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Surgical Neurology International

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Case Report

Removal of a central venous catheter penetrating the vertebral artery: A case report on endovascular treatment for blunt cerebrovascular injury

Ryosuke Kaneko, Hiroyuki Ikeda, Minami Uezato, Masaki Chin

Department of Neurosurgery, Kurashiki Central Hospital, Kurashiki, Japan.

E-mail: *Ryosuke Kaneko - 1988ryosuke11kaneko18@gmail.com; Hiroyuki Ikeda - rocky@kuhp.kyoto-u.ac.jp; Minami Uezato - mu14443@kchnet.or.jp; Masaki Chin - mc13552@kchnet.or.jp

***Corresponding author:**
Ryosuke Kaneko,
Department of Neurosurgery,
Kurashiki Central Hospital,
Kurashiki, Japan.

1988ryosuke11kaneko18@gmail.com

Received : 04 December 2021
Accepted : 07 January 2022
Published : 11 March 2022

DOI
10.25259/SNI_1203_2021

Quick Response Code:

ABSTRACT

Background: Anticoagulation and endovascular therapy are commonly used treatment methods for blunt cerebrovascular injury (BCVI). However, in certain cases, the perforating objects damaging the blood vessels need to be removed. In such cases, stenting and coil embolization have been reported to be useful. Furthermore, we believe that distal embolization can arrest bleeding at the perforation site when using such treatments. In support of this procedure, we report a case of successful BCVI treatment using distal embolization through contralateral side and proximal protection.

Case Description: A 61-year-old man had an accidental placement of a central venous catheter that resulted in the perforation of the vertebral artery. Endovascular treatment was performed to remove the catheter and prevent bleeding during extraction. For this treatment, we used the method of distal embolization through the contralateral approach and proximal protection with a microballoon catheter followed by removal of the perforating catheter and additional embolization of the bleeding point under controlled blood flow.

Conclusion: Under distal and proximal protections, we were able to successfully remove the perforating catheter without bleeding and ischemic complications. While treating BCVI, which requires the removal of perforating material, attention should be paid to the various protection methods and procedures.

Keywords: Blunt cerebrovascular injury, Central venous catheterization, Endovascular treatment, Vertebral artery injury

INTRODUCTION

Blunt cerebrovascular injury (BCVI) is a trauma associated with stroke.[5] Injuries caused by stray central venous catheter (CVC) are rare, and no uniform treatment method exists. Hence, developing a strategy according to the situation is necessary.[4,8] Especially, in cases requiring the removal of perforating objects, treatment methods should be evaluated carefully. Stenting and embolization procedures used in the cases requiring perforator removal should include measures to prevent distal embolization and bleeding at the perforation site.[1,7,3] We report a case of successfully treated BCVI using retrograde embolization through a contralateral approach and proximal blood flow control with no hemorrhagic and ischemic complications.

CASE DESCRIPTION

A 61-year-old man with pneumonia underwent intubation and placement of a CVC with an outer diameter of 2.5 mm. The intended catheter, inserted into the left internal jugular vein, inadvertently entered the left vertebral artery (V1 segment), with its tip entering the aortic arch through the subclavian artery. Contrast-enhanced computed tomography (CT) revealed that the catheter was not inserted into the internal jugular vein but was incorrectly inserted into the left vertebral artery and caused occlusion of the left vertebral artery [Figure 1]. No antithrombotic drugs were administered. An endovascular management strategy was implemented that combined treatment through a contralateral approach. Treatment was started approximately 5 h following the inadvertent catheter insertion. Under general anesthesia, systemic heparinization was performed, and activated clotting time was maintained above 200 s. The left subclavian artery angiography revealed left vertebral artery main trunk occlusion and a collateral blood flow in the left V3 segment through ascending cervical artery [Figure 2a]. No vascular occlusions were found in the intracranial vessels. The right vertebral artery had a sufficient vessel diameter, the left vertebral artery was retrograde to the V4 segment, the left posterior inferior cerebellar artery (PICA) territory showed bilateral dominance, and the PICA was not bifurcated from the left vertebral artery [Figure 2b]. Due to the fear of thrombus formation in the area of stagnant blood flow due to the left vertebral artery occlusion, the distal left vertebral artery was first occluded from the other side to prevent distal embolization. Parent artery occlusion in the V2–V3 segment was considered possible. Initially, a 6 Fr guiding catheter was placed in the right V2 segment. Using ASAHI CHIKAI 10 200 cm (Asahi Intecc), SL-10 (Stryker) was induced in the left vertebral artery through union using TACTICS as a distal access catheter [Figure 2c]. The distal side of the lesion was approached from the right vertebral artery through the artery union, and coil embolization was performed from V2 to V3 [Figure 2d]. The left subclavian arteriography confirmed collateral blood flow preservation through the ascending cervical artery [Figure 2e]. The 6 Fr guiding catheter was subsequently implanted in the left subclavian artery. A microballoon catheter (Pinnacle Blue 27, Tokai Medical Products) and Carnelian Marvel 2.0 Non Taper (Tokai Medical Products) were coaxially guided into the left vertebral artery using Traxcess (Terumo). Through the perforation of the CVC, Carnelian Marvel was guided to the proximal part of the coil mass of the left vertebral artery, and Pinnacle Blue 27 was guided to the origin of the left vertebral artery [Figure 2f]. The balloon was dilated at the origin of the left vertebral artery and was embolized from the existing coil mass to the perforation of the CVC [Figure 2g]. With the proximal and distal blood flow to the perforation blocked, the CVC was removed and the balloon in Pinnacle Blue 27 was further dilated [Figure 2h]. The left vertebral artery was embolized with a coil from its perforation to its origin [Figure 2i].

