Trauma Case Reports 46 (2023) 100856

Contents lists available at ScienceDirect

Trauma Case Reports

journal homepage: www.elsevier.com/locate/tcr

Case Report

Aortic arch impingement with Salter Harris II epiphyseal fracture of the medial clavicle: A novel use of video assisted thoracoscopy☆

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ARTICLE INFO

Keywords:
Sternoclavicular dislocation
Aortic impingement
Mediastinal compression
Thoracic trauma
Video-assisted thoracoscopic surgery
VATS

ABSTRACT

Posterior dislocation of the sternoclavicular joint (SCJ), although uncommon, can be life-threatening. Displacement of the clavicular head poses a threat to the vital structures of the mediastinum. We describe the case of a 15-year-old boy with traumatic Salter Harris II medial clavicular fracture with posterior dislocation of the metaphysis resulting in impingement of the aortic arch, left subclavian and common carotid artery, as well as partial obstruction of the brachiocephalic vein. We describe the novel use of video-assisted thoracoscopy to assist with a safe open reduction and fixation of the fracture dislocation. The case highlights the importance of computer tomography imaging for diagnosis of posterior SCJ fracture/dislocations and the early recognition of potential life-threatening complications in the mediastinum.

Introduction

Posterior dislocation of the sternoclavicular joint (SCJ), although uncommon, can be life-threatening. Posterior displacement of the clavicular head poses a threat to the vital structures of the mediastinum. Oesophageal, tracheal, lung, great vessel, recurrent laryngeal nerve, and brachial plexus injuries have been reported [1–5]. We describe a novel use of video-assisted thoracoscopy to assist with the safe open reduction and fixation of a medial epiphyseal clavicular fracture/dislocation impinging on the aortic arch.

Case description

Case presentation

A previously well 15-year-old boy developed left-sided medial clavicular pain during a forceful tackle during a rugby game. His left arm was immobilised in a sling and he underwent plain film x-ray in an outpatient radiological service. No abnormality was reported on the plain film. They presented to the emergency department two days post-injury with ongoing left clavicle pain. Clinical findings demonstrated left-sided medial clavicle tenderness associated with a subtle bony step. He was haemodynamically stable. Neurovascular examination was normal. Blood results were unremarkable. Haemoglobin was 149 g/L.

Non-contrast computed tomography (CT) of the left clavicle demonstrated an epiphyseal and growth plate fracture (Salter Harris II)

☆ This paper has not previously been presented.

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https://doi.org/10.1016/j.tcr.2023.100856
Accepted 27 May 2023
Available online 29 May 2023

with posterior dislocation of the metaphysis. The posteriorly displaced metaphysis indented the aortic arch with an associated small volume mediastinal haematoma (Fig. 1). CT aortogram demonstrated a fracture fragment impinging of the aortic arch between the left common carotid artery (L CCA) and the subclavian artery (L SCA) (Fig. 2). The superior edge of the fracture fragment appeared to impinge on the common carotid artery (L CCA) (Fig. 3). The left brachiocephalic vein was nearly completely occluded. There was no evidence of aortic wall disruption or intramural haematoma. The patient was planned for open reduction and internal fixation (ORIF) of the fracture-dislocation. There was significant concern for major haemorrhage during manipulation of bone fragments and the case was conducted in conjunction with cardiothoracic surgery.

Operative details

Operative preparation included the presence of two cardiac anaesthetists, large bore intravenous access in the right arm and the placement of a double-lumen endobronchial tube allowing for left lung isolation. The patient was positioned supine. Right femoral venous and arterial sheaths (6fr) were placed under ultrasound guidance to facilitate rapid percutaneous cannulation for cardiopulmonary bypass. Right lung ventilation was initiated. A single 12 mm thoracoscopic port was placed in the left anterolateral 5th intercostal space. The 10 mm thoracoscope was used to explore the pleural space. There was noted to be significant mediastinal haematoma extending from the aortic arch through the left anterolateral pericardium (Fig. 4). The metaphyseal head was visible in the thoracic cavity associated with a breach in the parietal pleura (Fig. 4).

The clavicular head was maintained under direct-vision during the subsequent ORIF. A skin incision was made 2 cm below and parallel to the left clavicle. The platysma was divided and pectoralis major followed to the medial end of the clavicle, which was within the pleural cavity. The clavicle was then grasped by a towel clip and reduced. Feedback was given to the orthopaedic surgeon regarding the transfer of pressure to the mediastinum. Throughout fracture manipulation there was no increase in haematoma size, development of sub-adventitial haematoma or frank haemorrhage. The fracture was stabilised with 2.0 Ethibond in a figure-eight fashion. A 34fr intercostal catheter was tunnelled through the port site and placed along the mediastinal edge towards the apex, and the lung was re-inflated. The arterial and venous sheaths were removed and external compression applied. The patient was immediately extubated.

