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Case Report

Multiple trauma complicated by traumatic vertebral artery injury without cervical vertebral injury: A case report

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ABSTRACT

Background: Blunt traumatic vertebral artery injury is commonly associated with head and cervical spinal trauma. However, those associated with chest or upper extremity injuries without cervical spine-related trauma are rare.
Case presentation: A 94-year-old woman was injured in a motor vehicle crash. She was diagnosed with traumatic subarachnoid hemorrhage, bilateral subdural hematomas, right vertebral artery injury, and right clavicle fracture. No cervical spine injuries were observed. It was possible that the fracture fragment of the right clavicle may have directly injured the right vertebral artery. Coil embolization was performed for the vertebral artery injury. The patient had a good postoperative course and was transferred to the hospital for rehabilitation on day 65.
Conclusion: Regarding the high-risk injury mechanism, blunt traumatic vertebral artery injuries in the V1–2 segment may occur in cases with clavicle fractures.

Introduction

Traumatic vertebral artery injuries, especially due to blunt injury (BTVAI) occur in 0.5–2 % of all patients with trauma. BTVAI are frequently associated with head and cervical spine injuries [1] and approximately 40 % of cervical fractures [2]. Cervical fractures involving the upper cervical spine, with subluxation, or extending into the foramen transversum are considered at high risk for BTVAI and 70 % of BTVAI cases are associated with cervical spine fractures [3]. However, reports of BTVAI associated with thoracic or upper extremity injuries without cervical spine-related trauma are extremely rare. Here we report a rare case of traumatic vertebral artery injuries associated with clavicle fracture in the absence of cervical spine-related trauma.

Case presentation

The patient was a 94-year-old woman with no relevant medical history. She was hit by a motorbike at a speed of 40 km/h from her

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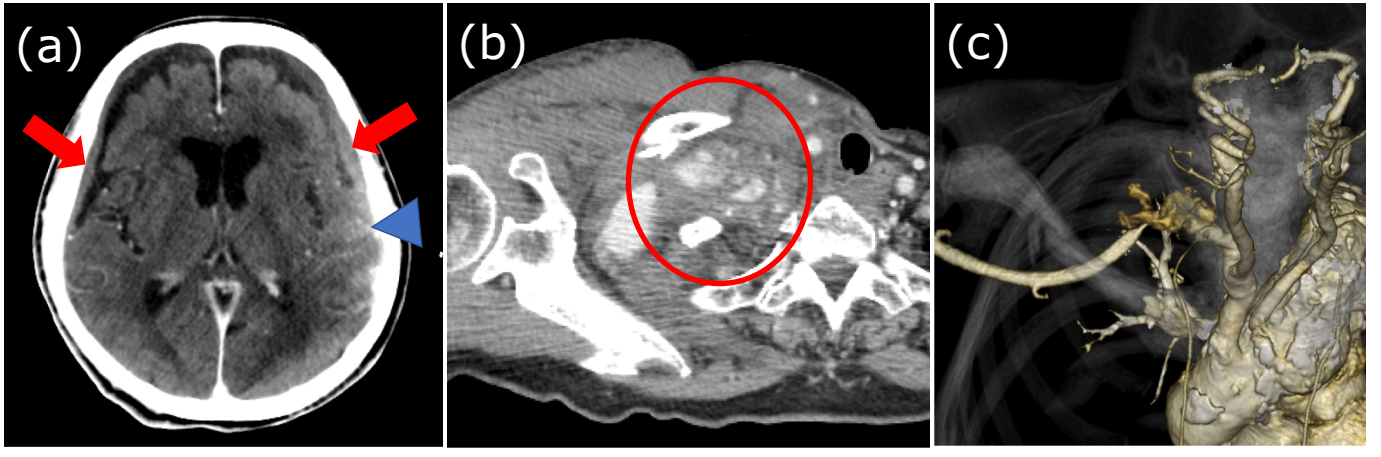

Fig. 1. Whole-body CT at the initial arrival. (a) Head CT shows traumatic subdural hemorrhage (arrow head) and bilateral acute subdural hematomas (arrow). Neck-pelvis contrast-enhanced CT reveals hematoma around the same area as the right clavicle fracture (Robinson classification type 2B2). (b, c) Contrast medium extravasation from the vertebral artery is seen in the arterial phase (circle).

