Case Report

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Endovascular Management of a Combined Subclavian and Vertebral Artery Injury in an Unstable Polytrauma Patient: Case Report and Literature Review

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ABSTRACT

While blunt trauma of the head and neck are a common pattern of injury, significant problems related to the prompt diagnosis and optimal management of traumatic artery injuries have been reported in the literature. While patients with major artery injuries might develop hemorrhagic shock very rapidly, patients with blunt cerebrovascular injuries (BCVI) can present asymptomatic, but complications like basilar territory infarction, cortical blindness and death may occur.

We report the life- and limb-saving management in a 57-year-old hemodynamically unstable trauma patient. The individual developed hemorrhagic shock, and other major complications, including cortical blindness, related to a posterior circulation stroke. Full recovery was achieved by immediate endovascular prosthesis for subclavian artery (SA) rupture and stenting of a traumatic vertebral artery occlusion. Endovascular and alternative treatment options are discussed and the management of subsequent sequelae associated with aggressive anticoagulation in trauma patients is reviewed, including intracranial, abdominal and other sites of secondary hemorrhage.

Keywords: Subclavian Artery; Vertebral Artery; Vascular injuries; Blunt cerebrovascular injury (BCVI); Artery repair/stenting.

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Introduction

While blunt trauma of the head and neck are a common pattern of injury, significant problems related to the prompt diagnosis and optimal management of traumatic artery injuries have been reported in the literature. While patients with major artery injuries might develop hemorrhagic shock very rapidly, patients with blunt cerebrovascular injuries (BCVI) can present asymptomatic, but complications

like basilar territory infarction, cortical blindness and death may occur. Due to the wide range of clinical presentations, treatment options, and literature paucity regarding the optimal screening and management protocol, blunt artery injuries remain a special clinical challenge in trauma care.

Current indications for endovascular management of vascular injuries in stable polytrauma patients include an intima dissection, transections of major vessels, AV-fistulas, pseudoaneurysms and traumatic aortic ruptures. Patients in extremis might be stabilized with the temporary ballon occlusion technique.

Case Presentation

A 57-year-old male sustained blunt multiple trauma (Injury Severity Score (ISS) 54 points, New ISS 66 points) in a high-energy motorcycle accident. The primarily stable patient (Glasgow Coma Scale (GCS) 14) presented with a sudden abnormal neurological status including anisocoria and delayed pupil reaction. Due to the deteriorating neurological status, the individual was intubated at the scene, received spinal immobilization, and was still hemodynamically stable when he was admitted to a certified urban Level 1 trauma center within 30 minutes after the emergency call was dispatched.

In the trauma center, the patient was managed according to the Advanced Trauma Life Support (ATLS) protocol and German S3-guidelines for polytrauma: A right tension pneumothorax with flail chest was immediately addressed by chest tube insertion, and minor blood volume was drained (<250mL). A liver hematoma (2.7cm) around the falciform ligament was found in rapid sonography. External soft-tissue injuries included a Morel-Lavallée lesion of the right ventral thigh and a significant hematoma around the right shoulder girdle. The neurovascular exam revealed diminished pulses of the right upper limb. A contrast-enhanced whole-body computed tomography (WBCT) was performed and the transected SA was confirmed as the primary source of excessive hemorrhage into the shoulder girdle, axilla, mediastinum, and cervical region (Figure 1). The patient developed hemorrhagic shock right after imaging. Arterial blood pressure was 80/40mmHg and heart rate (HR) was 140bpm. Hemoglobin levels dropped from 12.4 g/dL as low as 6.1 g/dL. In order to resuscitate the patient, significant amounts of volume, blood products and vasopressors were required. A mass transfusion protocol (10 pRBCs, 8 FFPs) was initiated according to local institutional guidelines. The patient was simultaneously transported to the interventional angiography suite. While under general anesthesia, access to the femoral artery (9F) was established. Endovascular stenting was performed of the right VA (Figures 2 and 3) with a 5/18 mm Ultralink (Abott Vascular, Santa Clara, CA, USA) and of the transected right SA with a covered 10/60mm Fluency graft (C.R. Bart GmBH, Karlsruhe, Germany). The upper limb was re-vascularized, distal perfusion was confirmed and the patient was hemodynamically stabilized. The liver hematoma and the Morel-Lavallée lesion were primary treated conservatively and the patient was admitted to the surgical intensive care unit.

