Optimal Treatment for Diverticulum-like Projections of the Retrohepatic Inferior Vena Cava Occurring after Inferior Vena Cava Packing: A Case Report

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Introduction: Although the outcomes of patients with retrohepatic inferior vena cava (IVC) injury have improved because of damage control (DC) strategies, some rare complications have been observed.
Case Presentation: We present the case of a 35-year-old man with diverticulum-like projections (DLPs) of the retrohepatic IVC that occurred following peri-IVC packing based on DC strategies. The DLPs were treated conservatively with anticoagulant therapy and he recovered completely.
Conclusions: Caution must be exercised regarding such rare complications after abbreviated surgery. Conservative therapy may be the optimal treatment for patients with DLPs of the retrohepatic IVC after peri-IVC packing.

Key words: retrohepatic inferior vena cava injury, diverticulum-like projections, complications, damage control, surgery

INTRODUCTION

Retrohepatic inferior vena cava (IVC) injuries are rare and potentially life-threatening, with a mortality rate of 50% [1]. Although the outcomes of patients with lethal hepatic injury have improved because of the introduction of damage control (DC) strategies [2, 3], some rare complications in patients who underwent DC surgery have been observed [4–6]. Herein, we report the case of a patient with a life-threatening penetrating hepatic injury who underwent left sublobular resection for a large laceration of the left lobe with left hepatic vein transection and peri-IVC packing for retrohepatic IVC injury. The patient underwent conservative therapy for diverticulum-like projections (DLPs) of the retrohepatic IVC after abbreviated surgery.

CASE REPORT

A 35-year-old man was stabbed with a knife by an unknown assailant while working. On presentation, he was pale and had severe pain. His Glasgow coma scale score was E3V5M6, respiratory rate was 30 breaths/min, pulse was 100 beats/min, and systolic blood pressure was 70 mmHg. A wound approximately 50-mm in size was seen directly below the xiphoid process. The laboratory results revealed that his base excess was -6.9 mmol/L and his serum lactate level had increased to 41 mg/dL. A focused sonographic assessment indicated trauma in the cardiac sac and intra-abdominal cavity. Plain chest radiography showed no hemo-pneumothorax. Therefore, we diagnosed cardiac tamponade and massive intra-abdominal hemorrhage. Cardiac sac drainage and emergency laparotomy were immediately planned. The patient was taken to the operating room approximately 30 minutes after admission. Although the patient was almost in cardiac arrest just before surgery, spontaneous circulation was restored by cardiopulmonary resuscitation, massive transfusion, cardiac sac surgical drainage, and hepatic compression with the palms after crash laparotomy. We confirmed that there was no injury to the heart or persistent cardiac sac hemorrhage; subsequently, we performed left hepatic sublobar resection via the Pringle maneuver because the knife went through the left hepatic lobe containing the left hepatic vein and penetrated the caudate lobe. Then, we diagnosed an IVC injury because of persistent massive hemorrhage from the injured caudate lobe. We attempted IVC repair via total hepatic vascular exclusion (THVE). However, massive hemorrhaging from the injured caudate lobe was uncontrollable. After judging that direct IVC repair was too difficult, we attempted gauze packing in the peri-IVC space. However, this did not allow blood pressure maintenance due to infusion failure caused by hard compression of the IVC and failure to control hemorrhaging. Therefore, we attempted extensive hepatorrhaphy of the caudate lobe as DC. As a result, hemostasis was completely achieved without gauze packing. Drainage tubes were inserted in the cardiac sac, left subphrenic space, and perihepatic space. Thereafter, surgery was completed. Details of the surgery are shown in Table 1. Hemodynamics and blood data regarding the perioperative course are shown in Fig. 1.

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Table 1 Details of the operation

Parameter	
Operation time, min	468
Pringle maneuver cumulative time, min	53
Total amount of blood loss, ml	31812
Total amount of blood transfusions, units	
Red blood cells	120
Fresh frozen plasma	110
Platelet	50

