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• Case Report •

A Blunt Traumatic Vertebral Artery Injury: A Case Report

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Blunt traumatic vertebral artery injury (TVAI) is relatively rare, but it may frequently be associated with head and neck trauma. TVAI is difficult to diagnose with diverse outcomes, thus it is a clinical challenge. There are no widely accepted guidelines for treatment and diagnosis, so that the diagnosis of TVAI can be easily delayed. Therefore, any clinical suspicion from clues on the initial imaging is important for diagnosis of TVAI. The authors report on the case of a patient diagnosed as having a TVAI with a transverse foramen fracture. [J Trauma Inj 2016; 29: 28-32]

Key Words: Cerebrovascular trauma, Vertebral artery dissection, Vertebrobasilar insufficiency, Spinal fractures

I. Introduction

Blunt traumatic vertebral artery injury (TVAI) is relatively rare, but its incidence of diagnosis is increasing with development of diagnostic radiology.(1) TVAI shows various clinical features and prognosis, thus diagnosis is difficult. Most cases of TVAI does not show symptoms, but it may cause a fatal condition when serious complications such as brain infarction of the basilar artery area occurs.(2) However there are no standard guidelines for diagnosis of TVAI. TVAI can occur in patients with multiple or severe trauma and diagnosis may be delayed because of difficulty of neurological examination and various onset of symptoms.(3) The authors report on a case of TVAI diagnosed early because of an accompanying fracture of the transverse foramen.

II. Case

A 48-years old male patient who was struck on his right face by a metal structure was transported to a trauma center by medical helicopter. There was no special medical history and the patient's only complaint was facial pain. At the time of the visit, the patient showed an alert mental status and rela-

Fig. 1. A communited mandible fracture accompanied by severe soft tissue injury and hematoma is observed on facial bone CT.

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tively stable vital signs (151/95 mmHg of blood pressure, pulse rate of 56, respiratory rate of 17, and body temperature 36.8°C). The patient's right neck was swollen and a laceration measuring 3 cm length was observed. According to blood test, complete blood cell count was relatively normal (serum hemoglobin 11.5 g/dL, hematocrit 34.4%, serum platelet 229,000 mm^3, prothrombin time 11.8 sec, activated partial prothrombin time 28.8 sec), and other examinations were also within normal range. Computed tomography (CT) performed for evaluation of facial bones and neck. showed a fracture of the right condyle, right angle, and symphysis of the mandible (Fig. 1), and a fracture of the right transverse foramen of the first cervical vertebra (Fig. 2). CT angiography occlusion of the distal area of the right vertebral artery (Fig. 3). The patient was sedated and mechanical ventilation with intubation was applied because the patient was suffering from pain associated with the mandible fracture and air way obstruction caused by neck swelling and hematoma was a concern. Anticoagulation therapy with unfractionated heparin was started on the third hospital day after a cooperative examination with neurology. The patient underwent open reduction and internal fixation of the mandible fracture on the

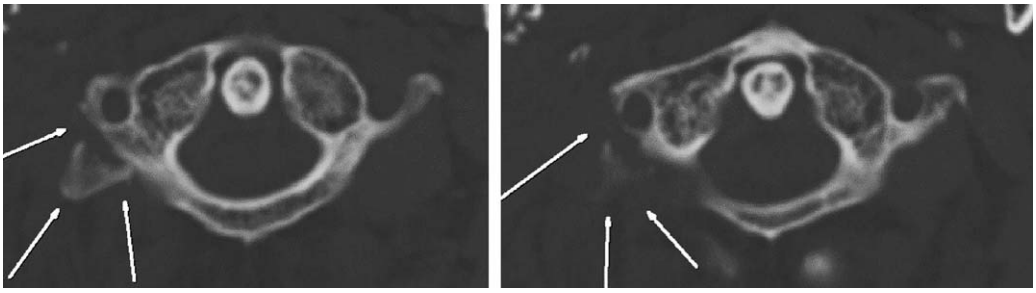

Fig. 2. A transverse process fracture of the atlas observed on the cervical-spine CT.

