

Review Article

Vertebral artery injury during anterior cervical vertebral surgery caused by transverse foramen malformation-appendix: case report and literature review

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Abstract: One male patient at 59 years old of age was diagnosed as cervical myelopathy for unsteady gait and stiff lower limbs, followed by cervical 3/4 and 5/6 discectomy plus bone grafting and internal fixation, when processing the superior endplate of left cervical 4 disk, a large number of arterial bleeding occurred, which was stopped by packing method, and followed by continued cervical discectomy plus internal fixation. This patient was followed up for five years, the left vertebral artery was blocked, while no significant vascular injury-associated complication occurred, nor the symptoms of spinal cord further aggravated. We believed that the missed-diagnosed transverse foramen malformation before surgery led to the occurrence of almost catastrophic intraoperative bleeding, which might be ignored by the vast majority of clinicians and imaging physicians in preoperative routine magnetic resonance imaging (MRI) examination, therefore, paying high attention to this situation, as well as preoperative vertebral CT scanning or vertebral artery angiography would be essential.

Keywords: Vertebral artery injury, anterior, transverse foramen, malformation

Introduction

Vertebral artery injury (VAI) during anterior cervical vertebral surgery is one rare but serious risk, with the occurrence rate as about 0.3% to 0.5% [1, 2], and the majority of this injury occurs during discectomy. Because preoperative cervical vertebral MRI would often miss-diagnose vertebral artery malformation [3], and VAI caused by vertebral artery malformation is more rare during conventional anterior discectomy and fusion, the occurrence of this incidence would catch the surgeons totally unprepared, so that the consequences would be much more serious, even threaten patient's life. Oga et al [4] systematically classified vertebral artery malformation, among which the 4th type manifested as vertebral artery invaded into the interior side of uncovertebral joint at the level of transverse foramen, which is the most rare form, and the so-called safe decompression range has no reference value towards this type of patients. In this article, we reported

one case of VAI caused by this type for malformation during anterior cervical vertebral surgery, and reviewed the relevant literatures, aiming to attract the attention from the majority of clinicians towards this type of injury.

Case description

Patient Chen, male, 59 years old, was admitted because of unsteady gait and stiff lower limbs for more than six years. This study was conducted in accordance with the declaration of Helsinki. This study was conducted with approval from the Ethics Committee of Shaoxing Central Hospital. Written informed consent was obtained from all participants. This patient began to appear unsteady gait and stiff lower limbs more than 6 years ago after one trauma, and was accompanied by constipation, sweating abnormality and progressively aggravated symptoms, the patient was once diagnosed as "amyotrophic lateral sclerosis" in other hospital, while not improved after symptomatic treat-



Figure 1. Preoperative MRI.

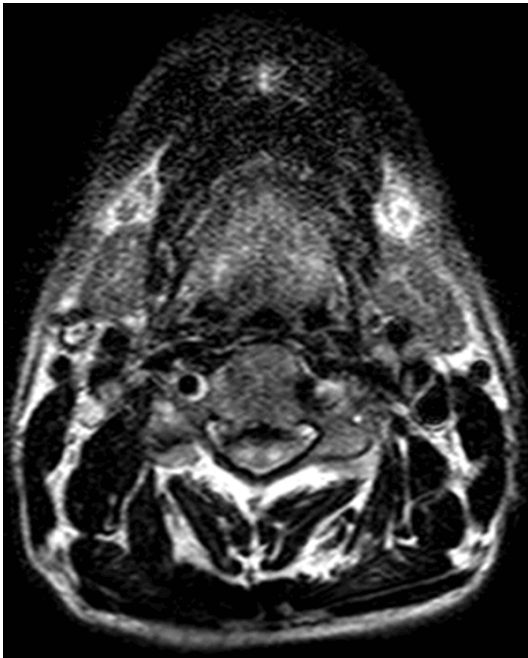


Figure 2. Preoperative MRI.

ments, so he was transferred to our hospital for treatment. Physical examination at admission revealed that the muscle strength of bilateral upper limbs was at level 4, with high muscle tension, bilateral biceps reflex (+++), triceps

reflex (+++) and bilateral Hoffman sign (+); the muscle strength of bilateral lower limbs was at level 4, with high muscle tension and bilateral Babinski sign (+). All limbs still existed deep and superficial sensibility; preoperative the journal of arthroplasty (JOA) score was 13 points. Preoperative imaging examination (no preoperative CT scan was performed): MRI exhibited cervical degeneration, disc protrusion at C3/4 and C5/6, and significant compression on dural sac (**Figures 1, 2**). Therefore, this patient was diagnosed as: cervical myelopathy.

