Video-assisted thoracic surgery repair of subclavian artery injury following central venous catheterization: a new approach

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Abstract

OBJECTIVES: Iatrogenic subclavian artery puncture following central venous catheterization is a rare but potentially fatal complication. There are very few reports in the literature on this condition. We propose the use of video-assisted thoracic surgery (VATS) in the management of these injuries.

METHODS: The technique of VATS to manage subclavian artery injury was described. We presented the first reported case of successful repair of subclavian artery injury using VATS.

RESULTS: Using a two-incisional approach for VATS, the haemothorax was rapidly evacuated and the subclavian artery injury was successfully repaired using pledgetted sutures under direct thoracoscopic visualization. The patient had an uneventful postoperative recovery.

CONCLUSIONS: VATS can be successfully applied to repair subclavian artery injury. The advantages include rapid intrathoracic access, excellent thoracoscopic visualization of the thoracic inlet, and avoidance of the morbidity associated with open thoracotomy.

Keywords: Video-assisted thoracic surgery • Subclavian artery injury • Central venous catheter

INTRODUCTION

The true incidence of subclavian artery injuries following internal jugular vein (IJV) cannulation is unknown and probably underreported [1]. Currently, there are no definitive guidelines in the literature to address the management of these injuries. While these injuries have been conventionally managed by open surgical exploration, newer techniques such as endovascular repair continue to evolve. Open surgery has significant disadvantages such as severe postoperative pain and reduced shoulder girdle movement, which increases the risk of complications in patient populations that are already critically ill. We propose the use of video-assisted thoracic surgery (VATS) in the management of these inadvertent subclavian artery injuries as it minimizes the morbidity associated with open surgery and enhances the visualization of anatomical structures in the thoracic inlet. We present the first reported case of successful repair of subclavian artery injury using VATS.

TECHNIQUE

For this approach to be effective, lung isolation with the use of a double lumen endotracheal tube or bronchial blocker is mandatory. The patient is placed in the lateral decubitus position. Two 1-cm incisions are made on the anterolateral chest for

VATS. The first incision is at the sixth intercostal space at the mid-axillary line for placement of a 5-mm 30° thoracoscope. The second incision for instrumentation is placed anterior to the border of the latissimus dorsi muscle at the fourth intercostal space at the anterior axillary line. The haemothorax is rapidly evacuated and the pleural cavity is inspected. Once the location of the subclavian artery injury is identified, bleeding is immediately controlled by applying direct pressure through a small piece of rolled gauze. The subclavian artery injury can then be repaired with pledgetted sutures using an endoscopic needle driver under thoracoscopic visualization. The use of an extracorporeal knot-tying device allows for easy tying of the suture.

CASE

A 44-year old gentleman with a history of rectal adenocarcinoma was admitted for intestinal obstruction. A left internal jugular central venous catheter was inserted, and the patient underwent emergency laparotomy. Postoperatively, the patient developed hypotension and a massive left pleural effusion on chest radiography (Fig. 1A), with a drop in haemoglobin from 13.6 to 9.8 g/dl. A left chest tube was inserted, and >1 l of blood was immediately evacuated.

The patient underwent emergency left VATS exploration and evacuation of the haemothorax. He was positioned in the right

Figure 1: (A) Preoperative chest radiograph showing a massive left haemothorax with a chest tube *in situ*. (B) Immediate postoperative chest radiograph showing successful evacuation of the left haemothorax with re-expansion of the left lung. (C) Chest radiograph upon discharge, showing complete resolution of the haemothorax with complete lung re-expansion.