The next day the patient was extubated, and complained of complete blindness and loss of right upper extremity function. Consecutive angio-CT and MRI scans showed no progression of a subarachnoid hematoma (SAH), patency of both stented vessels, but revealed evidence of an ischemic posterior cerebral stroke (Figure 4) and nerve root traction injuries (C3-8). Due to paralysis of the right diaphragm, the patient suffered from respiratory exhaustion and re-intubation was required at day 2. In the further course, tracheostomy was performed. After establishing the necessary anticoagulation (PTT 50-60s) and anti-platelet medication (ASA), no progressions of the SAH or the liver hematoma were found. However, an increasing hematoma related to the Morel-Lavallée lesion in the lower extremity was noted and surgically addressed. The hematoma (500mL) was evacuated and negative pressure wound therapy was initiated at day 3. The vacuum sealing was changed three times consecutively before the

Fig. 1. Hematoma of right shoulder girdle **A)** day 2, **B)** day 7.

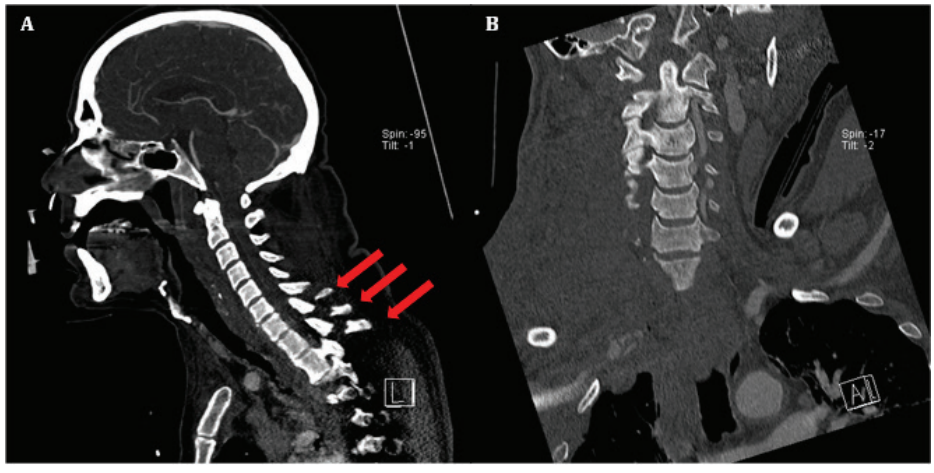

Fig. 2. Computed tomography Angiography (CTA): sagittal view demonstrating multiple spinous process fractures in the cervico-thoracic junction (A) and absent perfusion of the right vertebral artery in coronal view (B).

