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# Preduodenal superior mesenteric vein and Whipple procedure with vascular reconstruction—A case report

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ABSTRACT

*INTRODUCTION:* Portal vein (PV) disorders are various, but rare. Here, we report a preduodenal superior mesenteric vein (PDSMV) in a patient who underwent a pancreaticoduodenectomy.
*PRESENTATION OF CASE:* A 67-year old woman with familial adenomatosis polyposis was suspicious for cancer of the papilla of vater and scheduled for surgery. Pre-operative diagnostic revealed a PDSMV continuing into the left PV. The splenic vein (SV) continued directly into the right PV without forming ananatomic PV confluence. Eight centimetre of the PDSMV were resected during the pancreaticoduodenectomy and reconnected using a polytetrafluoroethylene prosthesis. On day 1, early graft thrombosis was treated by thrombectomy and change to a larger graft. Pathology confirmed a R0-resection of the adenocarcinoma of the papilla of vater (pTis pN0,G2). At three-month follow-up, the patient was cancer-free and clinically asymptomatic, although, a late graft thrombosis with accompanying newly build venous collaterals passing mesenteric blood to the SV were found.
*DISCUSSION:* Rare PV disorders like a PDSMV do not contradict pancreatic surgery, but should be treated in experienced centres. Skills of SMV/PV reconstruction and its peri-operative management might be beneficial for successful outcome. Despite late graft thrombosis no clinical disadvantage occurred most likely due to preservation of the SV and of potential venous collateral pathways.
*CONCLUSION:* Extended surgical procedures like a pancreaticoduodenectomy are realisable in patients with PV disorders, but require awareness, adequate radiological interpretation and specific surgical experience for secure treatment.


## 1. Introduction

Malformations of the portal vein (PV) like absent branching, duplications, congenital absence or preduodenal course are rare [1,2]. A preduodenal PV is mostly associated with a situs inversus or other congenital disorders [3]. However, to the best of our knowledge, there has been no report on an adult with a preduodenal superior mesenteric vein (PDSMV) and absent formation of a typical PV with standard abdominal anatomy. In this case report, we describe the surgical performance of a pylorus-preserving pancreaticoduodenectomy (PPPD) with reconstruction of a PDSMV using a polytetrafluoroethylene (PTFE) graft. We are particularly focusing on the surgical techniques in this special anatomic case and the postoperative complication like thrombosis of the mesenteric prosthesis.

## 2. Presentation of case

A 67-year-old female with known familial adenomatous polyposis and condition after proctocolectomy in 1973 was diagnosed as having suspect adenomas in the duodenum. The patient underwent an exploratory laparotomy for a pancreaticoduodenectomy at an external hospital. As an unexpected PV disorder was found, the surgery was terminated and the case was referred to our department. CT analysis revealed that the SMV ran ventrally of the duodenum into the left PV, draining the blood from the jejunum and ileum (Fig. 1A and B). The splenic vein (SV) ran underneath the pancreas and led directly into the right PV (Fig. 1C). A small intrahepatic connection between the right and left PV was present at the liver hilum (Fig. 1D), but SMV and SV drained separately into the liver without forming an anatomic PV (Fig. 2A). No associated

*Abbreviations:* PDSMV, preduodenal superior mesenteric vein; PPPD, pylorus-preserving pancreaticoduodenectomy; PTFE, polytetrafluoroethylene; PV, portal vein; SMV, superior mesenteric vein; SV, splenic vein.

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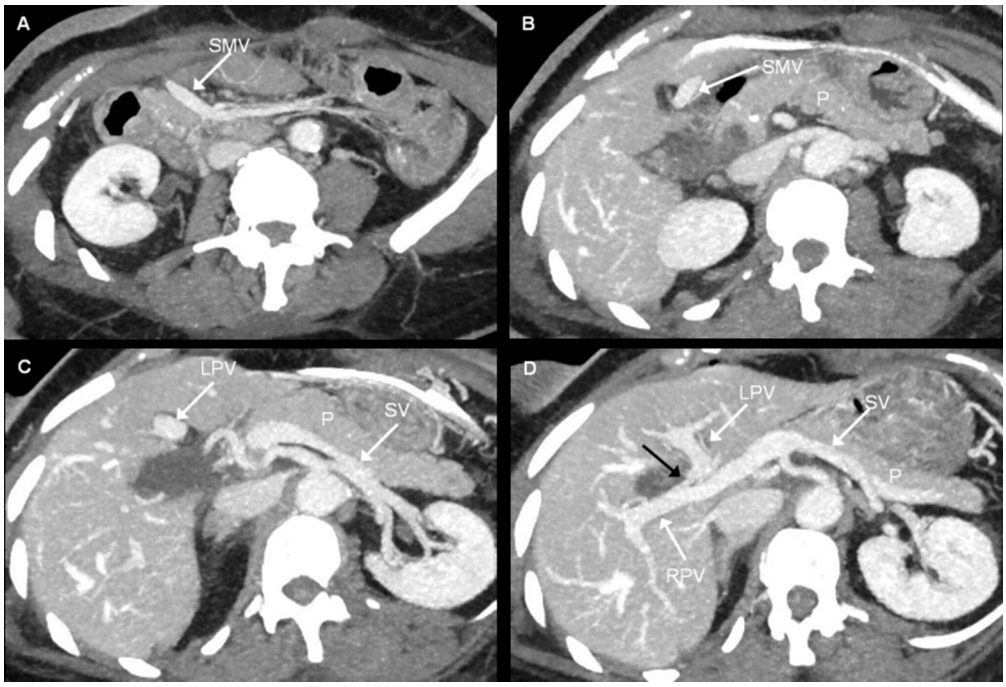


