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CASE REPORT

Unilateral vertebral artery injury in a patient with displaced upper cervical spine fractures: the treatment for one case of vertebral artery embolism

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Abstract
Purpose To report a novel treatment method for vertebral artery injury. Vertebral artery injuries may be caused during trauma by fracture and excessive motion with subluxation from C2 to C6 in spite of vertebral artery deeply seated and normally well protected inside the transverse foramen. Optimal medical management of the occluded vertebral artery has yet to be determined.
Methods We report on a severely displaced C2–C3 fracture that was found to have a vertebral artery injury. Medical records and imaging were reviewed.
Results A 50-year-old lady was hit by steel tube without loss of consciousness, but complaining of severe cervical and bilateral periscapular pain. Physical examination identified a neurologically intact patient with frontotemporal ecchymosis and posterior cervical tenderness. MRA and DSA showed an occluded left vertebral artery. After 3 days of observation, the patient showed no symptoms of brain ischemia or abnormal sensation and motor at four limbs. To ensure safety, we took the left vertebral artery embolism at the C2 and C5 levels before operation.
Conclusions To our knowledge, this is the first report of a displaced C2–C3 fracture in which transcatheter unilateral VAI embolization was used to prevent VAI bleeding during operation.

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Introduction

Vertebral artery injuries (VAIs) may be caused during trauma by fracture and excessive motion with subluxation from C2 to C6 in spite of vertebral artery (VA) deeply seated and normally well protected inside the transverse foramen. Nowadays, VAI caused by cervical spine injury has received considerable attention due to severe complications such as cerebral, brainstem, and spinal cord ischemia, even contributing to a poorer neurological outcome [1].

Here we report a case suffered left VAI with displaced upper spine fractures. This patient needs cervical surgery to reconstruct the stability of the cervical spine. After 3 days of observation, the patient showed no symptoms of brain ischemia or abnormal sensation and motor at four limbs. Afraid of VA bleeding during operation, we took the left vertebral artery embolism at the C2 and C5 levels before operation. In this case, we propose that transcatheter unilateral VAI embolization could be a selective insurance choice for the management of asymptomatic VAI before operation.

Case presentation

A 50-year-old lady was hit by steel tube without loss of consciousness, but complaining of severe cervical and bilateral periscapular pain. Physical examination identified a neurologically intact patient with frontotemporal ecchymosis and posterior cervical tenderness.

After 4 h, the patient presented to our hospital. Radiological screening revealed a dislocated fracture at C2–C3 with interspinous process widening, which was clearly unstable, a rotational anterolisthesis of C2–C3 in CT combined with a facet joint, and a transverse foramen fracture on the left side (Fig. 1). The C2 endplate was also fractured. In front of the C2–C7 vertebral bodies showed huge hematoma. Brain CT was normal. MRI confirmed dorsiflexion–distraction injury with C2 vertebral body moving forward (Fig. 2), but mainly an occlusion of the dominant left VA at the C2–4 level on MRA (Fig. 3).

Digital substraction angiography (DSA) confirmed the occlusion on the left VA at the V2 segment. Considering huge hematoma, occlusion of the left vertebral artery might be caused by vertebral artery injury. Although the occlusion of the dominant left VA was confirmed, collateral circulation had been found by DSA (Fig. 4). After 3 days of observation, the patient showed no symptoms of brain ischemia or abnormal sensation and motor at four limbs. To ensure safety, we took the left vertebral artery embolism at the C2 and C5 levels before operation.

At operation, the patient was positioned in slight cervical lordosis under Jaw-ovvipitalbelt allowing subtotal reduction of the dislocation. After removal of traumatic C2–C3 disk, the intervertebral space was first stabilized on a Peek cage filled up with allogeneic bone. Stabilization was completed from C2 to C3 with a plate using monocortical screws in variable positions (Fig. 5).

