A case of endovascular treatment for iatrogenic left vertebral artery injury due to central line catheter placement

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ABSTRACT

We describe a case of endovascular treatment for an iatrogenic left vertebral artery injury after central line catheter placement in a 68-year-old male patient. The patient had a massive pulmonary embolism, and a Swan-Ganz catheter was required to monitor the patient's circulatory condition. However, the catheter was inserted into the left vertebral artery and passed through the left internal jugular vein. Endovascular treatment was indicated due to the patient's poor general health. Complete hemostasis was achieved, and the postoperative course was uneventful without neurologic deficits. (J Vasc Surg Cases Innov Tech 2024;10:101368.)

Keywords: Central line catheter; Iatrogenic left vertebral artery injury; Pulmonary embolism; Subclavian artery; Swan-Ganz catheter

One of the common complications with central vascular catheter (CVC) placement is arterial injury.[1-3] However, there are few reports of iatrogenic vertebral artery (VA) injury because of its deep location. This report describes a case of endovascular treatment for left VA injury due to Swan-Ganz catheter misplacement. The patient provided written informed consent for the report of his case details and imaging studies.

CASE REPORT

A 68-year-old man with shortness of breath was admitted to the emergency room of our hospital. Contrast-enhanced computed tomography (CT) revealed extensive thrombi from the main pulmonary arteries bilaterally and deep vein thrombosis from the iliac vein to the popliteal vein. Although his oxygenation improved after tracheal intubation, extracorporeal membrane oxygenation (ECMO) was initiated due to unstable hemodynamics. In addition, the cardiologists inserted a Swan-Ganz catheter to monitor his hemodynamics.

An 8F sheath and a Swan-Ganz catheter were inserted from the left internal jugular vein under ultrasound guidance; however, arterial pressure waves were observed. Contrast-enhanced CT revealed that the 8F sheath had been inserted into the left subclavian artery (SCA) through the left VA, piercing the left internal jugular vein (Fig 1). Considering that he was still hemodynamically unstable even with ECMO and that anticoagulation therapy could not be discontinued due to the massive pulmonary embolism, we prioritized the treatment of the pulmonary embolism and did not perform one-stage surgery to avoid unnecessary invasion for the patient. His pulmonary hypertension was prolonged, and the cardiac team performed open heart thrombectomy on day 4 after admission. His condition improved after surgery, and ECMO support was discontinued 11 days after admission. We performed endovascular treatment of the an iatrogenic left VA injury 17 days after admission.

We established left brachial artery access by cutdown and common femoral artery (CFA) access by puncture with the patient under general anesthesia. An 8F guiding sheath was inserted into the left brachial artery, and a 6F guiding sheath (Destination; Terumo Corp) was inserted into the left CFA. A 0.014-in. guidewire (Agosal XS 0.8; ASAHI INTECC Corp) was inserted through the misplaced left cervical 8F sheath and captured with a snare catheter from the left CFA access to establish a through-and-through wire. This through-and-through wire was used to secure stable in-line access to the left VA injury point.

An 8 × 40-mm balloon catheter (Admiral Xtreme; Medtronic) was inserted from the left brachial artery into the origin of the left SCA and across the left VA ostium. The 6F guiding sheath from the left CFA access was advanced into the left VA using a through-and-through wire. We then carefully pulled out the misplaced left cervical 8F sheath after occluding the origin of the left SCA with the balloon (Fig 2, *A*). Massive bleeding was not observed at the left cervical puncture point. We embolized the left VA across the injury site with a 4-mm vascular plug (Amplatzer Vascular Plug 4; Abbott Laboratories) and coils (Interlock-35; Boston Scientific Corp) to prevent bleeding from the proximal

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The editors and reviewers of this article have no relevant financial relationships to disclose per the Journal policy that requires reviewers to decline review of any manuscript for which they may have a conflict of interest.

