



Case report

Recurrent acute portal vein thrombosis with severe abdominal infection after right hemihepatectomy in a patient with perihilar cholangiocarcinoma: A case report and literature review

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ARTICLE INFO

Keywords:

Acute portal vein thrombosis
Right hemihepatectomy
Perihilar cholangiocarcinoma
Case report

ABSTRACT

Introduction and importance: Portal vein thrombosis (PVT) is a serious complication after hepatobiliary-pancreatic surgery. There have been few studies on recurrent PVT after hepatectomy for perihilar cholangiocarcinoma.

Case presentation: We report the case of a 66-year-old woman who was diagnosed with perihilar cholangiocarcinoma and treated with right hemihepatectomy. On the sixth day, the patient developed acute portal vein thrombosis, and emergency portal vein incision and surgical thrombectomy were performed. On the seventh day after thrombectomy, the patient developed acute portal vein thrombosis again, and portal vein thrombectomy+portal vein bridging was performed again. There was still thrombosis after the operation. The patient was then treated with superior mesenteric arteriography + indirect portal vein catheterization thrombolysis and local thrombolysis + anticoagulation and systemic anticoagulation therapy. The patient had a complicated abdominal infection. The total hospital stay was 84 days. There was no thrombosis in the portal vein at discharge.

Clinical discussion: Although the procedure was carefully performed with a preoperative plan and fine intra-operative vascular anastomosis, postoperative PVT occurred. There are many factors of portal vein thrombosis, and there are many treatment methods.

Conclusion: PVT often develops in patients with liver cirrhosis postoperatively and after liver transplantation. Recurrent PVT after hepatectomy for perihilar cholangiocarcinoma is a rare complication.

1. Introduction

Portal vein thrombosis (PVT) is defined as any thrombosis that develops in the portal vein system [1]. It is usually recognized in patients with cavernous transformation of the portal vein with portal hypertension [2]. Postoperative PVT is considered a very rare and extremely lethal complication of hepatopancreatobiliary surgery [3,4]. Most reported cases have occurred in patients undergoing liver transplantation, splenectomy, or pancreaticoduodenectomy. Risk factors include liver cirrhosis, chronic hepatitis, splenectomy, the Pringle manoeuvre, and portal hypertension [5–7]. There have been many studies on PVT after partial hepatectomy for liver cancer, but there have been few studies on PVT after hepatectomy for perihilar cholangiocarcinoma. Herein, we report a case of acute posthepatectomy PVT (PH-PVT) in a patient with perihilar cholangiocarcinoma but without previously established risk

factors. Compared with the published literature, our case is unique because no similar reports can be found. This work has been reported in line with the SCARE criteria [8] and SCARE 2020 criteria [9].

2. Case presentation

A 66-year-old (BMI = 32.42) woman with obstructive jaundice had a history of hypertension, was nonsmoking, used no anticoagulant medications and had no allergies. Enhanced computed tomography (CT) showed bile duct enhancement in the arterial phase (Fig. 1A) and fatty liver, with no obvious cirrhosis and a normal portal vein (Fig. 1B). The patient was diagnosed with perihilar cholangiocarcinoma, Bismuth–Corlette type IIIa. T2aN0M0, stage II (UICC). Laboratory tests revealed the following: leukocytes, $5.9 \times 10^9/L$ (reference value: $3.5\text{--}9.5 \times 10^9/L$); platelets, $135 \times 10^9/L$ ($125\text{--}350 \times 10^9/L$);