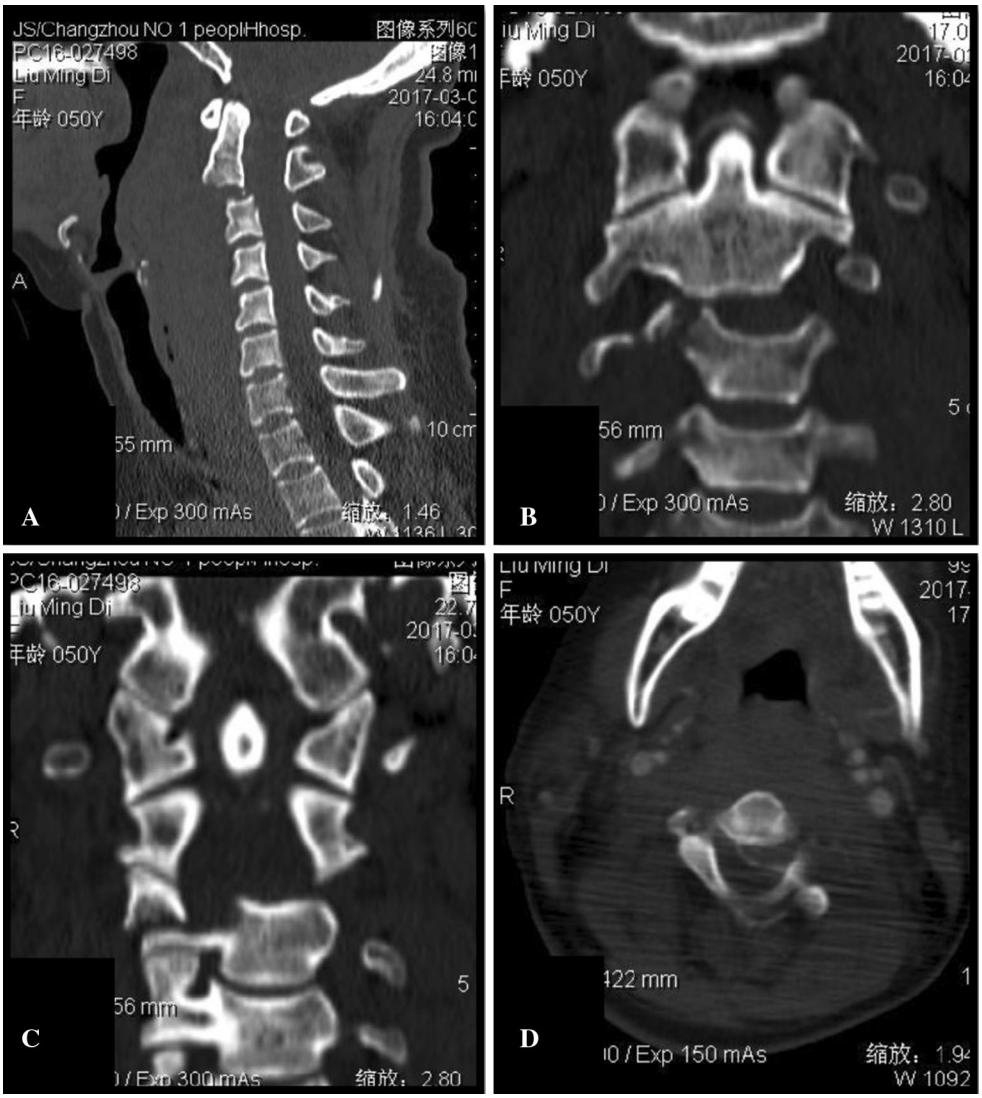

Fig. 1 Sagittal 3D reformatted cervical CT (**a**–**d**) showing a dislocated fracture at C2–C3 with interspinous process widening, which was clearly unstable, a rotational anterolisthesis of C2–C3 in CT combined with a facet joint, and a transverse foramen fracture on the left side

Fig. 2 Sagittal cervical MRI (**a**, **b**) demonstrating disruption of the C2/3 disk and in front of the C2–C7 vertebral bodies showed huge hematoma

