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## CLINICAL INFORMATION

# Endovascular repair of subclavian artery injury secondary to internal jugular vein catheterization: case report



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### KEYWORDS

Subclavian artery injury;  
Internal jugular vein catheterization;  
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### PALAVRAS-CHAVE

Lesão da artéria subclávia;  
Cateterização da veia jugular interna;  
Correção endovascular

### Abstract

**Background and objectives:** Ultrasound-guided internal jugular vein catheterization is a common and generally safe procedure in the operating room. However, inadvertent puncture of a noncompressible artery such as the subclavian artery, though rare, may be associated with life-threatening sequelae, including hemomediastinum, hemothorax, and pseudoaneurysm.

**Case report:** We describe a case of the successful endovascular repair of right subclavian artery injury in a 75-year-old woman. Subclavian artery was injured secondary to ultrasound-guided right internal jugular vein catheterization under general anesthesia for orthopedic surgery.

**Conclusion:** Under general anesthesia several factors such as hypotension can mask the signs of subclavian artery injury. This case report indicates that clinicians should be aware of the complications of central venous catheterization and take prompt action.

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### Correção endovascular de lesão de artéria subclávia secundária à cateterização de veia jugular interna: relato de caso

### Resumo

**Justificativa e objetivos:** A cateterização da veia jugular interna guiada por ultrassom é um procedimento comum e geralmente seguro em sala cirúrgica. No entanto, a punção inadvertida de uma artéria não compressível, como a artéria subclávia, embora rara, pode estar associada a sequelas e risco para vida, incluindo hemomediastino, hemotórax e pseudoaneurisma.

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*Relato de caso:* Descrevemos um caso bem-sucedido da correção endovascular de lesão da artéria subclávia direita em uma paciente de 75 anos de idade. A artéria subclávia foi lesionada após cateterização guiada por ultrassom da veia jugular interna direita sob anestesia geral para cirurgia ortopédica.

*Conclusão:* Sob anestesia geral, vários fatores, como a hipotensão, podem mascarar os sinais de lesão da artéria subclávia. Este relato de caso indica que os médicos devem estar cientes das complicações da cateterização venosa central e tomar medidas imediatas.

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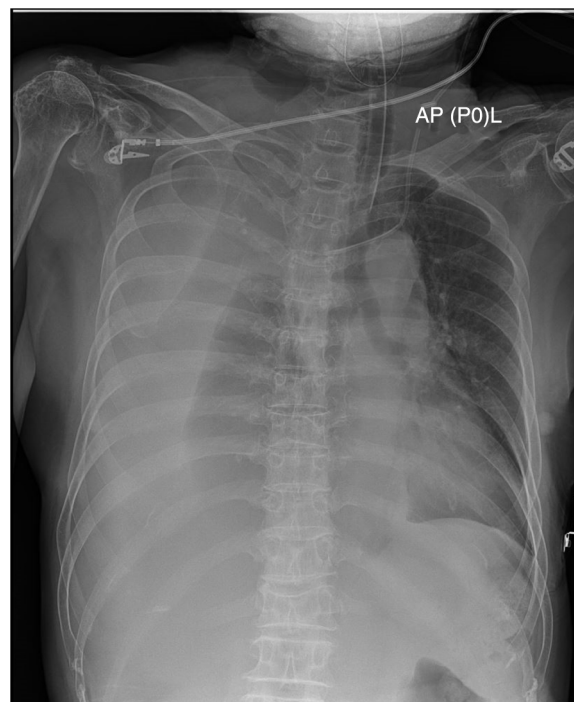
## Introduction

Ultrasound-guided internal jugular vein (IJV) catheterization by anesthesiologists is a common and generally safe procedure in the operating room (OR). However, associated complications may range from simple to fatal ones. The most common arterial complication is carotid artery puncture; inadvertent puncture of a noncompressible artery such as the Subclavian Artery (SCA), though rare, may be associated with life-threatening sequelae, including hemomediastinum, hemothorax, and pseudoaneurysm.<sup>1-4</sup> Therefore, prompt diagnosis and treatment are essential.

