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Diagnosis and treatment of vertebral artery injuries due to blunt trauma: A case series

Ryo Matsuzaki^{a,*}, Chie Nakada^a, Kosuke Kondo^a, Masataka Mikai^a,
Yuki Sakaeyama^a, Yutaka Fuchinoue^a, Kei Uchino^b, Sayaka Terazono^a,
Naoyuki Harada^a, Nobuo Sugo^a

^a Department of Neurosurgery (Omori), School of Medicine, Faculty of Medicine, Toho University, Japan

^b Department of Neurosurgery (Sakura), School of Medicine, Faculty of Medicine, Toho University, Japan

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ABSTRACT

Blunt traumatic vertebral artery injuries are rare, but they cause rapid secondary strokes with worsening prognoses. We report four blunt traumatic vertebral artery injury cases that were diagnosed before developing stroke and successfully treated with coil embolization. All four patients were male, aged between 45 and 71 years (mean 57 years). The injuries were caused by road accidents in 2 cases and falls in 2 cases. The GCS at initial examination was 15, except for one case of hypoxic encephalopathy associated with pulmonary contusion (11 points). The vertebral arteries were completely occluded (Denver grade IV). Before treatment, only one patient had a mild right cerebellar hemispheric stroke, but three patients were asymptomatic. All patients underwent coil embolization (2 on 0 days, 1 on 7 days, and 1 on 17 days), and the postoperative course was uneventful. The neuroradiological imaging studies should be performed as early as possible in vertebral artery injuries due to blunt neck trauma. Moreover, endovascular coil embolization is a safe, effective treatment for blunt traumatic vertebral artery injuries.

Introduction

Rare blunt traumatic vertebral artery injuries are increasingly diagnosed by Computed Tomographic Angiography (CTA) [1]. In 2016, the Boston criteria were published as the criteria for performing CTA for head and neck trauma (Table 2) [2]. Moreover, the severity and mortality of this traumatic disease have been clinically recognized [3]. Treatment of vertebral artery injuries included antithrombotic and endovascular therapy. However, the choice and timing of treatment are still controversial. With a literature review, we report four blunt vertebral artery injury cases successfully treated with aggressive endovascular therapy.

* Corresponding author at: Department of Neurosurgery (Omori), School of Medicine, Faculty of Medicine, Toho University, 6-11-1, Omori-nishi, Ota-Ku, Tokyo 143-8541, Japan.

E-mail address: ryo.matsuzaki@med.toho-u.ac.jp (R. Matsuzaki).

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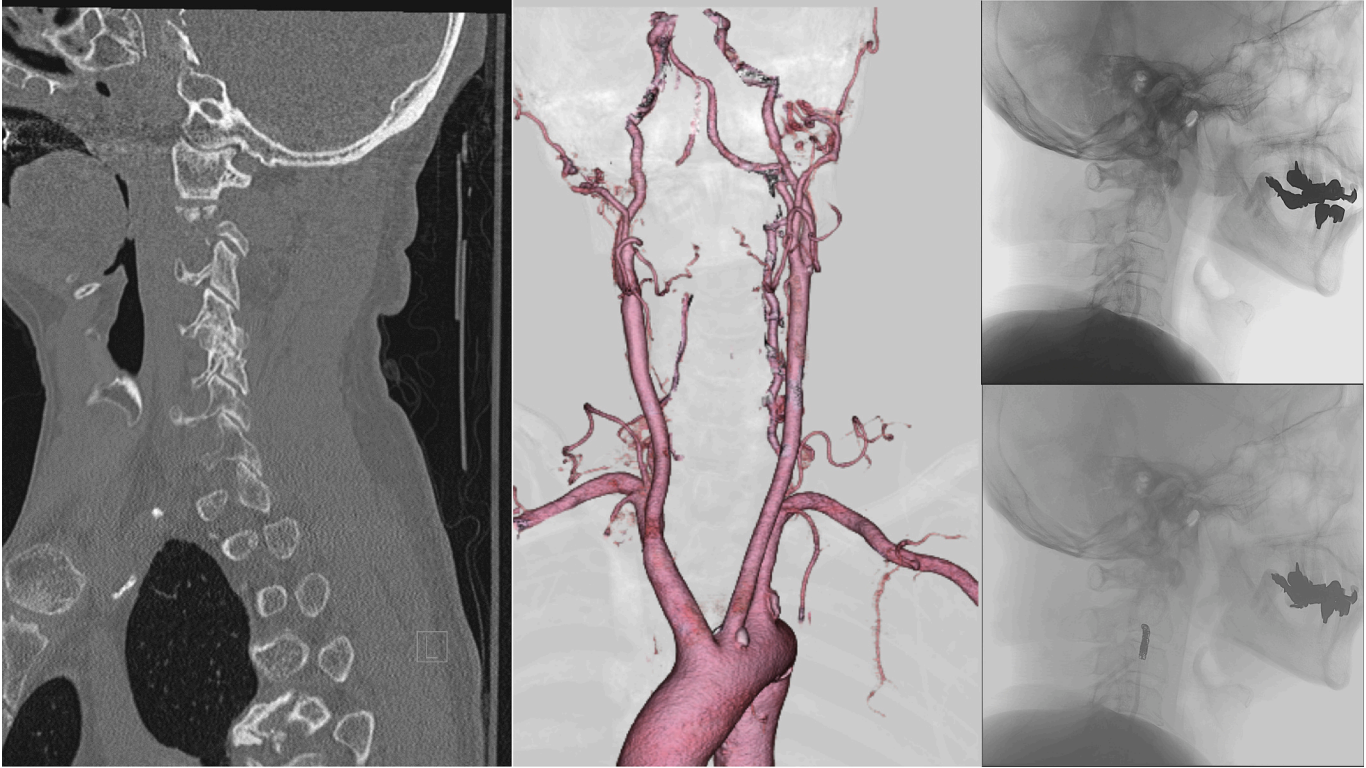


