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Prepancreatic Postduodenal Portal Vein: Report of a Case

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Abstract
We report an unusual case of a prepancreatic postduodenal portal vein (PPPV), incidentally discovered during total gastrectomy. If it had not been noticed, this portal vein might have been ligated and divided with disastrous consequences. This anomaly was not diagnosed preoperatively, but it could have been. Although embryological anomalies of the portal venous system, such as PPPV and preduodenal portal vein, are rarely encountered in abdominal surgery, surgeons must be aware of their possibility and be able to recognize them to avoid major intraoperative injury.

Key words Prepancreatic postduodenal portal vein · Embryological anomaly · Surgical hazard

Introduction

Anomalies of the portal vein are occasionally found in the preduodenum; however, a prepancreatic postduodenal portal vein (PPPV), as first reported by Brook, is rare. We present a case of this anomaly and describe its embryological etiology in comparison with that of the preduodenal portal vein (PDPV). We also discuss its characteristics and surgical hazards.

Case Report

A 50-year-old man was hospitalized for treatment of early gastric cancer in the posterior gastric wall just under the cardia. An enhanced computed tomography (CT) scan (Fig. 1) showed that the portal vein had an unusual appearance, running from the front of the pancreatic body to between the duodenum and pancreatic head. However, this was not clear before the operation. At surgery, we found no congenital anomalies of the gallbladder, common bile duct (CBD), pancreas, stomach, intestine, or spleen. We initially mistook the portal vein to be the right gastroepiploic vein, but after the total gastrectomy, we investigated the anatomy. There was no web development of the veins from the bowels and spleen, or any carvenous transformation, but we found a PPPV. The portal vein arose in the pancreatic head, and its course was L-shaped and convexly caudad (Fig. 2). The CBD lay behind the portal vein. The patient had an uneventful recovery and was discharged from hospital without any complications.

Discussion

The embryological development of the normal portal system was described by Marks in 1969.[1] In early fetal life, at the 5-mm stage, venous blood from the foregut is drained by the parallel vitelline veins, which are connected by three anastomoses: the cranial anastomosis intrahepatically, the middle anastomosis behind the duodenum, and the caudal anastomosis in front of the duodenum. In later weeks, at the 9-mm stage, the caudal anastomosis, the lower portion of the right vitelline vein, and the upper part of the left vitelline vein disappear, leaving the middle anastomosis behind the duodenum.

The liver, biliary system, and pancreas develop in parallel with the portal system. Figure 3 shows the developmental relationship of the portal vein, liver, gallbladder, biliary system, and pancreas.[1–4] The pancreas develops from two separate primordia, which arise from the duodenal endoderm. The dorsal pancreatic bud grows rapidly and extends dorsocranially into the me-

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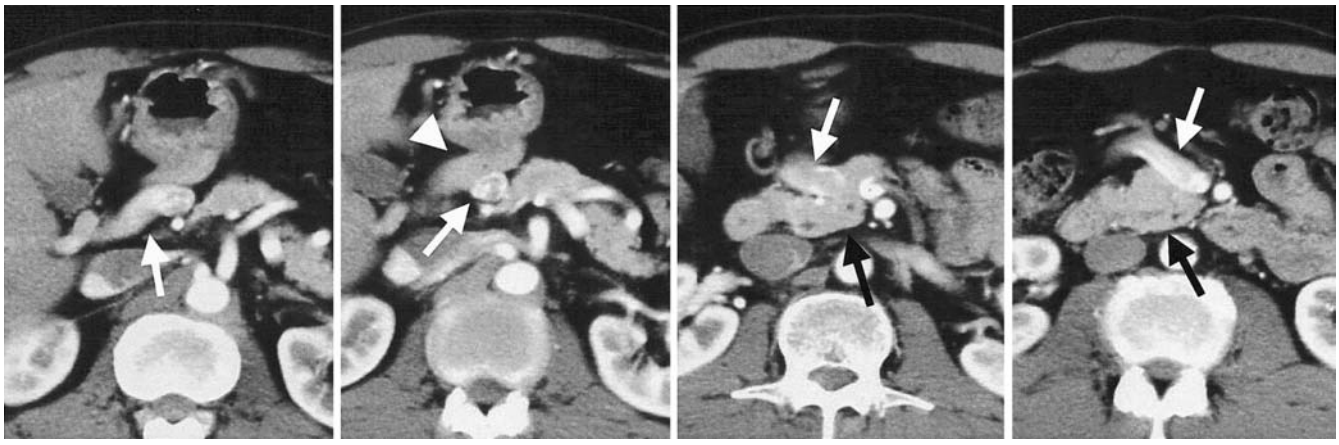