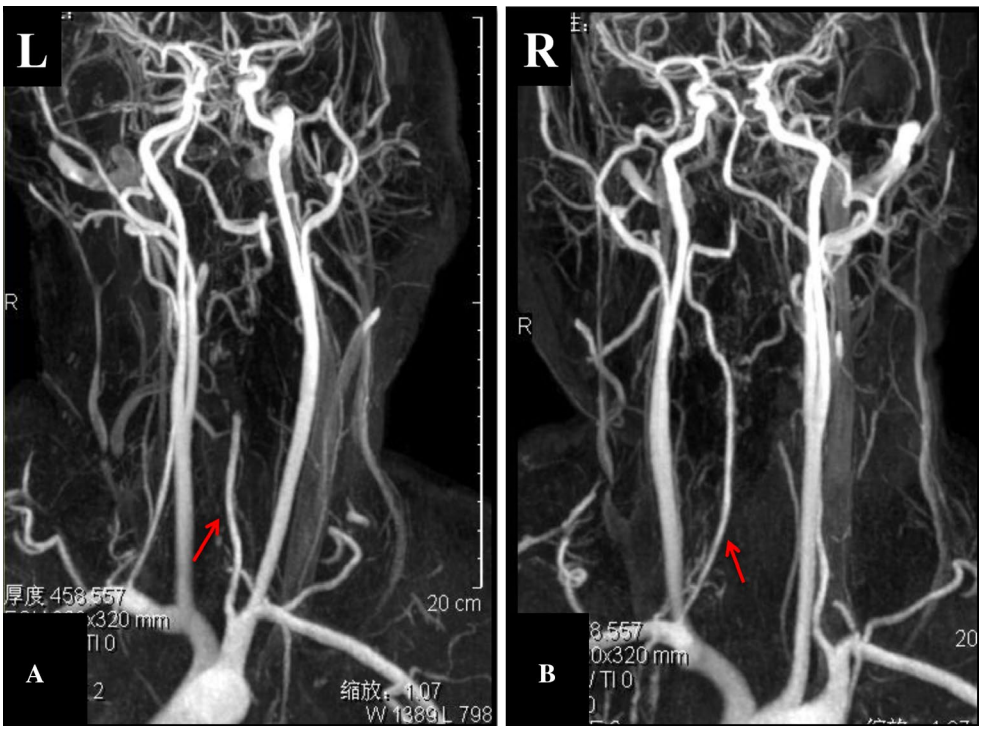

Fig. 3 MRA showing the occlusion on the left VA at the C2–4 level

Outcome

The remainder of this patient's hospitalization was uneventful. At the time of extubation on postoperative day 2, there were no neurological deficits and the patient was discharged on postoperative day 7. The patient was immobilized in a brace for 6 weeks and the follow-up lasted 3 months. At 3 months post-surgery, the fracture seemed to be united and the instrumentation intact.