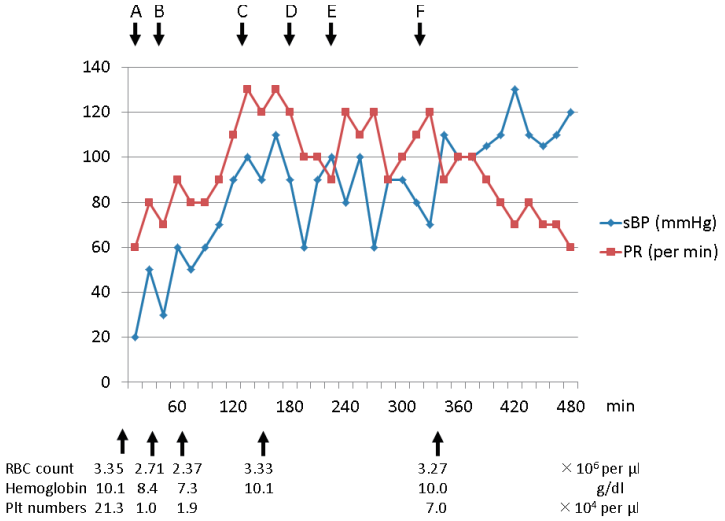

Fig. 1 Hemodynamics and blood data during surgery. RBC, red blood cell; Plt, platelet. The following surgeries were performed. A: Cardiac sac drainage, emergency laparotomy, hepatic compression with palms. B: Left hepatic sublobar resection. C: Total hepatic vascular exclusion. D: IVC direct repair. E: Gauze packing in the peri-inferior vena cava space. F: Extensive hepatorrhaphy of the caudate lobe.

Venography of the IVC was performed the next day. DLPs of the retrohepatic IVC that were observed (Fig. 2A, B, C, D) were conservatively managed. The central venous pressure was controlled, and the target pressure did not exceed 5 mmHg. We used anticoagulant drugs to prevent thrombosis. His vital signs became stable after completion of surgery. Hemorrhaging from the drains and progression of anemia were not observed. Therefore, because there was no coagulopathy, acidosis, or hypothermia, we considered the patient's condition to be improved. Unfractionated heparin was used first, and the target value of the activated partial thromboplastin time ratio was 2.0. We performed follow-up of the injured IVC using ultrasonography (US) and computed tomography (CT). Three days after surgery, US detected a tiny thrombus in the diverticulum Therefore, we added warfarin to his treatment; the target value of the international normalized ratio was 2.0 to avoid thrombus formation in the IVC trunk. We performed trachea extubation on day 6 after surgery. According to US, at 7 days after surgery, the thrombus disappeared and DLPs were gradually reduced. The patient was in the intensive care unit for 9 days. Using venography at 3 weeks after surgery, we confirmed that the DLPs of the IVC had disappeared (Fig. 3A, B, C, D). He was discharged home on postoperative day 23. Thereafter, he had no adverse events without drugs.

DISCUSSION

The main finding of this study was that peculiar complications can easily occur in patients who undergo abbreviated surgery. In this case, DLPs of the retrohepatic IVC that occurred following peri-IVC packing were treated conservatively.

The most frequent retroperitoneal vascular injury with penetrating abdominal trauma is incurred in the IVC; this is associated with high mortality due to massive hemorrhaging [7]. Bardes *et al.* reported that the ideal initial management of a bleeding retrohepatic hematoma is packing [8]. Our patient also underwent peri-IVC packing by extended hepatorrhaphy without gauze after other DC surgeries. We decided to perform DC surgery for several reasons. First, injury of the retrohepatic IVC was confirmed vertically at the anterior and posterior walls. Furthermore, the wound sizes were large (50 mm and 40 mm, respectively). Additionally, we controlled the hemorrhaging using THVE. Nevertheless, hemorrhaging from the injured caudate lobe persisted. Although we considered that inflow of the adrenal, lumbar, inferior phrenic, and other veins was related to the uncontrolled hemorrhaging, we speculated that ligation was difficult because the posterior wall of the IVC next to them was also injured. Moreover, we assessed that it was difficult to perform suturing even though an atriocaval shunt was placed.

