



Hybrid laparoscopic Inokuchi shunt procedure for refractory pleural effusion and ascites associated with primary biliary cirrhosis: A case report

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ABSTRACT

INTRODUCTION: Portosystemic shunts associated with portal hypertension are generally treated using non-invasive procedures, with open surgery required for refractory cases. Herein, we present a case of refractory pleural fluid and ascites associated with primary biliary cirrhosis (PBC), successfully treated using a hybrid laparoscopic Inokuchi shunt procedure.

CASE PRESENTATION: The patient was a 74-year-old woman with a history of PBC, presenting with breathing difficulty. Computed tomography revealed massive pleural fluid and ascites and engorged coronary and azygos veins, indicative of a portosystemic circulation shunt and a 3-cm wide hepatocellular carcinoma (HCC) on liver segment 2. The Child-Pugh score was 11. With the portosystemic shunt outflow considered as the cause of pleural fluid and ascites; therefore, we proceeded with a hybrid laparoscopic selective Inokuchi shunt procedure and tumor enucleation. Laparoscopically, the greater omentum was divided for devascularization, a 7-cm right subcostal skin incision was made, and the abdomen was opened for HCC enucleation under direct vision. The left gastric vein was divided at its junction with the portal vein and connected to the vena cava using a left external iliac vein graft through the ommental foramen. After this procedure, the pleural effusion and ascites disappeared, blood ammonia level decreased to normal, and Child-Pugh score decreased to 9.

DISCUSSION: Using the Inokuchi shunt procedure, the portosystemic shunt, via the left gastric vein, was closed to increase portal blood flow and improve liver function.

CONCLUSION: As a less invasive procedure, hybrid laparoscopic approach should be considered for portosystemic shunt via the left gastric vein.

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1. Introduction

Currently, first-line treatments for portosystemic shunts are non-invasive procedures, such as endoscopy or interventional radiology (IVR). However, some cases are refractory to non-invasive treatments, with impairment in liver function associated with portosystemic shunts. In these cases, surgical treatment is required. Herein, we report a case for a patient with a portosystemic shunt with massive pleural effusion and ascites associated with primary biliary cirrhosis (PBC), refractory to non-invasive treatments. A successful outcome was achieved by performing a selective Inokuchi shunt procedure [1,2]. Via a hybrid laparoscopic approach, which resulted in significant improvement in liver function, pleural effusion, and ascites. Using a hybrid laparoscopic approach is less invasive and produces superior cosmesis than an open approach.

2. Presentation of the case

Our case was prepared as per the SCARE guideline [3]. The patient was a 74-year-old Asian woman with a history of hypertension, endoscopic variceal ligation for an esophageal varicose vein, and PBC. She was referred to our hospital by a local clinic for treatment of refractory massive pleuroperitoneal fluid associated with breathing difficulty. The patient had been treated with tolvaptan, spironolactone, and furosemide. Her family history was unremarkable. A Denver shunt had been placed at the previous hospital but was already occluded. A 2-cm hepatocellular carcinoma (HCC) was observed on the surface of liver segment 2, with impaired liver function.

The patient's body weight, height, and body mass index were 50 kg, 160 cm, and 19.5 kg/m², respectively. On physical examination, the patient appeared alert and oriented; her abdomen was distended due to massive ascites. Her Child-Pugh score was 11, grade C, and relevant blood parameters were as follows: albumin (Alb), 2.5 g/dL; total bilirubin (T-bil), 2.0 mg/dL; prothrombin time (PT), 67 %; ammonia (NH₃), 166 µg/dL; platelet count (Plt),

