CASE REPORT

Tangential gunshot injury of the right portal vein branch resulting in subacute main portal vein thrombosis: Successful treatment without hepatectomy

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ABSTRACT

This report describes the successful treatment (without hepatectomy) of a patient who underwent laparotomy and bullet removal for a gunshot injury to the liver at another institution. The patient was later referred for hemobilia and was found to have an unrecognized tangential injury to the right portal vein branch, resulting in portal vein thrombosis, diagnosed on the twelfth day after injury. The patient subsequently developed severe cholangitis. Hepatic arteriography did not identify the source of hemobilia. Following thrombectomy of the main portal vein and its left branch, along with portal vein repair, bilateral external biliary drainage from the common hepatic duct was performed. Hemobilia ceased after portal revascularization. A low-volume biliary fistula developed in the early postoperative period but resolved within 17 days with gradual removal of abdominal drains. The patient experienced no further complications during six months of follow-up. Standard biochemical blood tests remained within normal limits, except for slightly elevated alkaline phosphatase (167 U/L: 40-129) and gamma-glutamyl transpeptidase (100 U/L: 8-61) levels. Follow-up contrast-enhanced computed tomography scans on postoperative day 10 and at six months confirmed patency of the main portal vein and its left branch. Additionally, right lobe atrophy and left lobe hypertrophy were observed. In conclusion, applying principles from elective hepatopancreatobiliary surgery to trauma care, and avoiding major hepatectomy in the setting of severe cholangitis, played a crucial role in achieving a successful outcome.

Keywords: Hemobilia; isolated portal vein injury; penetrating portal vein injury; portal vein injury; portal vein ligation; portal vein thrombosis.

INTRODUCTION

Isolated traumatic injury of the portal vein is extremely rare.[1-7] In this paper, we report the successful treatment (without hepatectomy) of a patient who underwent laparotomy and bullet removal for a gunshot injury to the liver. The patient was later referred for hemobilia and was found to have an unrecognized tangential injury to the right portal vein branch, resulting in portal vein thrombosis on the 12th postoperative day.

CASE REPORT

A 27-year-old male patient underwent emergency laparotomy at another institution for a gunshot wound to the abdomen. The bullet entered the liver through the right posterior section and lodged in the subcapsular area of segment 2. It was removed and the liver capsule was repaired with sutures. No other significant findings were reported at that time. Beginning on postoperative day 3, the patient developed melena and fluctuating jaundice. Computed tomography (CT) re-

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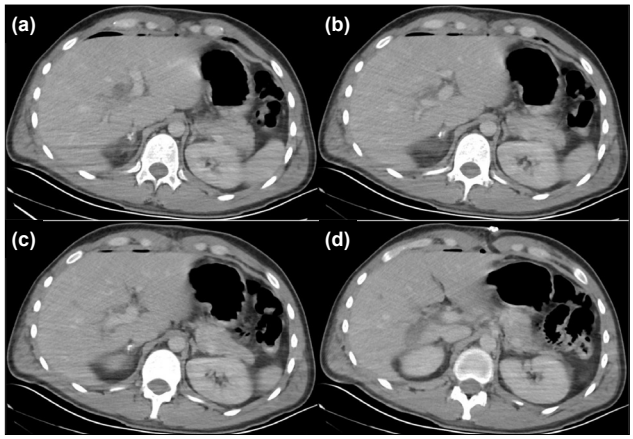

Figure 1. (a,b,c,d) Computed tomography (CT) performed on postoperative day 3 for evaluation of jaundice and melena. No obvious vascular injury was observed.

vealed no obvious vascular injury (Fig. 1a-d). He was referred to our institution on postoperative day 9. At admission, the patient was jaundiced but otherwise in moderate-to-good general condition, with stable vital signs. Laboratory results were as follows: erythrocytes: 2.4×10^{12}/L, hemoglobin: 7.4 g/dL, hematocrit: 20%, leukocytes: 13.1×10^{9}/L, platelets: 424×10^{9}/L, C-reactive protein: 19 mg/L (<10), procalcitonin: 0.5 ng/mL (<0.05), urea: 24 mg/dL, creatinine: 0.9 mg/dL, alanine aminotransferase: 140 U/L (0-35), aspartate aminotransferase: 225 U/L (10-35), gamma-glutamyl transpeptidase (GGT): 899 U/L (5-85), total bilirubin: 19.4 mg/dL (0.1-1.2), direct bilirubin: 13.1 mg/dL (0.0-0.3), albumin: 3.0 g/dL, amylase: 56 U/L (28-100), lipase: 66 U/L (13-60), and international normalized ratio (INR): 1.1.