Fig. 1. CT and DSA results from case 1.

(A)Sagittal plane CT scan of cervical spine shows fracture of C2.

(B)CTA of reveals right vertebral artery occlusion.

(C)DSA of right vertebral artery shows stagnation of contrast medium.

(D)DSA of the right vertebral artery after embolization.

Case report

Case 1

A 66-year-old male fell from 4 m and sustained head trauma and left humerus fracture. The clinical assessment indicated a Glasgow Coma Scale (GCS) E4V5M6 with no neurological deficit. The computed tomography (CT) showed fractures of the axial vertebral body and right transverse process, so CTA was performed for suspected vertebral artery injury (Fig. 1). The results showed complete occlusion of the right vertebral artery (Denver Grade IV) (Fig. 1). On the day of injury, the proximal portion of the right vertebral artery (C2 level) was embolized with coils to prevent secondary stroke (Fig. 1). Six days after the injury, the patient underwent a posterior cervical fixation surgery; 10 days after the injury, surgery for the left humeral fracture was performed. The patient transferred to a rehabilitation hospital 61 days after injury for motion training of the left upper extremity.

Case 2

A 46-year-old male was hit by a 3-ton truck while driving a motorcycle. Head injury and flail chest appeared at the initial examination with GCS E3V3M5. The CT scan of the trunk showed multiple rib fractures and right lung contusion, and on the same day of injury, a right lung mesilebectomy and rib reconstruction were performed. Moreover, C3 and C4 fractures were also observed on CT of the cervical spine. After the patient was diagnosed with a Denver Grade IV vertebral artery injury at the C4 level on 3D computed tomographic angiography (3DCTA), the parent artery was coil embolized at the C4 level. The patient was discharged on day 22 of the injury without no postoperative complications.

Case 3

A 71-year-old male was injured while riding a bicycle after colliding with a cab at 40 km/h and was blown 5 m away. Clinical examination showed GCS E4V5M6, a contusion wound on the forehead, and tenderness in the right shoulder. However, there were no neurological symptoms. On the day of injury, a CT scan revealed no abnormality. However, a CT scan the next day indicated a new low-density area in the right cerebellar hemisphere. Moreover, CTA showed right vertebral artery occlusion from the ostium, and the right posterior inferior cerebellar artery was preserved via blood flow from the left union. The right vertebral artery was disrupted from its origin on CTA, and the right posterior inferior cerebellar artery was depicted via union from the left vertebral artery. Therefore, vascular coil embolization was performed at the origin of the right vertebral artery. There was no postoperative complication, but the patient was admitted to a nursing home on day 75 of the injury due to disuse syndrome.

Case 4

A 45-year-old male was admitted to a hospital with neck pain, numbness in the right upper and lower extremities, and dizziness after a fall. He was diagnosed with C6 right superior articular process fracture, C5/6 unstable cervical spine, and right vertebral artery occlusion and transferred to the hospital 3 days after injury. Angiography showed that the right vertebral artery was stagnant with contrast at the C6 level, and blood flow from the left vertebral artery to the right AICA/PICA via union was preserved. Posterior cervical fixation surgery was performed 4 days after injury, and right vertebral artery embolization was performed 17 days after injury. He was discharged 18 days after injury with residual right upper extremity paraplegia (Table 1).