Fig. 1. Computed tomography scan. The portal vein (*white arrows*) arose between the duodenum (*arrowhead*) and the pancreatic head (*black arrows*), and ran parallel to the pancreatic head. Its course was L-shaped and convexly caudad

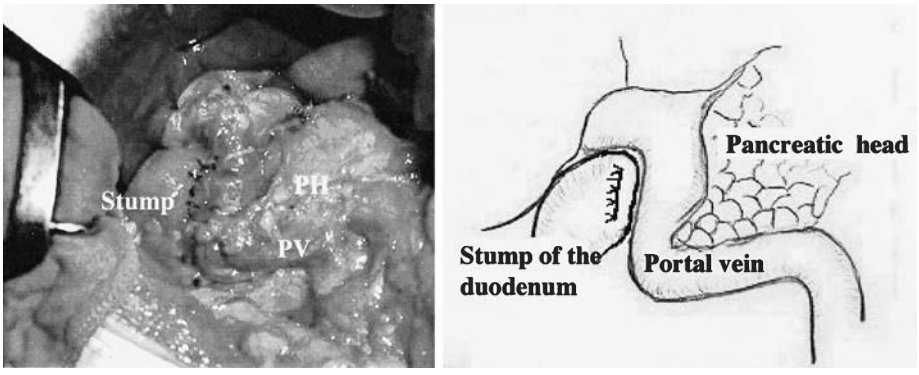

Fig. 2. Intraoperative photograph, taken after gastrectomy, and its schematic illustration. *PH*, pancreas head; *PV*, portal vein; *Stump*, stump of the duodenum

soduodenum to the left side of the vitelline veins. The ventral pancreatic bud arises soon after, in the angle below the hepatic rudiment. As the duodenum rotates to the right, the two pancreatic primordia fuse to form a single organ, in about the 7th week of embryonic life. The main pancreatic duct of Wirsung usually opens into the duodenum with the CBD, via the ampulla of Vater.[3]

PDPV is a rare embryological anomaly, although since its first description by Knight[5] in 1921, more than 100 cases have been reported. According to some reports,[6,7] PDPVs in children have a high frequency of associated visceral anomalies, such as intestinal malrotation or biliary atresia. In most adults with PDPV,[6,7] the association of cholelithiasis is encountered at laparotomy or autopsy. This means that PDPV can manifest later in life in some patients who do not have severe associated visceral anomalies.

On the other hand, only eight cases of PPPV,[7–12] including ours, have been reported since the first description by Brook and Gardner[8] in 1972. Their two cases were associated with cholelithiasis, while the other cases were associated with malignant diseases. These PPPVs were L-shaped in four cases, inversely L-shaped in one, and linearly shaped in one. Five lay anterior to the CBD and one was parallel to it. There was no association of visceral malformations. Brook and Gardner did not report the shape, relationship, or association. Five of the PPPVs, excluding Brook's and ours, were found by preoperative examinations, including abdominal CT and ultrasonography (US), or during surgery. The development and widespread use of radiological diagnostic modalities, such as CT, US, and portography, will increase the diagnostic opportunity of detecting portal anomalies.

A hypothesis about the embryological development of the normal portal system was presented by Hashimoto and Yura[13] who speculated that the ventral and dorsal pancreatic buds arise in front of the right and left vitelline veins, respectively (Fig. 4). The right rotation of the ventral pancreatic bud, caused by the unequal duodenal growth,[14] will then cut the right vitelline vein between the middle and caudal anastomoses, and the development of the duodenal bulbus will cut the left vitelline vein between the cranial and middle anasto-

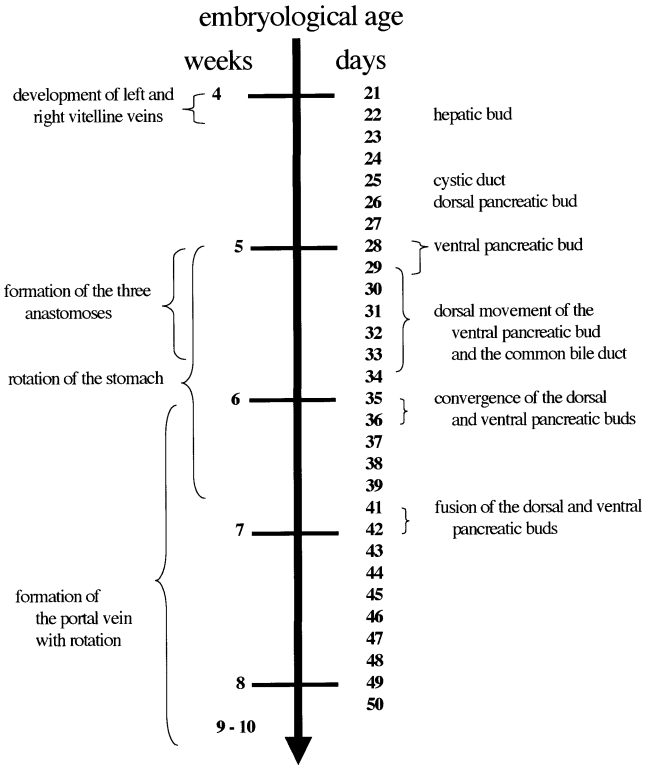

Fig. 3. Development of the portal vein, pancreas, biliary system, and liver. The *left side* shows the development of the portal vein. The *right side* shows the development of the pancreas, biliary system, and liver

