Blunt intrapericardial superior vena cava injury – A trap for the unwary

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1. Introduction

We present a case of haemodynamically unstable blunt thoracic injury that required emergency mediastinal exploration and vascular repair for rupture of the intrapericardial superior vena cava and innominate artery. In addition, on further imaging after operation the patient was found to have a third great vessel injury and this was managed non-operatively.

The case reinforces the need for all emergency surgeons to: be able to approach and repair the great vessels of the chest, employ re-examination and re-evaluation and the use of advanced imaging to diagnose all injuries and to assure long-term follow-up for those lesions managed conservatively.

Workup of blunt thoracic vascular injuries is directed by the physiology of the patient. Unstable patients have limited preoperative management and treatment relies on rapid surgical exploration and repair. Stable patients can undergo further radiographic workup and the intervention selected based on the imaging results. This intervention may range from open repair, endovascular stenting, or observation in patients with lesser injuries.

2. Case presentation

A 49-year-old restrained female driver was brought to the trauma bay of a level one trauma center by emergency medical personnel after a head-on collision with a tree. After a prolonged extrication, she was found to be unresponsive and hypotensive for which she underwent rapid sequence intubation in the field. With chemical paralysis administered en route, her GCS on arrival to hospital was 3T but her pupils were found to be equal and reactive bilaterally. Upon arrival to hospital she received a single unit of uncrossmatched blood after which she became normotensive but with mild persistent tachycardia. Her upper and lower extremity pulses were normal and symmetric.

The plain film of the chest (Fig. 1) was concerning for medial displacement of the nasogastric tube, suggestive of a mediastinal haematoma. The abdominal views of the focused abdominal ultrasound for trauma (FAST) were negative but a large fluid stripe was clearly seen in the pericardial view (Fig. 2). The patient remained intermittently hypotensive but fluid responsive and she was taken emergently to the operating room.

On the operating room table the patient was prepped and draped from chin to knees and a median sternotomy was performed. Upon opening the chest, bright red pulsatile bleeding was noted in the superior aspect of the surgical field; this was controlled with direct pressure while the rest of the mediastinum was explored. Upon opening the pericardium, 400 cc of venous blood and clot was quickly evacuated with immediate stabilisation of the patient’s haemodynamic parameters. Inspection of the pericardial contents revealed a 3-cm laceration of the anterior superior vena cava (SVC) at the atroicaval junction. This was controlled with a curved vascular clamp (Fig. 3) and repaired using pledgeted horizontal mattress sutures. Dissection of the superior mediastinum revealed an intact left brachiocephalic vein but pulsatile bleeding from a longitudinal 2-cm rent in the distal innominate artery immediately proximal to its bifurcation. After obtaining proximal and distal control, the innominate artery was also repaired using pledgeted horizontal mattress sutures (Fig. 4). At the conclusion of the case, the patient’s pupillary exam remained unchanged and a repeat abdominal FAST exam was found to be negative.

The patient was taken to the CT scanner on the way to the surgical intensive care unit to evaluate for associated head and abdominopelvic injury. CT scans of the head, cervical spine, and abdomen demonstrated no injury but a CT angiogram of the chest revealed dissection of the proximal left subclavian artery with flow through both true and false lumens (Fig. 5). The dissection extended from the origin of the left subclavian artery for 12 cm and rejoined the main lumen in the axillary artery. Peripheral pulses remained symmetric and normal. This injury was managed conservatively with anti-platelet therapy.

The patient was extubated after 48 h and was discharged to a skilled nursing facility on postoperative day 20. At 10 months follow-up, she is doing well at home. She has completely recovered from her thoracic injuries and a follow-up CT of the chest demonstrated a stable dissection of the left subclavian artery with no extension or pseudoaneurysm formation. She remains...
compliant with her anti-platelet therapy and we have elected to continue to manage her non-operatively.

3. Discussion

Here we present the case of a patient with three major intrathoracic vascular injuries after blunt trauma: injury to the intrapericardial superior vena cava, injury to the innominate artery, and a left subclavian artery dissection. As in any haemodynamically unstable blunt trauma patient, the principle of cavitary triage is of the utmost importance in guiding therapy. While the chest and pelvis can be rapidly evaluated with anterior–posterior (AP) radiographs, the FAST examination is the gold standard for triage of the abdomen and the pericardium. The pericardial view on the FAST examination is extremely sensitive in detecting the presence of intrapericardial fluid.7 As in the case we present here, the finding of a positive pericardial view on FAST examination in an unstable trauma patient is an indication for sternotomy. Further diagnostic testing is not required prior to operation and performance of a subxiphoid pericardial window in this situation is mentioned only to be condemned. Opening the pericardium without cardiac exposure will do nothing but release tamponade, resulting in possible exsanguination during the exposure which must subsequently be performed. Where possible, the patient should be prepped and draped from the knees to the chin prior to the induction of anesthesia, as induction may cause loss of cardiac preload and lead to decompensated tamponade physiology.

In patients with a positive pericardial FAST who loose vital signs before they can be taken to the operating theatre, emergency department thoracotomy is warranted. If left thoracotomy does not provide access to the pericardial space, sternotomy is required. Figure 1 shows an anteroposterior X-ray of the chest with a left-sided deviation of the nasogastric tube. No evidence of intrathoracic fluid is appreciated. Figure 2 shows the pericardial view taken during performance of FAST in the trauma bay. Figure 3 shows the sternotomy view (cephalad direction to top left of image) with the superior vena cava that has been clamped with a curved vascular clamp. The aortic arch at the take off of the right innominate artery is demonstrated with a solid arrow, and the surgeon’s finger maintaining pressure to stop pulsatile bleeding near the sternal notch. SVC injury controlled by a vascular clamp (curved arrow).
not provide adequate cardiac exposure, extension of the thoracotomy across the sternum and into the right chest “clamshell thoracotomy” will maximise exposure at the expense of incisional morbidity, should the patient survive. Because intrapericardial injuries can be challenging to deal with even with optimal lighting, retraction and exposure, every effort should be made to get the patient to the operating theatre where possible. For surgeons who do not routinely operate in the chest, cardiothoracic surgery consultation is desirable but should not delay operation.

In haemodynamically stable trauma patients, a positive pericardial view in the FAST examination does not always warrant immediate operative exploration. Particularly in the elderly population, the differential diagnosis of medical causes of pericardial effusion must be considered and the overall clinical picture of the patient must be considered. This caveat aside, a positive pericardial view on the FAST examination must be considered haemopericardium until proven otherwise.

After exposure has been obtained, blunt injury to the intrapericardial superior vena cava can often be temporised by direct digital pressure. Vascular clamps can then be applied followed by a primary repair with pledgets or a running non-absorbable suture. The need for cardiac bypass has not been reported with this injury, likely due to the preponderance of favourable anterior anatomic location.

Conventional management blunt thoracic arterial injury has historically been open surgical repair; however, in haemodynamically stable patients significant associated multisystem trauma may warrant delay in repairing this injury until patients are better able to tolerate operation. Open surgical repair may be conducted with the assistance of cardiopulmonary bypass, hypothermia with circulatory arrest, vascular shunts or by simple primary repair of the injured artery as in this case. Endovascular repair of blunt thoracic arterial injuries has been reported in carefully selected haemodynamically stable patients, but the long-term results of this approach remain unknown.

4. Conflict of interest statement

The authors disclose no financial or personal relationships with other people, or organisations, that could inappropriately influence (bias) their work, all within 3 years of the beginning the work submitted.

References