Magnetic resonance imaging for evaluation of the biliary tree could not be performed due to a prior shrapnel injury. Given that the CT scan performed at the onset of hemobilia did not reveal any major vascular injury in the liver, hepatic arteriography was conducted to investigate the possibility of hemobilia from a small arterial branch. The hepatic arterial system appeared normal on angiography, with no evidence of pseudoaneurysm, extravasation, or fistula.

Because the biliary tree was prominent but not dilated, the hydropic gallbladder was drained percutaneously to relieve jaundice, resulting in the drainage of bile mixed with blood. The hemorrhagic component in the cholecystostomy drain fluid gradually decreased over two days, and the patient had no fever. Following drainage, total bilirubin levels dropped to 14.7 mg/dL but increased again to 20.6 mg/dL the next day. The persistence of hemobilia led to the decision to perform a triphasic CT scan, which revealed occlusion of the right branch of the portal vein and a partial thrombus extending into the main trunk and left branch (Fig. 2a-b). The patient experienced an episode of cholangitis, accompanied by hypotension that could not be managed with fluids alone and required moderate-dose catecholamine support. After initial stabilization, the patient was taken to the operating room.

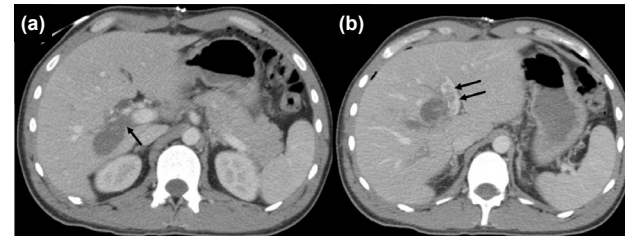

Figure 2. Computed tomography (CT) performed due to fluctuating jaundice following gallbladder drainage: **(a)** Occlusion of the right portal vein branch by thrombus (arrow). **(b)** Partial thrombus in the left branch (double arrows).

There was no free blood or bile in the abdominal cavity. The site where the bullet had been removed and the capsule repaired was observed in segment 2. The common hepatic duct was approximately 2 cm wide. It was opened between stay sutures, and thrombi obstructing the biliary tree were removed using a Fogarty catheter and lavage. Persistent venous oozing from the left hepatic duct was observed. Intraoperative cholangioscopy using a rigid ureteroscope did not reveal the exact site of bleeding. Doppler ultrasonography (USG) showed patent hepatic artery branches in both lobes. However, there was no portal vein flow in the right lobe, and a thrombus was present in the main portal vein and its left branch, allowing only partial flow. Cholecystectomy was performed. The main portal vein, along with its right and left branches, was exposed. The posterior walls of the right anterior and posterior branches of the portal vein were found to be damaged by the bullet, but there was no bleeding due to thrombosis.

The main portal vein was clamped, and the left branch was occluded with looped tapes. A venotomy incision extending from the right branch into the main portal vein was performed to evacuate all thrombi. The anterior walls of the right portal vein branches were used to close the stump with single 5/0 Prolene sutures. Doppler USG confirmed normal flow in the left portal vein branch. There was no visible difference between the right and left lobes in terms of external appearance. Hemobilia resolved following portal revascularization. Cholangioscopy was performed via both the right and left hepatic ducts using a ureteroscope, but no source or ongoing bleeding was identified. However, repeated Doppler USG revealed slow flow in the portal vein. When the main portal vein was milked with forceps, reflux from the liver was found to be weak. Upon opening the venotomy, a thrombus was observed extending from the right branch stump into the main portal vein. The thrombus was removed, and the stump wall was further shortened by circular excision and closed with single 5/0 Prolene sutures. A stable flow velocity of 10-20 cm/s was consistently observed in the left portal vein branch until the end of the operation. There was no back-bleeding from the distal part of the right portal vein branch. Two 8F catheters were inserted through the anterior wall of the hepatic duct into the right and left ducts, and the