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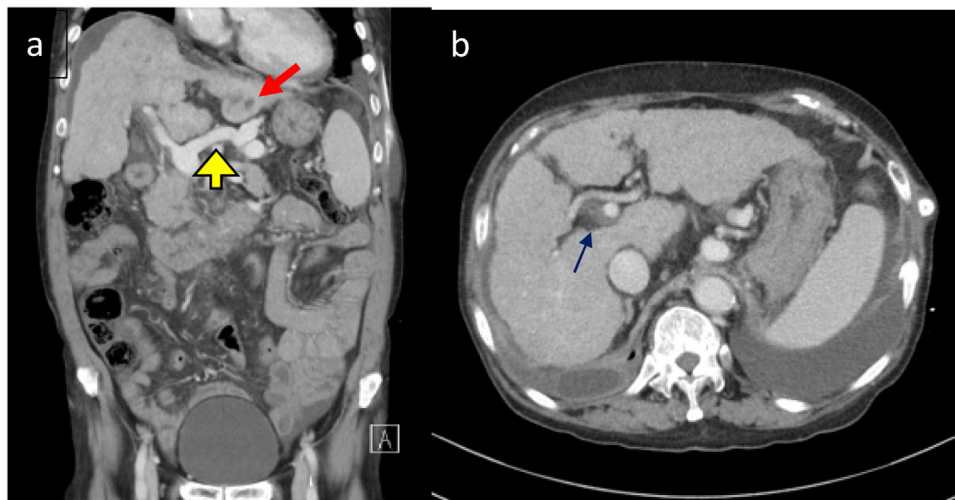


Fig. 1. Computed tomography images showing (a) a hepatocellular carcinoma on the surface of liver segment 2 (red arrow) and a dilated coronary vein (yellow arrow) and (b) an intravascular clot in the portal vein (blue arrow).

$9.6 \times 10^4 / \mu\text{L}$; hemoglobin (Hb), 8.6 g/dL; and protein-induced vitamin K antagonist II (PIVKA-II), 700 mAU/mL. Chest and abdominal computed tomography revealed massive ascites and pleural fluid. The left gastric and azygos veins were engorged, indicative of a portosystemic shunt. Portal vein thrombosis and a 2-cm wide HCC, located on the surface of liver segment 2, were also identified (Fig. 1). Immediately following admission, bilateral thoracocentesis was performed to drain the pleural effusion and facilitate breathing. A hybrid laparoscopic Inokuchi shunt and enucleation of the HCC located in liver segment 2 were indicated.

The lead surgeon (Y.S.) had 30 years of experience. The patient was placed in the supine position, with legs spread to accommodate the assistant surgeon. Two 12-mm and three 5-mm ports were placed (Fig. 2). Under laparoscopic vision, massive ascites and a cirrhotic liver with irregular surface and nodules were observed (Fig. 3). The Denver shunt was completely occluded and, thus, removed. The greater omentum was divided along the greater curvature up to the esophagus for devascularization. Care was taken not to damage the left epiploic artery and vein. The lesser omentum was also opened, with engorgement of the left gastric vein identified (Fig. 4). A 7-cm skin incision was made in the subcostal area and the abdomen was opened. Through this window, real-time sonazoid-enhanced liver ultrasound was performed. A 2-cm HCC was detected on the surface of liver segment 2, confirming computed tomography findings; no other lesions were observed. The tumor was enucleated through this window. Subsequently, the common hepatic artery, gastroduodenal artery, proper hepatic artery, and left gastric artery were identified. The portal venous pressure, measured by direct puncture, was 30 cmH₂O. To connect the vena cava and coronary vein, a 4-cm left external iliac vein graft was taken from the left inguinal area. The coronary vein was divided at the junction of the portal vein, and the orifice of the portal vein was closed using a running suture of 6-0 Prolene. The left external iliac vein graft was anastomosed with the coronary vein using a running suture of 6-0 Prolene in an end-to-end manner. The other end of the left external vein graft was passed through the omental foramen and anastomosed with the vena cava using a running suture of 6-0 Prolene in a side-to-end manner. After the completion of anastomoses, adequate blood flow was confirmed by Doppler ultrasound. The abdomen was irrigated and hemostasis assured. Closed drainage tubes were placed in the right sub-diaphragm region and Morison's pouch. The abdomen and left inguinal wound were closed. The patient tolerated this procedure well. The operative time was 427 min.

The postoperative course was uneventful, and the patient was discharged on postoperative day 14. One month after surgery, the pleuroperitoneal fluid disappeared and liver function improved. Her Child-Pugh score decreased to 9 and blood parameters improved as follows: NH₃, 63 $\mu\text{g/dL}$; Alb, 3.0 g/dL; T-bil, 2.3 mg/dL; and PT, 73.4 %. The patient remains healthy 1 year after surgery.

3. Discussion

Our case highlights two important clinical issues. First, the Inokuchi shunt procedure increases portal blood flow and improves liver function, which led to improvement of massive pleural effusion and ascites. The hybrid laparoscopic procedure is less invasive and provides better cosmesis than an open surgical approach.