Figure 2: Repair of the left subclavian artery injury using pledgetted sutures under thoracoscopic visualization. Suture repair was performed with the pledgets placed at the exact site of the arterial injury.

lateral decubitus position and was intubated with a double lumen endotracheal tube. The previous chest tube placement site was utilized as one of the incisions for VATS, and an additional 1-cm incision was made on the left anterolateral hemithorax. A spurting puncture wound in the left subclavian artery at the thoracic inlet was clearly visualized as the only source of bleeding. This defect was repaired with a single pledgetted non-absorbable (4/0 polypropylene) suture using an endoscopic needle driver under thoracoscopic visualization, and the buttressed suture was tied using an extracorporeal knot-pushing device (Fig. 2). Intraoperative blood loss was minimal, as direct pressure was applied to the arterial defect during the suturing process, and haemostasis was achieved immediately after the repair was performed. Postoperatively, the patient made an uneventful recovery (Fig. 1B) and was discharged home in good condition (Fig. 1C).

DISCUSSION

It was reported that 8.1% of all hospitalized patients required central venous catheterization (CVC) insertion [1], and an estimated 1% of these insertions developed complications [2]. Subclavian artery injury following IJV cannulation is less common, but has been reported in the literature [3–8]. The

majority of inadvertent arterial punctures are recognized because of the bright red, pulsatile backflow of blood from the access needle or catheter. However, serious complications, such as distal emboli, pseudoaneurysm formation and vessel rupture with frank bleeding may arise if arterial puncture is not immediately recognized [9–11]. The exact mechanism of subclavian artery injury following CVC of the IJV is not clear. Although it has been suggested that left-sided subclavian artery puncture is physically unlikely because of the anatomical relationship with IJV [12], injury may still occur as evidenced in this report, depending on the position of the needle placement, direction of aim, angle of trajectory and depth of insertion.

While no clear guidelines exist on the management of these injuries, the options available are varied and include open thoracotomy, interventional radiological (IR) techniques, and endovascular techniques [9, 13]. Endovascular and IR approaches are novel techniques that are minimally invasive but are limited to specialized centres. In addition, these techniques do not address other issues that may be associated with the CVC injury such as retained haemothorax. Standard thoracotomy can be performed, but tends to be associated with increased post-operative pain and shoulder dysfunction. Patients who are already critically ill and have sustained a CVC-related injury may not tolerate a standard thoracotomy and may become at risk of even higher complication rates.

Although VATS is often only available in specialized tertiary medical centres, this technique is gradually gaining popularity, and more applications are being discovered. VATS can provide rapid intrathoracic access compared with a standard thoracotomy. It allows for superior visualization of the subclavian artery at the thoracic inlet and provides a magnified panoramic view of the pleural cavity. Haemostatic techniques that can be utilized during VATS include direct pressure, direct arterial repair with pledgetted sutures and application of haemostatic agents such as tissue sealants. The use of VATS minimizes postoperative pain and shoulder dysfunction and is associated with a lower incidence of complications, which may benefit these groups of patients. Patients may also enjoy other benefits of VATS such as faster recovery, earlier return to normal activities and higher overall satisfaction.

CONCLUSION

VATS can be used to successfully repair subclavian artery injury following central venous catheterization. This technique allows

for superior visualization of the thoracic inlet intraoperatively, and minimizes pain and shoulder dysfunction postoperatively.

Conflict of interest: none declared.

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eComment. Iatrogenic subclavian artery injuries and video-assisted thoracic surgical repair

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Injuries affecting the subclavian artery during central venous catheterization are a quite common problem in the everyday practice, especially in hospitals with intensive care units and dialysis departments where subclavian vein puncture is a routine procedure. The echo-guided insertion of catheters has solved many of the existing problems, keeping related arterial complications to a minimum. This method should, in our opinion, be available in all hospitals. The video-assisted thoracic repair of the subclavian artery described by Tam *et al.* [1] is a novel method promising good results, as it bears the advantages of: i) magnified vision, which makes suturing for the experienced convenient; ii) opportunity to evacuate the hemothorax; and iii) opportunity to inspect the hemothorax for coexisting injuries or other pathologies.

We therefore congratulate the authors and expect that the VATS method will find an additional indication in this case.

Conflict of interest: none declared.

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