2468-4287

https://doi.org/10.1016/j.jvscit.2023.101368

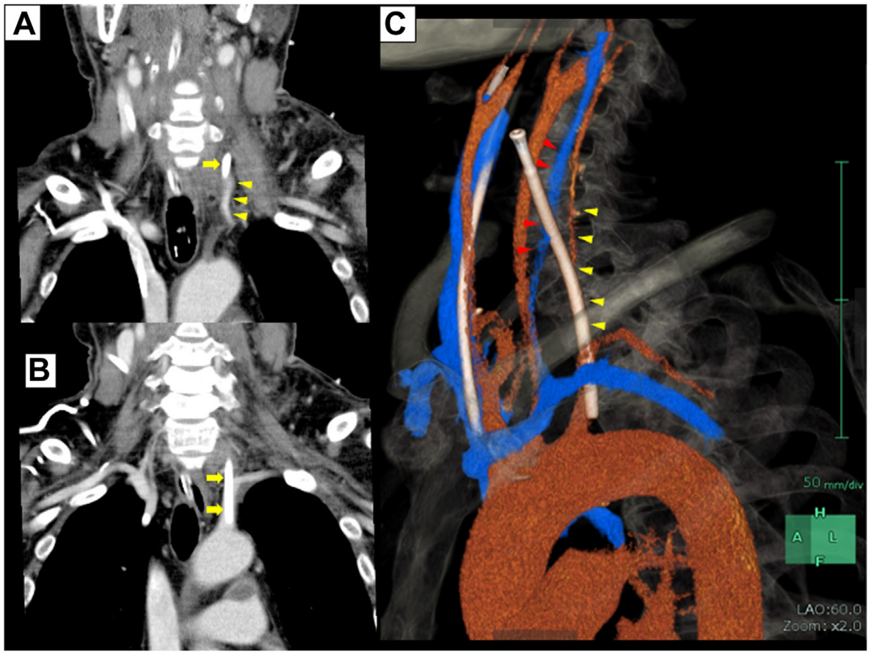

Fig 1. Contrast-enhanced computed tomography (CT) scan showing an 8F sheath (*yellow arrows*) inserted into the left vertebral artery (*yellow arrowheads*) through the jugular vein (*red arrowheads*), with the tip of the sheath reaching the left subclavian artery (SCA). **A** and **B,** Arterial phase coronal views. **C,** Three-dimensional reconstructed view.

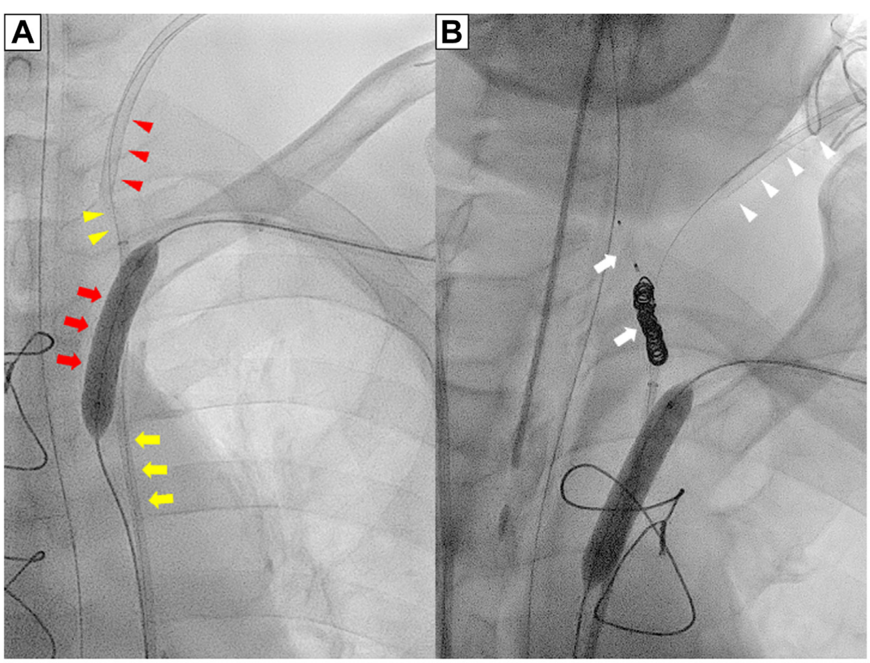

Fig 2. Intraoperative angiography. **A,** A through-and-through wire (*yellow arrowheads*) was established between the misplaced 8F sheath (*red arrowheads*) and left groin access. A 6F guiding sheath was inserted into the left vertebral artery (VA) from the left groin access over the through-and-through wire (*yellow arrows*). Balloon protection was performed during sheath removal (*red arrow*). **B,** The misplaced catheter was removed (*white arrowheads*), followed by embolization of the left VA across the injury site using a vascular plug and coils (*white arrows*).

