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CASE REPORT

Transhepatic Major Vascular Injury Secondary to Chest Tube Insertion

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ABSTRACT

This case describes a 68-year-old female who, after an aortic valve replacement, developed a symptomatic pleural effusion and had a chest tube unintentionally inserted transhepatically. Due to the major vascular injury and excessive risk of intraabdominal hemorrhage, the patient was taken to the operating room and the tube was successfully removed.

Key words: *Injuries, Trauma, Iatrogenic injury, Liver injury, Thoracentesis*

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ÖZET

Göğüs Tüpü Tatbikine Bağlı Transhepatik Majör Vasküler Yaralanma

Bu olgu, 68 yaşında bir kadın hastanın aortik kapak replasmanı sonrasında gelişen semptomatik plevral efüzyonu için, göğüs tüpünün, istemeden transhepatik olarak takılmasını tanımlıyor. Büyük damar yaralanması ve yüksek intraabdominal kanama riski nedeniyle, hasta ameliyathaneye alındı ve tüp başarıyla çıkarıldı.

Anahtar kelimeler: *Yaralanma, Travma, İyatrojenik yaralanma, Karaciğer hasarı, Torasentez*

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INTRODUCTION

Chest tube placement is a common procedure routinely performed by physicians. Although chest tube insertion is a relatively straightforward procedure, early complication rates range between 3% and 8%[1]. Major complications include hemorrhage, infection, re-expansion pulmonary edema, and chest tube clogging[2]. Other major, but rare, complications include injury to intraabdominal organs or vessels.

We describe the successful removal of a chest tube that was inadvertently inserted into the liver through the middle hepatic vein into the retrohepatic inferior vena cava (IVC) with the tip curling into the right hepatic vein. There have been several reports of misplaced chest tubes and catheters into solid abdominal organs; however, to our knowledge, this is the first case reported in which a chest tube was successfully removed from a transhepatic major vascular injury.

CASE REPORT

A 68-year-old female who underwent an elective aortic valve replacement due to severe aortic stenosis developed shortness of breath secondary to a symptomatic right pleural effusion on post-operative day 4 that necessitated a pleural drain. This patient was prophylactically anticoagulated prior to surgery. The Seldinger technique was used to insert a 14 French pigtail catheter to drain the pleural effusion (Figure 1)[3]. On subsequent chest X-ray, the symptoms of the effusion persisted as the catheter tip was superior to the effusion, and a second pleural drain was attempted at one intercostal space inferior to the first using the same technique. This chest tube consequently drained approximately 700 mL of blood and was immediately clamped by the medical staff. A chest X-ray suggested an intrahepatic placement, which was confirmed on a contrast-enhanced computerized tomography (CT) scan showing the catheter coursing through the middle hepatic vein into the suprahepatic IVC with the tip curling into the right hepatic vein, in addition to a small amount of hemoperitoneum (Figures 2,3). The patient remained stable with no evidence of hypovolemia and her hemoglobin was 86 g/L. After a multidisciplinary discussion, it was decided to take the patient to the operating room to establish complete vascular control during the removal of the chest tube.

The procedure was performed in the operating room under general anesthesia, and a bilateral subcostal laparotomy was performed for adequate mobilization of the liver and exposure of the IVC. The catheter was located, clamped intra-abdominally and internalized. The right lobe of the liver was mobilized and detached from the right coronary and triangular ligaments. The hepatoduodenal ligament, infrahepatic IVC and suprahepatic IVC were dissected, isolated and clamped, in respective order. The patient tolera-

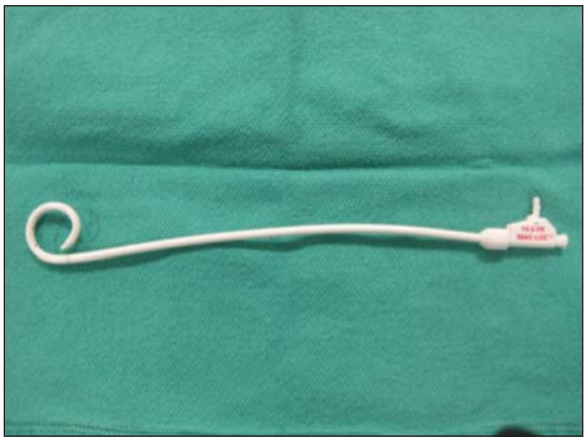

Figure 1. A 14 French pigtail catheter identical to the one removed in this case.

Figure 2. Three consecutive CT slices demonstrating the catheter coursing into the anterior aspect of the intrahepatic inferior vena cava and looping posterolaterally, terminating in the uppermost aspect of the right hepatic vein.

Figure 3. 3D CT reconstruction showing the course of the chest tube entering the liver.

