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Ballistic Axillary Vein Transection: A Case Report

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Data Collection B
Statistical Analysis C
Data Interpretation D
Manuscript Preparation E
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Conflict of interest: None declared

Patient: Male, 25-year-old
Final Diagnosis: Axillary vein transection
Symptoms: Shortness of breath
Medication: —
Clinical Procedure: Ligation of the axillary vein
Specialty: Surgery

Objective: Management of emergency care

Background: Axillo-subclavian vessel injuries were traditionally the result of combat-related trauma encountered by military surgeons. An increase in gun-related violence in our backyards, however, have brought these injuries to our doorsteps. The majority of the available data explores the management of arterial injuries. There is a deficiency in the literature discussing the management of isolated axillo-subclavian venous injuries.

Case Report: We report the case of a 25-year-old male who presented after sustaining a gunshot wound to his right lateral chest and axillary area. Computed tomography angiography revealed axillary vein transection. Upon emergent operative intervention, vascular control of the hemorrhage was achieved with ligation of the axillary vein. The patient had an uncomplicated postoperative course and follow up in the office was unremarkable.

Conclusions: Axillo-subclavian vessel injuries can result in exsanguination and are associated with a significant mortality risk. Early detection and expeditious management are essential for preserving the patient's limb and preventing the loss of life. Isolated axillary vein injuries can be managed in an unstable patient with ligation and is well-tolerated by patients with an evanescent upper extremity edema.

MeSH Keywords: Axillary Vein • Subclavian Vein • Treatment Outcome • Wounds, Gunshot

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Background

The majority of the published literature regarding axillo-subclavian vessel injuries is centered around subclavian and axillary artery injuries with a deficiency in the literature describing the evaluation and management of the venous injuries [1–3]. Historically, these injuries were a result of war and battleground wounds seen in the military setting; however, due to the gun violence epidemic, axillo-subclavian vessel injuries are also encountered in the civilian setting [4].

Contrary to what might be commonly believed by many physicians, axillo-subclavian venous injuries have been reported to confer a greater mortality risk than its arterial counterparts [5]. Axillo-subclavian vessel injuries are associated with an in-hospital mortality rate as high as 30% [1]. Additionally, isolated axillary vein injury, although rare, is likely underreported in the literature as many venous injuries are encountered with arterial bleeds, which often gets the most attention [6]. Due to the frequency of penetrating vascular trauma, usually secondary to gun violence, axillary vessel injury requires more attention and rumination.

While axillary vein transection has the potential to be lethal, ligation of the vein quickly achieves hemostatic control and is well-tolerated by patients [7–9]. We report the case of an axillary vein transection secondary to a gunshot wound to the right chest which resulted in massive hemorrhage. The SCARE criteria were taken into consideration in reporting this case [10].

Case Report

A previously healthy 25-year-old male presented to our trauma bay after sustaining a gunshot wound (GSW) near the junction of his right upper extremity and chest. Upon arrival, his airway was intact, but he had an oxygen saturation of 80% on a non-rebreather mask. He was tachycardic to 120 bpm, and hypotensive with a systolic blood pressure of 100 mmHg. Emergency medical services (EMS) performed an emergency needle decompression in the field because of no breath sounds on the right. On arrival, the patient was intubated, and a right chest tube was simultaneously inserted for a suspected tension pneumothorax, which returned minimal air. The saturations did improve to 100% after this. Plain chest radiograph showed the endotracheal tube and chest tube to be in good position.

Our attention was then turned to the wound in the patient's right axillary area (Figure 1). An expanding hematoma was also present. On examination, radial and ulnar pulses were present. The patient responded to a bolus with improvement in blood pressure and heart rate. Because the patient had reached a state of hemodynamic stability, we took him for

Figure 1. Open wound and rapidly expanding hematoma on presentation in the trauma bay.

