

## Successful Treatment of Iatrogenic Vertebral Artery Pseudoaneurysm with Coil Embolization: Case Report

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### Abstract

**Introduction:** Iatrogenic vertebral artery injury (IVAI) is a rare intricacy during cervical spine screw fixation or removal surgery. The overall incidence of vertebral artery (VA) injury related to craniocervical surgery is about 0.2% in literature.

**Case presentation:** We report a case of 52-year-old male who suffered iatrogenic vertebral artery injury (VAI) as a result of surgical removal of C1-2 screw that was successfully fixed at posterior cervical spine on account of traumatic atlantoaxial dislocation four (4) years ago. The surgical removal was on going at a periphery hospital when the patient suffered this intricacy with massive bleeding. He was immediately transferred to our facility. CT angiography done at our facility revealed a pseudoaneurysm measuring about 5.5 cm in diameter at the cervical region.

**Conclusions:** We successfully treated this pseudoaneurysm with coil embolization without any further neurological deficits. Although the occurrence of iatrogenic VAI pseudoaneurysm as a result of the removal of C1-2 screw is extremely rare, its occurrence can be very fatal with very serious neurological deficits or death.

**Keywords:** Iatrogenic; Pseudoaneurysm; Embolization; Vertebral artery; Angiography

### Introduction

Iatrogenic vertebral artery injury (IVAI) is a rare intricacy after cervical spine screw fixation surgery. The overall incidence of vertebral artery (VA) injury as a result of after cervical spine screw fixation surgery is about 0.2% that is about 17/8213 operations annually [1]. VA injury can lead to severe blood loss, intradural or extradural hemorrhage, and the development of arteriovenous fistulae or pseudoaneurysms [2-8]. Furthermore, the consequences of VA injury can be fatal and even result in death because of the difficulty in controlling the pulsating hemorrhage which can cause severe hypotension resulting in cardiac arrest and finally death. Therefore, timely diagnosis and intervention of these spontaneous occurrences is crucial in determining the interventional outcome. We represent a case report of iatrogenic vertebral artery pseudoaneurysm, which we successfully managed via urgent endovascular embolization with no neurological deficit. We also discussed the causes for the iatrogenic VAI as well as suitable management options with very minimal or no neurological deficits.

### Case Report

We report a case of 52-year-old male who suffered iatrogenic vertebral artery injury (VAI) as a result of surgical removal of C1-2 screw that was successfully fixed at posterior cervical spine on account of traumatic atlantoaxial dislocation four (4) years ago (Figure 1). The surgical removal was on going at a periphery hospital when the patient suffered this intricacy with massive bleeding and was immediately transferred to our facility. The patient opted for the removal of the screws because of stiffness of his neck. He was not able to flex, extend or rotate his neck one (1) month prior to the surgery. Intraoperatively, while removing of the screw was on going, a sudden, non-pulsatile welling of bright red blood was appeared. Although the blood was adequately tamponaded, the patient remained hemodynamically and neurologically stable during the procedure. CT angiogram done at our

facility revealed a pseudoaneurysm arising from the right vertebral artery (V3 segment), just superior to the posterior arch of C1 while DSA revealed a pseudoaneurysm and extravasation of contrast media in the right vertebral artery at the level of C1-2 (Figure 2). Emergency laboratory investigations done at our facility were all at normal ranges. An emergency interventional operation was carried after his relatives had signed the concern form.