Discussion

Vertebral artery injuries are common in motor vehicle accidents and falls, occurring in 0.53 % of all blunt trauma cases [1]. The incidence is 2.7 % when the injury severity score (ISS) is higher than 16 points [4]. As posterior circulation stroke was observed in 24 % of cases, with a high mortality rate of 8 % [1], active screening for vertebral artery injury is important. Reportedly, 5.1 % of patients with high-energy trauma have abnormal findings in the cervical spine, even in cases with low ISS and no abnormal neurological findings [5]. Therefore, an examination for vertebral artery injuries is essential depending on the injury mechanism. Moreover, 71 % of vertebral artery injury cases are complicated by cervical spine injury [1]. For diagnosis of vertebral artery injury, CTA is a good choice with a sensitivity of 100 % and specificity of 94 % [3]. In all reported cases here, vertebral artery injury was diagnosed by 3DCTA

Table 1
Characteristics of the 4 cases.

Case	Age in year/sex	Injury mechanism	ISS	GCS	Stroke	Cervical spine fracture	Denver grade	TAE	GOS
1	66/M	Blunt	32	15	–	C2	IV	0	Mild deficit
2	46/M	Blunt	33	11	–	C3	IV	0	Normal
3	71/M	Blunt	2	15	Cerebellum	–	IV	8	Mild deficit
4	45/M	Blunt	16	15	–	C6	IV	17	Mild deficit

The ISS is a score that attempts to standardize the severity of injuries sustained during a trauma. This standardization allows one to more accurately study and predict morbidity and mortality outcomes after traumatic injuries.

Table 2

Boston criteria for blunt cerebrovascular injury.

First tier	Second tier
Skull base fractures: petrous and basilar fractures	Diffuse axonal injury
Any cervical spine fractures	Complex faccial fractures with midface instability
Cervical spine injury (cord, vertebral body, or ligaments)	Combined significant head and chest trauma
Soft-tissue injury to anterior neck with swelling/ecchymosis/hematoma/or bruit	Near-hanging
Significant neurologic deficit: lateralizing neurologic deficit, TIA, Horner syndrome	Seat belt abrasions on neck
Evidence of brain infarct on CT	Other unexplained neurologic deficits: certigo, tinnitus, or GCS \leq 6

First tier criteria: CTA screening on presentation.

Second tier criteria: CTA screening within 24–48 h of presentation.

Abbreviations

ISS Injury Severity Score.

GCS Glasgow Coma Scale.

TAE Transcatheter Arterial Embolization.

GOS Glasgow Outcome Scale.

This table: Denver grade.

GradeI Irregularity of the vessel wall or lumen stenosis<25 %.

GradeII Intimal flap or lumen stenosis>25 %.

GradeIII Pseudoaneurysm.

GradeIV Vessel occlusion.

GradeV Complete transection of the artery.

within 3 days from the day of injury, demonstrating its usefulness.

The heparin administration improves neurological prognosis, which is widely available, will be useful for many spine centers with limited resources [1,6]. Recently, coil embolization to prevent secondary stroke was documented [4,7] and it can be performed with only a small amount of heparin and is often used in cases involving traumatic injury in the trunk or intracranial space. For example, case 2 presented with a pulmonary contusion and pancreatic injury that needed emergency open-chest surgery, and subsequent coil embolization of the vertebral artery was performed. The coil embolization should precede cervical spine surgery, as in cases 1, 2, and 3 that were prophylactically embolized before the surgery. Consequently, this may prevent the dispersal of thrombus from the vertebral artery following the surgery. As the incidence of cerebral infarction is the same even if the vertebral artery injury occurred on the dominant side [1], aggressive embolization is recommended.

Conclusion

Blunt vertebral artery injuries, which were previously considered rare, can be properly diagnosed by CTA according to screening criteria. Endovascular coil embolization may be an effective and safe treatment for blunt traumatic vertebral artery injuries.

Statement of informed consent

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Study Design and Concept: Ryo Matsuzaki, Nobuo Sugo.

Data Acquisition, Analysis and Interpretation: Ryo Matsuzaki, Chie Nakada, Masataka Mikai, Yuki Sakaeyama, Yutaka Fuchinoue, Kei Uchino, Shin'ichi Okonogi, Sayaka Terazono.

Manuscript preparation: Ryo Matsuzaki, Kosuke Kondo, Naoyuki Harada, Nobuo Sugo.

Declaration of competing interest

The authors declare no competing interest.

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