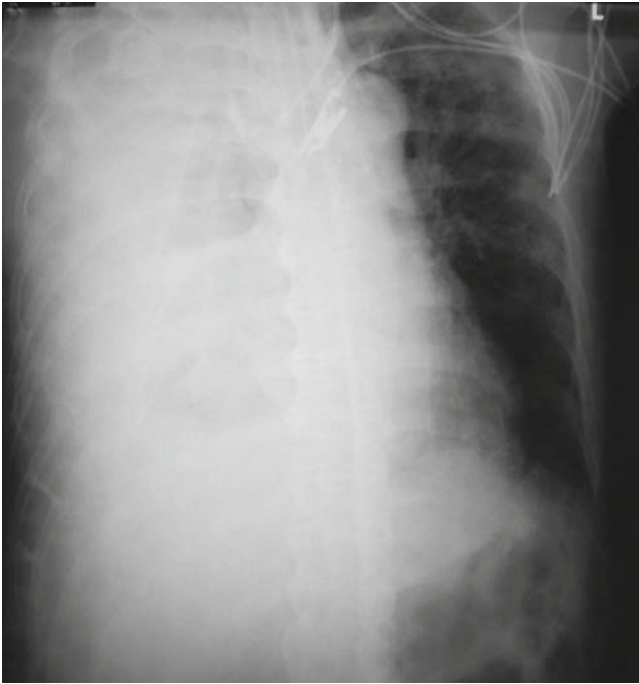


Fig. 1. Emergency chest radiograph shows a significant hemothorax

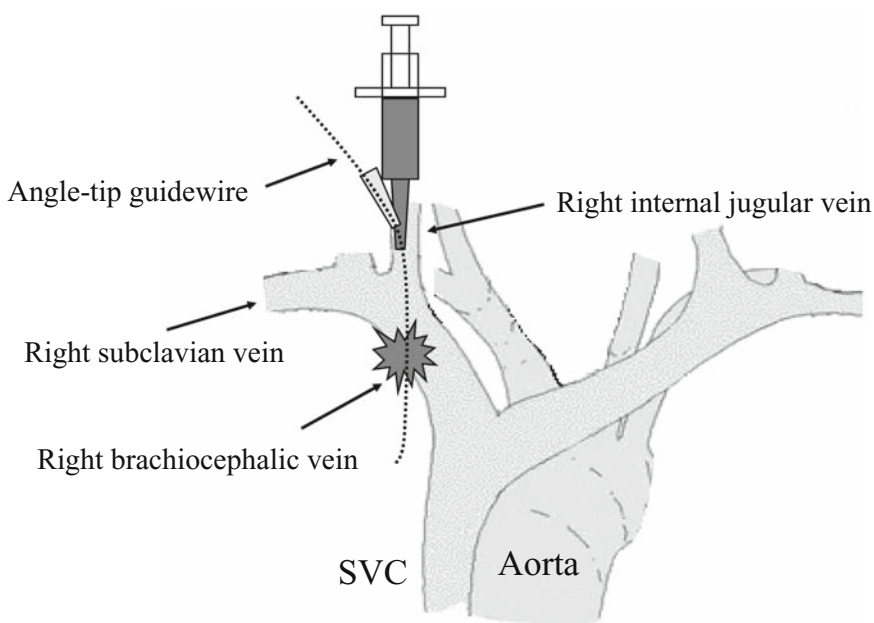


Fig. 2. Schema of the guidewire which probably punctured the right brachiocephalic vein. SVC, Superior vena cava

Discussion

We present a case of hemothorax caused by right brachiocephalic vein injury secondary to right internal jugular vein cannulation. We considered that the guidewire had punctured the right brachiocephalic vein extraluminally and the catheter inserted over the guidewire had enlarged the size of the perforation. The operative findings revealed that the perforation in the brachiocephalic vein wall was located at the extension line of the right internal jugular vein (Fig. 2) and that this serious event was a consequence of internal jugular vein cannulation. We also discovered that the shape of the angle-tip guidewire was straight (not curved like the J-tip; Fig. 3) enough to perforate the vessel wall. Another possible mechanism of injury may have been malposition of the guidewire. When the guidewire reaches the brachiocephalic vein wall and is inserted deeper, it usually twists and moves toward the superior vena cava. When the tip of the guidewire turns laterally into the subclavian vein, the dilator is unable to follow the course of the guidewire into the subclavian vein and finally causes a tear in the brachiocephalic vein. However, this mechanism can be denied in our case, because the dilator was only advanced within a few centimeters from the skin, which was not deep enough to reach right brachiocephalic vein.