Follow up

Progress CT venogram one day post reduction demonstrated ongoing patency of the brachiocephalic vein with moderate to severe external compression from mediastinal fat and haematoma. The chest drain was removed on the second post-operative day and the patient was discharged home on day three of admission. At follow up, six-months following surgery, he had regained the full range of shoulder motion and the radiographic appearance of the sternoclavicular joint was normal. No cardiothoracic follow up was required.

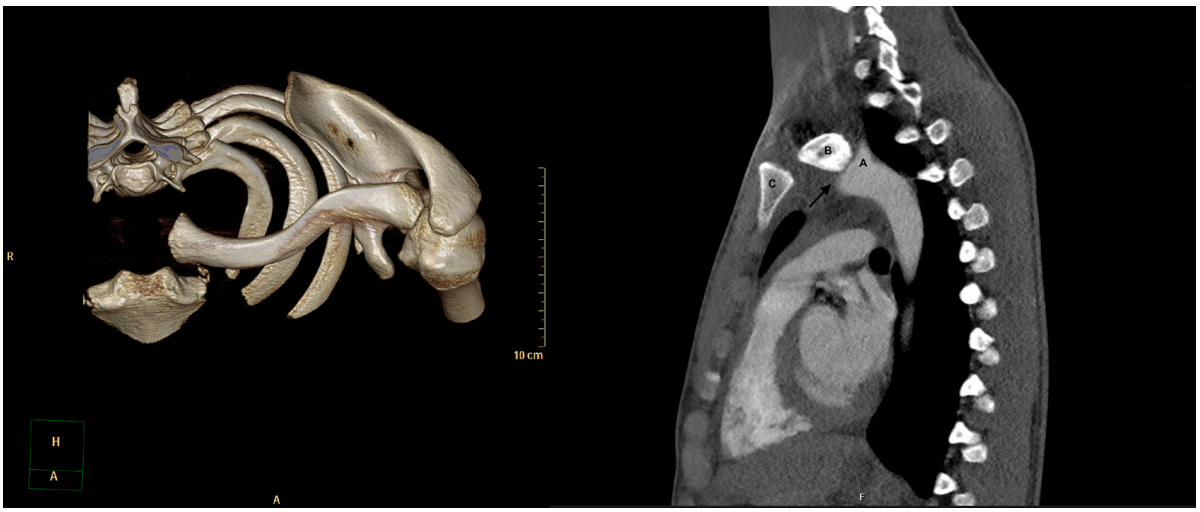

Fig. 1. a) 3D reconstruction and sagittal scan demonstrating degree of posterior displacement of medial clavicular head.
1b) Sagittal plane computed tomography demonstrating degree of posterior displacement of medial clavicular head and association with the aortic arch.
A) Aortic arch with subclavian vein take-off.
B) Medial clavicle.
C) Manubrium.

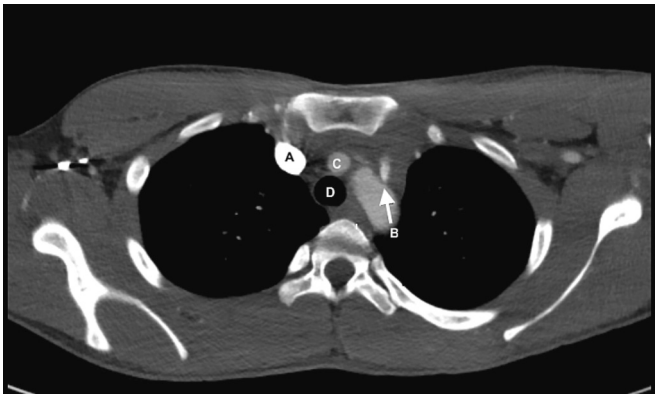

Fig. 2. Axial plane computer tomography aortic angiogram demonstrating fracture fragment impinging on the aortic arch.
A) Superior Vena Cava.
B) Posterior displacement of the clavicular metaphysis impinging on the aortic arch.
C) Innominate artery.
D) Trachea.

