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### Case study

# Subclavian artery injury following blunt trauma: A report of three cases

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#### ABSTRACT

Subclavian artery injuries are rare in blunt chest trauma, constituting just 1–2 percent of all acute vascular injuries. The diagnosis of injury to the subclavian artery is challenging as a good percentage of patients with such vascular injuries have palpable distal pulses, no signs of any external local trauma and associated injuries often divert the attention of treating physicians. Subclavian artery injuries are the second most common injuries to occur to the aortic arch vessels. The mechanism of injury to these vessels varies from deceleration to traction on upper extremity and neck. Angiography is vital in diagnosis and surgical planning of these patients depends on the site and side of the vascular injuries. Early surgical treatment is an important part of management of these patients. Endovascular treatment is of value in a selected subgroup of subclavian artery injury patients. Reported mortality of subclavian artery injuries varies according to haemodynamic status of patient, time of presentation and other associated injuries. A high degree of suspicion is key to diagnosing these vascular injuries. Early appropriate surgical repair of vascular injury, in combination with aggressive treatment of associated injuries, is important for the optimal outcome of these cases. Here we report three cases of subclavian artery injury, which were successfully treated in Hamad General Hospital by vascular surgery and intensive care teams.

*Keywords:* trauma, subclavian artery, angiography, surgery, endovascular therapy

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## INTRODUCTION

Subclavian vascular injuries are rare in blunt chest trauma, consisting of just 1–2 percent of all acute vascular injuries.<sup>1</sup> Frequently these vascular injuries are difficult and challenging to diagnose and manage, as there can be palpable distal pulses and no external signs of injury in most of the cases. There are few reports of extensive experience with great vessel injury in blunt chest trauma, as many patients die at the scene and, if they reach hospital, multiple associated injuries divert the attention of the treatment teams.<sup>2</sup> The aim of this case report is to increase awareness about subclavian vascular injuries and their management. We report three cases of subclavian artery injury, which were successfully treated in Hamad General Hospital, Doha.

## ILLUSTRATED CASE (1)

A 27-year old lady passenger was involved in road traffic accident. On arrival to hospital, she was awake and initial x-rays showed bilateral clavicular fractures and mandibular fracture. Computed tomography (CT) scans of the head showed a fracture in the occipital bone with a small frontal contusion. CT scans of the chest revealed left haemothorax with bilateral lung contusion, and possible subclavian artery injury. She was haemodynamically stable, but there was increasing swelling in the left supraclavicular area and the left radial pulse was absent. Angiography revealed left subclavian artery injury. The patient was shifted to the trauma intensive care unit after initial fluid resuscitation and, after insertion of chest drain on left side, vein patch repair of left subclavian artery was done. After repair, both radial arteries were palpable and she was haemodynamically stable.

She was ventilated with appropriate sedation and analgesia, then started on enteral feeding with gradual increase to match patient's caloric requirement. Seven days after admission, the chest tube was removed. She was arousable, weaned from the ventilator and extubated on day 10. All invasive lines were removed and she was started on normal diet, then transferred to ward on the eleventh day. From the ward she was discharged home, to be followed by appointments in the vascular and maxillofacial outpatient department.



Case No. (1). Angiogram showing occlusion of the left subclavian artery.

## ILLUSTRATED CASE (2)

A 36-year old Asian man, involved in a road traffic accident, was brought to the trauma room of our hospital. He was restless but arousable and moving all limbs. Intubation was performed due to respiratory distress. Initial X-rays showed a fracture in the mandible, fibula, left acetabulum and dislocation of the right sternoclavicular joint. After initial resuscitation, swelling in the right supraclavicular area was noticed with non-palpable right radial pulse. CT scans of the head showed a right frontal contusion, bilateral haemopneumothorax and right subclavian artery injury. Angiography confirmed the injury to the right subclavian artery at the origin from the brachiocephalic artery and



**Case No. (2).** Angiogram showing the injury at the origin of right subclavian artery.

associated injury of right innominate vein. After insertion of bilateral chest drain, median sternotomy was performed, through which ligation of both distal part of the subclavian artery and innominate vein with repair of the brachiocephalic artery was performed. His general condition and instability did not allow immediate bypass to his arterial injury. Post-operatively he has biphasic doppler signals heard over the right radial artery with good hand perfusion. The patient was shifted back to trauma intensive care, ventilated with proper sedation and analgesia. Next day he was started on enteral feeding, gradually increased to match the patient's nutritional status. On day 9 he underwent fixation of the mandible and other fractures. Percutaneous tracheostomy was carried out on day 12. Chest drain was removed on day 16. He was weaned from the ventilator and allowed to breathe spontaneously with HME (heat and moisture exchanger) on day 22. He was stable; all invasive line and nasogastric tubes removed and he started a normal diet. Tracheostomy was decanulated on day 24. He was shifted to ward, then to rehabilitation, and from there discharged home to be followed by appointments in the vascular, orthopedic and neurological outpatient departments.

