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Case Report Open Access

Penetrating Subclavian Vessel Injury: Diagnosis and Treatment

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Abstract

Thoracic vascular injuries constitute a complex and uncommon challenge to the trauma surgeon. Subclavian vessel injuries, in particular, are rare but carry significant morbidity and mortality. Early detection and prompt management are essential to improve survival. Surgical management varies depending on the patient's hemodynamic, mechanism of injury, and associated injuries. In this case study, we present a penetrating subclavian artery and vein injury with an associated hemopneumothorax, vascular compromise, and hemodynamic instability.

Introduction

In 1892 Halsted reported the first successful subclavian aneurysmal ligation. [1] Simple ligation was a common practice during early wartime; nevertheless, subclavian vessel injuries occurred with low incidence from 0.8 - 3.8% [2-5]. Throughout the history of war, low occurrence rates were presumed to be related to exsanguination on the battlefield and therefore under reported.

The overall incidence of all acute vascular trauma, including subclavian vessel injury, is approximately 5% [3, 4, 6, 7]. The majority of subclavian vessel injuries in the civilian population is the result of penetrating trauma. Subclavian artery injury in particular, accounts for 1-2% of all acute vascular injuries in major trauma centers [3, 4, 6, 7]. In this case report, we present a case of a subclavian artery and vein injury from a penetrating stab wound.

Case Report 1

A 46 year-old gentleman sustained multiple stab wounds to the left posterior shoulder and the left upper chest, inferiolateral to the sternoclaviclar junction. He was evaluated at an outside facility, where he was initially hypotensive with a Systolic Blood Pressure (SBP) less than 80 mmHg and tachycardiac, all suggestive of class III shock. After fluid resuscitation with two units of packed red blood cells and crystalloid, his SBP improved to 140 mmHg, however he remained tachycardic. A left hemopneumothorax was decompressed with a thoracostomy tube and a total blood return of 300 cc. Subsequent Chest Radiography (CXR) showed no evidence of any residual pneumothorax but the presence of a pulmonary contusion was visible. All wounds were surgically dressed and the patient was then transferred to our facility.

On arrival, the patient appeared distressed, diaphorectic, tachycardiac and complained of paresthesia to his left upper extremity. He was subsequently intubated without delay and additional packed red blood cells and fresh frozen plasma was transfused. Vascular exam revealed a triphasic Doppler signal to the axillary, brachial, radial, and ulnar arteries although pulses were weakly palpable on the side of injury. Manual sphygmomanometer pressures displayed a SBP of left extremity to be less than 60 mmHg compared to the right upper extremity of 150 mmHg. Thoracostomy drainage remained stable and on examination, all wounds appeared hemostatic, however upon log roll, pulsatile bleeding was evident from the anterior chest wound. Digital pressure was administered and the patient was emergently brought to the operating room for a suspected left subclavian artery injury given its location, the presence of vascular hard signs, and an abnormal ankle-brachial index.

The patient's chest and bilateral groins were prepped and draped in a sterile fashion with the left arm abducted 30 degrees. An infraclavicular incision was made at the Sterno Clavicular (SC) junction and extended onto the deltopectoral grove while still maintaining digital pressure. A clavicular resection and disarticulation of the SC joint was performed with associated separation of its muscular attachments to facilitate exposure. A near complete subclavian artery transection and adjacent contusion was identified in addition to a partially transected subclavian vein. Once complete vascular control was obtained, the subclavian vein was repaired primarily and the artery was debrided and resected (Figure 1). Given the patient's hemodynamics and coagulopathy, no systemic heparinization was utilized, a distal thrombectomy was performed, and a size appropriate 6mm prosthetic graft (Figures 2 and 3) was chosen for revascularization. The patient was admitted to the intensive care unit postoperatively for vascular checks and continued fluid resuscitation.

The patient postoperatively developed a Deep Vein Thrombosis (DVT) of the subclavian vein on surveillance ultrasonography and was treated with therapeutic anticoagulation prior to discharge. Paresthesia to the anterior and posterior forearm present on admission improved on subsequent follow-up clinic visits and at this point has resumed to his daily normal activities without sequelae.

Discussion

The subclavian vessels anatomic location allows for a protective

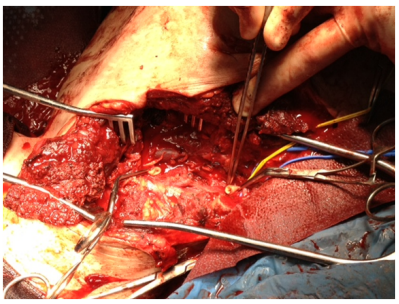

Figure 1: Subclavian artery debridement and resection.