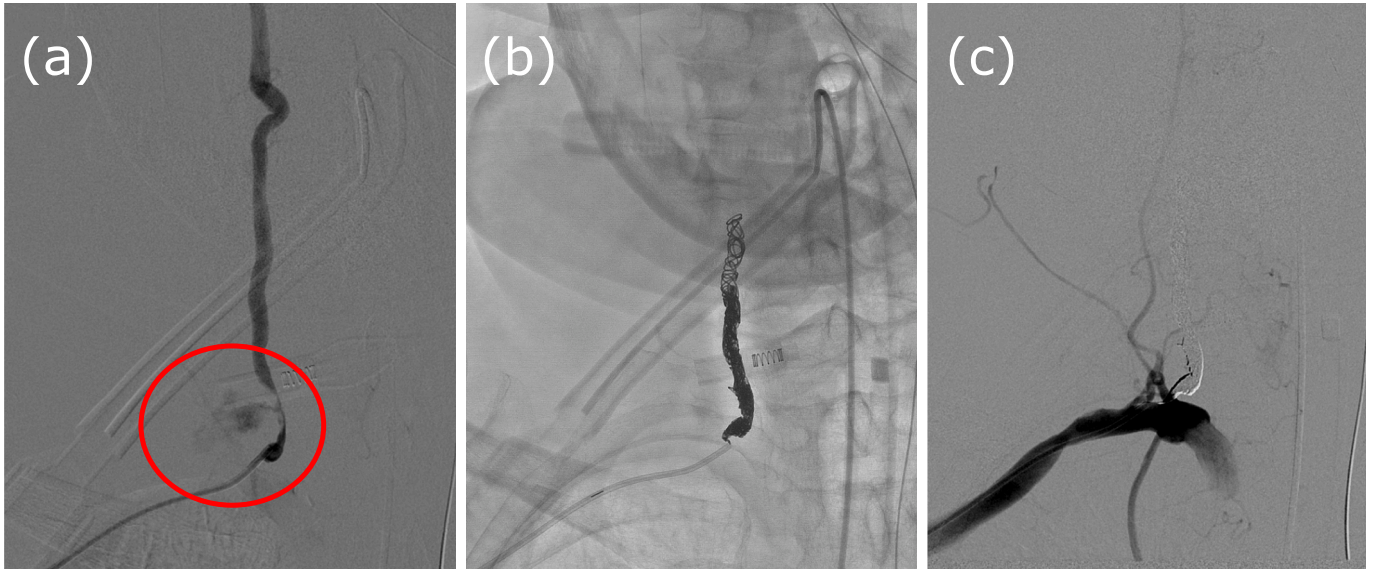

Fig. 2. Endovascular treatment for vertebral artery injury. (a) The right vertebral artery angiography shows Pearl and string sign, and extravasation of contrast medium is confirmed in the V1 segment (circle). (b) Microcatheter is passed through the injury site of the right vertebral artery, and the injury site is isolated by embolization using a metallic coil. (c) The right subclavian artery angiography shows the disappearance of contrast medium extravasation after coil embolization of the right vertebral artery.

right side while walking on a crosswalk. She was then transported to our facility. In the prehospital situation, her consciousness level was poor, and she was barely awake when spoken to. On arrival at our hospital, the patient's vital signs were as follows: respiratory rate, 28/min; saturation, 100 % (O2 10 L/min); blood pressure, 102/87 mmHg; and heart rate, 87 bpm. Focused assessment using sonography for trauma was negative. The Glasgow coma scale (GCS) score was 11 points (E3 V3 M5). A secondary survey showed a 3 cm subcutaneous hematoma on the right side of the head and swelling from the neck to the right shoulder. No laterality in limb movement was confirmed. Head computed tomography (CT) showed traumatic subarachnoid hemorrhage and bilateral acute subdural hematomas (Fig. 1a). Contrast-enhanced neck-pelvic CT revealed a right clavicle fracture (Robinson classification type 2B2), extravasation from the right vertebral artery, hematoma around the right vertebral artery (Denver grading scale Grade V), and a thoracoabdominal aortic aneurysm (Fig. 1b). No fracture or dislocation in the cervical spine was found; the injury severity score was 29, Revised Trauma Score was 6.904, and probability of survival was 72.4 %. Blood tests on initial arrival showed no significant findings.

We diagnosed the patient with right traumatic vertebral artery injuries and attempted hemostasis using endovascular treatment. Right vertebral artery angiography showed pearls and string signs in zones V1–V2 and extravasation of contrast medium in the same area. The right brachiocephalic artery was temporarily blocked using a balloon catheter from the right brachial artery. We then confirmed that cerebral perfusion was maintained during the right vertebral artery occlusion by the left vertebral artery angiography. Subsequently, coil embolization of the right vertebral artery was performed (Fig. 2). After embolization, extravasation of the right vertebral artery disappeared.