### **ILLUSTRATED CASE (3)**

A 35-year old male, front seat passenger was involved in a road traffic accident. On arrival to our hospital he was fully awake, tachycardic and had stable blood pressure. The general examination showed swelling of right shoulder, axillae and right arm with absent pulsation in the right arm and forearm. CT angiography of the chest showed right subclavian artery injury (Fig. 2) with no perfusion to the right arm, and hematoma of the right chest wall. CT scans of the head and abdomen were normal. The radiological survey of the extremity showed bilateral fracture of the tibia, right ankle fracture and dislocation and fracture of the right radius. He was immediately taken for surgery. With right infraclavicular incision, the right subclavian artery was exposed, incision extended to the axilla and right arm and axillary artery exposed with missing segment of axillary artery. Right subclavian artery to axillary bypass was performed using reversed saphenous vein graft and fasciotomy of the right arm. The brachial plexuses were avulsed from its trunk. For right ankle injury, debridement with external fixation was carried out. The patient was extubated on day 2, transferred to the orthopedic ward, subsequently underwent intramedullary nailing of left tibia and below-knee amputation of right leg on day 5 and 14. He remained haemodynamically stable, fully awake, but displayed weakness in right



**Case (3). The CT angiogram showing, the right subclavian artery injury.**

forearm. Electromyography confirmed the injury to the right brachial plexuses and he transferred to the rehabilitation ward. Subsequent appointments followed in the orthopedic and vascular out patient clinics.

### DISCUSSION

Subclavian artery injuries are rare, but potentially catastrophic. An active trauma centre can expect an average of 2 to 4 cases of subclavian artery injury per year.<sup>3</sup> Blunt injuries involving major arterial branches of the aortic arch are rare and the involvement of the subclavian artery is less common than innominate artery.<sup>4</sup> The majority of subclavian artery injuries arise from penetrating trauma, but 1–5 percent result from blunt chest trauma.<sup>1</sup> Anjum *et al.* reported an unusual case of convulsion leading to subclavian artery injury with critical limb ischemia.<sup>5</sup> In rare circumstances, the subclavian artery injuries are due to anterior dislocation of the shoulder and can jeopardize the patient's limb and life.<sup>6</sup> Divyan *et al.* reported a case of subclavian artery injury presented as pseudoaneurysm two months after the fracture clavicle.<sup>7</sup> The main mechanisms by which subclavian arteries can be injured in blunt trauma are deceleration, crush injury or traction on upper extremity or neck, but the exact mechanism through which thoracic arterial injuries occur is not known. Binet<sup>8</sup> hypothesized that there is compression to mediastinal content between vertebral column and sternum in deceleration injury. Distraction and hyperextension of the shoulder joint are common factors involved with subclavian artery injury. The net result of this mechanism is an acute stretching of all, or a portion, of the wall of the brachiocephalic arteries, producing intimal tear, disruption of media or complete transaction of the artery. In the clinical presentation of subclavian artery injuries, the signs or symptoms of arterial occlusion are more frequent than massive hemorrhage. Decreasing or absent pulses in the upper extremity and signs of chest trauma are common findings on initial physical examination. Palpable pulsatile mass in supraclavicular areas and signs of upper extremity ischemia can occur with subclavian artery injuries. Usually these patients have multiple injuries, which may cause delay in diagnosis, with an associated increase in morbidity and mortality.<sup>8</sup> Closed head injuries and other chest injuries are particularly devastating in these settings.<sup>9</sup> Radiography is the most important mode of diagnosing subclavian artery injury. X-rays of the chest will show a wide mediastinum in most of the cases. Ultra-fast, contrast-enhanced C.T, and angiography<sup>10</sup> will allow diagnosis of occult injuries and distinction between subclavian artery and thoracic aortic injury or a combination of the two. It will also help in planning the operative procedure

more precisely and efficiently if the anatomical site of injury is identified. The operative management of subclavian artery injuries is quite extensively described. The standard approach to left-sided injuries is anterolateral thoracotomy with subsequent supra or infraclavicular incision, while the right-sided injuries are typically managed by median sternotomy with supraclavicular extension. A few authors have successfully used median sternotomy for exposure of left subclavian artery, as it is safe, reliable, gives rapid haemostasis and maximum exposure of the operative field.<sup>11</sup> This classic surgical procedure has complications such as damage to vein, nerve, brachial plexuses, thoracic duct and lung.<sup>12</sup> The endovascular repair of subclavian and axillary vascular injury is a less invasive option, particularly with penetrating injuries; it provides immediate and rapid benefit in stabilization of a bleeding patient.<sup>12,13</sup> The complications of endovascular treatment are embolization, displacement of stent, arterial thrombosis due to migrating stent, intimal hypertrophy leading to stent occlusion, reported in up to 17 percent of these cases.<sup>13</sup> Jeffery *et al.* described, indications, relative and strict contraindications for the endovascular repair of axillo-subclavian vascular injuries. Indications are pseudoaneurysm, arteriovenous fistulas, intimal flap and lacerations. The relative contraindications are substantial venous injury, refractory hypotension, upper extremity compartment with neurovascular compression, and the absolute contraindications are long segmental injuries, subtotal/total transection, insufficient proximal and distal vascular fixation points.<sup>14</sup> In our second case, the option of endovascular treatment was not possible as the patient was unstable and the subclavian artery injury was flush with the brachio-cephalic artery. In addition, arterial injury was associated with the venous injury.

The reported mortality of subclavian artery injury is 0–30 percent.<sup>15</sup> Head injury was a major associated non-vascular injury. The mortality was higher if, on arrival to the trauma centre, systolic blood pressure is less than 90 mmHg or if there was a delay in presentation of patients with pseudoaneurysm or arterio-venous fistula.<sup>16</sup> Our patients were diagnosed and treated early and aggressively.

## CONCLUSION

We conclude that a high degree of suspicion is the key for early diagnosis of subclavian artery injury. Surgical repair, or in selective cases endovascular repair, are the pillars of successful management.

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