Here we describe the successful management of right SCA injury secondary to ultrasound-guided right IJV catheterization during orthopedic surgery in a 75 year-old woman involved in a traffic accident.

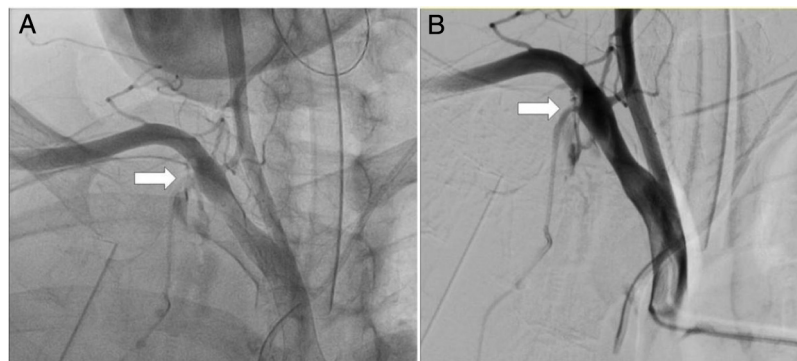
## Case report

A 75 year-old woman with a right intertrochantric fracture, left hemothorax, and bilateral rib fractures caused by a traffic accident presented for closed reduction and internal fixation to the orthopedic department. On arrival in OR, her blood pressure was 165/85 mmHg and peripheral oxygen saturation (SpO<sub>2</sub>) was 88%. General anesthesia was induced and an arterial line was placed in the left radial artery; the blood pressure at that time was 120/55 mmHg. Anesthesia was maintained with oxygen-air-desflurane-remifentanyl. The initial airway pressure was 20 cmH<sub>2</sub>O. For central venous catheterization, her right IJV was punctured under ultrasound guidance. On confirmation of free and nonpulsatile blood flow from the needle, a J-tip guidewire was threaded through the needle without difficulty. A dilator was advanced without resistance over the guidewire and subsequently removed. A central venous double-lumen catheter was then advanced over the guidewire. However, there was resistance during catheter insertion, and both the catheter and guidewire were withdrawn. We found that the distal part of the guidewire had curved. The right IJV puncture site was compressed and left IJV puncture was attempted. During this procedure, the systolic blood pressure decreased to 70 mmHg and the heart rate increased from 70 to 115 beats.min<sup>-1</sup>. We stopped remifentanyl infusion, lowered the desflurane concentration, and administered fluid and