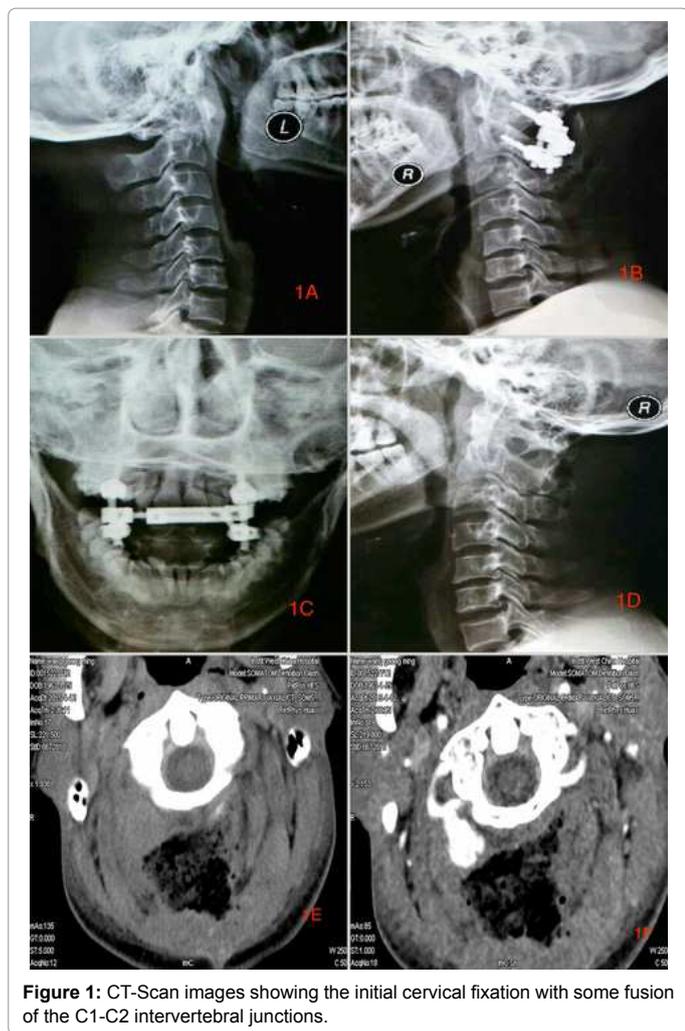
The procedure was performed using 1% lidocaine as local anesthetic and standard Seldinger technique to access the left femoral artery and placement of 6-French sheath. A 6 F Envoy catheter was advanced over a 0.035 guidewire and placed at the distal cervical segment of the right vertebral artery. A DSA run showed the pseudoaneurysm arising from the V3 segment. The aneurysm was selected with a 0.014-inch microcatheter (Enchalon-10, eV3, Plymouth, MN) and a 0.010-inch microguidewire (Transend, Boston Scientific, Natick, MA). Overall, one detachable coil, measuring 15 mm × 30 mm, was inserted into the aneurysm sac. The postprocedural angiogram showed the aneurysm was filled out by the contrast medium (Figure 1). Furthermore, via the left, one detachable coil, measuring 8 mm × 30 mm, was also inserted into the aneurysm sac. The postembolization angiogram showed complete occlusion of the pseudoaneurysm at right vertebral artery

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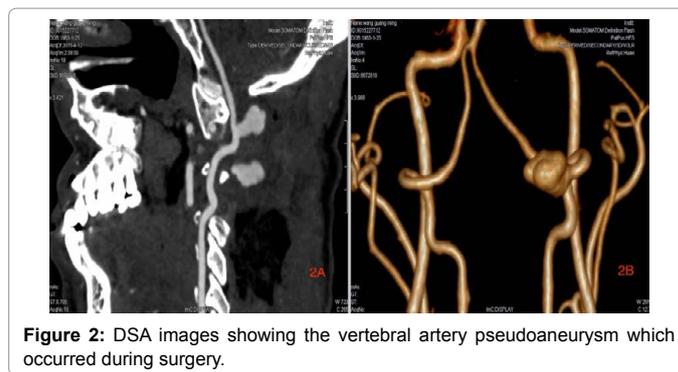
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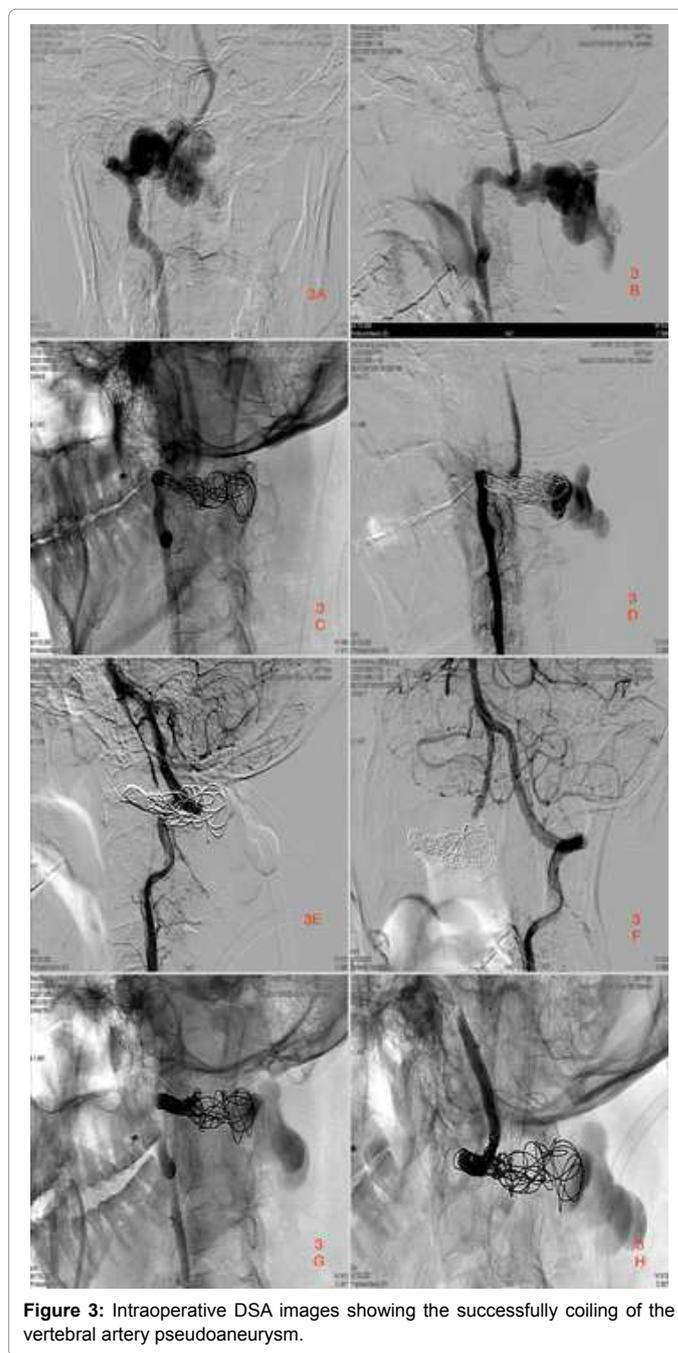
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**Figure 1:** CT-Scan images showing the initial cervical fixation with some fusion of the C1-C2 intervertebral junctions.



