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CASE REPORT

Elective surgery for liver injury and misinserted tube into the inferior vena cava associated with chest tube replacement: A case report

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Abstract

Background: Several reports on organ injury and death due to incorrect chest tube insertion exist; however, reports on the chest tube penetrating the liver and reaching the inferior vena cava are limited.

Case Presentation: A 79-year-old man presented with a clamped tube because of massive bleeding from the tube following right chest tube replacement in the hospital of origin. The tube entered the inferior vena cava from the hepatic parenchyma via the right hepatic vein and was removed 15 h later because his hemodynamics stabilized. A ruptured pseudoaneurysm necessitated further transcatheter arterial embolism on the second hospitalization day, and the patient was transferred back to the referring hospital on day 17.

Conclusion: Liver injury caused by an inferior vena cava misinsertion-associated chest tube can be treated with elective surgery in anticipation of the tube's tamponade effect. However, due to the risk of rebleeding, imaging follow-up is necessary soon after surgery.

KEYWORDS
chest tube, elective surgery, incorrect insertion, liver injury, misinserted tube into inferior vena cava

INTRODUCTION

Several reports on organ injury and death due to erroneous chest tube insertion exist; however, reports on the chest tubes penetrating the liver and reaching the inferior vena cava (IVC) are limited. In this case, chest tube replacement caused this type of injury, and elective surgery was successfully performed.

CASE PRESENTATION

A 79-year-old man with a history of pulmonary emphysema was transferred to our emergency department due to 1200-mL bleeding from the tube after the chest tube (22-Fr diameter) was replaced using the same insertion hole in the hospital of origin due to right spontaneous pneumothorax. The patient's systolic blood pressure dropped to 70, and his level of consciousness decreased. Because liver injury was suspected, the tube was immediately clamped and 840 mL of red blood cells were transfused at the hospital of origin for low blood pressure.

The patient's vital signs upon arrival were as follows: Glasgow Coma Scale, E4V5M6; respiratory rate, 21 breaths/min; oxygen saturation, 100% under oxygen mask at 8 L/min; heart rate, 94 beats/min; and blood pressure, 124/74 mmHg. Furthermore, the laboratory results were as follows: white blood cell count, 10,100/μL; hemoglobin,

14.1 g/dL; hematocrit, 39.2%; platelet count, 163,000/μL; alanine aminotransferase, 58 U/L; aspartate aminotransferase, 71 U/L; total bilirubin, 0.4 mg/dL; blood urea nitrogen, 47.8 mg/dL; creatinine, 1.26 mg/dL; creatine kinase, 208 U/L; C-reactive protein, 1.0 mg/dL; international normalized ratio of prothrombin time, 1.12; activated partial thromboplastin time, 51.0 s; D-dimer, 9.23 μg/mL; and blood lactate level, 0.7 mmol/L.

The tube was inserted from the eighth intercostal gap on the right side, mainly via the hepatic S7 region, and inserted into the right hepatic vein; the tip had reached the IVC near the right atrium on the diaphragm (see Figure 1).

Laparotomy and thoracotomy were necessary to open the pericardium and remove the tube. However, after the initial blood transfusion at the hospital of origin, the patient's vital signs were stable and intra-abdominal bleeding on computed tomography scan was less. Therefore, surgery was performed the next day (i.e., 15 h after the transfer and 21 h after the injury) in collaboration with the emergency, cardiovascular surgery, and liver surgery departments with a heart–lung machine on standby. The hepatic hilum was secured and prepared for Pringle's procedure; the IVC was secured above and below the liver to isolate it in case of significant bleeding; and the liver was mobilized for compression hemostasis. Transdiaphragmatic thoracotomy and pericardial incision were performed to demonstrate the absence of cardiac or IVC injury. The tube was removed from the hepatic S7 region, and the liver was compressed with both hands for 30 min to obtain hemostasis. Intraoperative liver echo confirmed that the right hepatic vein was thrombotic, but there was no thrombus in the IVC. The liver puncture location was then sutured, and the diaphragm and abdomen were closed. The surgery took 3 h and 34 min; there was 110 mL of bleeding; and intraoperative blood transfusion was unnecessary (Figure 2).

Follow-up computed tomography on the first day after surgery (19 h after surgery) revealed that hemostasis was complete, whereas that on the second day after surgery (43 h after surgery) revealed increased intrahepatic hematoma in the hepatic S8 region. Transcatheter arterial embolization (TAE) with coils was performed to control bleeding after hepatic angiography revealed an arterioportal shunt and a ruptured pseudoaneurysm in the hepatic S8 region (Figure 3). After this event, the clinical course of the patient was satisfactory. For a right pneumothorax that was still under treatment at the previous hospital, a new insertion (20 Fr in diameter) was made from the right fifth intercostal space before surgery at our hospital, and it was removed on the 11th hospitalization day. Eventually, he was transferred back to the hospital of origin for follow-up on the 17th hospitalization day.

