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*Case Report*

# Traumatic cervical vertebral artery aneurysm associated with suicidal stabs

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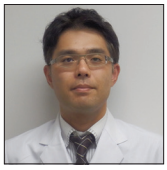

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## ABSTRACT

**Background:** Cervical vertebral artery (VA) aneurysm occasionally develops in association with penetrating injury. However, its treatment strategy is not yet determined.

**Case Description:** A 50-year-old woman with bipolar disorder attempted suicide by stabbing herself in the lateral neck. At presentation, focal neurological deficits were not observed. Spinal computed tomography (CT) showed unclear delineation of the VA in the right C4/5 intervertebral foramen. CT performed 7 days later identified an aneurysm of the right VA at C4/5, with abnormal arteriovenous shunts between the aneurysm and paravertebral venous plexus. The patient underwent coil embolization of the VA segment involving the aneurysm on the same day that was complicated by cerebellar ataxia due to procedure-associated infarction.

**Conclusion:** Traumatic VA aneurysms associated with penetrating injuries should be carefully managed with a detailed presurgical evaluation of the relevant cranial and spinal structures.

**Keywords:** C4/5 intervertebral foramen, Cervical vertebral artery, Coil embolization, Penetrating injury

## INTRODUCTION

Vertebral artery (VA) injury can be caused by trauma involving the head-and-neck regions. Most extra-cranial VA injuries are known to occur due to penetrating injuries with knives. Although infrequent, such VA injuries have been managed as distinct entities that can result in a pseudoaneurysm and subsequent stroke.[1,2,5,8] Conventional catheter angiography and computed tomography (CT) angiography are used for the diagnosis and planning of a treatment strategy on a case-by-case basis.[7,9,17] The treatment strategy for penetrating VA injuries is not yet determined. Currently, endovascular management for VA injury with or without removal of retained knife blades is the preferred treatment option.[4,10-13,15] The usefulness of endovascular therapy for pseudoaneurysms that develop in association with cervical VA injuries has been documented.[8]

The three-dimensional morphology and size of the intervertebral foramina differ at each level from C2/3 to C6/7 [Figure 1]. The cross-sectional areas of the intervertebral foramina have been documented to be narrower at C4/5 than at C5/6 and C6/7.[3]

Here, we present a unique case of traumatic cervical VA aneurysm that developed following penetrating injuries with a knife and was treated with coil embolization.

## CASE PRESENTATION

A 50-year-old woman with bipolar disorder attempted suicide by stabbing herself in the lateral neck with a stainless-steel fruit knife with a 15 cm long blade. The patient was emergently transported to our hospital on the day. At presentation, the patient was awake, with 14 points on the Glasgow Coma Scale, and did not present focal neurological deficits. Her blood pressure was 96/42 mmHg, and her serum hemoglobin level was 11.4 g/dl. Four stab wounds were identified on the lateral surface of her neck, but active bleeding was not observed. The spinal CT at presentation revealed crushed paraspinal soft tissues around the right C4/5 intervertebral foramen with unclear delineation of the VA [Figure 2a]. No spinal instability was observed. Vascular injuries to other major cervical vessels or retained knife blades were not identified. Head CT performed at presentation did not show any abnormal findings in the lower cerebellum [Figure 2b]. Spinal CT performed again on posthospitalization day 7 identified lateral protrusion of the right VA wall at the C4/5 level [Figure 3a and b]. Three-dimensional CT and catheter angiography showed a broad-based VA aneurysm with an irregular contour [Figures 3c and 4a] projecting laterally at the C4/5 level, with a maximal dimension of 10 mm. Dominance between the VAs was not observed. In addition, abnormal arteriovenous shunts were observed between the aneurysm and the paravertebral venous plexus [Figure 4b]. Substantial retrograde blood flow was observed on occlusion of the right VA. Then, the patient underwent emergency coil embolization of the VA segment involving the aneurysm on the same day [Figure 4c and d]. Antecedent balloon test occlusion was not performed. During the endovascular procedure, heparin was intravenously administered so as to maintain an activated clotting time approximately twice of the normal control value. At the initiation of the procedure, a 6 Fr guiding sheath was deployed in the right VA through the right femoral artery. Next, two microcatheters were advanced in the guiding catheter to place at the proximal and distal sites of the aneurysm neck. The right posterior inferior cerebellar artery (PICA) was found to arise from the extracranial segment of the VA. Then, the aneurysm and continuous VA segment from which it arose were embolized using platinum coils. Postoperatively, the patient presented with slight cerebellar ataxia in the right upper and lower extremities. Magnetic resonance imaging performed immediately after surgery revealed an infarct in the distribution area of the right PICA. The right PICA was not detected on cerebral magnetic resonance angiography [Figure 5]. The patient was discharged on posthospitalization day 22 with a modified Rankin Scale score of 1 presenting subtle residual cerebellar ataxia.