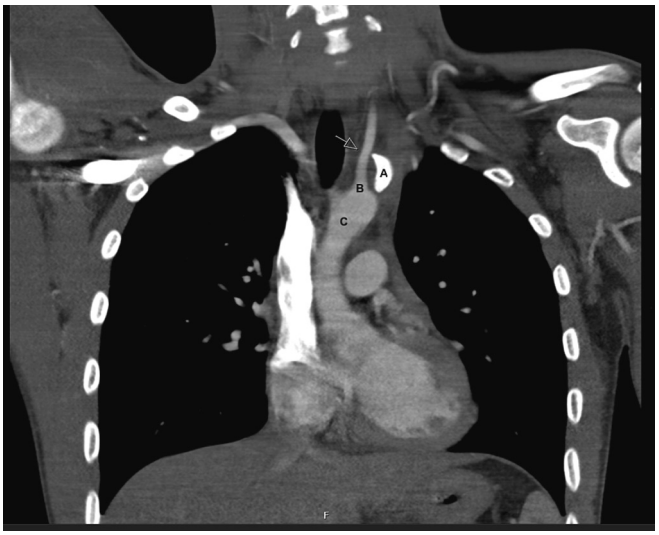

Fig. 3. Coronal plane computer tomography aortic angiogram demonstrating fracture fragment impinging on the left common carotid.
A) Clavicular metaphysis.
B) Left common carotid.
C) Aortic arch.

Discussion

Incidence and pathophysiology

SCJ dislocations are uncommon. Posterior dislocations represent only approximately 3–5 % of all SCJ dislocations and are predominately reported in contact sports. During skeletal development fusion of the medial clavicle physis occurs late. In children and young adults, the injury commonly involves a physeal fracture with posterior displacement of the metaphysis [6].

Diagnosis

Posterior dislocations are hard to diagnose [2,4]. Patients may present with clinical findings suggesting involvement of mediastinal structures including dyspnoea or dysphagia or with vascular and neurological compromise, however commonly these injuries are occult [7]. Our patient was screened with unilateral plain film anteroposterior x-ray of the left clavicle which demonstrated no abnormality, however only a unilateral view was requested. Posterior dislocations may show no radiological abnormality on plain or oblique views, although asymmetry may be noted if the contralateral clavicular head is also imaged. CT has improved sensitivity and