moses. According to this theory, PPPV is caused by the "posterior" position of the dorsal pancreatic bud in relation to the left vitelline vein, instead of the "anterior" position.[7] This is because the normal rotation forms of PPPV are rarely associated with intestinal malrotation or duodenal, biliary, or pancreatic congenital anomalies.

Based on our review of these eight cases, we have defined the following characteristics of PPPV:

1. PPPV is L-shaped or inverted L-shaped
2. PPPV runs in front of or parallel to the CBD
3. Most PPPVs are not associated with intestinal malrotation or duodenal, biliary, or pancreatic anomalies

The development of the pancreatic head would produce an L-shaped or inverted L-shaped portal vein. In the normal embryo, because the main pancreatic duct lies ventral to the portal vein and the CBD is contiguous to the main pancreatic duct, the CBD runs on the ventral side of the portal vein. Conversely, in PPPV, because the portal vein runs on the ventral side of the dorsal pancreatic bud, the CBD would run on the dorsal side of the portal vein around the head of the pancreas.

We report this case to remind surgeons of the possibility of anatomic variations such as PPPV and PDPV, which could result in devastating complications, including massive intraoperative hemorrhage[15] and thrombosis,[16] as previously reported.

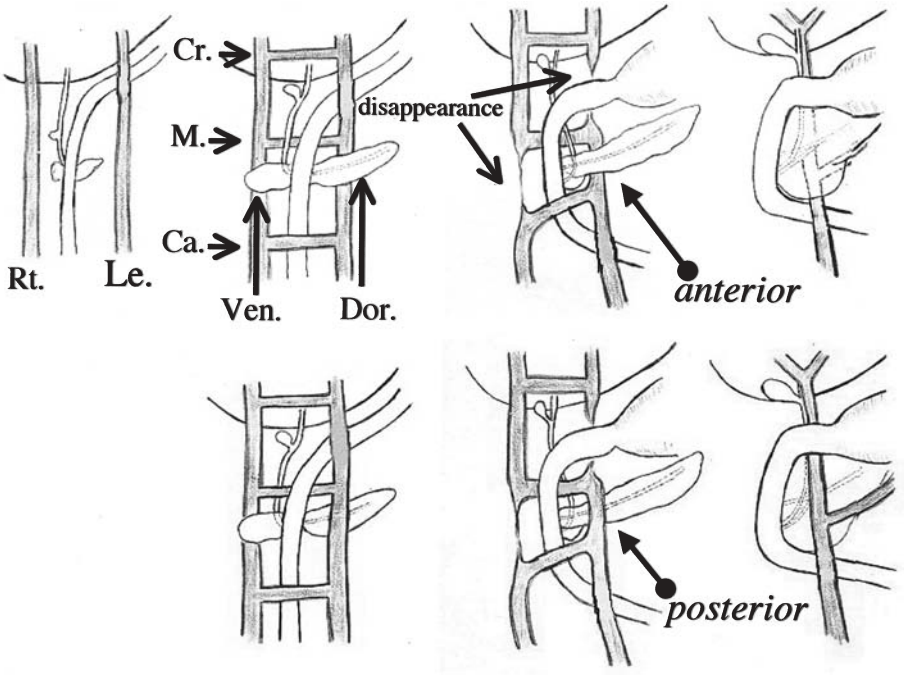

Fig. 4. Schematic illustrations of the hypothesis of Hashimoto et al. of the normal embryological development of the portal vein, and that of Matsumoto et al. of the prepancreatic postduodenal portal vein (PPPV). These schematic illustrations represent the embryological development of the normal portal vein (*above*) and the PPPV (*below*). The difference between the two lies in the position of the dorsal pancreatic bud. In the PPPV, it is posterior to the left vitelline vein instead of anterior to it. The upper diagram is cited from the hypothesis of Hashimoto et al.[13] and the lower diagram is derived from the hypothesis of Matsumoto et al.[7] *Rt.*, right vitelline vein; *Le.*, left vitelline vein; *Ven.*, ventral pancreatic bud; *Dor.*, dorsal pancreatic bud; *Cr.*, cranial anastomosis; *M.*, middle anastomosis; *Ca.*, caudal anastomosis

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