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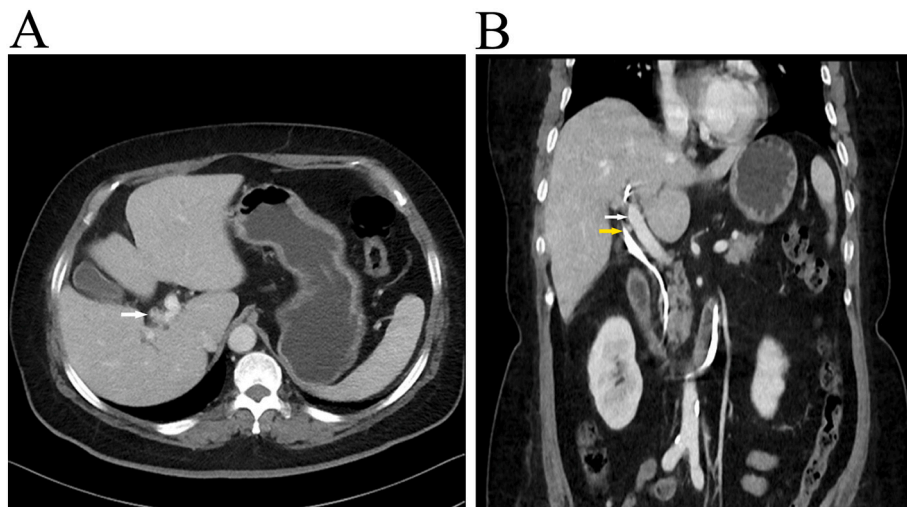


Fig. 1. Imaging examination. (A) CT showing lesions. (B) CT showing the portal vein. CT: computed tomography.

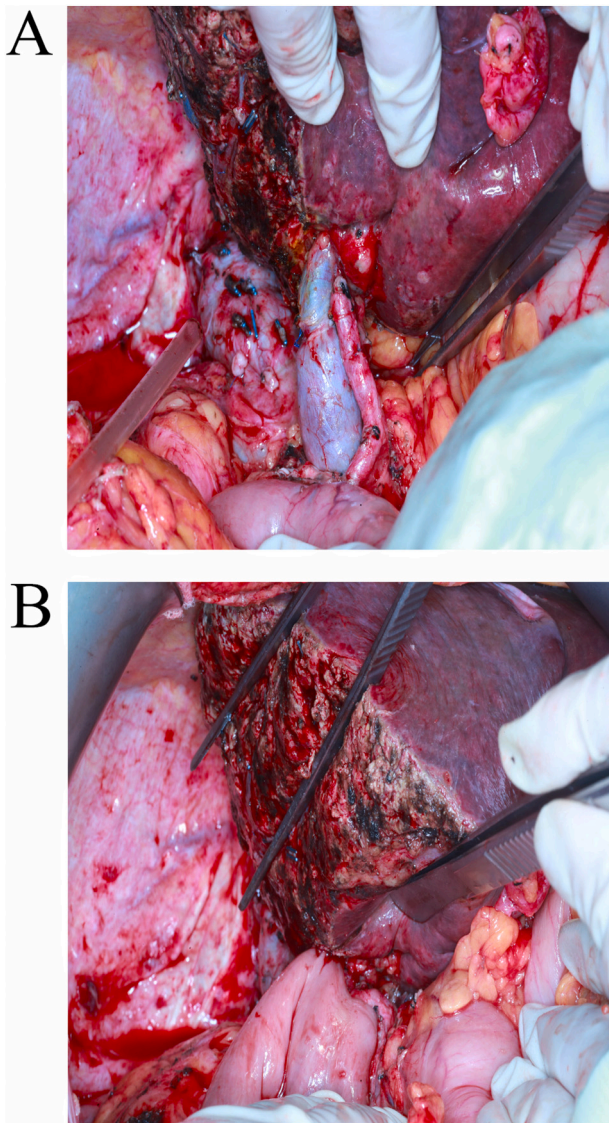


Fig. 2. Typical intraoperative pictures. The patient underwent right hemihepatectomy+portal vein resection and reconstruction (because the portal vein was long and angled)(Fig. 2A) + biliary intestinal anastomosis(Fig. 2B).

haemoglobin, 125 g/L (115–150 g/L); albumin, 35.6 g/L (38–51 g/L); total bilirubin, 187.7 $\mu\text{mol/L}$ (6–21 $\mu\text{mol/L}$); direct bilirubin, 98.9 $\mu\text{mol/L}$ (0–6 $\mu\text{mol/L}$); serum alanine aminotransferase, 376.4 IU/L (0–42 IU/L); aspartate aminotransferase: 231.1 IU/L (0–42 IU/L); prothrombin time, 12.30 s (9.8–13.7 s); α -fetoprotein, 4.19 $\mu\text{g/L}$ (0–20 $\mu\text{g/L}$); procalcitonin (PCT), 0.41 ng/mL (0–0.05 ng/mL);