DISCUSSION

Chest tube insertion is one of the most common surgical procedures, with even junior residents performing it. However, several complications are associated with it, and the complication rate is 5%–10%.[1] Most complications arise due to tube malpositioning; moreover, organ injuries have been reported.[1] In a previous study conducted by Harris et al.,[2] 47 cases (including eight deaths) of lung/chest wall injury, 10 cases (one death) of liver injury, five cases (one death) of spleen injury, five cases (three deaths) of heart injury, one case (no death) of colon injury, and one case (no death) of esophagus injury were reported. Furthermore, one death was reported as a result of IVC misinsertion. However, no other cases of chest tube misinsertion with IVC involvement have been reported, except for one case of cardiac herniation caused by severe chest trauma.[3]

Although this was an exceptionally unusual yet catastrophic case of liver injury with IVC involvement, tube clamping and blood transfusion at the hospital of origin stabilized the patient's vital signs upon arrival. Consequently, we had time to discuss surgical management. If the tube had remained only in the liver parenchyma, coil embolization in the fistula may have been considered.[4] However, in our case, the tube tip reached the IVC, posing a risk of injury

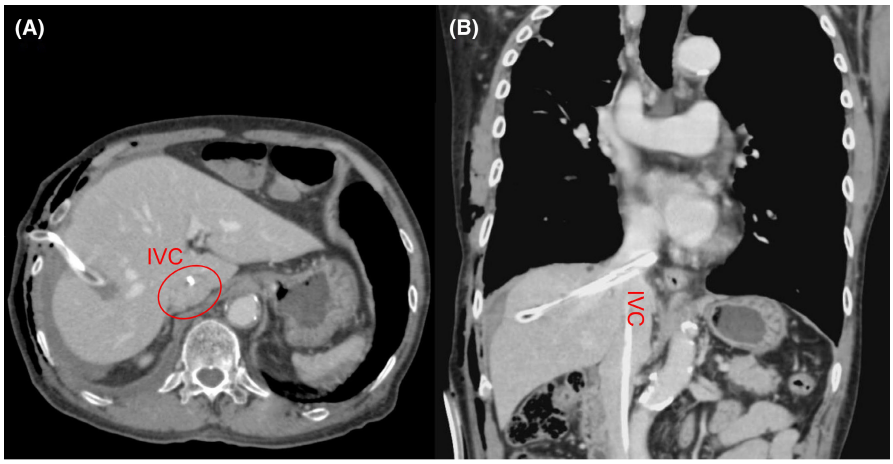

FIGURE 1 Computed tomography scans upon arrival at our hospital: (A) horizontal tomographic image and (B) sagittal tomographic image. The red ellipse indicates inferior vena cava (IVC). The thin tube in the IVC is a central venous catheter inserted through the groin.

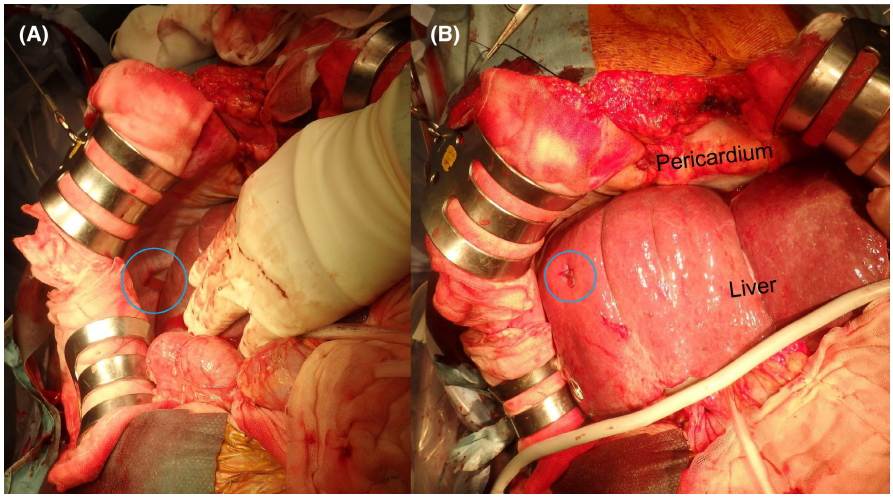

FIGURE 2 Surgical view (A) before and (B) after removing the chest tube. The blue circle indicates the insertion site of the chest tube.