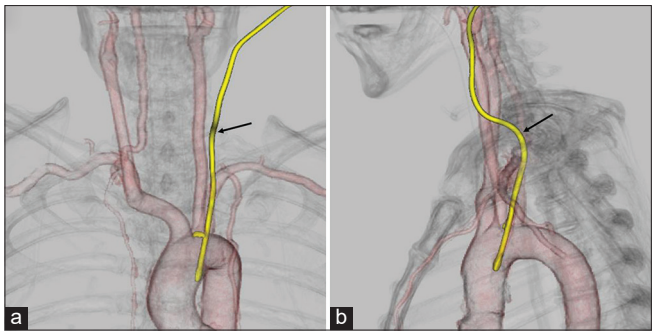

Figure 1: Preoperative contrast-enhanced computed tomography findings. The yellow line indicates a catheter that was inserted incorrectly, and the arrow indicates the entry site. The catheter tip can be seen reaching the aortic arch. The left vertebral artery was occluded. (a) Frontal view, (b) lateral view.

To arrest the remaining extravascular flow, n-butyl-2-cyanoacrylate (NBCA) was injected to obtain complete embolization. This procedure was performed under the deflating Pinnacle Blue 27 considering the adhesion of NBCA to the Pinnacle Blue 27 [Figure 2j]. The left subclavian angiography revealed complete occlusion of the left vertebral artery, and final right vertebral angiography revealed no avascular area [Figures 2k and l]. Contrast-enhanced computed tomography on the day following the surgery showed good vessel occlusion [Figure 3a]. No extravascular leakage around the perforation site was observed, and the internal jugular vein was confirmed to be open. Follow-up magnetic resonance imaging showed no cerebral infarction foci and no neurological dropout findings [Figures 3b and c]. Consent from the patient's family was obtained before the procedure, and permission to publish the features of this case was also taken from the patient. Furthermore, the identity of the patient has been protected.

DISCUSSION

Three learning points should be taken from this case. First, the left vertebral artery was occluded. This finding needs to be considered since blood flow to the left vertebral artery was unlikely and thrombus formation occurred in the occlusion site. This indicates a high risk of skipping the clot formed during blood flow resumption following catheter placement in the left vertebral artery and passing through the lesion [Figures 4a and b].[6] To avoid this, occlusion of the distal left vertebral artery through the right vertebral artery was required [Figure 4c]. Second,