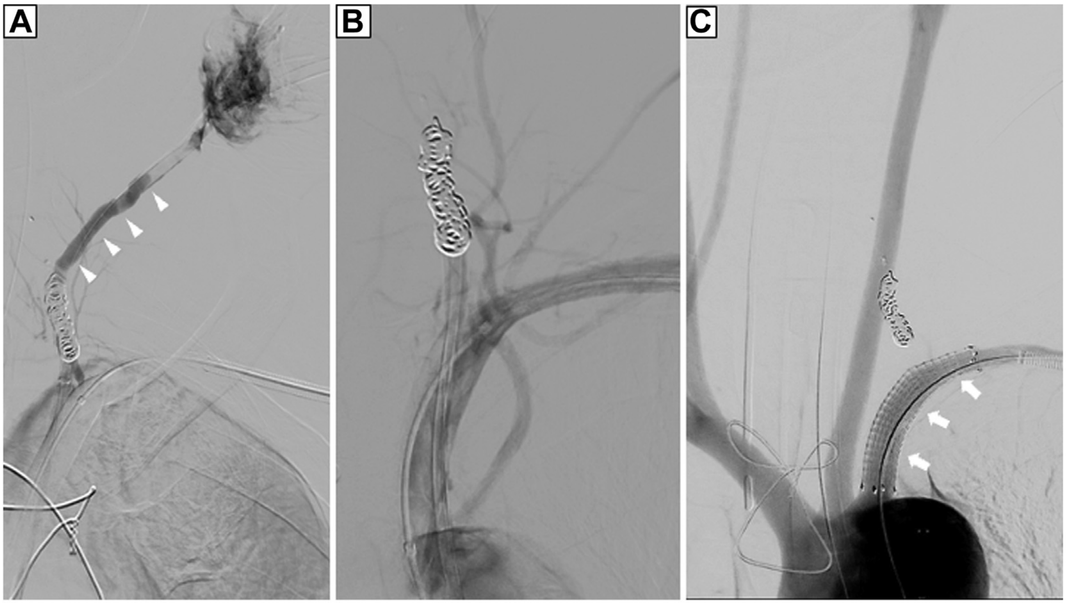

Fig 3. **A,** Intraoperative angiogram after left vertebral artery (VA) embolization. Residual extravasation occurred from the site of injury of the VA to the neck surface through the tract of the misplaced catheter (*white arrowheads*). **B,** Angiogram after removal of misplaced sheath and through-and-through wire, with almost no extravasation visualized. **C,** Angiogram obtained after placement of a self-expanding covered stent in the left subclavian artery (SCA; *white arrows*) showing resolution of the extravasation.

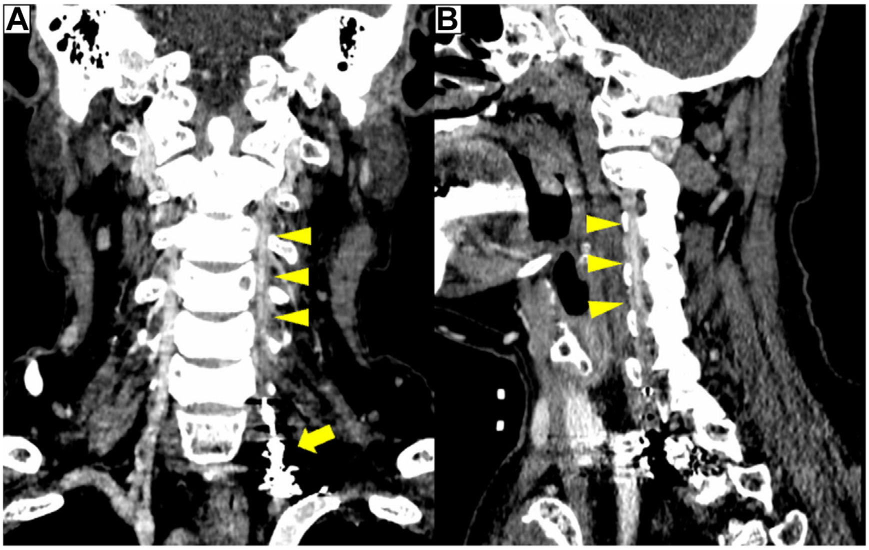

Fig 4. Contrast-enhanced computed tomography (CT) scan performed 2 months after endovascular treatment showing occlusion coils in the vertebral artery (VA; *yellow arrow*) and continued blood flow distal to the coils (*yellow arrowheads*). **A,** Arterial coronal view. **B,** Arterial sagittal view.