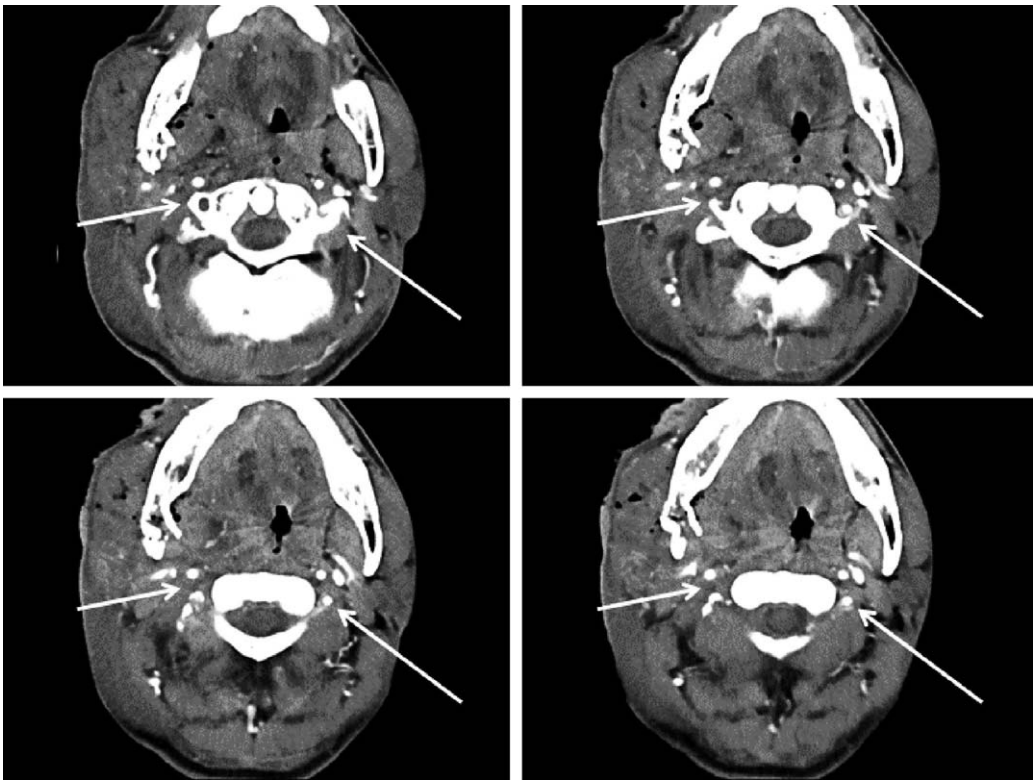

Fig. 3. Right vertebral artery occlusion observed at the portion of the fracture of the atlas on CT angiography.

fifth hospital day. Mechanical ventilation was stopped after surgery and extubation was performed on the sixth hospital day. The patient complained of intermittent headache after extubation, but respiration was stable and there were no abnormal neurological signs. CT angiography scanning of the head was performed on the 12th hospital day and compared with initial CT angiography, but no significant differences were observed between the two examinations (Fig. 4). Unfractionated heparin was changed to oral anticoagulant before discharge. Care was focused on headache and wound management, and the patient was discharged on the 25th hospital day with no specific findings. No abnormal physical or neurological findings were observed at the patient's visit to the outpatient clinic one month after injury. Magnetic resonance (MR) angiography performed one month after the injury showed no significant differences between MR angiography and prior CT angiography (Fig. 5).

Fig. 4. Right vertebral artery is not recanalized on the follow-up CT angiography. However, the CT angiography does not show any proceeding of occlusion or deterioration of posterior circulation.

III. Discussion

The prevalence of TVAI is approximately 0.5~2.0 % to overall trauma patients,(3) but it tends to rise in head and neck trauma patients and TVAI is found in approximately 20% of head injury patients.(4)

TVAI is caused by overextension, overflexion, traction, and direct impaction. Specifically, previously described causes can result in a traction force at the fixed area of the vertebral artery that penetrates the transverse foramen and mobile area of the vertebral artery above the fixed area.(3) TVAI frequently occurs at the fixed area of the vertebral artery because of the mechanism described above.(3) TVAI can be caused by not only strong impaction but also activities that induce overextension and overflexion such as chiropractic procedures, massage, and yoga, or repeated neck activities such as swimming.(3,5)

Most cases of TVAI occur unilaterally, but bilateral TVAI is reported in one third of cases, while unilateral hypoplasia of the vertebral artery is reported in ten percent of the population, in whom unilateral hypoplasia of the vertebral artery is compensated by the contralateral vertebral artery or fetal-type posterior communicating artery.(6) Type of TVAI is similar to other vascular injury. TVAI can present as occlusion, dissection, thrombosis, intimal injury, pseudoaneurysm, rupture, arteriovenous fistula, and division. The prognosis of TVAI patients is influenced by various factors including bilateral injury, hypoplasia and its compensations or modifications, type of injury, and the presence of atherosclerotic