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barrier by the overlying first rib and clavicle, explaining the rarity in trauma. Penetrating trauma remains the most common type of mechanism of injury. The presence of a first rib fracture in blunt trauma, however, demonstrates subclavian injuries in 5-9% in previous publications. [8, 9] Boney fractures and rapid deceleration injury are responsible for blunt injury to the subclavian vessels.

The clinical presentation may commonly go unrecognized secondary to a normal physical examination, while others present with the hallmark signs of hemodynamic instability, pulse deficit, and expanding hematoma. The presence of collateral flow through the thyrocervical trunk with proximal injuries may conceal small number of vascular injuries as in this particular case. On the other hand, a comprehensive vascular examination may also reveal a cool, pulse less, and pale extremity. Neurologic deficits, overlying bruits, and obvious pulsatile bleeding are diagnostic clues of an underlying vascular injury. As DeGiannis and Agarwal reported in their published series, profound shock with an initial systolic blood pressure of <100 mmHg was present 50 to 80% of patients on presentation. [10-12]

Radiographic studies should be reserved for only hemodynamically stable patients. Chest X-ray should be performed in all patients to asses for mediastinal widening or a massive hemothorax. Another simple and immediate diagnostic test included in any physician's armamentarium is performing an Ankle-Brachial Index (ABI); an ABI of less than 0.9 is considered abnormal and is highly suspicious for an underlying vascular injury [6]. Other published series advocate the routine use of angiography however we recommend its use only when patients are hemodynamically stable and if its use provides additional information for surgical planning or endovascular interventions [6]. Readily available computed tomography is a favorable alternative and in most facilities replaced conventional angiography.

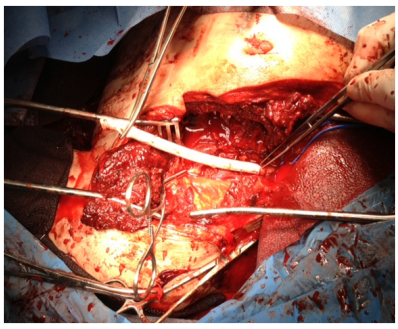

Figure 2: Insertion of a 6 mm polytetrafluoroethylene (PTFE) graft.

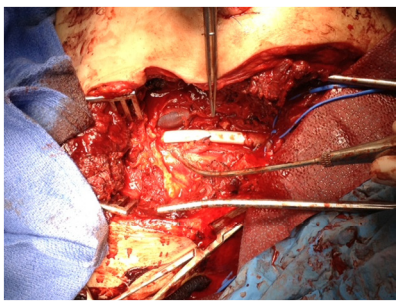

Figure 3: Completed revascularization of subclavian artery and repair of subclavian vein.

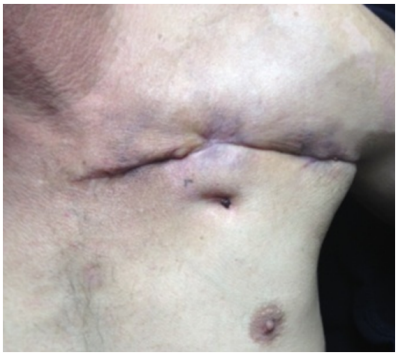

Figure 4: Surgical approach by an inferioclavicular incision.

Operative management typically employs basic vascular surgical techniques; however operative exposure remains a challenge. A median sternotomy with cervical extension can be used for right subclavian artery injuries, while an infraclavicular (Figure 4) or not so commonly used "trap door" incision for left subclavian artery injuries. Venous repair should be performed over ligation whenever possible [6]. In cases when venous ligation is necessary, Demetriades and Asensio [13] observed transient swelling of the upper extremity, but no significant venous-related complication. The use of temporary intravascular shunts may be utilized in cases of hemodynamic instability and multiple life-threatening injuries, with the intent for a return procedure. Arterial injuries when feasible are treated with debridement and repair. Conventional arterial reconstruction can be performed by the use of autogenous vein or prosthetic grafting [6, 14]. Recent advancements in endovascular techniques have provided another viable option to those who are poor surgical candidates and meet strict selection criteria.

Conclusion

Due to the rarity of subclavian vessel injuries, many surgeons have minimal experience in the surgical management of these injuries. The diagnosis of a subclavian vessel injury should be prompt following a thorough examination of the injured patient. These injuries are associated with significant morbidity and mortality and expeditious surgical repair is essential. The overall management may vary based on the patient's hemodynamic stability, mechanism of injury, and associated injuries however the morbidity and mortality from subclavian vessel injuries remains high.

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