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Hepatic artery injury during left hepatic trisectionectomy for colorectal liver metastasis treated by portal vein arterialization

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ABSTRACT

Portal vein arterialization (PVA) has been applied as a salvage procedure in hepatopancreatobiliary surgeries, including transplantation and liver resection, with revascularization for malignancies. Here we describe the use PVA as a salvage procedure following accidental injury of the hepatic artery to the remnant liver occurred during left hepatic trisectionectomy for colorectal liver metastases (CRLM). A 60-year-old man with cancer of the sigmoid colon and initially unresectable CRLM received 11 cycles of hepatic arterial infusion chemotherapy with 5-fluorouracil (1500 mg/week), after which CRLM was downstaged to resectable. One month after laparoscopic sigmoidectomy, a left trisectionectomy and wedge resection of segment 6 were performed. The posterior branch of the right hepatic artery, the only feeding artery to the remnant liver, was injured and totally dissected. Because microsurgical reconstruction of the artery was impossible, PVA was used; PVA is the sole known procedure available when hepatic artery reconstruction is impossible. The patient then suffered portal hypertension, and closure of arterio-portal anastomosis using an interventional technique with angiography was eventually performed on postoperative day 73. Therefore, it is considered that because PVA is associated with severe postoperative portal hypertension, closure of the arterio-portal shunt should be performed as soon as possible on diagnosing portal hypertension.

1. Introduction

Liver resection for colorectal liver metastases (CRLM) provides the only chance of long-term survival, with a 5-year survival rate of 38–58% in selected patients [1–3]. CRLM is initially unresectable in approximately 80–90% of patients [4], but recent improvements in surgical techniques and response rates to chemotherapy have expanded its resectability [5]. However, in such advanced cases, radical liver resection with revascularization of the liver is often required.

Portal vein arterialization (PVA) was originally established as an alternative strategy for preventing liver failure in patients with severe cirrhosis in conjunction with portacaval shunt placement [6]. It has been reported that PVA increases oxygen supply to the portal vein, prevents liver failure, and promotes liver regeneration [7–9]. PVA also has been applied as a salvage procedure in various types of hepatopancreatobiliary surgeries, including transplantation and liver resection, with revascularization for malignancies [10–13]. However, these studies have only included a small number of cases, and very few publications have reported the use of PVA in patients with CRLM who underwent hepatectomy.

Therefore, in this report we describe a case of an accidental injury of the hepatic artery to the remnant liver that occurred during left hepatic trisectionectomy for CRLM and was successfully treated using PVA as a salvage procedure.

2. Case report

A 60-year-old man, in whom multiple liver tumors had been detected by abdominal ultrasonography, was admitted to our hospital. Colonoscopy revealed cancer of the sigmoid colon, and computed tomography (CT) and magnetic resonance imaging (MRI) revealed more than 20CRLMs with the involvement of the root of the left and middle hepatic veins (Fig. 1A, B). We initially diagnosed the patient with unresectable CRLM, and hepatic arterial infusion (HAI) chemotherapy with 5-fluorouracil (1500 mg/week) was initiated. After 11 cycles of HAI, a partial response was achieved (Fig. 1C, D); therefore, we planned resection of the primary sigmoid colon cancer as the first step and hepatectomy as the second step.

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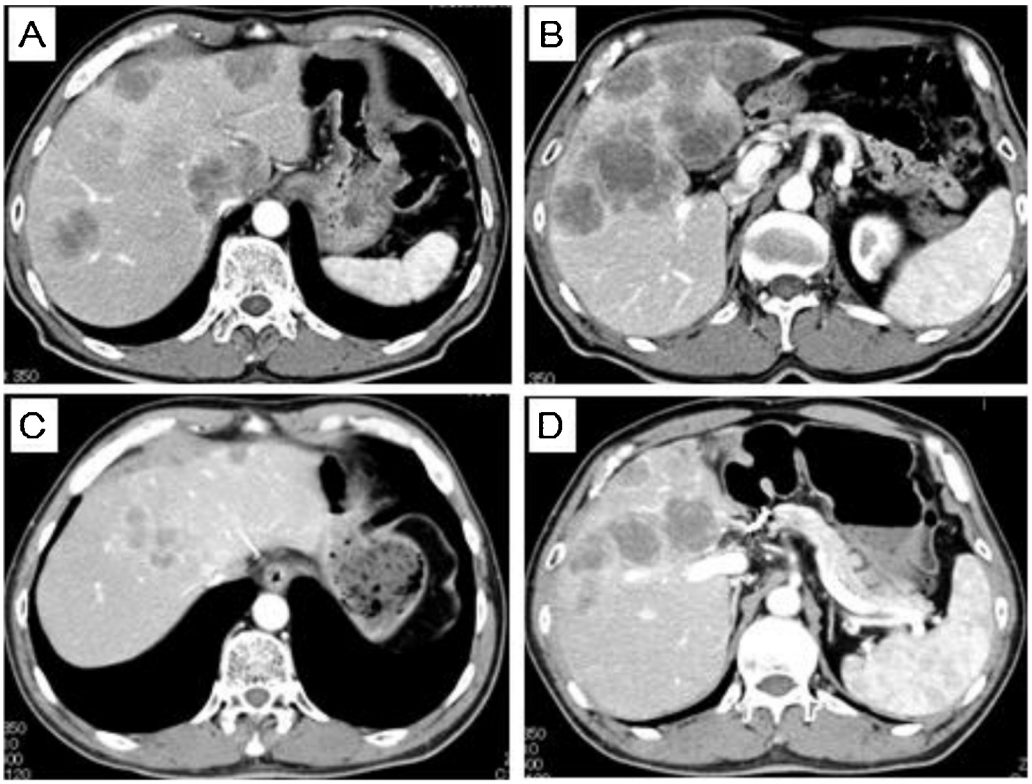