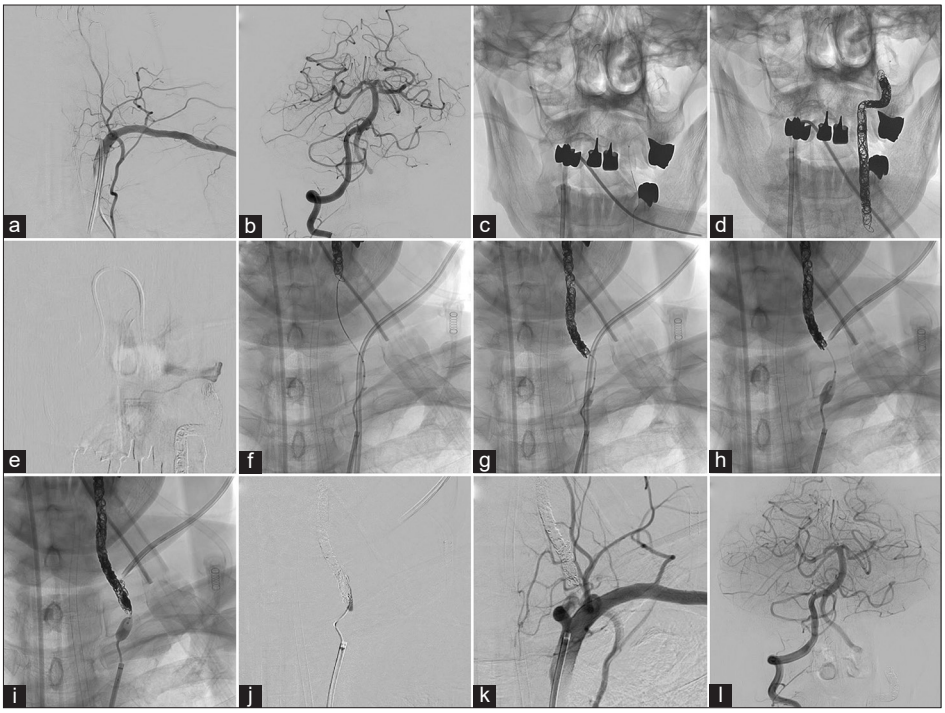

Figure 2: Pre- and intra-operative angiography. (a) Preoperative left subclavian artery angiography shows occlusion of the main trunk of the left vertebral artery and collateral blood flow in the left V3 segment. (b) Preoperative right vertebral artery angiography shows that the left vertebral artery is retrograde to the V4 segment, and the left posterior inferior cerebellar artery territory shows bilateral dominance. (c) Retrograde approach from the contralateral side. SL-10 was guided to the left vertebral artery through union using TACTICS as a distal access catheter. (d) V2 to V3 segment was embolized by contralateral approach. (e) After embolization of the V2 to V3 segment of the left vertebral artery, subclavian arteriography showed preserved collateral blood flow in the V3 segment. (f) Proximal approach to the affected side. The presence of the distal coil allowed the passage of the perforator site with the Carnelian Marvel microcatheter. (g) Under proximal protection with the Pinnacle balloon, coil embolization was performed up to the perforator site. (h) Under proximal protection, the central venous catheter was removed while the Pinnacle balloon was inflated. (i) The proximal part and perforator site were embolized under balloon dilation. (j) Injection of n-butyl-2-cyanoacrylate. (k) After embolization, subclavian arteriography confirmed complete occlusion of the left vertebral artery. (l) Postembolization right vertebral artery angiography showed no avascular area.

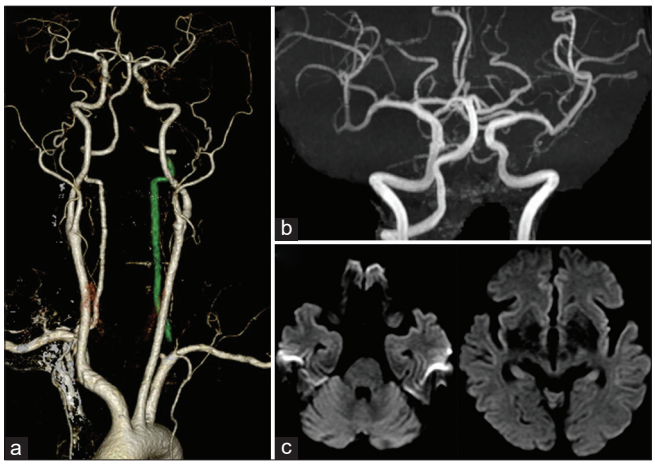

Figure 3: Postoperative images. (a) Postoperative computed tomography angiography showed complete occlusion of the left vertebral artery. The green line indicates the coil mass. (b) Postoperative magnetic resonance angiography showed occlusion of the left vertebral artery. (c) Postoperative diffusion-weighted image showed no ischemic lesion.

the passage of the lesion under distal embolization would have prevented the complication of distal embolization [Figure 4d]. If blood flow in the left vertebral artery remained, the risk of thrombus formation would be low, and embolization from the left vertebral artery could be possible without a contralateral approach; hence, detecting the left vertebral artery occlusion was extremely important. Third, the CVC was removed and embolized with both distal and proximal protections. Bilateral protection was completed by prior distal embolization and proximal balloon blockade. The CVC could be removed without any bleeding by embolizing the proximal part through the perforation [Figures 4e-g]. Furthermore, NBCA was added to obtain complete left vertebral artery occlusion [Figure 4h]. Consequently, the ingenuity of these processes helped avoid ischemic or hemorrhagic complications. However, certain limitations exist, that is, if the affected vertebral artery is the main blood supply, stenting should be considered, which leads to distal