**Fig. 1.** CT in the portalvenous phase demonstrating the anatomic situation prior to revision surgery.
Axial maximum intensity projections of the upper abdomen at four different levels (A–D; (A) is below (D)). The SMV crosses the abdomen in front of the duodenum and the pancreas (A), reaching the liver at the site of the falciform ligament (B) and continuing into the left portal vein. The splenic vein runs behind the pancreas (C), reaching the liver hilum and continuing into the right portal vein (D). A filiform connection between the LPV and RPV is present at the liver hilum (black arrow in D). SMV = superior mesenteric vein; LPV = left portal vein, RPV = right portal vein; SV = splenic vein; P = pancreas.

congenital anomalies of the common bile duct, the gallbladder nor gastric and oesophageal varies were seen. The differential diagnosis of a congenital vascular anomaly and a possible jump graft, potentially implanted during the former proctocolectomy, were discussed. Research in the archived documents including the report of surgery, discharge note, medical postoperative reports and anaesthesia records did not show any evidence for a jump graft implantation.

However, we performed a PPPD in the following manner. After abdominal exploration and division of the adhesions, the PDSMV and the SV were identified (Fig. 3). The hepatic artery and the gastroduodenal artery were dissected. Next, the Kocher manoeuvre and dissection of the transverse colon were routinely performed. At this point, the SMV could be fully detected; SMV and SV ran separately to the liver. After fully loosening the duodenum and preparation of the bile duct, the PDSMV had to be clamped and cut. The duodenum was disconnected 3 cm distal the pylorus, the jejunum right behind the ligament of Treitz. The PPPD was finished, and the SMV reconstruction was performed with an 8 cm long 8 CH PTFE prosthesis in an end-to-end technique (Fig. 4). Intraoperative ultrasound showed a good blood flow and liver perfusion. Gastrointestinal reconstruction was finalised by an end-to-side pancreaticojejunostomy, end-to-side hepaticojejunostomy and end-to-side duodenojejunostomy.

The next day, ultrasound identified a loss of blood flow over the prosthesis area despite extension of the partial thromboplastin time to 50–60 s. A re-laparotomy was necessary for resection of the prosthesis and re-anastomosis with a larger graft (9 CH PTFE). Multiple ultrasounds confirmed good blood flow during the following days. The further postoperative course was without complications and the patient was discharged in a good health status three weeks after surgery.

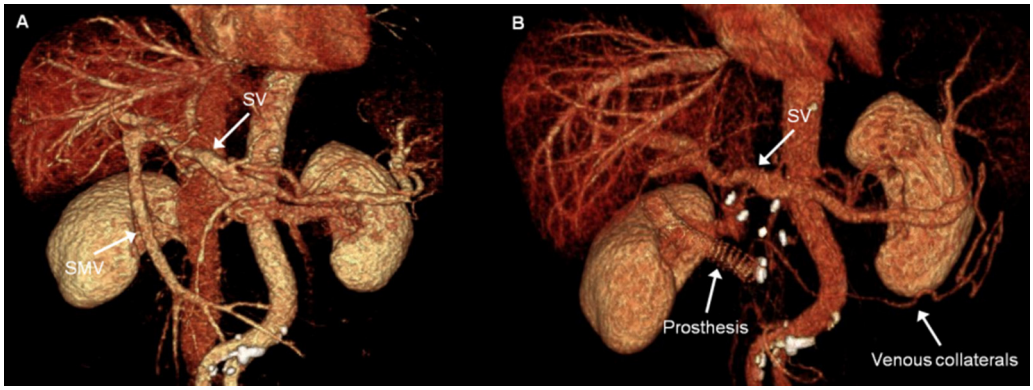


**Fig. 2.** Oblique coronal volume rendered images before (A) and after (B) revision surgery with insertion of a Gore-Tex prosthesis.
SMV and SV drain separately into the liver without forming an anatomic portal vein (A). Three months after surgery the prosthesis is occluded and newly formed collaterals can be observed draining blood from small mesenteric branches into the SV (B). SMV = superior mesenteric vein; SV = splenic vein.

