

## CASE REPORT

# Complication of portal vein thrombosis after right hemihepatectomy in a patient lacking the portal vein bifurcation

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**Abstract :** Absence of portal vein bifurcation is a rare anomaly. We report a patient with this anomaly who underwent right hemihepatectomy for treatment of hepatocellular carcinoma. Although the procedure was carefully performed with a preoperative three-dimensional simulation and intraoperative cholangiography, postoperative portal vein thrombosis occurred. *J. Med. Invest.* 63 : 315-318, August, 2016

**Keywords :** portal vein anomaly, hepatectomy, portal vein thrombosis

## INTRODUCTION

Absence of portal vein bifurcation (APVB) is a rare anomaly that was initially reported in 1957 by Couinaud (1). Marks *et al.* reported that this anomaly, in which no left or right primary extrahepatic branch exists, is present in 0.03%-2% of all cases (2). Failure to recognize this anomaly in patients receiving right hemihepatectomy could cause misligation of the main portal vein and portal vein thrombosis with multiple organ failure (3). Therefore, detailed preoperative simulation and planning of liver resection are necessary (4). This report presents a rare case of APVB with postoperative portal vein thrombosis following liver resection.

## CASE PRESENTATION

A 61-year-old man was referred to our department after a liver tumor was detected at a health check-up. The patient had a history of chronic hepatitis C and interferon therapy. Laboratory tests revealed the following : leukocytes, 5400/mm<sup>3</sup> ; hemoglobin, 15.0 g/dl ; platelets, 18.9×10<sup>4</sup>/mm<sup>3</sup> ; albumin, 4.0 g/dl ; total bilirubin, 0.7 mg/dl ; direct bilirubin, 0.1 mg/dl ; serum alanine transaminase, 57 IU/l ; and prothrombin time, 10.5 s. The patient was negative for hepatitis B surface antigen but positive for hepatitis C antibody, and hepatitis C viral RNA concentration was 4.0 log<sub>10</sub> IU/mL. The indocyanine green dye retention rate after 15 min was 9.1% (control range < 10%). Levels of serum tumor markers were as follows :  $\alpha$ -fetoprotein, 3 ng/mL ; a proportion of  $\alpha$ -fetoprotein L3 isoform, < 0.5% ; and des- $\gamma$ -carboxy prothrombin, 1288 mAU/ml.

Dynamic multi-detector computed tomography (MDCT) showed a contrast effect inside the tumor, which measured 10 cm in diameter, in the arterial phase (Fig. 1A). In the portal and delayed phases, the contrast agent was not retained. In addition, APVB was detected by MDCT (Fig. 1B).

The patient underwent right hemihepatectomy as a curative

treatment for hepatocellular carcinoma. In the hepatic hilum, the left portal vein was not visible (Fig. 1C). Intraoperative ultrasonography was performed and hepatic transection was started along the Cantlie line. Once the left portal vein was revealed in the transection plane, the anterior and posterior Glissonean pedicles were exposed (Fig. 1D). The optimal incision line was determined by preoperative simulation with the SYNAPSE VINCENT volume analyzer (Fujifilm, Japan) (Fig. 2A). Intraoperative cholangiography was performed to confirm the resection line of the Glissonean pedicles (Fig. 2B) before stapler-assisted resection (Fig. 2C and D). After the operation, ultrasonography showed normal intrahepatic portal vein flow and no stenosis of the portal system.

Until postoperative day 2, the patient's course was uneventful. However, on postoperative day 3, ultrasonography revealed portal vein thrombosis with an increased volume of ascitic fluid in the drainage tube. A portal thrombus was observed from the superior mesenteric vein through the left portal vein by CT (Fig. 3A). Administration of low-molecular-weight heparin and anti-thrombin III formulation was initiated to dissolve the thrombus. The thrombus did not increase in size, although CT showed the formation of new collateral vessels on postoperative day 8 (Fig. 3B). Ascites decreased gradually without any other complication, and the patient was discharged from hospital on postoperative day 28.