The patient underwent endoscopic retrograde cholangiopancreatography (ERCP) + endoscopic sphincterotomy (EST) + SpyGlass examination+biliary double plastic stent placement to reduce jaundice. On the night after the operation, the patient's temperature reached 39.6 °C, and the PCT level was 12.3 ng/mL. The PCT level reached 25.69 ng/mL on the third day and 4.59 ng/mL on the fifth day after the operation. The blood amylase level was normal. The results of the β -D-glucan test, galactomannan and tuberculosis tests and blood cultures were negative. Imipenem and CILASTatin sodium, linezolid, caspofungin acetate, piperacillin sodium and tazobactam sodium were given successively empirically.

Author 1 (assistant) and author 6 (surgeon) performed the surgery. The patient underwent right hemihepatectomy+portal vein resection and reconstruction (because the portal vein was long and angled) (Fig. 2A) + biliary intestinal anastomosis(Fig. 2B). Segment 4 was not resected. The operation lasted 392 min, and the blood loss was 510 mL. Hepatic portal occlusion occurred 3 times. The first time was for 15 min, and the second and third times were for 10 min. The patient had poor postoperative coagulation function and a long portal vein and angle, which were relieved after the operation, so anticoagulants were not used after the operation. On the sixth day after the operation, the patient had dyspnoea, and the peritoneal drainage turned red. CT examination showed that the PVT was located in the superior mesocentric vein, main portal vein, and left branch of the portal vein (Fig. 3A), and emergency portal vein incision and surgical thrombectomy were performed. Anticoagulant therapy was administered after the operation. PVT was found on the seventh day after thrombectomy (Fig. 3B). Portal vein thrombectomy+portal vein bridging (artificial vessel, S0804, W.L. Gore & Associates, Inc. Arizona, USA) was performed again. That is, the original suture of the portal vein was disconnected, the thrombus was removed, cut approximately 2 cm from the near and far ends of the portal vein was cut, and then the near- and far-end portal vein was anastomosed with artificial blood vessels. Under treatment with heparin 6 U/kg/h, on the second day after the second thrombectomy, CT showed PVT still existed (Fig. 3C). The patient was then treated with superior mesenteric arteriography + indirect portal vein catheterization thrombolysis and local thrombolysis + anticoagulation and systemic anticoagulation therapy.

The patient was infected with the bacteria *Klebsiella pneumoniae*, *Pseudomonas*, *S. aeruginosa* *Enterococcus faecium*, *Candida magnoliae*,