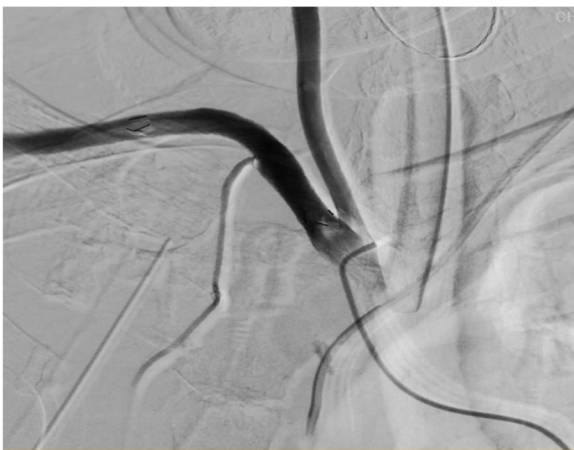


**Figure 1** Chest radiograph. The chest radiograph shows a large hemothorax in the right thoracic cavity.

inotropic agents. After left IJV catheterization, a hematoma was observed on the right side of the neck. Preparations for surgery were made while the puncture site was compressed. Soon, the airway pressure increased to 27 cm H<sub>2</sub>O and SpO<sub>2</sub> decreased to 87%. On auscultation, no breath sounds were heard over the upper part of the right lung. Arterial blood gas analysis showed a hemoglobin level of 7.7 g.dL<sup>-1</sup>. A chest radiograph revealed massive right hemothorax (Fig. 1). Chest tube thoracostomy was performed, 1500 mL of blood was drained, and packed Red Blood Cell (RBC) transfusion was initiated. Urgent endovascular treatment was recommended via discussions with a chest surgeon, radiologist, and cardiovascular intervention specialist. The patient was transferred to the angiography room. Angiography showed extensive contrast staining from the right SCA to the thoracic cavity; this suggested SCA rupture (Fig. 2). First, balloon



**Figure 2** Angiography. The right subclavian artery (SCA) was injured, secondary to internal jugular vein cannulation. (A) Angiography shows extensive contrast media extravasations (arrow). (B) Selective Digital Subtraction Angiography (DSA) shows perforation of the SCA (arrow) and bleeding into the thoracic cavity.



**Figure 3** Selective DSA. After stent graft implantation, there was no extravasation of contrast media, but blood flow to the vertebral and internal mammary arteries was blocked.

tamponade (Cordis POWERFLEX<sup>®</sup> Pro 6 × 6) was attempted for 25 min (alternating between 2 atm for 10 min and 1.5 atm for 10 min). During balloon tamponade, her blood pressure was 100/72 mmHg and heart rate was 116 beats.min<sup>-1</sup>. Despite prolonged balloon tamponade, follow-up angiography revealed sustained massive extravasation of contrast medium into the pleural space. Therefore, a peripheral graft stent (Seal vascular stent graft 8 × 60, SNG Biotech, Korea) was deployed. Subsequent follow-up angiography revealed good flow through the stent, without any contrast extravasation or dissection (Fig. 3). Her blood pressure and heart rate improved to 111/69 mmHg and 119 beats.min<sup>-1</sup>, respectively. After angioplasty, the patient was moved to the intensive care unit and managed by the cardiothoracic surgery department. A total of 14 units of packed RBCs were transfused, and her hemoglobin level improved to 12.3 g.dL<sup>-1</sup>. The patient was extubated 2 days after angioplasty, and another 3 days later (fifth postoperative day), she underwent the originally planned closed reduction and internal fixation procedure under general anesthesia in the orthopedic department. The chest tube was removed on the first postoperative day, and the patient exhibited uneventful recovery until discharge.

## Discussion

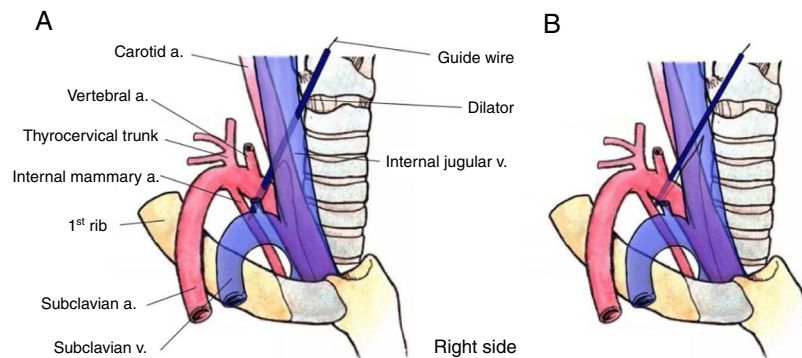
In OR, central venous catheterization is essential for fluid management, transfusion, drug infusion, and central venous pressure monitoring. Ultrasound-guided right IJV catheterization is the most common procedure because of short duration, increasing success rate, and fewer complications.<sup>5</sup> The most common complication is arterial puncture (1.9%–15%),<sup>2,6</sup> with the carotid artery being the most common site of damage during IJV catheterization. Noncompressible SCA injury is a rare but fatal complication leading to hemomediastinum, hemothorax, and pseudoaneurysm.<sup>1–4</sup>