Negative aspiration may be one of the early indicators of severe complication. If there is negative aspiration after central venous catheterization, there are several causes, including external kinking, internal kinking or compression by the muscles, or a false lumen. One might advocate that immediate CXR with aggressive treatment should not be delayed in any patient with

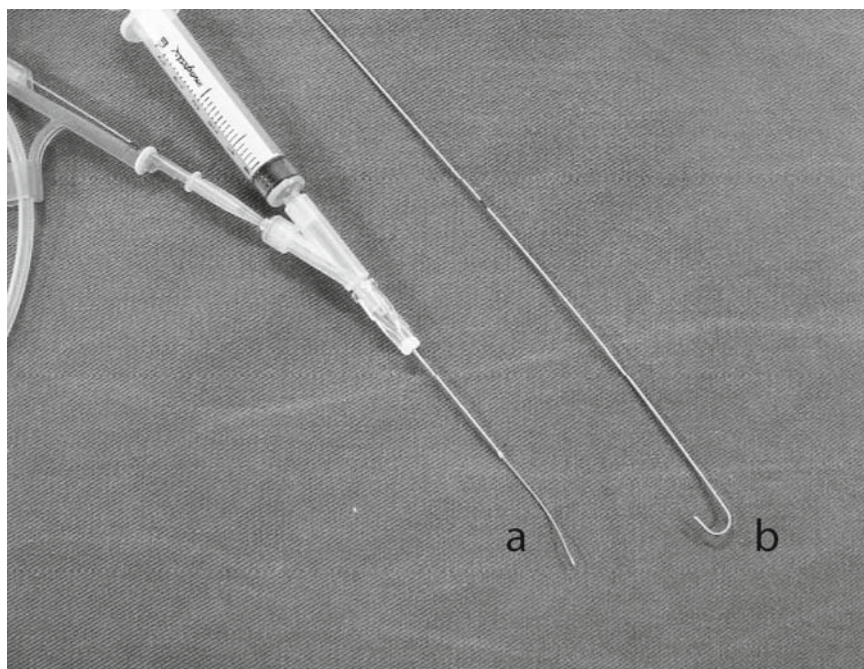


Fig. 3. Angle-tip guidewire as used in the present case (*a*) and J-tip guidewire (*b*); the J-tip guidewire is included in the Multi-Lumen CVC Kit produced by ARROW International (Reading, PA, USA)

negative aspiration. Although immediate CXR cannot detect early signs of hemothorax, malposition of the catheter would be detected.

The most common complication associated with internal jugular vein catheterization is carotid artery puncture [2]. Other sites of injury, where known, are the superior vena cava, subclavian vein, and left innominate vein [1]. A literature review identified no cases of guidewire-induced brachiocephalic vein perforation. However, a dilator-induced brachiocephalic vein perforation has been documented, and that case was fatal [3]. Thus, this is the first reported case of a life-threatening hemothorax, in a patient who could be resuscitated, resulting from right brachiocephalic vein perforation during right internal jugular vein cannulation. Hemothorax associated with internal jugular vein catheterization was described previously and was caused by arterial puncture [2,4–7]. On the other hand, in our patient, the hemothorax was detected approximately 3 h after right brachiocephalic vein perforation. At that time, more than 1000 ml of blood had leaked into the right hemothorax. If an artery had been perforated or lacerated, the patient would have exhibited hemodynamic instability earlier. In clinical experience, bleeding from a small penetrating hole in a vein will be stopped spontaneously by vasospasm or external compression of the surrounding tissues. The occurrence of continuous bleeding is uncommon, except when it occurs coincidentally with other potential factors, such as thrombocytopenia or coagulopathy. In our patient, the surgeon used approximately 5000 units of heparin during the opera-

tion. This heparinization may have been the most important factor to induce the continuous bleeding. Another possible reason that it took 3 h to develop hypovolemic shock is that the lung was ventilated with positive pressure and the inflated lung may have compressed the venous perforation.

Although the use of an ultrasound-guided technique has recently been recommended and become widespread, we had not introduced this technique at the time of this case. However, because the right brachiocephalic vein would not have been easily detected by ultrasound imaging, we believe that even if we had adopted this technique, we would not have been able to get an image of the perforation in this area. At the level of the internal jugular vein, the ultrasound imaging would have shown normal guidewire placement. Therefore, we strongly emphasize that, because of the limitations of the ultrasound-guided technique, anesthesiologists must be aware of uncommon complications, as occurred in our patient.

Hemothorax as a consequence of the perforation of the brachiocephalic vein can be a lethal complication of internal jugular vein catheterization; however, as our case illustrates, hemodynamic compromise can be delayed. Despite the employment of proper technique, as used in our patient, an angle-tip guidewire may perforate the venous wall. Therefore, in the event of hemodynamic collapse following central venous catheterization, a high index of suspicion, prompt recognition, and intervention may prevent a potentially fatal outcome. Moreover, when there is negative aspiration

after central venous catheterization it is important to perform a CXR before proceeding with surgery, and it is important not to use an angle-tip guidewire.

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