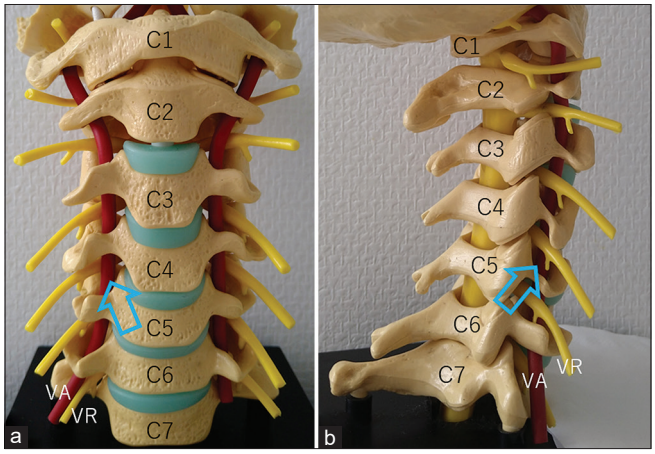


**Figure 1:** Frontal (a) and right posterolateral (b) views of cervical spine model showing the right C4/5 intervertebral foramen (arrow) where the vertebral artery segment is lying in the anteromedial aspect of the spinal ventral root. The three-dimensional morphology and size of the right intervertebral foramina are different at each level between C2/3 and C6/7. VA: Vertebral artery, VR: Ventral root.

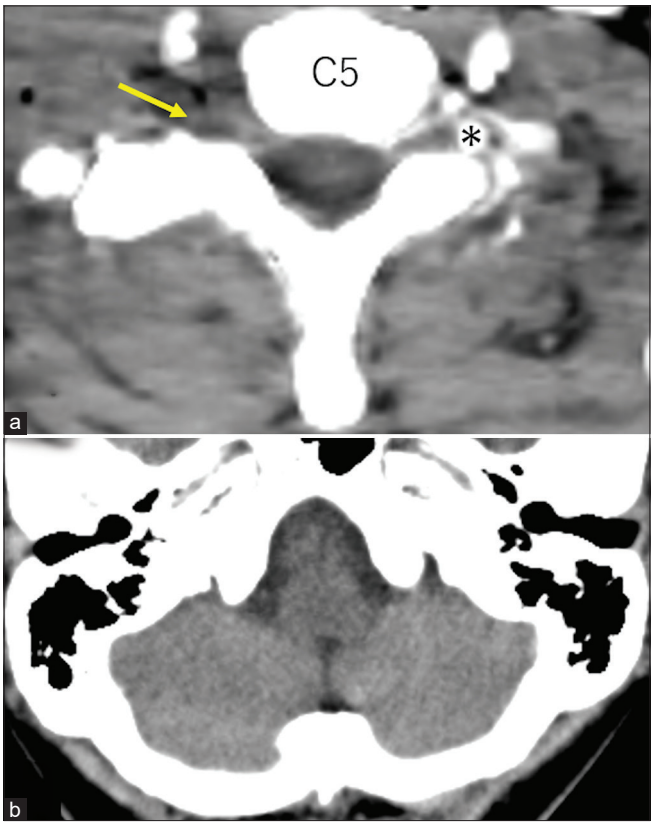


**Figure 2:** (a) Post-contrast axial computed tomography at the C5 level showing crushed paraspinal soft tissues around the right C4/5 intervertebral foramen with unclear delineation of the right vertebral artery (arrow). No extravasation of contrast agent is observed. (b) Non-contrast axial computed tomography of the head showing no abnormal findings in the lower cerebellum. Asterisk: Left vertebral artery.