The Inokuchi shunt procedure is useful for patients with portosystemic shunt associated with portal hypertension caused by cirrhosis. The procedure shuts down the outflow from the portal vein, leading to improvement of liver function, pleural fluid, and ascites. We recognize that non-invasive procedures, such as endoscopy and IVR, are recommended as first-line treatment for esophagogastric varices shunts associated with portal hypertension. However, our patient had previously undergone esophageal varicose ligation for gastroesophageal varices. An endoscopically untreatable portosystemic shunt had developed between the left gastric and the azygos veins, leading to refractory pleural fluid and ascites associated with low liver function. The selective Inokuchi shunt procedure was used to shut down blood outflow via the coronary vein to increase portal blood flow. Compared to the distal splenorenal shunt procedure [4,5], the selective Inokuchi shunt procedure is rarely performed because of its procedural complexity. However, in this case, the main portosystemic shunt outflow was through the coronary vein, which favored the use of the selective Inokuchi shunt procedure. Importantly, we had prior experience using the selective Inokuchi shunt procedure, with good clinical outcomes achieved [6]. Splenectomy was not performed as there was no evidence of pancytopenia on blood reports. After this surgery, pleuroperitoneal fluid decreased and liver function significantly improved. The Child-Pugh score decreased from 11 to 9, downgraded to class B, and blood reports confirmed a decrease in NH₃ levels to 67 $\mu\text{g/dL}$ (within normal limits). Use of the Inokuchi shunt procedure also allowed us to successfully resect the HCC in liver segment 2 simultaneously.

The hybrid laparoscopic procedure is less invasive than an open surgical approach and provides better cosmesis. More importantly,

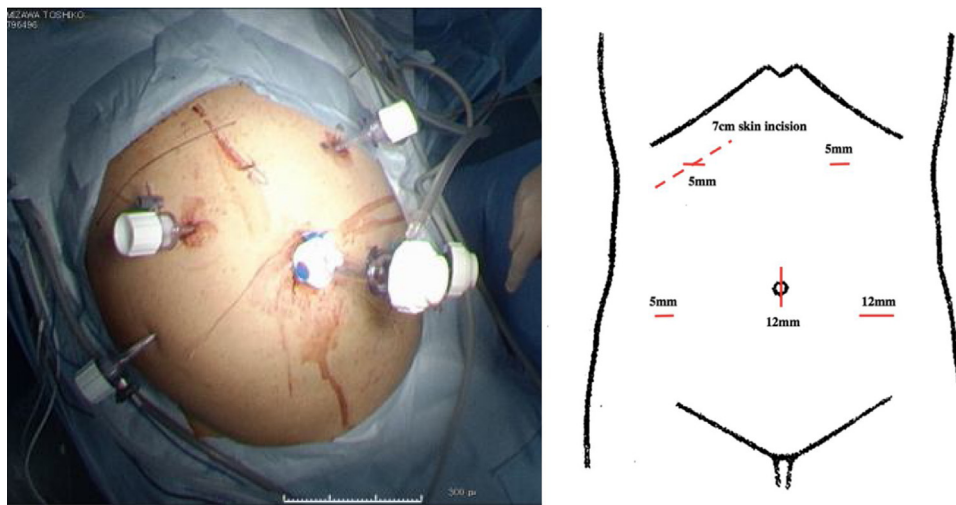


Fig. 2. Port placements and skin incision.

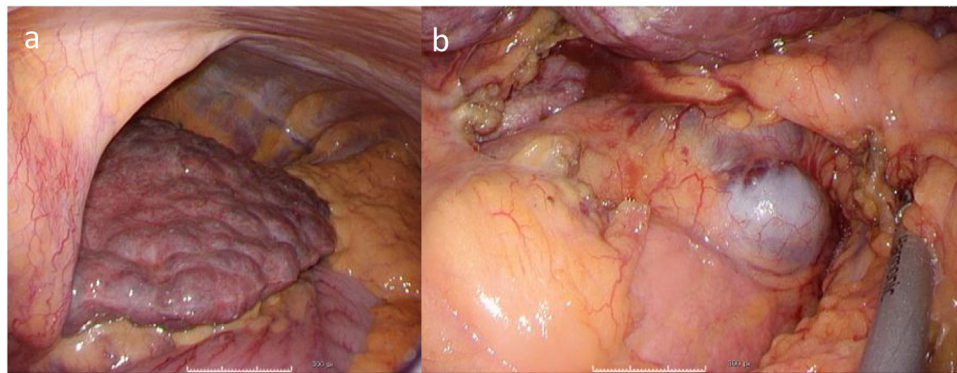


Fig. 3. Laparoscopic view of the cirrhotic liver showing (a) an irregular surface and nodules and (b) an engorged coronary vein.