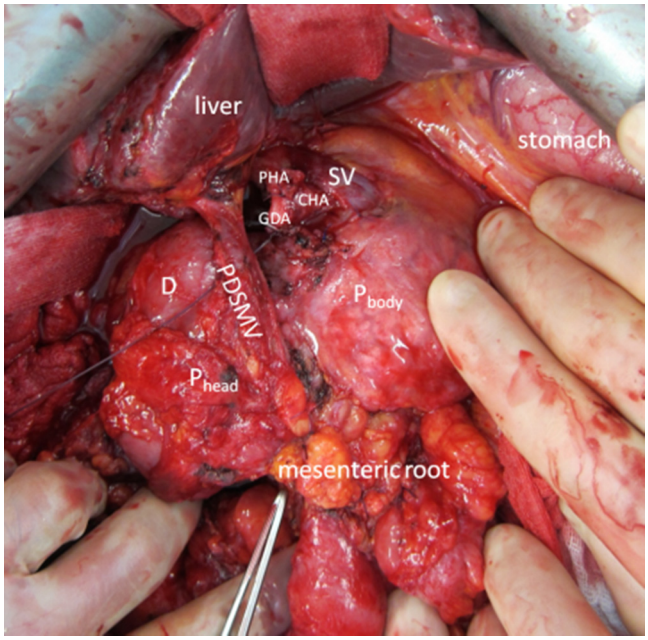


**Fig. 3.** Intraoperative situs before resection of the preduodenal superior mesenteric vein (PDSMV).
The PDSMV was inseparable from the neck of pancreas and ran from the mesenteric root in front of the pancreas head ($P_{head}$) as well as the bulbus of duodenum (D) to feed the left portal vein via the falciform ligament. The splenic vein (SV) ran behind the body of the pancreas ($P_{body}$), crossed ventrally the common hepatic artery (CHA) to reach the right portal vein dorsally the proper hepatic artery (PHA). The gastroduodenal artery (GDA) was already cut.

Results from pathology confirmed a R0-resection of the adenocarcinoma of the major duodenal papilla (pTis pN0, G2) and polyposis of the pancreatic duct. The patient's three-month follow-up showed a re-thrombosis of the prosthesis (Fig. 2B). Clinical symptoms as diarrhoea, bloody stool or abdominal pain were missing. At one year-follow-up the patient is still in a good health status without signs of cancer, malnutrition nor portal hypertension.

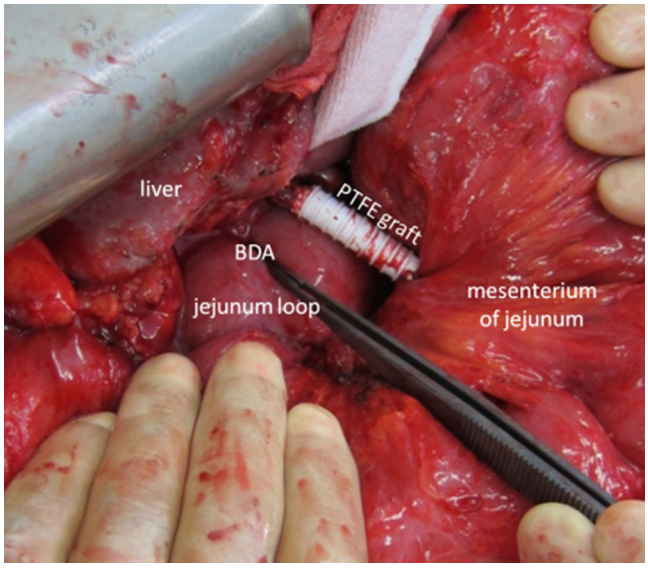


**Fig. 4.** Intraoperative situs after the Whipple procedure and recontruction of the SMV using a PTFE graft in end-to-end technique.
The Whipple reconstruction was performed using a single jejunum loop, an end-to-side pancreaticojejunostomy and an end-to-side hepaticojejunostomy (BDA). The PTFE graft crossed the pancreaticojejunostomy ventrally.