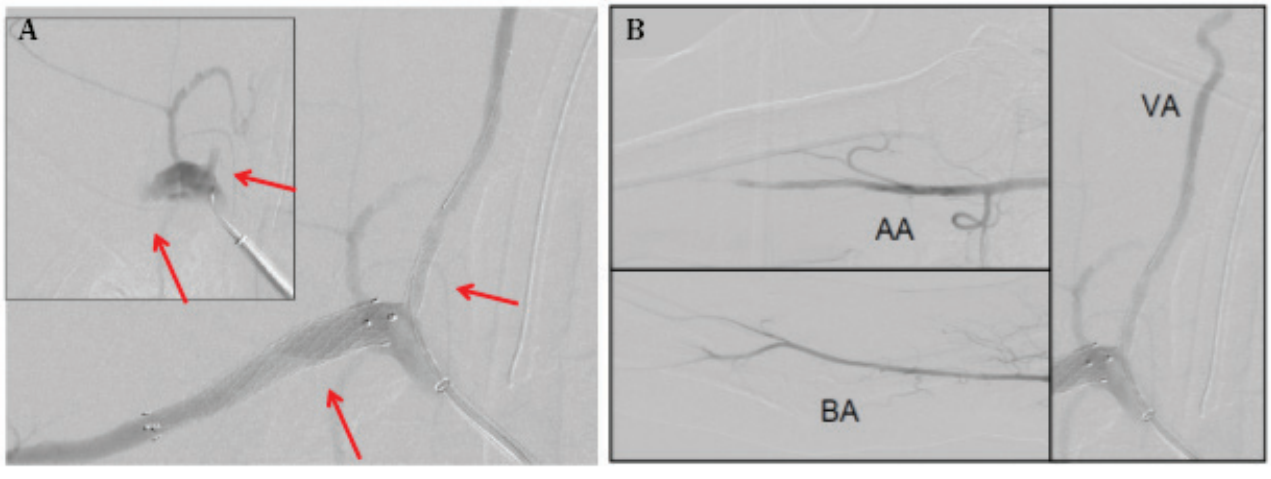

Fig. 3. Digital subtraction angiography; endovascular stenting of vertebral artery (S1 segment) and subclavian artery (A) and controlling of distal perfusion (B). AA: Axillary artery; BA: Brachial artery; VA: Vertebral artery.

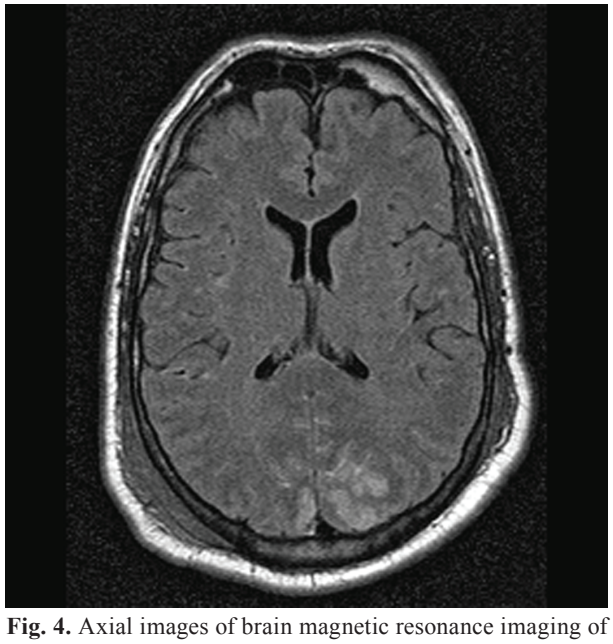

Fig. 4. Axial images of brain magnetic resonance imaging of the patients demonstrating ischemia of the both occipital cortex (primary visual cortex) resulting in cortical blindness.

soft-tissue defect could be covered with mesh-graft at day 14. Another hemorrhagic complication was related to significant bleeding from a gastric ulcer, which developed despite proton pump inhibitor (PPI) medication, and was addressed by gastroscopic clipping. During a 17 days' ICU interval, the patient also developed severe bacterial pneumonia from E. coli and was taken under appropriate intravenous antibiotic coverage. An anterior cruciate ligament (ACL) tear was diagnosed during secondary survey, but arthroscopic reconstruction was delayed due to the soft-tissue conditions around the knee joint and the general condition of the patient. Cortical blindness recovered to minor visual impairment. For weaning purposes, he was finally transferred to a weaning and rehabilitation facility, the inpatient rehabilitation period spanned 14-months.

Discussion

After obtaining informed consent, we report the unique case of successfully combined endovascular management involving a SA transection and ipsilateral BCVI; and a highly educational subsequent ICU phase.