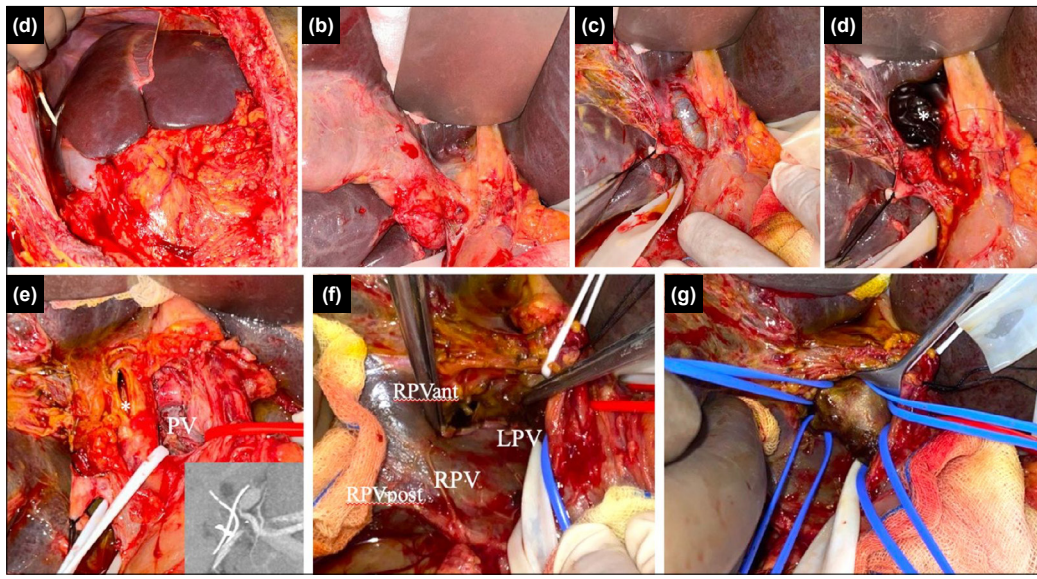

Figure 3. (a) The abdomen at laparotomy, with the percutaneous cholecystostomy catheter visible in the left upper corner. **(b)** The hepatoduodenal ligament after separation of adhesions. **(c)** The cystic duct stump under traction; the blood-filled extrahepatic bile duct (*) is visible. **(d)** Evacuation of blood and clots (*) from the bile duct. **(e)** The bile duct (white) and the hepatic artery (blue) are taped along with adjacent tissues. The incision used to evacuate the bile duct (*) and the anterior surface of the portal vein (PV) are visible. The inset shows the positions of the external biliary drainage catheters in relation to the vascular structures on computed tomography (CT) obtained in the early postoperative period. **(f)** Exposure of the right portal vein (RPV) branch and its anterior (RPV ant) and posterior (RPV post) divisions, as well as the left portal vein (LPV) branch. **(g)** Isolation of the main portal vein and its left, right anterior, and right posterior branches using vessel loops.

duct was closed using single 5/0 PDS (polydioxanone) sutures (Fig. 3).

The early postoperative course was complicated by a low-output biliary fistula, which healed within 17 days following gradual removal of the abdominal drains. The patient received 2x4000 IU of enoxaparin subcutaneously per day for one and a half months. Contrast-enhanced abdominal CT on postoperative day 10 showed the stump of the right portal vein, a patent main portal vein, and a normal left branch. The biliary catheters were clamped and subsequently removed at three months. The patient has remained asymptomatic during six months of follow-up. Standard biochemistry test results were within normal limits, except for mildly elevated alkaline phosphatase (ALP: 167 U/L; 40-129) and GGT: 100 U/L (8-61) levels. Contrast-enhanced abdominal CT at six months demonstrated hypoperfusion and heterogeneity in the right posterior section, with patent flow in the main portal vein and its left branch. Hypertrophy of the left lobe was also noted (Fig. 4a-c).

The patient provided written informed consent for all information regarding his treatment to be used in medical publications and educational activities, on the condition that his name not be disclosed.

Figure 4. CT performed six months postoperatively: **(a)** The main portal vein and the left branch are patent. The portal vein appears dilated compared to previous imaging (arrow). **(a,b,c)** Hypertrophy of the left lobe is observed (compare with Figure 1). **(c)** Hypoperfusion and heterogeneity are seen in the right posterior section (double arrows).

DISCUSSION

Portal vein injuries are associated with very high mortality, primarily due to exsanguination, as well as injuries to adjacent organs and major vessels.[1-4,6] Most patients likely succumb to blood loss before reaching the emergency department.[8] Isolated portal vein injuries are rare,[1] and treatment recommendations are at the level of expert opinion,[9] even in international guidelines.[10] Primary venorrhaphy is recommended when feasible.[6,10] Although there are reports of survival following main portal vein ligation,[3,7,11] this should be considered a last resort, and only in patients with an intact hepatic artery.[7,12] The patient in this report had subacute portal vein thrombosis, which was amenable to surgical thrombectomy.