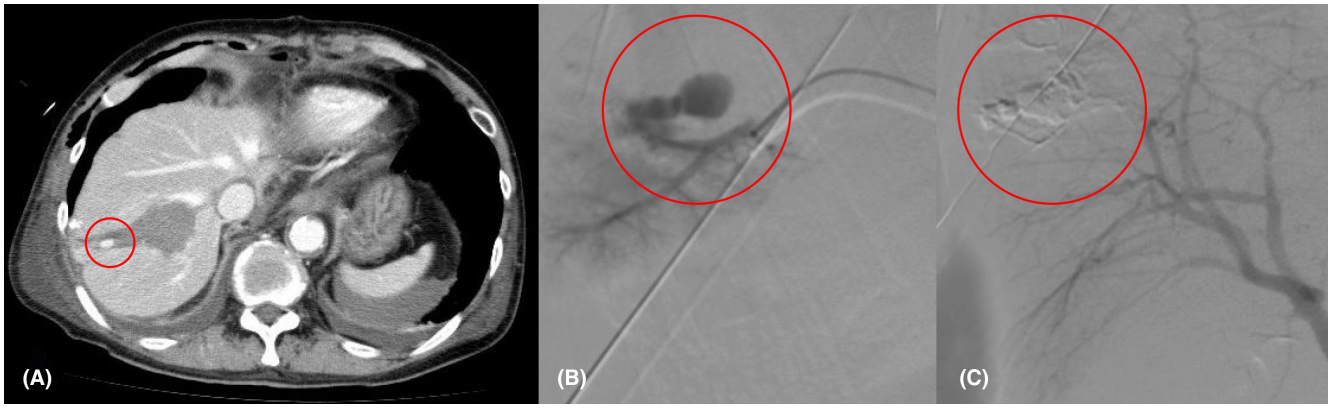

FIGURE 3 Images of ruptured intrahepatic pseudoaneurysm in (A) computed tomography scan, (B) hepatic angiography before coil embolization, and (C) hepatic angiography after coil embolization. The red circle indicates a ruptured intrahepatic pseudoaneurysm.

to the right atrium. Thus, surgery was the only alternative for removing the tube under direct vision. We finally chose elective surgery after planning for emergency surgery if the patient's condition changed. Tube removal would have possibly needed highly invasive surgery, including right hepatic lobectomy or right atrioventricular incision, in cooperation with specialist surgeons, anesthesiologists, and clinical engineers. Furthermore, we had to wait till they were fully available. We also expected hemostasis of the liver parenchyma due to the tube's tamponade action. The balloon tamponade (internal tamponade) approach for penetrating liver injury has been described in trauma surgery; the balloon is withdrawn 24–48 h after hemostasis is complete.[5]

The likelihood of thrombosis in the tip of the tube reaching the IVC was one of the concerns of elective surgery. Although central venous catheters have been reported to cause thrombosis, the relationship between catheter thickness and indwelling period is unclear.[6] Reccius et al.[7] evaluated the development of venous thrombosis in 20 patients who had undergone therapeutic hypothermia using an endovascular cooling catheter (9.3-Fr diameter) placed in the IVC and reported thrombosis in all patients except for two patients whose catheter was indwelled within 2 days with a prophylactic anticoagulant. In the present case, anticoagulants could not be used owing to the risk of bleeding; however, a waiting time of ≤24 h was considered appropriate. Inserting a temporary IVC filter to prevent pulmonary embolism was not possible because the tip of the tube was near the right atrium.

The fact that the patient presented with bleeding on the second day after surgery due to the rupture of the intrahepatic pseudoaneurysm shows that pseudoaneurysm should be diagnosed in advance and prophylactic TAE should be performed. The active diagnostic imaging, such as hepatic arterial angiography, should have been performed early in the postoperative period or intraoperatively, even if follow-up computed tomography on the first day after surgery revealed that hemostasis was complete. Nevertheless, we believe that elective surgery and minimally invasive approaches resulted in a satisfying outcome in this case.

Finally, although chest tube insertion is a basic procedure, it is important to remember that organ injury due to incorrect insertion can be life-threatening. Particular attention should be paid to the risk of intraperitoneal insertion when inserting through the lower intercostal space. Also, when replacing a tube using the same insertion hole, as in

this case, it should be noted that the drain tip may reach unexpected locations due to adhesions in the surrounding area or other causes.

CONCLUSION

If a patient's hemodynamics are stable, liver injury caused by an IVC misinsertion-associated chest tube can be treated with elective surgery in anticipation of the tamponade effect of the chest tube. However, due to the risk of rebleeding, careful observation, including follow-up imaging soon after surgery, is necessary.

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CONFLICT OF INTEREST STATEMENT

Authors declare no Conflict of Interests for this article. Dr. Jun Oda is Editor-in-Chief of the journal and co-author of this article. They were excluded from the peer-review process and all editorial decisions related to the acceptance and publication of this article. Peer-review was handled independently by Acute Medicine and Surgery editorial office and Dr. Yausyuki Kuwagata as the Editor to minimize bias.

DATA AVAILABILITY STATEMENT

The data that support the findings of this study are available from the corresponding author upon reasonable request.

ETHICS STATEMENT

Approval of the research protocol: Not applicable.
Informed consent: Informed consent was obtained from the patient.
Registry and the registration no. of the study/trial: N/A.
Animal studies: Not applicable.

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