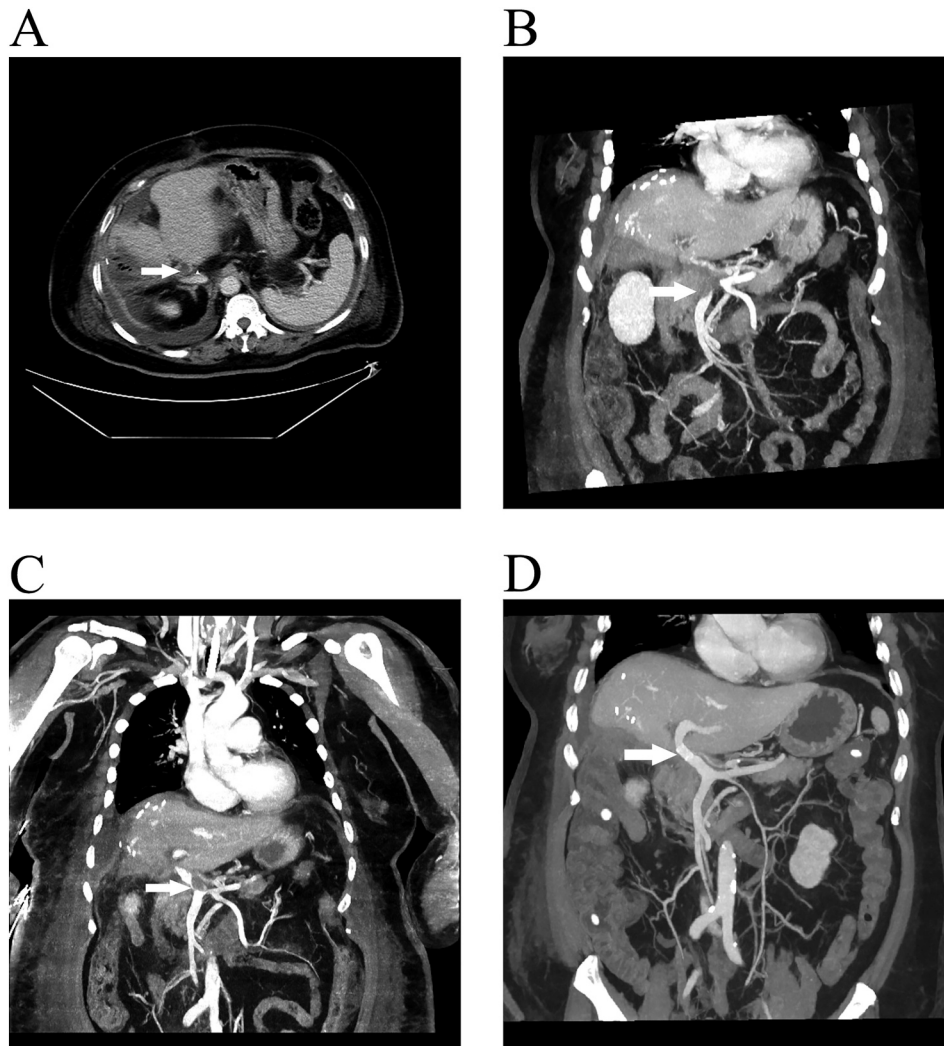


Fig. 3. Imaging examination showing thrombosis. (A) CT on postoperative day 6 showing a thrombus in the portal vein (arrowheads). (B) CT on day 7 after the first thrombectomy showing a second thrombus in the portal vein (arrowheads). (C) CT on day 2 after the second thrombectomy showing a third thrombus in the portal vein (arrowheads). (D) CT showing the portal vein upon re-examination at discharge.

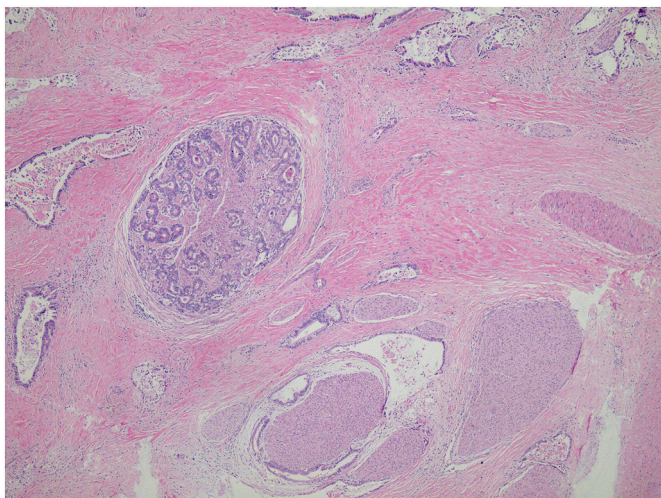


Fig. 4. Typical images of histopathological findings of samples obtained after right hemihepatectomy.

Candida glabrata, and *Candida albicans*. The following treatments were administered as per culture results: tigecycline, amikacin, fosfomycin, ceftazidime avibactam sodium 4:1, and teicoplanin. The patient had gastrointestinal bleeding during the course of the disease. The total hospital stay was 84 days. There was no thrombosis in the portal vein at discharge (Fig. 3D). Postoperative pathology confirmed cholangiocarcinoma (Fig. 4).