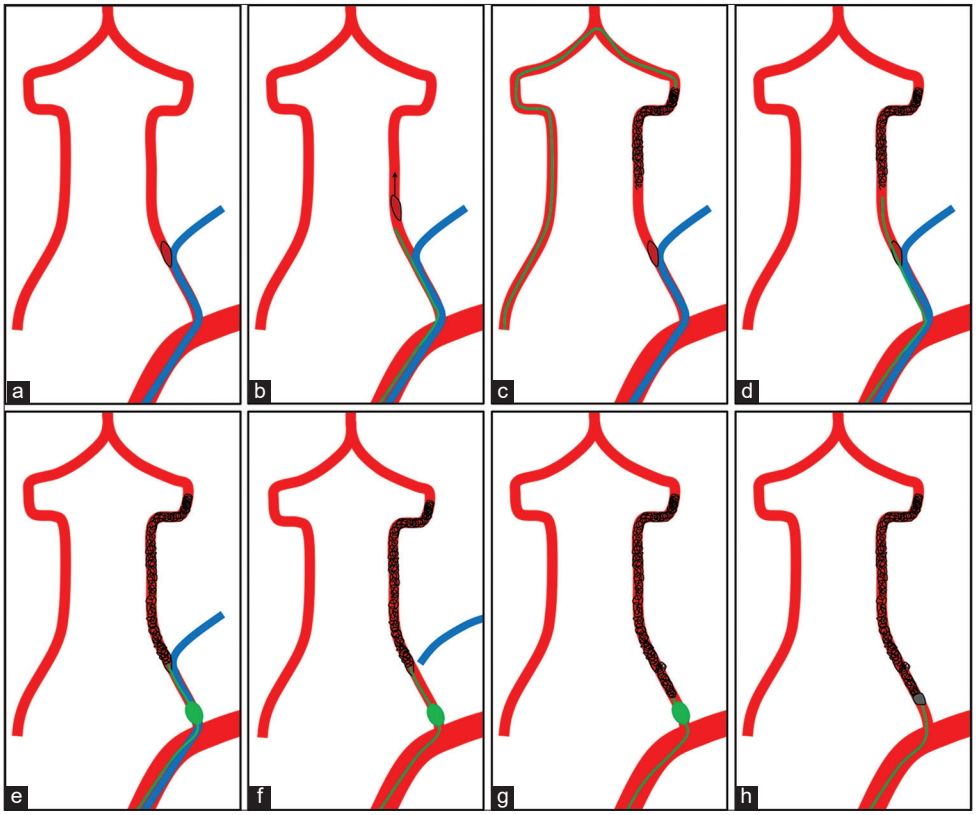

Figure 4: The schema of strategy. The red lines represent the bilateral vertebral and subclavian artery, and the blue lines represent the catheters that were inserted incorrectly. The catheter entry point corresponds to the point where the blue line extends outside the red line. (a) Assumed condition of the puncture site: we had to assume the presence of a blood clot near the catheter, as shown in the shape outlined in black in the figures. (b) Approaching from the catheter side could have caused distal embolization by thrombus in the direction indicated by an arrow in the figure. In this case, this was because the catheter had to extend beyond the misinsertion point, as shown by the green line. (c) Retrograde embolization for distal embolic protection was performed through the contralateral side. The green line shows the actual part of the microcatheter used for embolization. (d) The green line indicates the catheter passing through the lesion from the proximal side. At this point, the coil is in a position to safely pass the lesion. (e) Coil embolization up to the catheter entry point with the balloon dilated (green). (f) The catheter was not completely removed but has slowly moved to the outside of the vessel (blue), while embolizing the perforation so that it was filled with coils. (g) Completion of embolization while removing the central venous catheter. (h) N-butyl-2-cyanoacrylate injection.

embolization risk.[2] Furthermore, based on the vertebral artery union angle, the contralateral approach may be difficult. In both cases, although this method may not be possible based on the patient's vascular factors, we believe that it is important to understand the blood flow and maneuvers potentially causing distal embolization, and accordingly, develop procedures to avoid them.

CONCLUSION

We were able to successfully treat a case of BCVI, emphasizing on distal embolization prevention. Considering the limitations discussed in this study, this method may be useful in similar cases of puncture trauma.

Declaration of patient consent

The authors certify that they have obtained all appropriate patient consent.

Financial support and sponsorship

Nil.

Conflicts of interest

There are no conflicts of interest.

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How to cite this article: Kaneko R, Ikeda H, Uezato M, Chin M. Removal of a central venous catheter penetrating the vertebral artery: A case report on endovascular treatment for blunt cerebrovascular injury. Surg Neurol Int 2022;13:84.