VA (Fig 2, *B*). Although the angiogram demonstrated a fair amount of residual extravasation from the injury site in the left VA (Fig 3, *A*), almost no extravasation was visualized after removal of the wire and misplaced sheath (Fig 3, *B*). However, we implanted a 9 × 50-mm, self-expanding covered stent (Viabahn; W.L. Gore & Associates) at the origin of the left SCA and covering the left VA ostium to achieve reliable hemostasis. The final angiogram revealed no extravasation from the left VA (Fig 3, *C*). The postoperative course at the surgical site was uneventful, and his general condition gradually improved. He was withdrawn from the ventilator on postoperative day 16 and discharged on postoperative day 82 without any neurologic deficits (Fig 4).

DISCUSSION

Previous studies have reported that the incidence of arterial injury during CVC insertion into the internal jugular vein is 3.0% to 9.5% and the incidence of catheter misplacement is 0.17%.[1-3] VA injury from CVC placement is rare because of its deep position in the neck. The consequences of VA injury include hematoma, pseudoaneurysm formation, fistula formation, hemorrhage, and stroke secondary to artery occlusion.[4] Although several repair techniques for VA injury after advertent CVC placement have been described in case reports and case series, there is no standard approach for managing this complication. Ultrasound guidance is essential to prevent iatrogenic artery injury. However, in cases in which VA diameter is small, it can be difficult to detect the VA with ultrasound and the frequency of arterial injury could be higher.

Generally, treating arterial injury during CVC placement can be classified into three approaches: catheter removal and direct pressure, open surgery, and endovascular treatment.[4-9] Anatomically, the VA can be divided into four segments (V1-V4).[10] A previous study reported that the V1 segment had a predilection for injury, followed by the V2 segment.[4] The main pathologies in patients with iatrogenic VA injury are arteriovenous fistulas and pseudoaneurysms.[11] In cases of arteriovenous fistulas, endovascular techniques have been preferred for treatment in recent years.[4-9] However, surgical excision of aneurysms remains the mainstay of treatment.[4,11] In our patient, injury to the V1 to V2 segment of the left VA was suspected and was expected to be difficult to compress directly. In addition, the patient's general condition did not fully improve after ECMO withdrawal. Considering these underlying conditions, we carefully planned an endovascular procedure for this clinical situation.

Although we initially considered placing a self-expanding covered stent across the VA injury site, we did not choose that option because the size of the left VA, ~3 mm in diameter, was too small for the device (the smallest size was 5 mm in diameter). Therefore, we decided to embolize the left VA to occlude the injury site and to cover the ostium by placing a self-expanding covered stent in the left SCA. The two key techniques to safely complete this complex treatment were establishing a through-and-through wire between the left cervical and groin access sites and occluding the left VA's ostium while performing embolization with a balloon. The through-and-through wire provided stable in-line access to the injury site, enabling secure manipulation of the catheters. Balloon protection was used to prevent bleeding when removing the misplaced sheath, diminishing the distal stroke risk during embolization of the VA injury site.

Simple VA occlusion can cause a severe neurologic deficit by creating a massive ischemic stroke; however, patients can tolerate the effects if an abundant intracranial collateral network is provided by the circle of Willis and the connection between the anterior and posterior cerebral circulation systems, which can visualized using CT angiography and magnetic resonance angiography.[12,13] For our patient, the neurosurgeons estimated the stroke risk from the left VA occlusion to be acceptable because the distal segment of the left VA was seen to be well perfused through the intracranial collateral network on CT angiography. Thus, we decided to perform endovascular treatment without reconstituting the left VA antegrade perfusion.

Previous studies have reported good long-term outcomes of endovascular treatment of arterial injuries in the axillary—clavicular region.[14,15] However, the long-term outcomes of endovascular treatment of cervical artery injuries remain unclear because of the small number of cases. Therefore, these patients must be followed up regularly and continuously to guarantee longevity.

CONCLUSIONS

Endovascular treatment of iatrogenic VA injuries is a minimally invasive procedure that is both safe and effective for patients in poor general condition.

We would like to thank Editage (www.editage.com) for English language editing.

DISCLOSURES

None.

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Submitted Sep 13, 2023; accepted Oct 24, 2023.