## DISCUSSION

In the present case, an initially undetected VA aneurysm, accompanied by abnormal arteriovenous shunts between the aneurysm and paravertebral venous plexus, appeared at the site of injury 7 days following penetrating injury. Therefore, the aneurysm was thought to be a traumatic pseudoaneurysm that developed in association with the preceding penetrating injury by a knife. Piper *et al*. described that VA injuries, especially penetrating injuries by gunshots and stabbings, were rare but considerably devastating. Mortality rates associated with penetrating VA injury were documented to be 3–19%, but they may be underestimated for associated brainstem infarction that results in a rapid death before hospitalization.[11]

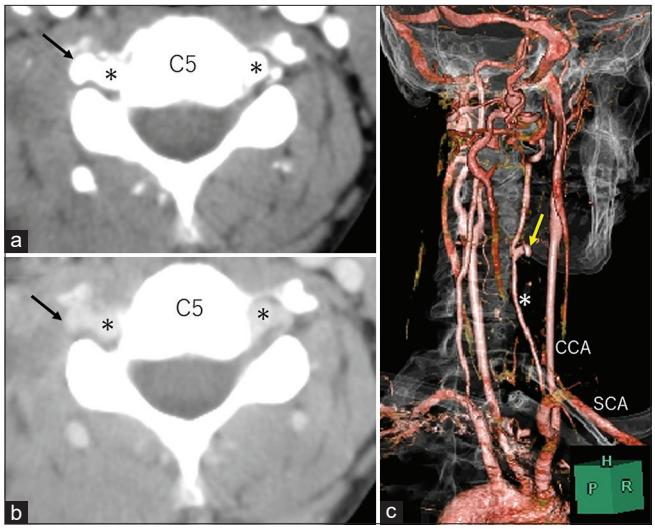


**Figure 3:** Post contrast axial computed tomography at the C5 level (a) and its delayed-phase image (b) showing lateral protrusion of the right vertebral artery wall (arrow). (c) Three-dimensional computed tomography angiography, right posterolateral view, showing an aneurysm with a maximal dimension of 10 mm projecting laterally (arrow) at the C4/C5 level. Dominance between the vertebral arteries is not observed. CCA: common carotid artery, H: head side, P: posterior, R: right, SCA: subclavian artery, Asterisk: vertebral artery.

The traumatic aneurysm appeared in the absence of spinal instability, suggesting the need for prompt management to prevent possible ischemic stroke. Radiologically, dominance was not found between the VAs. In contrast, substantial retrograde blood flow from the left VA was observed on occlusion of the right VA. Therefore, we assumed, as previous report, that obliteration of the VA segment involving the aneurysm would be tolerated by the patient without confirmation by antecedent balloon test occlusion.[16] However, a cerebellar infarction developed postoperatively. We assumed that it was due to, at least partly, lack of administration of antecedent antiplatelet agent. If intraprocedural interruption of the VA is anticipated, administration of antecedent antiplatelet agent may be safe and recommended. Alternatively, we should have administered more intense heparinization, or choosen guiding catheter with balloon, instead of guiding sheath. Balloon test occlusion with electrophysiological monitoring followed by stenting, if available, might have avoided cerebellar infarction as a procedure-associated complication. An emergency occipital artery-PICA bypass followed by trapping of the aneurysm might have been an alternative treatment option, but it requires complicated procedures with considerable invasiveness. Furthermore, to perform such surgery, in-depth knowledge of the variability of the occipital artery and PICA, as well as that of the intervertebral foramina and relevant neurovascular and muscular structures