Blunt abdominal trauma is an uncommon cause of portal vein thrombosis.[13-21] The diagnosis has been made as early as a few hours,[15] within one week,[16,18,20,21] and as late as one to six months[13,14] after abdominal trauma. Endothelial injury[19,21] and hemodynamic instability leading to venous stasis[17] have been implicated. Only one case of portal vein thrombosis resulting from an abdominal gunshot injury has been reported in the literature.[22] In that case, the diagnosis was made at least two years after the injury, and it is unclear whether the thrombosis was a direct result of the penetrating trauma or an indirect outcome precipitated by severe abdominal injury. Rare cases of vascular thrombosis caused by blast injury have also been reported.[23]

Another interesting aspect of this case was the unexplained hemobilia. This condition arises from an abnormal communication between the biliary tree and adjacent blood vessels within the portal triad.[24-31] Arterial hemobilia is more common than venous hemobilia,[31] and its usual source is a ruptured post-traumatic hepatic artery pseudoaneurysm.[30] However, in this patient, there was no evidence of pseudoaneurysm in the hepatic artery branches or extravasation into the bile tree on angiography. In contrast, hemobilia of venous origin is typically milder due to the lower pressure in the venous system[24-28,31] and is generally self-limiting.[26,28] In the present case, it is highly probable that the source of venous hemobilia could not be identified on CT. Notably, bleeding ceased after portal thrombectomy, which remains unexplained. A subsequent examination of the hepatic ducts using a ureteroscope revealed no signs of hemorrhage or an identifiable bleeding source.

The liver has a dual blood supply: approximately 75%-80% of the total volume comes from the portal vein, and the remaining 20%-25% from the hepatic artery.[32] Portal vein occlusion affecting a single lobe typically results in atrophy rather than necrosis.[33-35] Two-stage hepatectomy with portal vein ligation during the first procedure is considered a safe and effective strategy in oncologic cases involving a small future liver remnant.[36] Severe complications are rare.[37] This concept inspired the decision to avoid hepatectomy in a patient with severe cholangitis and hypotension requiring inotropic support.[38] It has been reported that patients with preoperative cholangitis have a significantly higher mortality rate following major hepatectomy compared to those without preoperative cholangitis.[39-41] Preoperative cholangitis is a risk factor for increased perioperative morbidity and mortality in patients undergoing hepatectomy.[41-44]

In conclusion, the combination of trauma surgery and hepatopancreatobiliary surgery principles led to the successful treatment of a patient with a tangential gunshot injury to the right portal vein branch, resulting in subacute main portal vein thrombosis. Avoiding hepatectomy in the setting of severe cholangitis and achieving successful portal revascularization of the left lobe were key factors in the favorable outcome.

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OLGU SUNUMU - *ÖZ*

Portal ven sağ dalının kurşun ile teğetsel yaralanmasına bağlı subakut ana portal ven trombozu: Hepatektomisiz başarılı tedavi

Bu yazıda, ateşli silahla vurulma nedeniyle götürüldüğü ilk hastanede laparotomi yapılan, izole karaciğer yaralanması saptanıp mermi çıkarılan, sonrasında gelişen hemobili nedeniyle sevk edilen ve on ikinci günde portal ven sağ dalında, daha önce bulgu vermemiş teğetsel yaralanma sonucu, ana portal ven trombozu gelişen, ağır kolanjiti başlayan hastanın, hepatektomi yapılmadan başarılı bir şekilde tedavisi bildirilmiştir. Hepatik arteriografide hemobili kaynağı saptanmamıştır. Ana portal ven ve sol dalından trombektomi ve portal ven onarımı yapılması sonrasında hepatik kanaldan bilateral biliyer drenaj uygulanmıştır. Hemobili, portal revaskülarizayondan sonra durmuştur. Ameliyat sonrası erken dönemde gelişen düşük hacimli safra fistülü, batın drenlerinin aşamalı çekilmesi ile 17 günde iyileşmiştir. Hastanın altı aylık takibinde herhangi başka bir sorunu olmamış, standart biyokimya kan testlerinin sonuçları, hafif artmış alkalen fosfataz (167 U/L: 40-129) ve gama-glutamil transpeptidaz (100 U/L: 8-61) seviyeleri dışında normal sınırlar içinde seyretmiştir. Ameliyat sonrası onuncu gün ve altıncı ayda yapılan takip amaçlı intravenöz kontrastlı bilgisayarlı tomografilerde ana portal venin ve sol dalının açık olduğu doğrulanmıştır. Ayrıca, sağ lobda atrofi, sol lobda hipertrofi gelişmiştir. Sonuç olarak bir travma hastasının tedavisinde yaklaşımın, elektif hepatopankreatobiliyer cerrahinin ilkelerinden ilham alınarak planlanması ve ağır kolanjiti olan hastada majör hepatektomiden kaçınılması, başarılı bir sonuç alınmasını sağlamıştır.

Anahtar sözcükler: Hemobili; izole portal ven yaralanması; penetran portal ven yaralanması; portal ven yaralanması; portal venin bağlanması; portal ven trombozu.

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