**Figure 2:** DSA images showing the vertebral artery pseudoaneurysm which occurred during surgery.

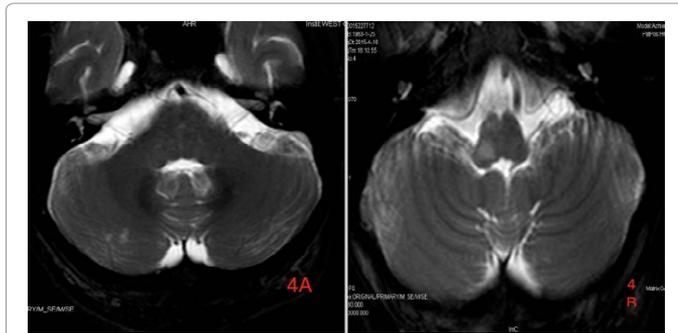


**Figure 3:** Intraoperative DSA images showing the successfully coiling of the vertebral artery pseudoaneurysm.

(Figure 3). The sheath was removed and a 6-French Angio-Seal is used as a closure device. After the procedure, the patient had an ischemic stroke in the area of the right posterior inferior cerebellar artery (Figure 4). Postoperative evaluation of the patient 3 days after the operation revealed modified Rankin scale (mRS) score of 4 so we discharged him home on the fourth (4<sup>th</sup>) day. Out patients' visits were scheduled every three (3) months for one year and later every 6 months. Two (2) years follow-up so far revealed massive improvement of his life.

## Discussion

The vertebral artery consists of four segments. V1 arises from the subclavian or innominate artery, and enters the C6 foramen transversarium. V2 lies within C6-C2 transverse foramina. V3 is from C2 to the foramen magnum. V4 stretches intradurally from the foramen magnum to basilar artery. If we recognized the normal anatomy and anomalies can avoid vertebral artery injury. We propose that before craniocervical operation, anomalies of the VA should be assessed with CTA/MRA/DSA. Most patients have a dominant VA. The left VA accounts for 50-60% of the population whereas the right VA accounts for in approximately only 25%. It is said that the remaining 25% of the population have equivalent vertebral arteries [9]. If the patient has a patent contralateral VA or well-developed collateral circulation from posterior circulation, an injured vertebral artery could be occluded by the neurosurgeon or endovascular team directly. If



**Figure 4:** MRI showing an ischemic stroke in the area of the right posterior inferior cerebellar artery.

the contralateral VA is underdeveloped or slender, vessel repair is the preferred treatment modality.