## DISCUSSION

A normal branching pattern of the main portal vein into the right and left portal veins is reported in ~80% of the population. The most common anomaly is trifurcation of the main portal vein, which is observed in ~10% of the population (5). In a previous report, APVB was defined as follows (6). The extra-parenchymal left portal vein was missing and the right portal vein entered the right hilum normally. After that, the right portal vein formed right posterior and anterior branches and turned left towards the umbilical fissure. This anomaly must be detected in patients who have undergone hepatectomy. Unless this anomaly is detected preoperatively, there is a risk of portal vein thrombosis resulting from wrongly identifying the portal vein branch and clamping the main portal vein. APVB in liver resection and postoperative fatal portal vein thrombosis were reported by Koh *et al.* in 1994 (3). After that report, cases

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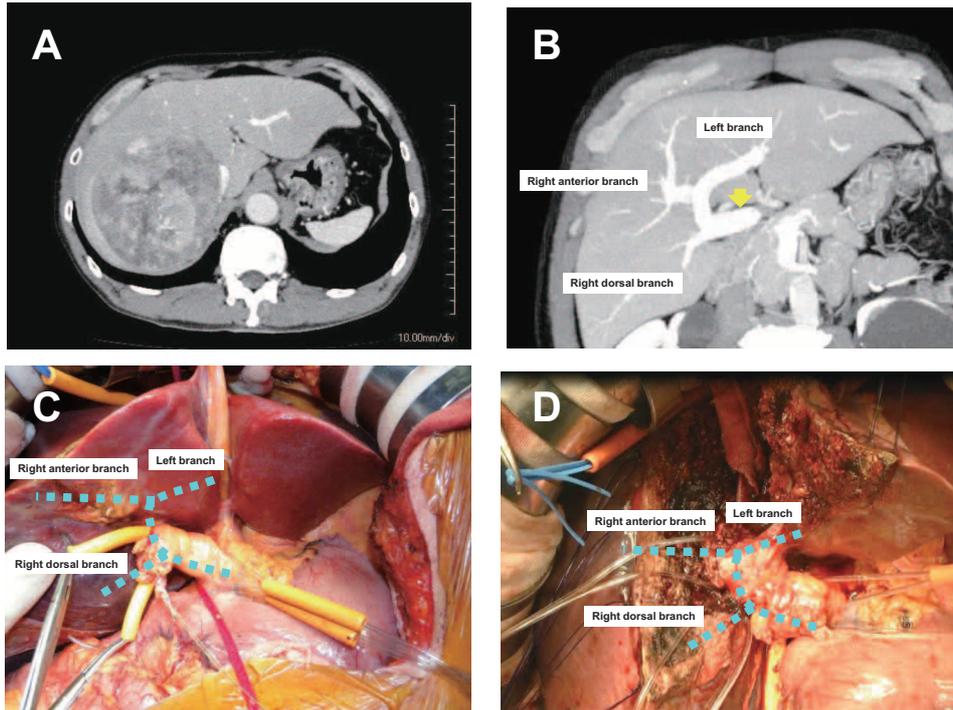


Fig 1. (A) Preoperative computed tomography imaging of the 10-cm tumor in the right hepatic lobe. (B) Maximum intensity projection imaging of the absence of portal vein bifurcation (yellow arrow) with an aberrant left branch originating from the right anterior branch. Intraoperative picture (C) prior to hepatic resection and (D) during hepatic resection showing the structure of the portal system (blue dotted lines).