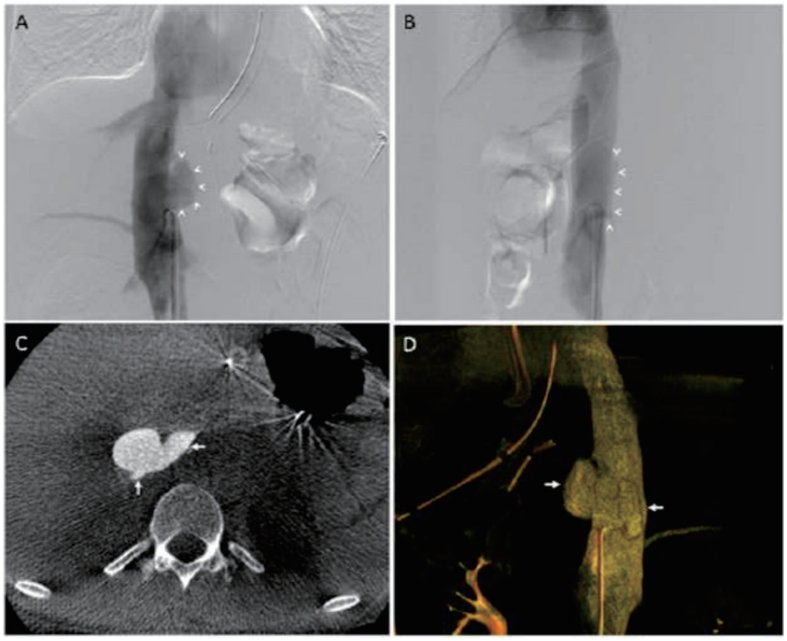

Fig. 2 A: Inferior vena cava (IVC) venography. Anterior-posterior view. A huge diverticulum-like projection (DLP) is shown at the left side of the IVC (arrowheads). B: IVC venography. Lateral view. A DLP is shown at the dorsal side of the IVC (arrowheads). C: IVC venography. Reconstruction of the axial computed tomography (CT) image. Two DLPs are shown at the left and dorsal sides of the IVC (arrows). D: IVC venography. Three-dimensional volume-rendered reconstruction of venography. Dorsal view. Two DLPs are shown at the left and dorsal sides of the IVC (arrows).

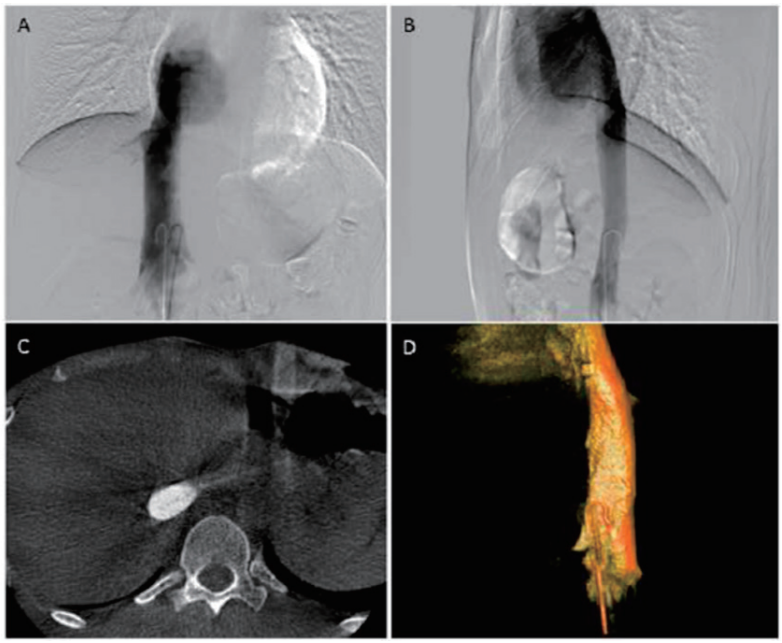

Fig. 3 A: Inferior vena cava (IVC) venography. Anterior-posterior view. A diverticulum-like projection (DLP) on the left disappeared. B: IVC venography. Lateral view. The dorsal side DLP disappeared. C: IVC venography. Reconstruction of the axial computed tomography (CT) image. Left and dorsal side DLPs disappeared. D: IVC venography. Three-dimensional volume-rendered reconstruction of venography. Dorsal view. Left and dorsal side DLPs disappeared.

As a result of abbreviated surgery, DLPs of the retrohepatic IVC occurred. We turned our attention to several complications that could most likely occur in such a patient. One complication is an IVC thrombus [9], which results in death. We performed anticoagulation therapy and careful US follow-up. No major complications were observed. However, there are no guidelines for antiplatelet and anticoagulant therapy to avoid thrombus in the IVC trunk after such trauma. This issue should be evaluated in future studies. Another complication is stenosis of the injured IVC. Severe stenosis of the IVC after repair was reported [10]. However, this retrohepatic IVC with DPLs was cured conservatively without stenosis or deformity. We considered inserting a stent graft into the IVC during/after surgery; however, we did not. Few venous stent repairs

have been described. Endovascular stent repair of the injured IVC may be an effective and life-saving alternative [11]; however, it remains controversial. Further studies are needed.

To successfully performed DC strategies, it is important to not only perform DC surgery but also manage complications that occur after surgery.

CONCLUSION

Caution must be exercised when rare complications occur after abbreviated surgery. Conservative therapy may be the optimal treatment for DLPs of the retrohepatic IVC after peri-IVC packing. More cases should be assessed to confirm this idea.

CONSENT FOR PUBLICATION

The patient has provided permission to publish the features of his case. The identity of the patient has been protected.

COMPETING INTEREST

There are no conflicts of interest.

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