## 3. Discussion

Already in 1951, an en-bloc-resection of a pancreas tumour with removing parts of the SMV has been described [4]. Ever since, discussions about improving patient survival by removal of pancreatic tumours with PV resection are going on. Several extended pancreas resections with different techniques of vascular reconstruction have been performed by experienced centres to achieve a better long term prognosis [5,6]. Because of specific risks like bleeding, graft infection or thrombosis, it might be reasonable to treat complex cases of PV disorders or advanced pancreatic cancer in centres with combined experience in vascular and pancreatic surgery.

There are several possibilities to manage reconstruction of the PV system, depending on the extent of vascular resection. In general options for venous reconstruction imply venous patch repair, tangential vein resection, primary end-to-end anastomosis and interpositions of autologous or synthetic grafts. Primary end-to-end anastomosis is the preferred technique after SMV and PV resection [7,8]. The leading rule for vascular reconstruction is to keep the patency and to prevent bending, narrowing or tension of the anastomosis. If too much tension exists for primary anastomosis, interposition of a graft is necessary. Autologous grafts exist by donors or have to be dissected, e.g. the left renal, the saphenous or superior femoral vein [9–11]. To avoid additional harvesting and shorten operative time another option is the use of synthetic prostheses like PTFE grafts [5,12]. There are few studies which compare postoperative morbidity and mortality of primary end-to-end anastomosis and use of PTFE grafts. First data showed no significant difference [5,12].

One defined postoperative risk after vascular reconstruction is graft thrombosis. Many authors differ between early and late postoperative thrombosis, meaning an occurrence within or after 30 days after surgery [12]. Previous data showed no difference in patency of a PTFE graft or primary anastomosis [5] Generally, clinical appearance of a mesenteric vein or PV system thrombosis is unspecific. Acute PV thrombosis might get along with abdominal pain, diarrhoea, vomiting or bloody stool [13]. Based on the potential blood draining barrier SMV thrombosis might result in intestinal dilatation and congestion [5]. Liao et al. [5] report about three cases of early graft thrombosis; two of them had severe ascites, and the other patient died. Cases of late thrombosis were not associated with disadvantageous clinical outcomes.

In our case, early thrombosis of the prosthesis occurred on the first postoperative day. Immediate surgery and change to a larger prosthesis was performed. Further ultrasounds showed good blood flow over the PTFE graft. In consideration of the severe outcome of early thrombosis, immediate surgery might have prevented serious complications. Thus, our patient could be discharged 3 weeks after PPPD in a good health status. The routinely performed 3-months follow-up CT scan revealed a re-thrombosis of the SMV prosthesis. The patient did not show any clinical symptoms at this time point and thereafter. More detailed analysis of the CT scan disclosed a newly build venous collateral system. Abreast the PTFE graft newly formed collaterals could be observed draining blood from small mesenteric branches into the SV. This venous collateral system secures the venous drainage and intestinal decompression. Respectively, it could be of immense importance to preserve the small and great omentum as well as the pylorus and the distal stomach during the PPPD to offer a collateral pathway for venous blood from the small bowel to the SV. Further, the lack of the normal confluence might be substantial for the patient's survival. If the tumour infiltrates the SMV/SV confluence, the SV is usually ligated. A SV reconstruction is often not performed to avoid a PV-bending. As a PV confluence was missing and the SV and the SMV ran separately

into the liver, the SV remained untouched and could therefore, build the collateral pathway.

## 4. Conclusion

Anatomic varies of the PV are rare, but could confront every physician dealing with multifarious disease nearby the PV. Thus, accurate radiological interpretation of the different PV disorders can prevent unintentional damage during surgery or small invasive interventions. Our case shows that, well-diagnosed anatomic PV disorders are not a contraindication for surgery, but increasing pre- and post-operative risks as well as specific challenges should be kept in mind. In this case, the patient profited by immediate surgical repair of the early graft thrombosis as well as by the protection of potential venous collateral circuits during the PPPD.

## Conflicts of interest

The authors report no conflict of interest.

## Funding

The authors have no funding to declare.

## Ethical approval

Written informed consent was obtained from the patient for publication of this case report and accompanying images.

## Consent

A copy of the written consent is available for review by the Editor-in-Chief of this journal on request.

## Author contribution

Kristina Höing collected the data, reviewed the literature, performed the follow-up, and wrote the main manuscript. She assisted during surgery.

Kristina I. Ringe gave a detailed CT-analysis and supplied Figs. 1 and 2.

Hüseyin Bektas performed the surgery and was involved in manuscript improvement and data interpretation.

Jürgen Klempnauer gave critical reviews as well as the final approval of the manuscript. He made critical suggestions for data interpretation and manuscript improvement.

Mark D. Jäger collected data, made substantial contributions to conception design and made critical suggestions for data interpretation and manuscript improvement. He was first assistant during surgery.

## Guarantor

Mark Jäger and Kristina Höing accept the full responsibility for this work.

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