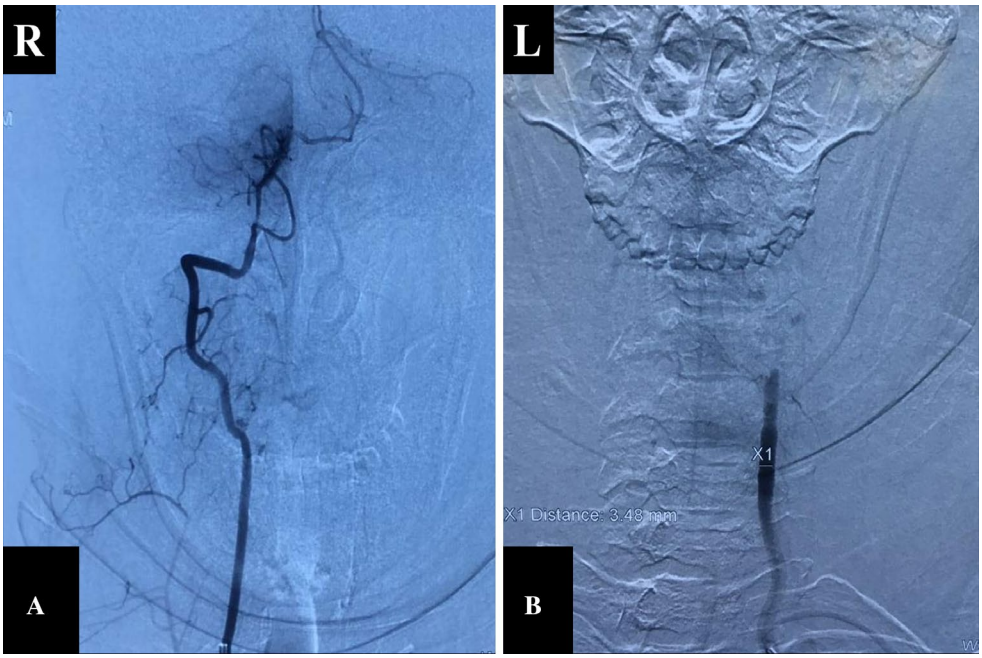

Fig. 4 DSA confirming the occlusion on the left VA at the V2 segment

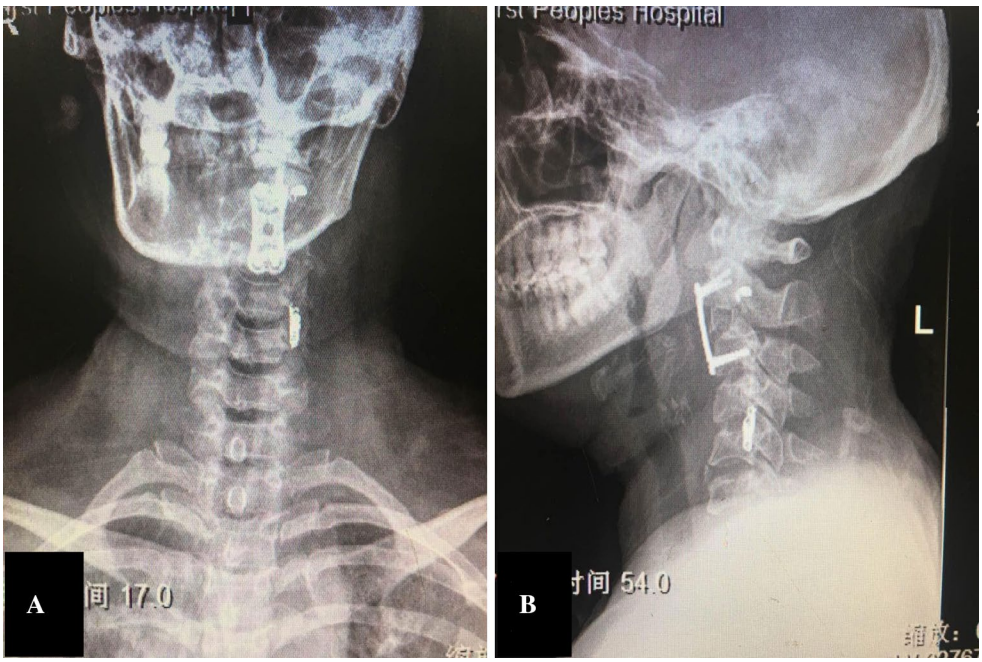

Fig. 5 Postoperative cervical radiograph (**a**, **b**) showing a C2/3 cage and plate anteriorly and the left vertebral artery embolism via transcatheter unilateral embolization at the C2 and C5 levels

Discussion

The reported incidence of VAI varies, ranging from 17 to 46% [2–4]. Most cases of VAI are asymptomatic by virtue of the cerebral vascular network. Although asymptomatic, traumatic VAI can lead to sudden, significant, and permanent neurologic sequelae in a patient who might otherwise have had an excellent functional outcome. Devastating VAI has been reported occasionally from previous papers [4–7]. In 2015, the case of a 57-year-old man was reported who sustained both a displaced Jefferson fracture and a fracture of the lateral aspect of C2, with initially

unrecognized bilateral VAIs that quickly progressed to cerebellar infarction and death [7].

By now, it has been well established that VAI is mostly caused by blunt trauma. Despite the fact that the clinical importance of VAI induced by blunt cervical spine injury is controversial, a more complete understanding of predisposing factors and the mechanism of injury in VAI should result in improved outcomes and reduced risk for patients with VAI associated with unstable cervical spine injury following blunt trauma [8]. Recent studies have focused on the trends predicting VAI and elucidated the fracture patterns that necessitate further evaluation of the vertebral artery [2, 4, 9–11]. According to Chung, a facet fracture is the most important risk factor for VAI in patients with a midcervical spine injury. The concurrent presentation of a facet fracture, unilateral facet dislocation (UD), and posterior wall involving fractures (P-TF Fx) strongly predisposes a trauma patient to VAI by logistic regression analysis [8].

Few high-quality papers drive the management of VAI. Treatment for symptomatic vertebral artery injury varies from watch and wait to antiplatelet medications, anticoagulant infusions, endovascular treatment, and surgery [12]. Treatment of asymptomatic patients likewise remains controversial with no current level 1 recommendation [13–15] especially combined with cervical subluxation needing surgery. Consequently, the American Association of Neurological Surgeons neither recommends for nor against anticoagulation in asymptomatic patients and refrains from making recommendations for symptomatic patients [12]. Furthermore, the prophylactic use of antiplatelet agents for the treatment of asymptomatic VAI might cause hemorrhage during operation [16, 17].

Up to now, we still did not find an effective treatment for VAI caused by trauma from the published papers. Nevertheless, VAI caused by cervical tumor surgery has made a feasible solution. According to the previous studies, we have found that preoperative embolization can be a good alternative. Osteoblastoma, a benign hypervascular cervical tumor, is often impeded by extensive intraoperative bleeding. Preoperative embolization reduces intraoperative bleeding, can make a complete resection more feasible, reduces postoperative complications, and has the potential to improve patients' outcomes [18], which was also effective in vertebral metastases [19]. The question is not whether all patients are suitable for embolization. Before embolization, temporary balloon occlusion testing should be carried out. The testing vertebral artery should be blocked for duration of 30 min [20], during or after the time central nervous system complications, such as Wallenberg's syndrome, cerebellar infarction, isolated cranial nerve paresis, quadriparesis, and hemiplegia, should not be appeared [21–23].

Conclusion

From this case report of a unilateral VAI in a patient with displaced upper cervical spine fractures, we recommend an MRA or a CTA as a screening tool for cervical spine fractures combined with a facet fracture, UD or P-TF Fx for VAI. VAI associated with unstable cervical spine injury needs surgery to reconstruct stabilization. Preoperative embolization is a feasible solution to reduce hemorrhage during operation. Before embolization, temporary balloon occlusion testing should be carried out.

Compliance with ethical standards

Conflict of interest The authors declare that they have no conflict of interest.

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