After admission, the patient was completed preoperative tests, then under general anesthesia, the patient was performed C3/4-C5/6 discectomy plus intervertebral bone grafting and internal fixation with plate: after cut the disc, scraped the disc tissues with nucleus forceps and curette; then invaded the posterior edge of vertebral body, and removed the posterior edge of hardened vertebral body and ossified disc with one electricity burr, when scraping the bone at the level of left C4 upper edge, arterial blood spurted out suddenly. Small gauze was then used quickly to pack the intervertebral gap of C3/4 for hemostasis, and this accident was analyzed as left VAI; after compression, the anterior wall of left transverse process was bit away at C5 level to reveal the left C5 vertebral artery; wore one No "4" line around the left C5 vertebral artery, then controlled the blood flow with the line to reduce the arterial pressure to 80 mmHg. Relieved the compression of gauze, and a small break could be seen on the side wall of vertebral artery, while the bleeding was weakened; used the hemostatic gauze to stop bleeding, and filled the break with bone cement. Therefore, the bleeding was stopped; totally resected C3/4 disc, implanted iliac bone block, and performed anterior cervical plate fixation. C5/6 discectomy plus intervertebral bone grafting and internal fixation was then performed.

Partial symptoms of this patient was relieved after surgery, and X-ray review on the first post-operative day showed that cervical plate location was good (**Figures 3, 4**), the patient was discharged 10 days later with stable conditions. Before discharging, the review exhibited stable cervical internal fixation, and CT showed that the left C4 transverse foramen was filled with bone cement, with one screw passing through close to the left C4 transverse foramen

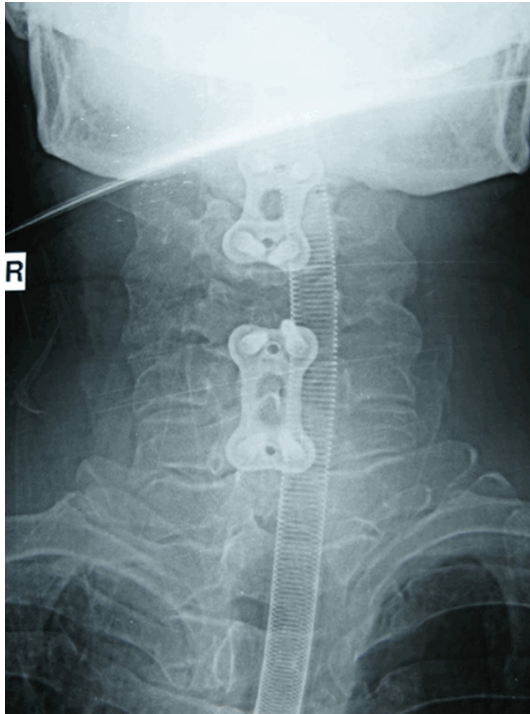


Figure 3. Normal X-ray on Day 1 after surgery.



Figure 4. Lateral X-ray on Day 1 after surgery.

(Figures 5, 6), the compression at spinal operated segment was relieved, and no such com-

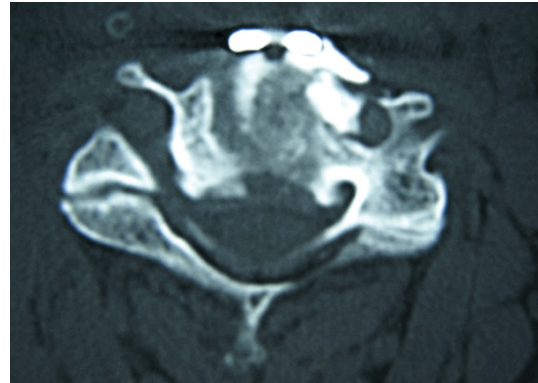


Figure 5. Postoperative C4 vertebral CT.

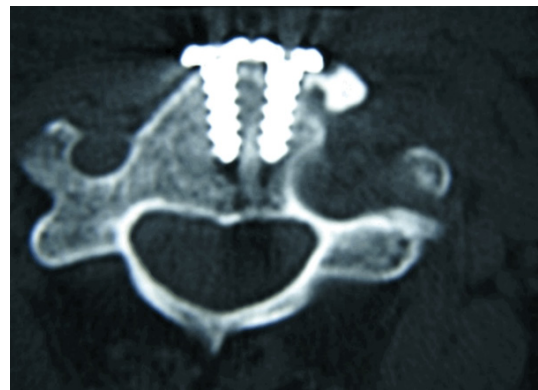


Figure 6. Postoperative C4 vertebral CT.

plications as postoperative delayed bleeding, cerebral blood supply insufficiency and arterio-venous fistula appeared. After discharging, the patient was not regularly reviewed because of his own reason, while returned to our hospital again for review in 2014 after telephone contact, X-ray and CT suggested good fusion of bone grafting (Figure 7), MRI exhibited that the adjacent segmental degeneration showed no significant aggravation, as well as no obvious aggravation or sequelae of VAI, magnetic resonance angiography (MRA) prompted the occlusion of left vertebral artery (Figure 8), and the JOA score was reviewed as 14 points.