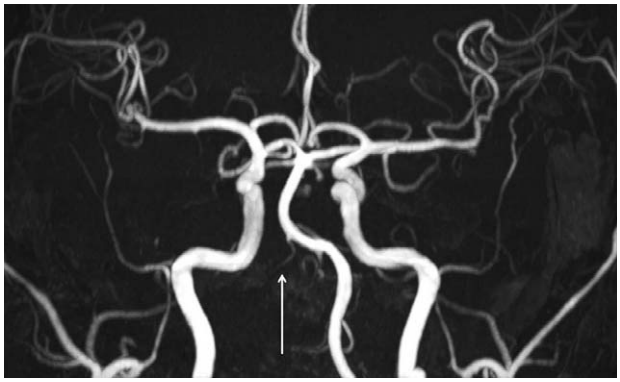

Fig. 5. Follow-up MR angiography shows good posterior circulation and compensation from the contralateral vertebral artery with no change from the previous CT angiography.

change of the vertebral artery.(3) Therefore, these factors should be considered when establishing a treatment plan.

Symptoms of TVAI are various, including headache, neck pain, disorder of speech, disorder of gait, disorder of vision, dizziness, nausea, vomiting, and disorder of consciousness or sense. These symptoms are thought to be caused by ischemia of the cerebellum, the brainstem, and the primary visual cortex.(3) In this case the patient's headache appeared to be a nonspecific symptom of head and neck injury, not a symptom of TVAI, because there was no lateralization sign. Therefore, anticoagulation therapy was applied for prevention of delayed complication of TVAI rather than for treatment of TVAI itself.

Diagnosis of TVAI is suggested when there is fracture of the transverse foramen, fracture of the facet joint, and subluxation of cervical vertebrae. According to a study by Willis et al., combination of these three findings can increase the accuracy of diagnosis of TVAI to 92%.(7) In this case, CT angiography was performed immediately after CT scan of the neck because fracture of the transverse foramen of the first cervical vertebra was found after CT scan, so that early diagnosis of TVAI was possible. In addition to the vertebral injury, modified Denver screening criteria (Table 1) announced in 2006 is helpful in diagnosis of TVAI. CT angiography scanning is recommended for patients included in these criteria.(8)

CT angiography is used in both screening and diagnosing examination of TVAI because it is rapid with accuracy similar to that of angiography.(8) Angiography is the most accurate diagnostic tool, but it is an invasive test that causes cerebral infarction in 0.5% of patients, thus it is performed only when an intravascular procedure is required.(3,8) MR angiography is also an examination with high diagnostic value, but, because of its long scanning time, it is not an optimal initial examination for trauma patients.(3) Duplex ultrasonography is a rapid and non-invasive examination, but its variable accuracy is dependent on the experience of physicians and low sensitivity (38.5%) causes physicians to avoid duplex ultrasonography as an initial examination for trauma patients.(3)

Table 1. Modified denver screening criteria for blunt cervical vascular Injury.(9)

Lateralizing neurologic deficit (not explained by CT* head)
Infarct on CT* head scan
Cervical hematoma (nonexpanding)
Massive epistaxis
Anisocoria/Horner's syndrome
Glasgow Coma Scale score<8 without significant CT* findings
Cervical spine fracture
Basilar skull fracture
Severe facial fracture (LeForte II or III only)
Seatbelt sign above clavicle (signs of hanging)
Cervical bruit or thrill

* CT: Computed tomography

Some special cases of TVAI are treated with endovascular interventions, but treatment of most TVAI patients is observation or anticoagulation therapy.(3) Anticoagulation therapy is usually used for TVAI patients because there are several retrospective studies mentioning low incidence of stroke in the experimental group compared with the control group, however evidence levels of these studies are low. Therefore, anticoagulation therapy must be carefully selected considering the risk of bleeding in patients. Anticoagulation therapy is currently recommended for patients with low bleeding risk, but there is not yet a consensus regarding which anticoagulant is optimal or recommended. However in multiple trauma patients or in patients requiring surgery, unfractionated heparin which can easily and rapidly normalize the blood coagulation after interruption is recommended.(3) Antiplatelet agent, instead of anticoagulation agent, may be used, but it is not yet known which antiplatelet agent is more effective.(3)