our hybrid approach was more appropriate than an open approach for our patient who presented with a low nutritional status due to PBC. Among patients with portal hypertension, wound healing is slower due to edema associated with undernutrition and the risk of surgical site infection is high [7]. Therefore, total laparoscopic surgery is preferable over an open approach. However, the required anastomosis between the coronary vein and vena cava with the left iliac vein graft through omental foramen is technically demanding, requiring hand-suturing under direct vision; leakage may cause fatal bleeding and, thus, secure suture placement is paramount. The enucleation of the HCC in liver segment 2 was scheduled to be performed laparoscopically prior to surgery. However, through the 7-cm laparotomy, via the right subcostal area, and using a moving window maneuver, a clear view of the tumor was obtained and the tumor was enucleated under direct vision.

Searches performed in PubMed and Google Scholar identified no prior report of either laparoscopic or hybrid laparoscopic Inokuchi shunt procedure. To the best of our knowledge, this is the first case of this procedure reported, providing a less invasive approach for the treatment of patients with a portosystemic shunt associated with portal hypertension and refractory to non-invasive treatment. Therefore, when the coronary vein is the main outflow of the portosystemic shunt, the hybrid laparoscopic Inokuchi shunt procedure could be considered. Moreover, for patients presenting with pancytopenia, splenectomy should be performed simultaneously. When the portal blood pressure is elevated to >32 mmHg while closing the shunt, a selective shunt procedure can cause liver congestion and impair liver function [6,8].

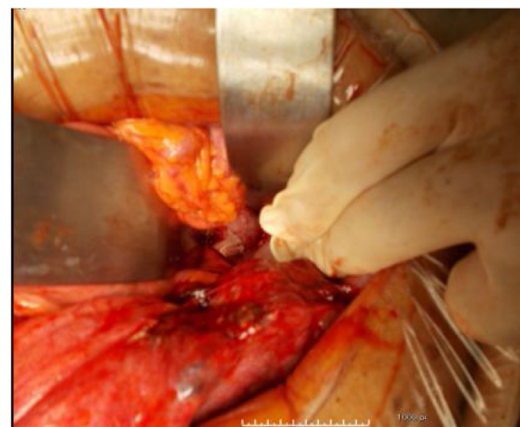


Fig. 4. Anastomosis of the external iliac vein graft with the vena cava in a side-to-end manner performed under direct vision.

4. Conclusion

The Inokuchi shunt procedure shuts down the portosystemic shunt to improve liver function, which leads to improvement of refractory pleural effusion and ascites associated with portal hypertension caused by liver cirrhosis. The hybrid laparoscopic approach is less invasive than the conventional open approach and provides better cosmesis. We must be aware that patients presenting with refractory pleural fluid and ascites associated with cirrhosis

may have a portosystemic shunt and, thus, imaging is indicated. In our case, the hybrid laparoscopic Inokuchi shunt procedure significantly improved liver function and pleural fluid and ascites. Evaluation of long-term outcomes of this approach and studies with a greater cohort size are warranted to determine if the outcomes are equal or better than those obtained with an open surgical approach.

Declaration of Competing Interest

Nothing to declare.

Funding

Not applicable.

Ethical approval

The ethics review board of Kashiwa Kousei General Hospital approved our procedure, which conforms to the provisions of the Declaration of Helsinki.

Consent

Written informed consent was obtained from the patient for publication of this case report and any accompanying images. A copy of written consent is available for review by Editor-in-Chief of this journal on request.

Author contribution

AO and YS conceived and designed the work. KK, MK, and TS contributed to the acquisition and interpretation of the data. AO and YS drafted the paper. KK, MK, and TS revised the manuscript. All authors approved the final version of the manuscript and agree to be accountable for all aspects of the paper.

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