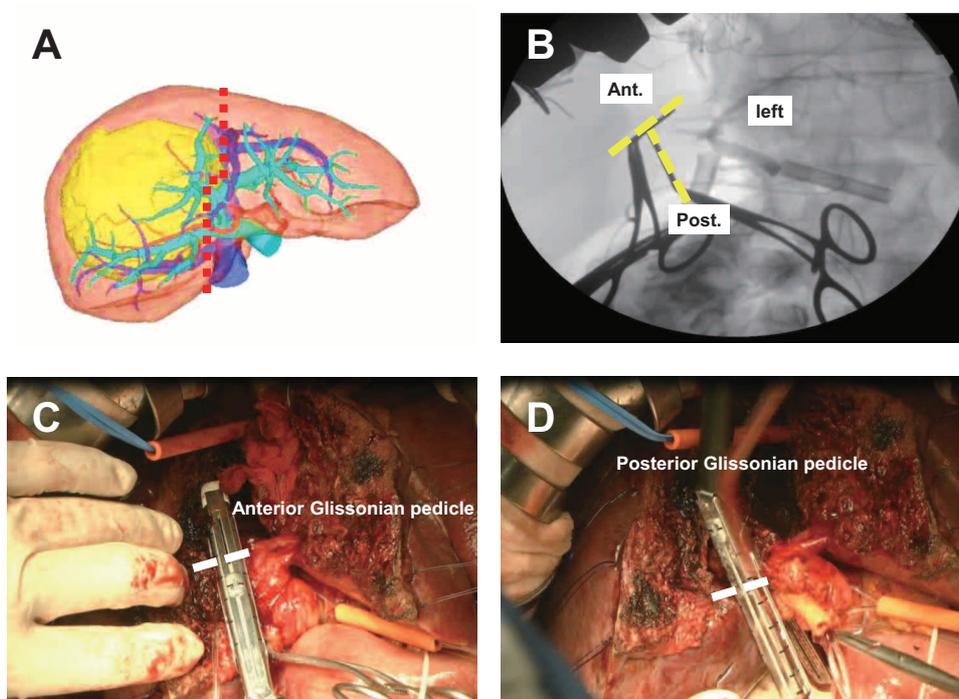


Fig 2. (A) Three-dimensional simulated imaging of the liver, tumor (yellow), hepatic artery (red), portal vein (pink), hepatic vein (blue) and inferior vena cava (blue) using SYNAPSE VINCENT volume analyzer. Red dotted line shows the simulated line of parenchymal liver transection for right hepatectomy. (B) Intraoperative cholangiography after clamping the anterior (Ant.) and posterior (Post.) Glissonian pedicle. The resection lines (yellow dotted lines) were distant enough from the main tract, and the left branch was well contrasted. Intraoperative pictures before stapler-assisted resection of (C) anterior and (D) posterior Glissonian pedicles (white dotted lines).

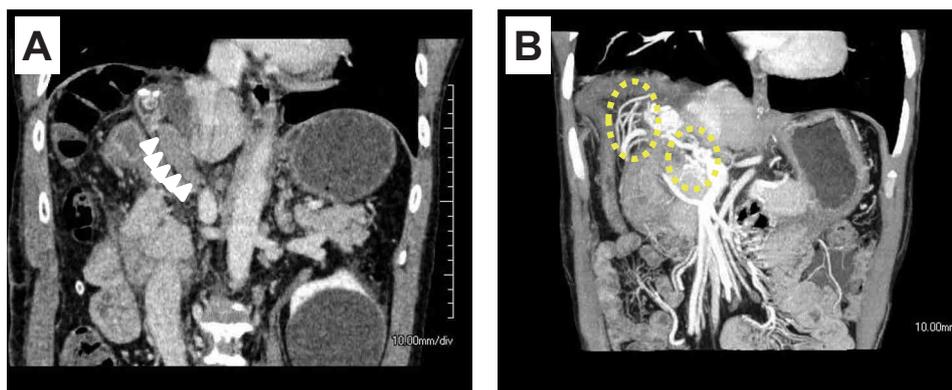


Fig 3. (A) CT on postoperative day 3. Thrombus of the portal vein was detected (arrowheads). (B) CT on postoperative day 8. Collateral vessels (yellow dotted circles) formed around the hepatoduodenal ligament. CT computed tomography.

of APVB with safe hepatic resection for cancer treatment or safe hepatic splitting for liver donation were reported (7, 8). Spampinato *et al.* described major right hemihepatectomy in a patient with APVB (4). They concluded that preoperative knowledge of the vascular structure from MDCT with three-dimensional reconstruction was beneficial for the surgeon to perform safe hepatectomy.

In our case, APVB was recognized preoperatively; however, portal vein thrombosis occurred. We performed intraoperative cholangiography and confirmed the presence of APVB by intraoperative ultrasonography. However, the incision line for the right anterior and posterior branches of the portal vein, using the stapler, may have been too close to the main portal vein, resulting in its lateral wall being cut.

The Glissonean pedicle approach is a simple method of dissection (9, 10). In cases of vascular anomaly, the ligation of the pedicle should be performed near the liver parenchyma to avoid injuring the elements that enter another section (9). Although we performed the liver resection with care, the stapling line might be too close to the right portal vein. Particularly in cases of APVB, the surgeon should be aware of this danger; careful Glissonean pedicle transection is required, or an intrafascial approach may be useful, which opens Glisson's capsule and treats the vessels individually.