The symptoms of hemothorax due to SCA injury include decreased blood pressure, tachycardia or bradycardia,<sup>7</sup> and decreased breathing sounds over the affected side of the chest.<sup>1</sup> Alert patients also complain of chest pain<sup>4</sup> and tachypnea.<sup>8</sup> When these symptoms are observed during central venous catheterization, arterial injury must be suspected. However, patients under general anesthesia are asymptomatic, and several factors are associated with decreased blood pressure. Therefore, SCA injury may not be easily suspected.

The mechanism underlying SCA injury during IJV puncture remains unclear. Kulvatunyong et al.<sup>3</sup> provided an explanation from the anatomical perspective. The right SCA branches form the brachiocephalic trunk and passes under IJV. In the present case, the SCA was damaged at the caudal, and not cephalic, position. We considered two possible reasons for this injury (Fig. 4). First, although the guidewire was inserted after confirmation of nonpulsatile blood flow from the needle, the skin was tough and the dilator was aggressively inserted. Accordingly, it could have penetrated both IJV and SCA (Fig. 4A). Second, even though the guidewire was inserted in IJV, the dilator may have bypassed it and penetrated the caudal part of SCA (Fig. 4B).

Regardless of the mechanism of underlying the injury, clinicians can prevent dilator-induced damage by verifying that the guidewire is freely mobile within the dilator before advancement.<sup>9</sup> The dilator should not be advanced further than the skin and subcutaneous tissue,<sup>10</sup> and its tip should not cross the clavicle.<sup>9</sup>

Chest radiography, ultrasonography, or Computed Tomography (CT) is needed for the diagnosing hemothorax. CT



**Figure 4** Two possible diagrams of the right subclavian artery (SCA) injury during Internal Jugular Vein (IJV) cannulation. (A) The guidewire was inserted in the IJV, but the dilator penetrated both the IJV and SCA. (B) The guidewire was inserted in the IJV, but the dilator bypassed the IJV and penetrated the SCA.

can confirm the bleeding point, but treatment may be delayed in the process.<sup>5</sup> Angiography can easily identify the bleeding point, and angioplasty is a treatment option. Stenting with balloon-expandable or self-expandable covered stents is widely used as a successful treatment option that is less invasive than surgical repair. Balloon-expandable covered stents are preferred for short lesions, while self-expandable covered stents are more useful for long and tortuous lesions.<sup>4</sup>

Surgical treatment is also considered for some patients. However, localization of the injured artery may be difficult and depends on the surgical approach.<sup>1</sup> In the present case, thoracic surgery was not a scheduled surgery, and the chest surgeon advised that surgical treatment for the injured SCA would be complicated. After thorough discussion, we decided to proceed with an intervention, and surgery was promptly performed. If we had continued the scheduled orthopedic surgery by maintaining the vital signs through blood transfusion and administration of inotropic agents, the hemothorax would have been discovered in the middle of surgery or after surgery, resulting in a poor prognosis.

Occlusion of the vertebral and internal mammary arteries can occur during stent implantation and is relatively common when the site of injury is the proximal SCA. The length of the stent should be precisely selected to prevent blockage of the orifices of other arteries.<sup>7</sup> In the present case, after a discussion regarding the risks and benefits, we decided to proceed with stent implantation because the contralateral vertebral artery was preserved. After stent implantation, angiography showed that blood flow to the vertebral and internal mammary arteries was blocked (Fig. 3).

## Conclusion

IJV cannulation is a common and safe practice. However, it can lead to fatal complications. Clinicians should be aware that several factors such as hypotension under general anesthesia can mask the signs of SCA injury. If acute

hypotension is observed during or after right IJV cannulation, the anesthesiologist must suspect SCA injury and take prompt action.

## Conflicts of interest

The authors declare no conflicts of interest.

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