3. Discussion

PVT is a rare and serious postoperative complication of liver resection. PVT is classified into three categories according to the location of the thrombus—main, hilar, and peripheral—with the main PVT further subclassified into three grades [10]. PVT frequently occurs following major hepatectomy, such as right hemihepatectomy [11]. Right-sided hepatectomy [12,13], right hemihepatectomy [14], patient age and left lateral sectionectomy [15] are independent risk factors for PVT following hepatectomy. The incidence of PH-PVT in patients being treated for liver cancer reported by Chinese scholars is 0.4% (5/1269) [16]. Yoshiya et al. reported that the incidence of PH-PVT was 9.1% [14]. Recurrent PVT has not been reported in the literature.

A high incidence of PVT has been found in hepatocellular carcinoma patients after hepatectomy. The frequency of the Pringle manoeuvre,

Table 1
Published English-language literature of patients with acute portal vein thrombosis following hepatectomy.

No.	Reference	No. of patients	Age	Usage of prophylactic anti-coag	Operational procedure		Associated liver disease			Time of PVT discovery (d)		Location of PVT				Treatment			Mortality	Risk factors
					Major hepatectomy	Minor hepatectomy	Cirrhosis	Malignancy	Hepatitis	Early	Late	MPV	PPV	MPV + PPV	Stump (hilar)	Surg	Lytic	Anti-coag		
1	Yoshiya [12] et	19/208	66.7 ± 0.8	No	7	12	0	19	0	7		7	12	0	0	0	0	13	0	Right hepatectomy
2	Kuboki [10] et	25/1193	64.0 ± 1.5 (PVT)63.9 ± 0.4 (No PVT)	No	18/446	7/747	4/25	24/25	0/25	n = 12	n = 13	5	3	17	0	9/11	0	12/14	2/25	Right-sided hepatectomy, caudate lobectomy, splenectomy, and postoperative bile leakage
3	Cao [18] et	6/177	68 (32–86)	No	6	0	0	6	0	6.5 (range, POD 0–22)		2	1	3	0	4	0	2	0	Narrowing of the remnant portal vein diameter and decreased portal vein angle
4	Uchida [19] et	9/81	72 (37–87)	No	9	0	0	9	0	7 (range, POD 3–14)		5	1	0	0	1	0	6	0	Postoperative portal vein angle less than 90°, remnant liver portal vein diameter, and diameter ratio less than 45%
5	Takata [15] et	13/65	73 (38–93)	No	3	10	0	13	0	7		5	3		5	0	0	8	0	Frequency of the Pringle manoeuvre
6	Onda [8] et	57/398	63.6 (18–90)	No	20	37	–	52	–	6 (range, POD 1–11)		14	13	0	30	2	0	34	0	Pringle manoeuvre time of 75 min or longer
7	Moriet [13] et	21/622	75.3 ± 6.3 (PVT)68.7 ± 9.9 (No PVT)	No	7	14	0	21	0	7 (range, POD 2–30)		7	0	0	14	1	0	15	1/21	Patient age, left lateral sectionectomy

Anti-coag = anti-coagulation therapy, lytic = thrombolytic therapy, MPV = main portal vein, PPV = peripheral portal vein, Surg = surgical. thrombectomy.

especially when the Pringle manoeuvre time is long [10], is a potential risk factor for postoperative PVT, and the postoperative/preoperative thrombin-antithrombin III (TAT) and D-dimer ratios may be used as early predictors of PVT after hepatectomy for hepatocellular carcinoma [17].

Virchow's triad of hypercoagulability, haemodynamic changes and endothelial injury are significant risk factors for PVT, and it has been reported that these factors usually coexist [18]. In addition, abnormal factor VIII and D-dimer levels are high-risk factors for PVT in patients with liver cirrhosis [19]. Low levels of postoperative plasma anti-thrombin III are associated with PVT after liver surgery. AT-III levels $\leq 60\%$ on POD3 should be carefully followed up regarding postoperative PVT [13]. The patient's AT-III level remained low. There is also literature indicating that narrowing of the remnant portal vein diameter and a decreased portal vein angle after major hepatectomy for perihilar cholangiocarcinoma are significant independent risk factors for postoperative PVT [20]. A postoperative portal vein angle of less than 90° (the angle of the PV was defined as follows: in right-sided hepatectomy and left-sided hemihepatectomy, the angle formed between the main PV and the first branch of the PV) and a diameter ratio of less than 45% (the diameter ratio was defined as the ratio of the remnant liver PV to the main PV diameter.) have been shown to eventually lead to PVT after hepatectomy for perihilar cholangiocarcinoma (PHCC) [21].