Because this patient exhibited VAI while the surgery did not deviate from the midline, and lateral decompression did not exceed the normal range, we carefully studied the results of preoperative MRI and reviewed cervical CT, and found left transverse foramen at C4 level had obvious malformation, with its inner edge exceeding the outer edge of vertebral body, so



Figure 7. CT reconstruction 5 years after surgery.



Figure 8. MRA of vertebral artery 5 years after surgery.

that severe vertebral artery bleeding occurred during the procedure of normal lateral decompression.

Discussion

The probability of VAI during anterior cervical vertebral surgery is very low, which is about 0.3% to 0.5% in the literatures [1, 2], while the improper handling could cause serious consequences, even threaten patients' lives. Because of the low incidence of VAI, therefore, transverse foramen malformation caused VAI during anterior cervical surgery would be much more rare. Oga et al [4] reported one patient with vertebral artery distortion in 1996, and he further retrospectively analyzed 22 similar cases, and systematically classified the malformation of transverse foramen and vertebral artery. Curylo et al [5] reported three cases of intraoperative VAI caused by vertebral artery distortion in 2000, and further observed the transverse foramen of 222 corpses, measured 888 C3~C6 vertebral segments, finally, he pointed out that incidence rate of VAI was 2.7%. In 2008, Müller et al [6] reported a patient with C3/4 traumatic dislocation, because of abnormal directions of left C4 vertebral artery, Stage 1 anterior corpectomy plus decompression and reduction, together with Stage 2 posterior fixation, were performed, and no serious consequence occurred, so he pointed out that this segment existed the trap of intraoperative VAI. Eskander et al [7] reported one case of C6 vertebral artery abnormality caused VAI during conventional anterior subcorpectomy in 2009, and he pointed out the importance of understanding vertebral artery malformation in anterior cervical surgery. Rosenthal et al [8] reported one case similar to the present study in 2013, which was also caused by transverse foramen malformation during anterior cervical surgery, and these cases all suggested the importance of careful film-reading before surgery.

Most scholars would not perform such tests as routine vertebral CT scanning or vertebral artery reconstruction to study the possible impacts before anterior cervical surgery, and because routine preoperative MRI examination would exhibit similar low signals towards blood vessels and endplates, as well as the ignore from clinicians, this smallformation would be easily missed. Through a prospective study, Aubin et al [3] compared the results of blind observation towards 79 cervical MRI images by 6 radiologists (among which 39 cases existed vertebral artery malformation, while the other

40 cases were normal), and found when not required to observe the arterial morphology, all radiologists ignored the existence of vertebral artery malformation. Therefore, it would be extremely unrealistic to expect physicians to provide MRI vertebral artery malformation report towards the patients with cervical spondylosis.

Transverse foramen packing could provide viable solutions for intraoperative temporary or postoperative permanent hemostasis. But Eskander pointed out that left vertebral artery existed 5.7% of hypoplasia and 1.8% of complete deficiency, which were 8.8% and 3.1% for right vertebral artery, respectively [9]. So under this situation, it would generally be difficult for the contralateral artery to provide compensation, so ligating or packing vertebral artery would be extremely dangerous, which might lead to lateral medullary infarction, clinically known as Wallenberg syndrome, especially when one side of vertebral artery was obviously thickened, it might suggest poor blood supply towards the contralateral vertebral artery, so it would not be suitable to ligate or pack this artery, and other safer surgery should be considered.

Conclusions

Unidentified vertebral artery malformation would set routine cervical discectomy in great risk of VAI, even intraoperative death. Most radiologists would not conventionally describe vertebral artery morphology, so it should be recommended that when performing routine MRI towards vertebral artery morphology, clinicians should describe vertebral artery morphology, as for the patient with suspected malformation, further vertebral CT or vertebral artery CT/MRI reconstruction should be performed. Packing or ligating vertebral artery should consider the development situations of contralateral artery, and the patient with high-risk should be considered other safer surgical approaches, or when the technical conditions allowed, intraoperative endovascular therapy could be performed to restore artery blood flow.

Disclosure of conflict of interest

None.

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