Anticoagulation agents cannot be used for TVAI patients when there is accompanying severe trauma or hemorrhage. Endovascular intervention should be considered when ischemic brain stroke has occurred after TVAI due to severe trauma. Endovascular intervention includes stent insertion, coiling, and embolization of the vertebral artery. These interventions have different indications, proper interventions should be selected considering accompanying complications (hemorrhage, dissection, or occlusion of the vertebral artery), modification of the vertebral artery, and anatomic variation of a com-

Table 2. Blunt carotid and vertebral arterial injury grading scale.(9)

Injury Grade	Description
I	Luminal irregularity or dissection with <25% luminal narrowing
II	Dissection or intramural hematoma with <25% luminal narrowing, intraluminal thrombus, or raised intimal flap
III	Pseudoaneurysm
IV	Occlusion
V	Transection with free extravasation

pensation artery.(3)

Middle portion of the vertebral artery is mostly protected by the transverse foramen, and the upper portion of the vertebral artery runs deep into the skull base. For this reason, surgical treatment is not recommended for TVAI patients unless hemorrhage is ongoing and impossible to control with endovascular intervention. When surgical treatment is indicated, ligation of the proximal portion of the vertebral artery is generally performed.(3)

Injury of the vertebral artery used to be considered in the category of cerebrovascular injury with carotid artery injury, and both vertebral and carotid artery are often treated according to an algorithm (Denver Blunt Carotid and Vertebral Artery Grading Scale and the Denver Screening Criteria for blunt cerebrovascular injury).(9) However there are several differences between the two arteries, which arise from the fact that the vertebral artery penetrates the transverse foramen. Surgery for TVAI is difficult to perform, has low relation to vertebral fracture, shows low incidence of aneurysm, and shows low mortality compared with the carotid injury (8~18% vs. 17~38%).(3) Denver system (Table 2) divides the severity of cerebrovascular injury according to five grades based on radiological findings,(9) and the prognosis of the carotid artery injury is well correlated with the grade of the Denver system. However clinical manifestations and prognosis of TVAI are less correlated with the grade of the Denver system. Therefore the treatment plan for TVAI should be decided carefully, considering not only radiological findings but also the characteristics of the vertebral artery.(10,11)

REFERENCES

1) Inamasu J, Guiot BH. Vertebral artery injury after blunt cervical trauma: an update. Surgical Neurology 2006; 65: 238-45.
2) Kim YK, Schulman S. Cervical artery dissection: pathology, epidemiology and management. Thrombosis research 2009; 123: 810-21.
3) Desouza RM, Crocker MJ, Haliasos N, Rennie A, Saxena A. Blunt traumatic vertebral artery injury: a clinical review. European spine journal: official publication of the European Spine Society, the European Spinal Deformity Society, and the European Section of the Cervical Spine Research Society. 2011; 20: 1405-16.
4) Meier DE, Brink BE, Fry WJ. Vertebral artery trauma: acute recognition and treatment. Archives of surgery 1981; 116: 236-9.
5) Berne JD, Norwood SH. Blunt vertebral artery injuries in the era of computed tomographic angiographic screening: incidence and outcomes from 8,292 patients. J Trauma 2009; 67: 1333-8.
6) Eskander MS, Drew JM, Aubin ME, Marvin J, Franklin PD, Eck JC, et al. Vertebral artery anatomy: a review of two hundred fifty magnetic resonance imaging scans. Spine 2010; 35: 2035-40.
7) Willis BK, Greiner F, Orrison WW, Benzel EC. The incidence of vertebral artery injury after midcervical spine fracture or subluxation. Neurosurgery 1994; 34: 435-41.
8) Eastman AL, Chason DP, Perez CL, McAnulty AL, Minei JP. Computed tomographic angiography for the diagnosis of blunt cervical vascular injury: is it ready for primetime? J Trauma 2006; 60: 925-9.
9) Biffl WL, Cothren CC, Moore EE, Kozar R, Cocanour C, Davis JW, et al. Western Trauma Association critical decisions in trauma: screening for and treatment of blunt cerebrovascular injuries. J Trauma 2009; 67: 1150-3.
10) Biffl WL, Moore EE, Elliott JP, Brega KE, Burch JM. Blunt cerebrovascular injuries. Current problems in surgery 1999; 36: 505-99.
11) Fusco MR, Harrigan MR. Cerebrovascular dissections: a review. Part II: blunt cerebrovascular injury. Neurosurgery 2011; 68: 517-30.