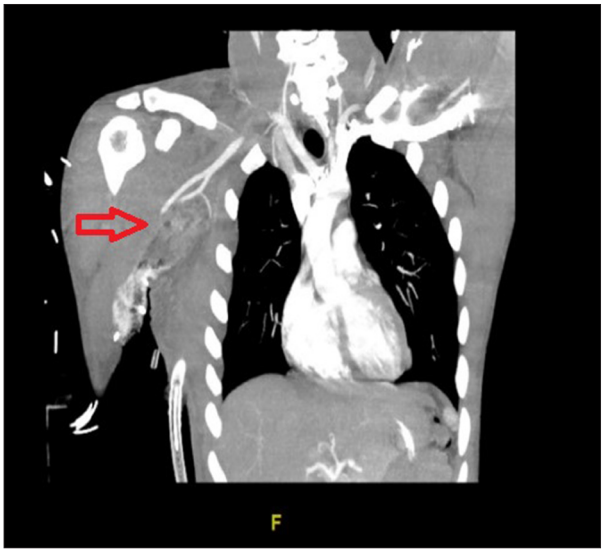

Figure 2. Computed tomography angiography of the chest, coronal view. The right shoulder is visualized with a high-grade injury to the right axillary vein with complete transection and extravasation of a large amount of intravenous contrast (arrow). There is also a suspected transection of the right axillary artery.

emergency imaging. Computed tomography (CT) angiography of the chest revealed contrast extravasation with transection of the axillary vein with possible arterial branch injury (Figure 2). Soft tissue swelling and a hematoma in the right axillary region were also evident on imaging. Multiple retained shrapnel fragments were also noted (Figure 3). The bullet did not penetrate the chest cavity.

The patient was then taken to the operating theater for emergent exploration. A deltopectoral approach was used. An incision was made in the deltopectoral groove to the upper arm and exposure of the axillo-subclavian vessels was obtained by dissecting the muscles down to the subclavian-axillary vein junction. Transection of the axillary vein was apparent, and

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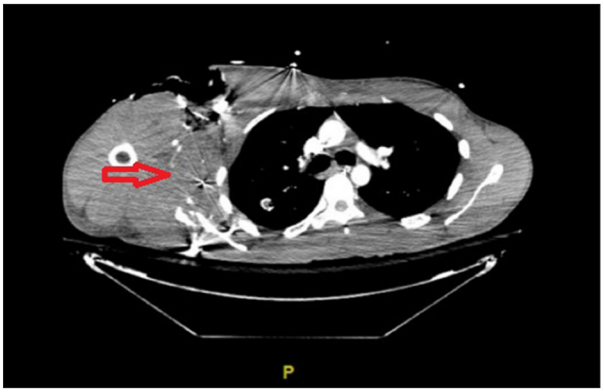

Figure 3. Computed tomography angiography of the chest, axial view. A large amount of soft tissue swelling of the right shoulder area is seen opposed to the left shoulder area due to hemorrhage and the presence of a rapidly expanding hematoma (arrow). Additionally, multiple bullet fragments, soft tissue injury and a comminuted scapular fracture with a large missile fragment lodged posterior to the right scapula are apparent.

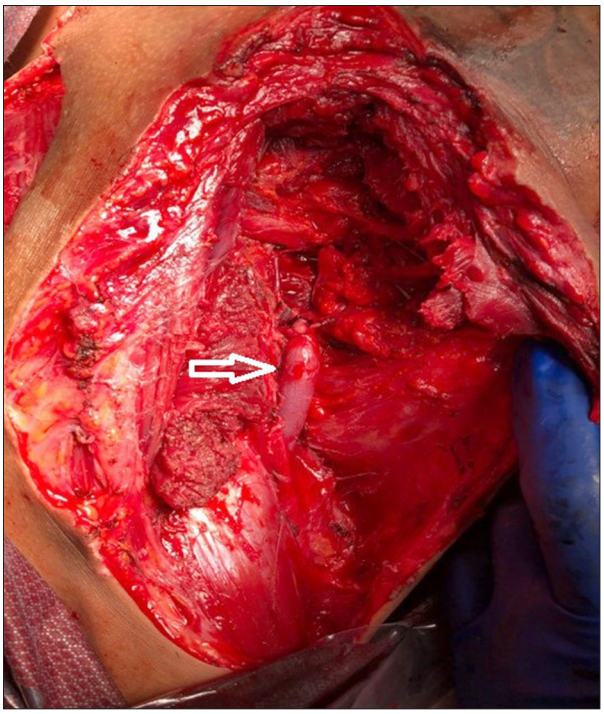

Figure 4. Exploration of the right axilla open wound status post gunshot wound. A deltopectoral approach was used to expose the axillary vein. Also pictured above is the axillary vein ligated (arrow).

the axillary vein was ligated (Figure 4). Minor arterial injuries to the thoracic branch and an upper lateral muscular branch of the subclavian artery were also visualized and ligated. In all, the patient required 5 units of packed red blood cells (PRBCs). Post-operative hemoglobin levels remained stable.