Portal vein thrombosis is a serious postoperative complication of liver resection. Yoshiya *et al.* reported that the incidence of portal vein thrombosis after hepatectomy was 9.1%, and right hemihepatectomy was a significant independent risk factor for main portal vein thrombosis (11). In the present case, the patient underwent right hemihepatectomy. Virchow's triad of hypercoagulability, hemodynamic changes and endothelial injury are significant risk factors for portal vein thrombosis, and it is reported that these factors usually coexist (12). A stapling line close to the right portal vein and the Pringle maneuver can affect the portal vein flow.

The presence of ascites indicates insufficient portal flow caused by portal vein thrombosis (13). When portal vein thrombosis is found, anticoagulation therapy or mechanical thrombectomy is required for early recanalization of the portal vein (13). In the present case, the portal vein thrombus was detected early by ultrasonography, and anticoagulation therapy with low-molecular-weight heparin and anti-thrombin III was given. The thrombus remained; however, sufficient collateral vessels were formed early to maintain the intrahepatic portal vein flow.

APVB is a rare anomaly. Careful preoperative simulation and planning is necessary. In the present case, portal vein thrombosis occurred, although APVB was recognized preoperatively. Hence, meticulous care with Glissonean pedicle transection is required

in patients with this anomaly.

#### INFORMED CONSENT

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

#### CONFLICT OF INTEREST

The authors declare that they have no conflict of interest.

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#### REFERENCES

1. C C. Le foie : Etudes anatomiques et chirurgicales. Masson, Paris, 1957
2. Marks C : Developmental basis of the portal venous system. *Am J Surg* 117 : 671-81, 1969
3. Koh MK, Ahmad H, Watanapa P, Jalleh RP, Habib NA : Beware the anomalous portal vein. *HPB Surg* 7 : 237-9, 1994
4. Spampinato MG, Baldazzi G, Polacco M, Vigo M, del Medico P, Gringeri E, Cillo U : Right hemihepatectomy in presence of congenital absence of portal vein bifurcation : a challenging but feasible procedure. *J Am Coll Surg* 215 : e1-4, 2012
5. Couinaud C : Surgical anatomy of the liver revisited. Couinaud, Paris, 1989
6. Chaib E : Absence of bifurcation of the portal vein. *Surg Radiol Anat* 31 : 389-92, 2009
7. Yamamoto H, Nagino M, Kawabata Y, Maki A, Takenouchi Y, Iwahashi N, Hayakawa N, Nimura Y : Resection of a hilar cholangiocarcinoma in a patient with absent portal bifurcation. *Hepatogastroenterology* 47 : 362-4, 2000
8. Mitchell A, Mirza D, de Ville de Goyet J, Buckels J : Absence of the left portal vein : a difficulty for reduction of liver grafts? *Transplantation* 69 : 1731-2, 2000
9. Yamamoto M, Katagiri S, Ariizumi S, Kotera Y, Takahashi Y :

- Glissonean pedicle transection method for liver surgery (with video). *J Hepatobiliary Pancreatic sci* 19 : 3-8, 2012
10. Yamamoto M, Katagiri S, Ariizumi S, Kotera Y, Takahashi Y, Egawa H : Tips for anatomical hepatectomy for hepatocellular carcinoma by the Glissonean pedicle approach (with videos). *J Hepatobiliary Pancreatic sci* 21 : 53-6, 2014
  11. Yoshiya S, Shirabe K, Nakagawara H, Soejima Y, Yoshizumi T, Ikegami T, Yamashita Y, Harimoto N, Nishie A, Yamanaka T, Maehara Y : Portal vein thrombosis after hepatectomy. *World J Surg* 38 : 1491-7, 2014
  12. Janssen HL, Wijnhoud A, Haagsma EB, van Uum SH, van Nieuwkerk CM, Adang RP, Chamuleau RA, van Hattum J, Vleggaar FP, Hansen BE, Rosendaal FR, van Hoek B : Extrahepatic portal vein thrombosis : aetiology and determinants of survival. *Gut* 49 : 720-4, 2001
  13. Thomas RM, Ahmad SA : Management of acute post-operative portal venous thrombosis. *J Gastrointest Surg* 14 : 570-7, 2010