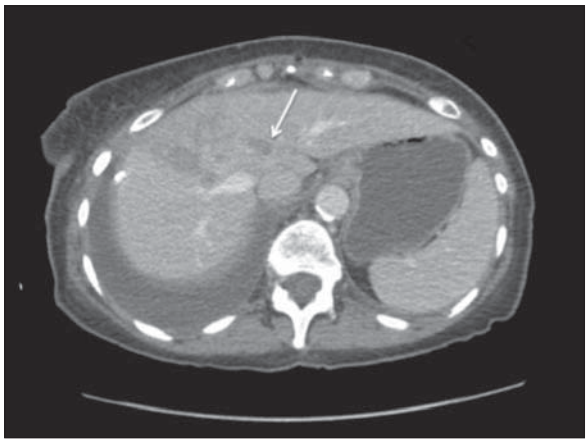

Figure 4. CT showing partial thrombosis (arrow) of the middle hepatic vein.

ted the clamping and anesthesia was comfortable to begin the chest tube removal.

The catheter was withdrawn and a surge of blood poured from the opening, which was quickly tamponaded. ABioGlue® surge tip applicator was carefully inserted into the opening of the track and 10 mL of BioGlue® was slowly injected while withdrawing the applicator to completely occlude and obliterate the track. The tip of the BioGlue® applicator was measured and compared to the length of the track on CT to ensure no BioGlue® was injected intravascularly into the IVC. The opening was closed with sutures buttressed with Gelfoam®. The area was manually tamponaded for 15 minutes. The suprahepatic IVC, hepatoduodenal ligament and intrahepatic IVC were sequentially unclamped with no evidence of hemorrhage or hematoma. The patient recovered uneventfully from the procedure. A Doppler ultrasound on post-operative day 1 showed patency of the hepatic vessels and a small intrahepatic hematoma. Liver function tests normalized in three days post-operatively. Follow-up CT one week post-operatively demonstrated patency of the IVC and right and left hepatic veins; however, the middle hepatic vein showed partial thrombosis (Figure 4). The patient recovered from the procedure with no complications and was discharged home on post-operative day 8. Three months post-operatively, the patient's liver function tests and liver ultrasound were normal, aside from the partial thrombosis of the middle hepatic vein.

DISCUSSION

For treatment of pneumothoraces, it is described to use the relatively wide, avascular second intercostal space in the midclavicular line for chest tube drainage[4]. Free-floating pleural effusions are drained using the sixth intercostal space in the midaxillary line, whereas loculated fluid is described to be drained using ultrasound or CT guidance[4]. It is recommended in the British Thoracic Surgery (BTS) guidelines that ultrasound be used if the effusion is small or the initial blind aspiration attempt fails[1,2]. Weingardt et al. described an 88% success rate of obtaining fluid by sonographically guided thoracentesis after at least one unsuccessful, clinically-guided attempt[5]. Our presented case underwent one previous unsuccessful thoracentesis attempt, and thus would have certainly benefitted from an ultrasound-guided attempt. Not only is ultrasound examination more sensitive than a plain chest radiograph at detecting pleural fluid, it is also better at differentiating pleural fluid from pleural thickening and pleural masses when compared to CT[6].

In the extremely rare circumstance that a chest tube is inserted intrahepatically, it is clinically necessary to recognize its presentation immediately to prevent further blood loss. In our case, the drainage of frank blood from the chest tube alarmed medical staff to clamp the drain and obtain a CT urgently. Even with vascular inflow and outflow occlusion in the operating room, blood poured from the entry site when the chest tube was removed, which validated the severity of the vascular injury.

Tait et al. described a similar case in which an 82-year-old female had a size 26 chest drain inserted through her liver with the tip touching the outside wall of the IVC, but not intravascularly[7]. This patient was not a candidate for general anesthesia due to her comorbidities and was left with the tube in place for seven days for granulation tissue to form; it was removed by tamponading via balloon catheterization with permanent embolization coils inserted as the tube was removed. Another related case was reported during a liver abscess drainage procedure where the catheter perforated the intrahepatic portion of the IVC with its tip in the lumen of the IVC[8]. In this case, the catheter was removed into the abscess under fluoroscopic guidance with the help of a metallic guide wire. The catheter tract was tamponaded by the intrahepatic pressure, and the wire was subsequently removed two days later with no complications.

In our case, the involvement of the three large vessels in this anticoagulated patient caused the multi-disciplinary team to be extremely cautious when choosing the management strategy in order to avoid additional intravascular injury or massive hemorrhage

and to decrease the risk of thrombosis from the intrahepatic chest tube. Although interventional radiology would serve as a potential approach, the inability to quickly and effectively treat a massive hemorrhage or intravascular injury made surgery the appropriate treatment in this case in order to have complete inflow and outflow control with the addition of BioGlue® to achieve hemostasis intrahepatically. BioGlue® is a surgical adhesive composed of purified bovine serum albumin (BSA) and glutaraldehyde that reaches its bonding strength within two minutes[9]. In this case, it helped to seal the track to prevent further bleeding.

In conclusion, chest tubes are used for a variety of reasons and have a number of known complications. In extremely rare circumstances, as in the case described, solid intraabdominal organs can be damaged, and prompt recognition is vital in order to prevent further hemorrhage and ultimately death. When a major vascular injury is recognized, the treatment should be individualized according to the patient's condition. Laparotomy was the safest option; however, the medical staff should discuss with the interventional radiology team alternative options and decide on a treatment that is patient-appropriate. Ultrasound-guided chest tube placement should always be used for small or complicated pleural effusions and when the first attempt is unsuccessful.

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