Figure 5. Right shoulder x-ray demonstrating multiple bullet fragments and comminuted fracture of the lateral border of the scapula with interposed and adjacent ballistic material (arrow).

In addition, the patient sustained a concomitant comminuted fracture of the lateral border of the scapula with interposed and adjacent ballistic material (Figure 5) which was managed non-operatively as per the orthopedic surgery team. There was also a large missile fragment posterior to the scapula, 2 mm deep to the surface of the skin.

The patient was extubated on hospital day 4. He began physical therapy and occupational therapy shortly thereafter. Additionally, due to patient request, the palpable retained bullet fragments were removed on hospital day 9. He was discharged to home doing well on hospital day 10. On follow up, in the office 2 weeks later, he was doing well and denied having any pain, swelling, or limitations. The surgical incision site was healing appropriately, and the patient had full range of motion of his upper extremity.

Discussion

The axilla is a unique space between the lateral chest and the upper extremity which contains a multitude of delicate neurovascular structures [11]. The axillary vein originates at the distal border of the teres major and latissimus dorsi with the unification of the brachial and basilic veins [7,12]. The vein then courses upwards until the outer border of the first rib where it continues onward as the subclavian vein [7,12].

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Injury to the axillo-subclavian vessels requires a high index of suspicion due to concomitant injuries which can mask their presentation. Nevertheless, as in our case, these injuries might present with active hemorrhage or a rapidly expanding hematoma. Other hard signs of vascular injury include absent or diminished pulses or a palpable thrill or bruit [4,13]. These signs generally indicate the need for operative intervention. Other signs which might suggest vascular injury include a history of arterial bleeding, the occurrence of an injury in close proximity to the location of a vessel, a nonexpanding hematoma, or a neurologic deficit associated with a nerve in the vicinity [4,13]. Further, depending on the hemodynamic stability of the patient, preoperative imaging might be permissible. CT angiography is most commonly used in detecting vascular injuries in the trauma setting. For hemodynamically unstable patients, emergent operative intervention, with or without imaging, is indicated.

All trauma cases should be initially managed using the Advanced Trauma Life Support (ATLS) protocol. Presently, there are no consensus guidelines on the management of upper extremity isolated venous injuries. The Eastern Association for the Surgery of Trauma (EAST) Management Guidelines currently address lower extremity arterial and venous injuries [6,13]. Of note, there are also no guidelines on how to manage isolated venous injury in penetrating trauma of the lower extremity either [6]. The Western Trauma Association (WTA) has published a 2-part position paper with algorithms on the evaluation, management, and operative techniques for peripheral vascular injuries [4,14]. Upfront, the authors acknowledge the lack of randomized or prospective data and state that their recommendations are largely based on observational studies and expert opinion [4,14].

Nevertheless, the management of penetrating vascular trauma of the extremity is premised upon 3 overarching goals – saving the life, preserving the limb, and retaining full function of the extremity [15]. For isolated axillary vein injury in an unstable patient, ligation can quickly achieve hemostasis. Repair with primary venorrhaphy is also an option [7]. Complex repairs are not recommended; however, as they have not resulted in improved outcomes nor have they resulted in a mortality benefit [7]. Additionally, most patients tolerate ligation of the axillary vein quite well with a brief and self-limited upper extremity edema [7–9].

Iscan et al. described an isolated axillo-subclavian vein injury secondary to a GSW which caused axillary and subclavian vein rupture. During repair of the injury with an autogenous saphenous vein graft, a total of 2100 cc of blood and blood products were replaced intraoperatively [5]. Githens reported a case which resulted in an unrecognized intraoperative axillary vein laceration which resulted in massive hemorrhage [8]. The case required activation of their massive transfusion protocol to stabilize the patient. Our case is remarkable not only due to its rarity or because it involves an injury which has the potential to result in exsanguination and even death but also because it is an injury that can be managed quite simply with ligation, if detected early and managed expeditiously. Additional research is warranted in this area to establish the optimal treatment approach as well as to determine possible longtime consequences of ligation over primary repair.

Conclusions

Axillo-subclavian vessel injuries are relatively uncommon yet are being encountered with greater frequencies at trauma centers. There are currently no guidelines for the management of penetrating peripheral vascular trauma in the upper extremity. Axillo-subclavian vessel injuries can result in exsanguination and are associated with a significant mortality risk. Isolated axillary vein injuries can be managed in an unstable patient with ligation and is well-tolerated by patients with only temporary upper extremity edema.

Department and Institution where work was done

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Conflicts of interests

None.

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