High-energy trauma is rarely associated with blunt vascular injuries, but an increasing incidence has

been described after implementation of advanced imaging techniques [1, 2].

Even as an isolated injury, the rupture of the subclavian artery carries a significant mortality rate (34%). While BCVI's can be asymptomatic, complications like basilary territory infarction, cortical blindness and death my result. Although cortical blindness and delayed sequelae related to BCVI are a rare finding, there is relative paucity in the literature concerning this type of visual impairment [3-6]. When the patient was followed-up two years after injury, the visual field was still compromised in terms of a quadrantanopia, which can be associated with lesions of the occipital lobe. Many authors recommend a high index of suspicion in high-risk patients, since the actual incidence of vertebral artery injuries and associated stroke has been underestimated in the past [7, 8].

Patients at risk for blunt cerebrovascular injuries remain very poorly characterized in the literature. In order to identify predictors of vertebral artery injury, several authors described patients at risk. Lebl *et al*., [9] evaluated a series of 1204 patients and identified 42 individuals with vertebral artery injury. The authors published a number of associated risk factors for VAI-related neurological events secondary to blunt cervical spine injury: basilar skull fracture, occipitocervical dissociation, fracture displacement into the transverse foramen >1mm, diffuse idiopathic skeletal hyperostosis (DISH), and facet subluxation/dislocation.

However, when Bruns *et al*. studied 256 patients with BCVI, only 70% (n=129) had one or more indicators for BCVI, while 30% (n=56) had no radiographic or clinical risk factors. The authors concluded, that our current screening guidelines might lead to missed patients with BCVI and associated risk for stroke [10].

In many cases severe hemorrhage is requiring excessive open surgery and is therefore associated with significant morbidity and poor prognosis [11, 12]. However, also endovascular repair has been advocated in blunt BVAI in order to reduce the systemic burden associated with surgical bleeding control [12]. In this context, Reuben *et al*. evaluated the application of endovascular technology in the emergency treatment of traumatic vascular injuries with a National Trauma Data Bank (NTDB) investigation. The authors found a lower mortality in the group of patients who underwent endovascular procedures (odds ratio, 0.18, p=0.029), even when controlling for injury severity and associated injuries [12].

However, in the past, endovascular management has been examined specifically in the context of penetrating trauma [13]. In contrast, literature regarding the efficacy of endovascular techniques in blunt traumatic artery injury is very limited due to the lack of prospective data and low case numbers in most centers. Feasible treatment options include observation, anticoagulative therapy, endovascular and open surgical treatment [11-14]. Despite potential complications, endovascular repair has been advocated in BCVI's in order to reduce embolization or rupture of pseudoaneurysms [10]. While endovascular management is advocated as an attractive adjunct to the modern trauma management, specific limitations have to be considered, especially when the endovascular management should be employed in hemodynamically unstable patients. An angiography suite including specialized staff must be available 24/7, in order to be available in the acute management of multiply injured patients. In these centers, however, patients might benefit from the immediate and minimally invasive bleeding control. If active bleeding is observed during angiography, a balloon occlusion technique can be employed to reduce the bleeding and making the stenting procedure easier and safer. Furthermore, according to the European Society for Vascular Surgery, anti-coagulative and anti-platelet therapy is recommended after endovascular repair of BVAI. This might result in bleeding complication as also present in our case with secondary bleeding from soft-tissue injuries and the development of a gastric ulcer. These adverse effects must be considered during decision-making.

In conclusion, prompt diagnosis based on advanced imaging and a multidisciplinary damage control approach allowed limb salvage and prevented from complete permanent loss of vision due to dissected VA and associated posterior stroke. Because of significant long-term functional impairment, orthopedic injuries of the cervical spine and shoulder girdle should alert surgeons to rule out any occult neurovascular lesions.

The lack of evidence based recommendations concerning the optimal screening and management of multiple injured patients with major vascular injuries need to be addressed by future studies.

Conflict of Interest: None declared.

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