Preoperative identification of anomalous arterial anatomy at pancreaticoduodenectomy

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ABSTRACT

The understanding of abdominal vascular anatomy and its anatomical variations is of considerable importance in upper abdominal surgery. We present the rare finding of a common hepatic artery arising from the superior mesenteric artery and passing anterior to the pancreatic gland in a patient undergoing a pancreaticoduodenectomy.

KEYWORDS

Variation – Hepatic artery – Superior mesenteric artery – Pancreaticoduodenectomy

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Anatomical variation of the arterial blood supply to the liver is common, with only 52–80%¹ of patients having ‘normal anatomy’ where the common hepatic artery (CHA) arises from the coeliac trunk, and divides into gastroduodenal artery and proper hepatic artery, which then divides into right and left hepatic arteries at the hilum of the liver. In 1955 Michels proposed a classification scheme with the 10 most common variants of arterial blood supply to the liver, based on the result of 200 cadaver livers.² Hiatt *et al* simplified the scheme in 1994 to just six arterial variants (Table 1).³ Type 9 in the Michels classification and type 5 in the Hiatt classification describe the variation with the CHA arising from the superior mesenteric artery (SMA), occurring in 1–5%.^{1,2}

Case History

A 75-year-old male patient presented with 14kg weight loss and progressive jaundice over four months. Endoscopic ultrasonography of the pancreas demonstrated a 1.6cm × 2.7cm mass in the head of the pancreas and fine needle aspiration confirmed an adenocarcinoma. Preoperative computed tomography demonstrated that the tumour was touching the portal vein, for less than 180° of its circumference over a 1.5cm distance, without invasion. The SMA was clear from the tumour. However, the entire CHA was seen to arise from the SMA, passing anterior to the pancreas, posterior to the first part of the duodenum and up to the hilum of the liver (Figs 1 and 2). There was no accessory or replaced left hepatic artery from the left gastric artery. The splenic arteries arose from the aorta as a separate branch.

The patient duly underwent a pylorus preserving pancreaticoduodenectomy. Intraoperative findings (Fig 3) confirmed the presence of a palpable pulse over the pancreatic head. The anatomical position of the CHA required careful dissection from the anterior surface of the pancreatic head, made complicated by the presence of an element of fibrosis. After resection, the artery was left running over the pancreas (Fig 4) and a pedicle of omentum was dissected. This was placed between the hepatic artery and pancreaticojejunostomy anastomosis in an attempt to decrease the risk of arterial complications should the patient develop a postoperative pancreatic fistula.

The patient spent one day in the intensive care unit. He was discharged without further complications after seven days and reviewed at two months. Postoperative histology

Table 1 Hiatt's classification of hepatic artery variations³

Type	Description
1	Normal
2	Replaced or accessory LHA
3	Replaced or accessory RHA
4	Replaced or accessory RHA + replaced or accessory LHA
5	CHA from SMA
6	CHA from aorta

LHA = left hepatic artery; RHA = right hepatic artery;
CHA = common hepatic artery; SMA = superior mesenteric artery

Figure 1 Original transverse computed tomography: The replaced common hepatic artery (rCHA) is seen arising from the superior mesenteric artery (SMA) in Fig 1A, and passing anterior to the superior mesenteric vein (SMV) and then the pancreas in Fig 1B. In Figs 1C and 1D, the rCHA is seen passing over the pancreatic head (HoP) and running posterior to the first part of the duodenum (Duo).

Figure 3 Replaced common hepatic artery (solid arrowhead) in relation to pancreas (arrow) and bifurcation in left and right hepatic artery (transparent arrowhead)

Duo = duodenum; HoP = head of pancreas; rCHA = replaced common hepatic artery; SMA = superior mesenteric artery; SMV = superior mesenteric vein

Figure 2 Reformatted 30mm thick transverse imaging showing the course of the replaced common hepatic artery in relation to the structures around the pancreatic head

Figure 4 Photograph after pancreaticojejunostomy showing anastomosis of pancreas and jejunum (arrow), replaced common hepatic artery (solid arrowhead), and bifurcation in left and right hepatic artery (transparent arrowhead)

confirmed a T3N1 (5/20 nodes) pancreatic ductal adenocarcinoma with R1 resection. The involved resection margin was the posterior pancreatic margin and not that in contact with the anomalous CHA.

Discussion

The CHA rarely arises from the SMA; Michels found this variant of the hepatic artery in 2.5% of 200 cadavers² while

Hiatt *et al* found it in 1.5% of 1,000 patients.⁵ In these reports, the course of the CHA in relation to the pancreas was not described although the majority run posterior to the pancreas. In 1984 Ohtsuka *et al* reported a CHA arising from the SMA and running anterior to the pancreas in a postmortem case.⁴ Huang *et al* subsequently described arterial anatomy in 486 patients and observed this variant in just two patients (0.4%), leading them to suggest classifying the course of the hepatic artery arising from the SMA into two types: pre and postpancreatic (3.2% and 96.8% respectively in their series).⁵ This relationship is shown in Fig 5.

In the present case, preoperative identification of this variant alerted the surgical team to the actual arterial anatomy. This demonstrates that it is important to understand 'normal' and frequently observed 'abnormal' arterial variants, and (b) that it is also important for surgeons to be able to interpret cross-sectional imaging and to do this routinely prior to performing an operation. (The above anatomy was identified prior to the procedure by the surgical team and was not described in the formal radiology report at the referring hospital or at the specialist multidisciplinary review.) In the case reported here, had preoperative identification not occurred, the risk of inadvertent iatrogenic damage would have been higher given the steps taken in a routine pancreaticoduodenectomy (where this artery appeared from behind the first part of the duodenum in the exact location where a gastroduodenal artery is usually found and ligated in the case of a pancreaticoduodenectomy).

Conclusions

Arterial variations of the upper abdominal visceral arteries are common. The CHA arising from the SMA with a prepancreatic course is, however, a very rare variation of the hepatic artery. In this case, it was identified owing to the surgeon's review of the preoperative imaging. In this specific procedure, it enabled early identification and safe dissection as well as ensuring there was no possibility of mistaking the CHA for the gastroduodenal artery.

References

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