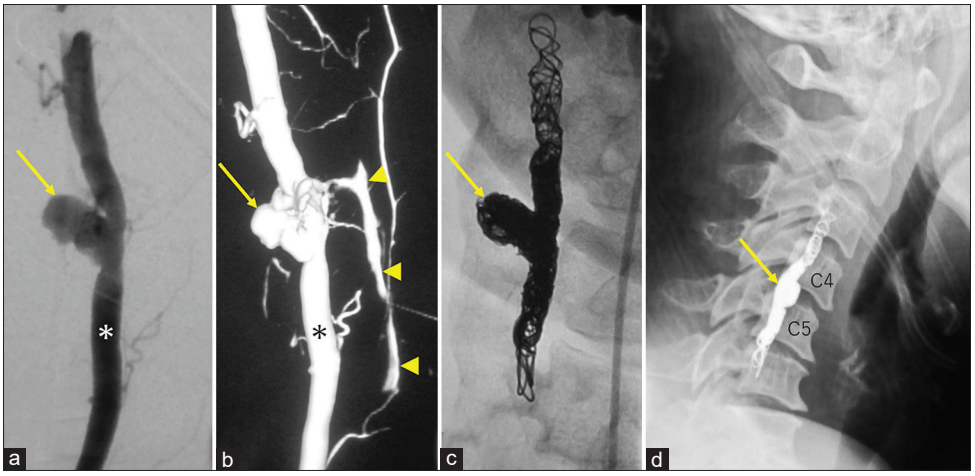


**Figure 4:** Intraprocedural images. (a) Right vertebral arteriogram, oblique view, showing a broad-based aneurysm with an irregular contour (arrow). (b) Three-dimensional right vertebral angiogram, oblique view, showing abnormal shunts formed between the aneurysm (arrow) and paravertebral venous plexus (arrowheads). Oblique view of the right vertebral arteriogram (c) and lateral view of the cervical X-ray (d) showing obliteration of the vertebral artery segment involving the aneurysm (arrow). Asterisk: Vertebral artery.

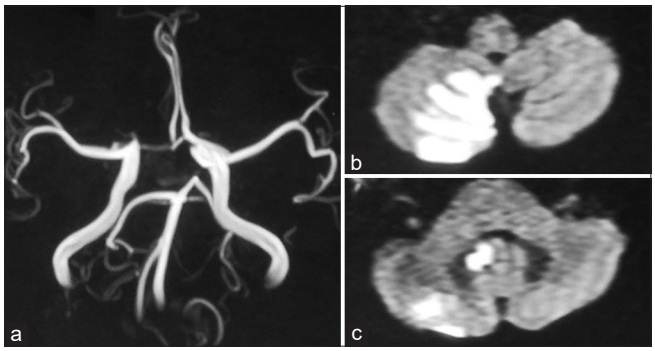


**Figure 5:** Cerebral magnetic resonance angiography (a) performd immediately after surgery showing the intact flow of the right vertebral artery, while not detecting the posterior inferior cerebellar artery. Axial diffusion-weighted magnetic resonance image (b and c) showing an infarct in the distribution area of the right posterior inferior cerebellar artery..

of the affected level is necessary.[3,6] Treatment paradigm of penetrating VA injury has significantly evolved with endovascular therapy being remarkably increasing. Piper *et al*. proposed an algorithm for penetrating VA injury where an endovascular treatment is recommended. Alternative option is an open bypass surgery that may be beneficial for patients with an unstable VA injury and not amenable to endovascular treatment.[11]

The cross-sectional areas of the intervertebral foramina are documented to be narrow at the C4/5.[3] This means that an open microsurgery at the level is, compared to other spinal levels, more difficult to perform, while an endovascular therapy is amenable with acceptable difficulty.

## CONCLUSION

Traumatic VA aneurysms associated with penetrating injuries should be carefully managed with a detailed presurgical evaluation of the relevant cranial and spinal structures.

### Declaration of patient consent

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

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Nil.

### Conflicts of interest

There are no conflicts of interest.

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