Fig. 1. (A, B) Representative images of abdominal computed tomography (CT) prior to treatment. More than 20 metastatic liver tumors were identified, with involvement of the root of the hepatic veins; (C, D) Representative images of abdominal CT after 11 cycles of hepatic arterial infusion chemotherapy. Tumors in the root of the hepatic veins were diminished, and tumors around the porta hepatis were smaller.

One month after laparoscopic sigmoidectomy, the left trisectionectomy and wedge resection of segment 6 were performed. Intraoperative findings revealed the metastatic liver tumors to be very close to the porta hepatis; furthermore, the separation of the anterior and posterior branches of the right hepatic artery was notably difficult. Finally, the posterior branch of the right hepatic artery, which was the only feeding artery to the remnant liver, was injured and totally dissected. The posterior branch of the portal vein and bile duct were also injured at the same time, and the injured wall of the portal vein was promptly repaired using a 5–0 monofilament nylon needle. A good blood flow in the portal vein to the remnant liver was subsequently confirmed. We then inserted a plastic stenting tube from the stump of the cystic duct to the distal side of the injured portion of the bile duct, and the injured wall of the bile duct was repaired using a 6–0 absorbable monofilament needle. After parenchymal transection, microsurgical reconstruction of the artery by end-to-end anastomosis was attempted. However, injury to the intima on the distal side of the artery was so severe that anastomosis was impossible. To avoid critical postoperative liver failure and subsequent patient death without reconstruction of the feeding artery to the remnant liver, we performed PVA by anastomosis of the right hepatic artery to the portal vein. The right hepatic artery was dissected again at the proximal side from the injured portion and then anastomosed to the frontal side of the portal vein using a 7–0 monofilament nylon needle (Fig. 2A, B). After anastomosis, ultrasonography confirmed an increase in the blood flow of the portal vein (Fig. 2C). The portal venous pressure, which was measured by the insertion of a catheter from the mesenteric vein to the portal vein, was 19 mmHg, which revealed portal hypertension that was not severe enough to require splenectomy. The operative time was 547 min and blood loss was 2141 ml.

Patient's serum aspartate aminotransferase level was elevated to 4500 IU/L on postoperative day (POD) 1, but decreased to less than 100 IU/L immediately thereafter. Portal venous thrombosis in the remnant liver occurred on POD 14 and disappeared gradually after anticoagulant therapy. Total bilirubin (T-bil) increased until POD 20 to a level of 20 mg/dL and then decreased gradually (Fig. 3B). CT on POD 30 revealed splenomegaly, and thrombocytopenia became increasingly severe each day. The platelet count decreased to less than $5 \times 10^4/\mu L$ after POD 60 (Fig. 3C).

We planned closure of the arterio-portal anastomosis using an interventional technique with angiography. However, before performing the closure, we confirmed collateral blood flow from the subphrenic artery to the remnant liver (Fig. 4A). Following this, the anastomosis was closed by coil embolization (Fig. 4B). The platelet count increased gradually and reached to more than $9 \times 10^4/\mu L$ by 3 weeks after the closure of the arterio-portal anastomosis.

Furthermore, the injured wall of the bile duct was repaired using a 6–0 absorbable monofilament needle, and the stenting tube was inserted. After the operation, a culture of the discharge from the stenting tube was checked weekly, and appropriate antibiotics were administered when cholangitis occurred. A cholangiography from the stenting tube revealed a diffuse biliary stricture. The stenting tube was removed on POD 94, after which cholangitis occurred frequently. The patient was eventually discharged on POD 159.

3. Discussion

Since the first report of PVA use in conjunction with portacaval shunting for patients with severe cirrhosis [6], this procedure has been applied as a salvage procedure in various types of hepatopancreatobiliary surgeries. However, although a few publications have reported the use of PVA in auxiliary liver transplantation [14–16],