The presence of ascites indicates insufficient portal flow caused by PVT [1]. PVT can cause obstructive jaundice [22,23] and liver failure [24], both of which have a poor prognosis and high mortality rate. Laparoscopic left lateral sectionectomy and major right hepatectomy might increase the risk of PH-PVT. Major right hepatectomy tends to lead to severe PH-PVT. Careful handling of the portal vein during hepatectomy and early treatment of PH-PVT are necessary [15].

When PVT is found, anticoagulation therapy or mechanical thrombectomy is required for early recanalization of the portal vein [1]. Anticoagulation and thrombolytic therapies are the traditional treatment options for PVT after hepatectomy [25]. Some literature reports have reported the use of anticoagulation therapy with low-molecular-weight heparin and antithrombin III, even though the thrombus remained; however, sufficient collateral vessels were formed early to maintain intrahepatic portal vein flow [11]. Urgent operative thrombectomy is strongly recommended for PVT detected early [12]. However, the role of anticoagulation therapy in chronic PVT requires further study [26]. In the present case, the patient underwent right hemihepatectomy, PVT was detected early by ultrasonography and CT, and urgent operative thrombectomy was performed. We reviewed the published English-language literature describing patients with acute PVT after hepatectomy to investigate the cause and treatment of this complication, and the results are shown in Table 1.

Unless the absence of portal vein bifurcation (APVB) is detected preoperatively, there is a risk of PVT resulting from incorrectly identifying the portal vein branch and clamping the main portal vein. In the present case, APVB, a rare anomaly, was not detected. We have not found an adequate explanation for the acute PVT after hepatectomy in the present case. It seems that this case can be partially explained by the portal vein angle of less than 90° and diameter ratio of less than 45%.

The patient was treated with anticoagulation therapy, surgery with transcatheter superior mesenteric artery catheterization and drug thrombolysis. Percutaneous interventional therapy is relatively simple and inexpensive, but it is contraindicated for patients with massive ascites and coagulation dysfunction [27]. Transjugular interventional therapy, local thrombolysis and balloon dilatation through a transjugular intrahepatic portosystemic shunt (TIPS) is a relatively complex and expensive strategy, but the success rate is high [28]. The reason why this patient did not undergo treatment with these two operations was extensive ascites and coagulation dysfunction.

In conclusion, PVT is a rare but fatal vascular complication after extensive hepatectomy for liver tumours. Patients with high-risk factors should be closely observed and actively administered preventative

treatment. Early detection and early treatment are key. The exact pathogenesis and effective methods for the prevention and treatment of PVT require further consideration and investigation.

4. Conclusion

4.1. Statement

This work has been reported in line with the SCARE criteria [8].

This work has been reported in line with the SCARE 2020 criteria [9].

Provenance and peer review

Not commissioned, externally peer-reviewed.

Sources of funding

No source of funding.

Ethical approval

Not applicable.

Consent

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

Research registration

(for case reports detailing a new surgical technique or new equipment/technology): Not applicable.

Guarantor

Dr. Qingsong Deng.
Dr. Leida Zhang.

CRedit authorship contribution statement

Dr. Qingsong Deng: The conception and design of the study, analysis and interpretation of data, drafting the article, final approval of the version to be submitted.

Ms. Minglian He: Acquisition of data, analysis and interpretation of data, drafting the article, final approval of the version to be submitted.

Ms. Yuehua Yang: Acquisition of data, analysis and interpretation of data, final approval of the version to be submitted.

Ms. Yanjiao Ou: Analysis and interpretation of data, final approval of the version to be submitted.

Ms. Yong Cao: The conception and design of the study, analysis and interpretation of data, critical revision of the manuscript for important intellectual content, final approval of the version to be submitted.

Dr. Leida Zhang: The conception and design of the study, analysis and interpretation of data, critical revision for important intellectual content, final approval of the version to be submitted.

Declaration of competing interest

None.

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