Studies have shown that posterior spine surgeries carry the highest risk of VAI [6,9]. There are several ways to prevent intraoperative VA injury. First, careful preoperative evaluation of the dilated or tortuous vertebral artery is most important to prevent iatrogenic VA injury. Failure to recognize an anomalous vertebral artery can result in catastrophic consequences even when lateral decompression is achieved within generally accepted safe limits. Second, an extensive lateral procedure such as decompression of the uncovertebral joints or neural foramen, lateral disc removal should be avoided. Maintaining the midline orientation is essential to adequate decompression of the neural structures, as well as to prevent injury to the vertebral artery. The medial uncovertebral joint should be a guide as to the lateral extent of any dissection or drilling. We speculate the removing of the screw might cause VA injury in this patient. The compression of the screw on the VA prevents hemorrhage.

Once a vertebral artery injury has occurred, the surgeon must always keep the treatment goals in mind in the appropriate order:

- Achieve control of the hemorrhage.
- Prevent acute central nervous system ischemia.
- Prevent postoperative complications such as embolism and pseudoaneurysm.

At first, we should oppress the parent artery for hemostasis, followed by hemostatic agents such as thrombin soaked gel foam and cottonoids. Sometimes operative treatment for a VA pseudoaneurysm may need proximal ligation of the first or second segments of the VA. However, ligation of the VA distal to the lesion is necessary on account of successive perfusion from distal collaterals [10,11]. This therapeutic modality requires exposure of the artery via the foramen transversarium around the injury. If the contralateral/collateral flow is poor, the only remaining option is a bypass surgery. To evaluate this, an aneurysm clip is applied proximal to the injury portion of the vertebral artery while the surgeon looks for significant retrograde flow from the cephalad end [12]. After the bleeding has been controlled, some authors propose close observation and any further treatment given according to the clinical course, whereas others recommend immediate postoperative angiography [10]. In our center, we favor the latter to rule out vascular complications and evaluate adequate collateral circulation to the brain.

Endovascular techniques include detachable balloon, coil, stent-assist coil, pipeline and other agents [3,11]. Most patients have a

dominant VA. The left VA accounts for 50-60% of the population whereas the right VA accounts for in approximately only 25%. It is said that the remaining 25% of the population have equivalent vertebral arteries [3]. If the patient has a patent contralateral VA or sufficient collateral posterior circulation, we could choose direct occlusion of an injured vertebral artery. However, we should preserve posterior inferior cerebellar artery and anterior spinal artery flow in the process. On the other hand, when there is no enough collateral circulation we should ensure that the artery patent. If the contralateral vertebral artery is hypoplastic, vessel repair, with patency of the artery, would be the preferred management via microvascular repair or placement of a stent into the vertebral artery across the injury. In wide-necked pseudoaneurysms, stenting across the neck may result in thrombosis within the sac because of the changes in flow dynamics.

If complete occlusion does not occur, coils can be placed within the lumen of the pseudoaneurysm by passing a microcatheter through the pores of the stent [13]. The micropore flow-diverting stents technique is the most recent improvement in endovascular therapy of intracranial aneurysms. The micropores are designed to obtain a greater change in aneurysm hemodynamics resulting in a diversion of flow within the stent. The SILK (SFD, Balt Extrusion, Montmorency, France) and Pipeline Embolization Device (PED, Covidien Vascular Therapies, Mansfield, MA, USA) promote flow diversion while preserving patency of branch vessels and perforating arteries. Ambekar et al. reported a case of iatrogenic vertebral pseudoaneurysm successfully treated using the PED [11]. In our case, the patient only chooses to sacrifice the parent artery, due to economic reasons. Vertebral artery occlusion or thromboembolic vertebrobasilar events may follow after operation resulting in brain stem or cerebellar dysfunction or may be asymptomatic [14-19].

## Conclusion

Iatrogenic pseudoaneurysms are rare, challenging lesions. If intraoperative profuse bleeding occurs, initial control can be obtained by hemostatic packing. However, due to a risk of delayed bleeding from pseudoaneurysm in such cases, postoperative vertebral angiography should be performed. Considering the high risk of formation of a pseudoaneurysm, prompt recognition is mandatory and endovascular treatment is an important strategy to avoid life-threatening bleeding.

## Authors' Contributions

CWZ conceived the project and designed the study. CWZ, SAR, CW, TW collected and analyzed the patient's data. CWZ and SAR wrote the paper as well as prepared the illustrations. XDX and LXL provided technical assistance in the study. All authors approved the paper for the submission.

## Ethics Approval and Consent to Participate

The ethical committee of the hospital full approved our case study. The patient and his relatives were dually informed about our intension to involve him in a case study and he/they agreed to partake in the study. He/they signed the concern form before the operation was carried out according to all surgical protocols.

## Consent for Publication

The patient and his relatives were dually informed about our intension to publish his case and he/they fully concerted to the use of these documents. The hospital also concerted to the use of this information for publication.

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