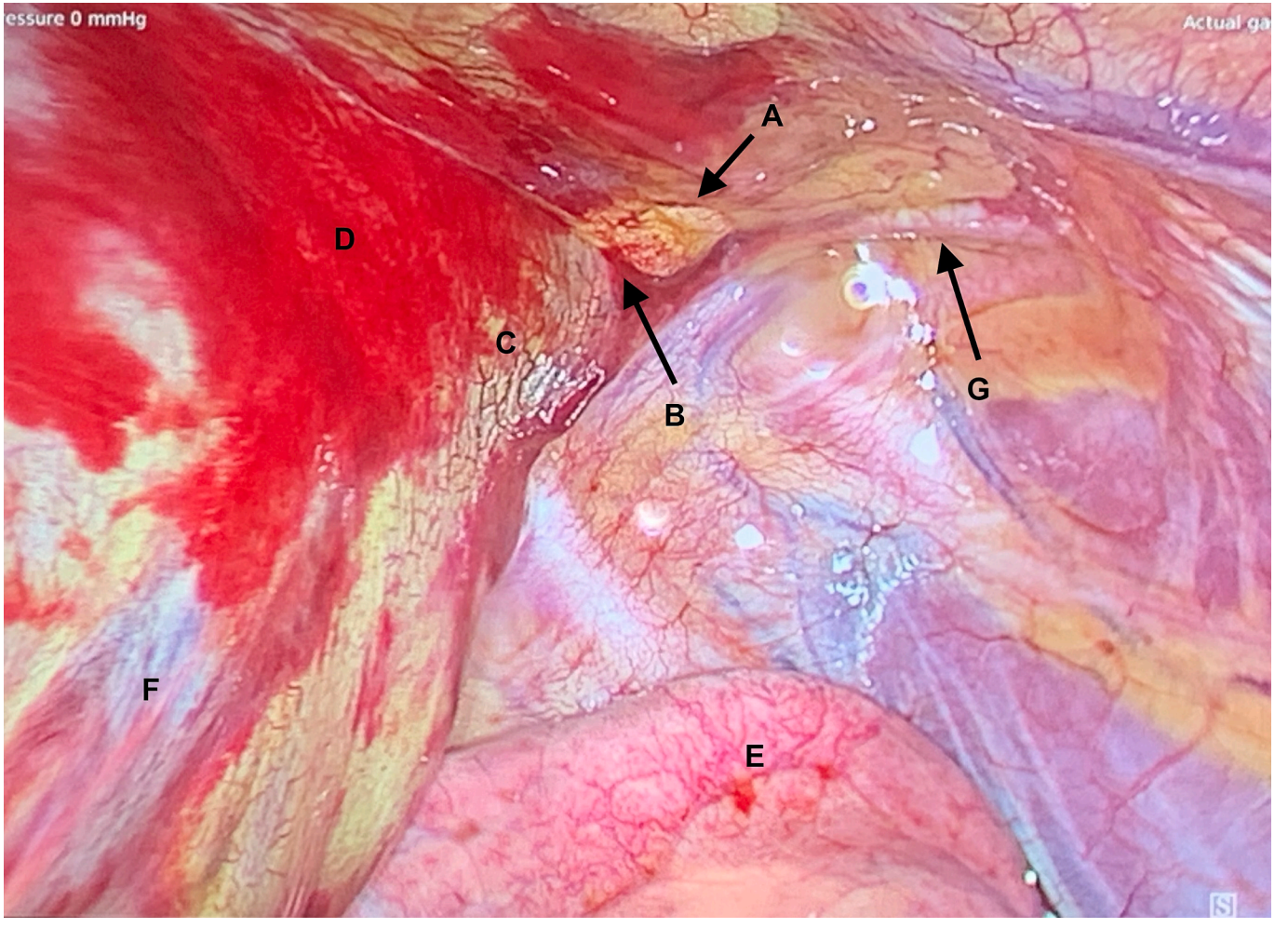

Fig. 4. Thoracoscopic image anterior mediastinal hematoma, medial clavicular metaphysis with parietal pleura breach.
A) Medial clavicular metaphysis.
B) Parietal pleural breach.
C) Aortic arch.
D) Mediastinal haematoma.
E) Apical segment of the left upper lobe.
F) Pericardium with the course of the phrenic nerve.
G) First rib.

additionally allows for evaluation of the mediastinal structures. If mediastinal involvement is present on CT imaging the cardiothoracic department should be consulted prior to reduction and fracture manipulation should occur in an operating theatre when possible [2].

Management approach

The described approach is conservative. Given the patient's young age and the potential implications of an aortic injury, we felt this degree of caution warranted. The presence of frank mediastinal haematoma on video-assisted thoracoscopy confirms direct trauma to the mediastinal fat and possibly the aortic adventitial vessels (Fig. 4). Evidently, the use of video assisted thoracoscopy is diagnostic only, with the aim of preventing further injury to the major vessels by monitoring the pressure exerted by the orthopaedic surgeon and to allow for the early recognition of any bleeding resulting from the decompression of the vessel wall. Video assisted thoracoscopic surgery is a minimally invasive and low risk procedure [8]. The use of one-lung ventilation allows safe pleural entry, and reduces the risk of lung or intercostal artery injury [8].

Two case reports describe bleeding associated with reduction of posterior clavicular dislocations removing the tamponade from the associated vessel [9,10]. Haemorrhage from aortic or supra-aortic vessels would be severe. Several litres of blood may accumulate in the pleural space before haemodynamic compromise is noted, especially in young fit athletes. Fenig et al. describe a fatal SCJ posterior dislocation associated with brachiocephalic vein transection. The patient in this case experienced a cardiac arrest during out of hospital transport and the fatal injury was identified on post-mortem [4].

Timely recognition and response to uncontrolled haemorrhage in the mediastinum is necessary to prevent death or unrecoverable neurological injury. Repair of a traumatic injury to the distal aortic arch would be difficult and beyond the scope of this article. Endovascular approach is limited by the anatomical location at the origin of the head and neck vessels. Open repair via emergency thoracotomy would be required. If direct control is not possible, femoral-femoral bypass and systemic cooling for circulatory arrest may be required. This highlights the importance of preparedness. A Cardiothoracic surgical consult should be sought for any patient with posterior SCJ dislocation with concerns for involvement of mediastinal structures.

Conclusion

Our case describes the use of VATS to assist the orthopaedic surgeons in conducting open reduction and fixation of posterior SCJ fracture/dislocation. VATS is a low-risk adjunct that may be used to prevent further vascular injury and allow early identification of haemorrhage. Our approach is conservative. We believe this caution is warranted given the severe consequences of an aortic wall or great vessel injury. We recommend Cardiothoracic consult be sought for any posterior SCJ dislocation with impingement of mediastinal structures.

Declaration of competing interest

No disclosures or financial relationships.

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