During coil embolization, hemoglobin and fibrinogen levels decreased to 7.0 g/dL and 153 mg/dL, respectively, and 8 units of red blood cell transfusion and 24 units of fresh-frozen plasma transfusion were needed. The clavicle fracture was treated conservatively with figure of eight immobilization.

Repeat head CT on day 2 showed a slightly increased subdural hematoma, but craniotomy was not required. On day 11, head magnetic resonance imaging showed scattered high-signal areas in the diffusion-weighted image; however, obvious evidence of cerebral infarction resulting from vertebral artery embolization was not detected. The patient's consciousness improved to GCS 13 points (E4 V4 M5), and she was transferred to rehabilitation on day 65.

Discussion

This case presented with vertebral artery injury complicated by clavicle fracture without cervical spine injury. Risk factors for BTAI have been reported to include complex skull fractures, upper rib fractures, mandible fractures, scalp degloving, and great vessel injury, in addition to cervical spine injury [4]. However, clavicle fractures were not observed in this report. The Denver grading scale proposed by Biffl et al. [5] is a well-known classification of blunt cerebrovascular injuries (Table 1). In this case, right vertebral artery injury and extravasation of contrast medium were observed on contrast-enhanced CT. Thus, the severity in this patient's injury was Grade V. The standard of treatment for Grade I-IV BTVAI is treatment with antithrombotic therapy unless the patients do not have any contraindication to antithrombotic therapy. Early antithrombotic therapy is relatively safe in preventing stroke-related mortality [6]. Surgical or endovascular treatment is generally the first consideration in Grade V cases [7]. We opted for endovascular embolization because of the high availability of endovascular therapy in our facility. When sufficient blood flow is maintained from the collateral vessels to the vertebrobasilar artery region during vertebrobasilar artery embolization, distal blood flow from the coil embolization area is considered inadequate [8].

In addition, since the neck was swollen with enlargement from the time of admission and the patient had a “hard sign,” tracheal intubation was performed early after arrival. In 90 % of cases of hard signs, such as pulsatile hematoma or tracheal deviation, there are vascular injuries of the neck region. Therefore, we should not hesitate in performing tracheal intubation because of the possibility of progression of neck injury [9].

Vertebral artery injuries can be anatomically divided into four regions. The V1 segment starts from the subclavian artery to the foramen transversum of the sixth cervical vertebra, the V2 segment passes through the foramen transversum to the second cervical vertebra, the V3 segment extends from the foramen transversum of the second cervical vertebra to the foramen occipitalis major, and the V4 segment extends from the foramen occipitalis major to its confluence with the basilar artery [7]. The V2 segment is the most frequent area where blood vessels are exposed to shear forces. In the V1 segment, which is the injured area in this case, Grade I and IV injuries are common, and Grade V is rare [7].

The mechanism of vertebral artery injury without cervical vertebral fracture is generally considered to be that the artery is injured by stretching due to rapid rotation or hyperextension of the neck [10]. This is because Grade I or IV injuries occur more frequently for V1 segment BTVAI. In this case, there were no obvious cervical spine injuries. Instead, a fracture of the right clavicle was observed. The vertebral artery injury and clavicle fracture occurred at the same level. This suggests that strong external force itself or rotation and

Table 1
Denver grading scale for blunt cerebrovascular injuries [4].

Grade I	Irregularity of the vessel wall or lumen stenosis <25 %
Grade II	>25 % luminal stenosis due to an intraluminal thrombus, intimal flap, dissection, or intramural hematoma
Grade III	Pseudoaneurysm
Grade IV	Complete luminal occlusion
Grade V	Complete vessel transection with free contrast extravasation or arteriovenous fistula

hyperextension of the neck applied directly injured the vertebral artery. It was also possible that the vertebral artery has been injured by the clavicle fragment, resulting in vascular injury with extravasation.

Conclusion

We report a rare case of traumatic vertebral artery injury associated with clavicle fracture without cervical vertebral fracture or dislocation. Regarding the high-risk injury mechanism, BTVAI in the V1–2 segment may occur in cases with clavicle fractures.

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Informed consent statement

Informed consent was obtained from the patient and her family for the publication of this case and accompanying images.

CRediT authorship contribution statement

Ayumi Takahashi: Writing-Original draft preparation, Takaaki Maruhashi: Conceptualization, Writing-Reviewing and Editing, Ryoichi Kitamura: Conceptualization, Daisuke Yamamoto: Data Curation, Yutaro Kurihara: Data Curation, Hiroyuki Koizumi: Writing-Reviewing and Editing, Satoshi Tamura: Data Curation, Yasushi Asari: Writing-Reviewing and Editing.

All authors read and approved the final manuscript.

Declaration of competing interest

None.

Details of any meeting at which the work was presented.

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