Prominent gastroduodenal artery: Endosonographic sign of celiac artery stenosis

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ABSTRACT
Celiac artery (CA) stenosis is a relatively common finding in patients undergoing pancreaticoduodenectomy (PD). In the presence of CA stenosis, arterial blood supply to the celiac territory is usually sustained from the superior mesenteric artery (SMA) through well-developed collaterals. In this paper, the authors report endosonographically identified prominent gastroduodenal artery as the sign of CA stenosis for the first time. Uncovering previously unidentified vascular abnormality, endoscopic ultrasound (EUS) has improved patient management. The patient had uneventful collateral preserving PD.

Key words: Celiac artery (CA), collateral circulation, endoscopic ultrasound (EUS), pancreatic cancer, pancreaticoduodenectomy (PD), stenosis

INTRODUCTION
Celiac artery (CA) stenosis is a relatively common finding in patients undergoing surgery.[1] In the presence of CA stenosis, arterial blood supply to the celiac territory is usually sustained from the superior mesenteric artery (SMA) through well-developed collateral vessels and the gastroduodenal artery [Figure 1]. During pancreaticoduodenectomy (PD), most of these collateral vessels are ligated and cut, potentially causing ischemia of the liver, biliary tree, or anastomosis. We present a case highlighting the importance of prominent and thickened gastroduodenal artery detected by endoscopic ultrasound (EUS) as the only sign of CA stenosis.

CASE REPORT
A 75-year-old female presented with abdominal pain. Contrast-enhanced computed tomography (CT) of the abdomen revealed pancreatic ductal dilatation and irregularity, but no obvious obstructing mass lesion. EUS examination revealed a 15 mm × 12 mm hypoechoic tumor located in the pancreatic head with a ductal dilatation of 6 mm. During EUS examination, a prominent and dilated gastroduodenal artery with a diameter of 7 mm was noticed [Figure 2]. Reevaluation of the abdominal CT did not

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Received: 2015-01-03; Accepted: 2015-12-03
identify discernable collaterals in the pancreatic head region, and there was no distant metastasis. During the operation, it was confirmed that gastroduodenal artery and anterior pancreaticoduodenal arcade (APDA) were clearly dilated. When the gastroduodenal artery was temporarily occluded, hepatic arterial blood flow ceased completely. PD was performed with the preservation of the gastroduodenal artery and APDA [Figure 3]. The diameters of the vessels were measured as 7 mm (normal ≤4.6 mm\(^2\)) and 6 mm (normal ≤3 mm\(^3\)), respectively. Postoperatively, aspartate and alanine aminotransferases were increased up to 1,685 IU/L and 1,375 IU/L, respectively. Serum bilirubin and prothrombin time were in the normal range.

**DISCUSSION**

The celiac axis and the SMA supply almost all of the blood flow to the upper gut viscera. Retrograde collateral blood flow through APDA and the gastroduodenal artery provide an effective blood flow to the liver through APDA and the gastroduodenal artery [Figure 4]. No further angiographic intervention was required as retrograde blood flow was sufficient. Serum aminotransferases returned to normal range within 7 days, supporting the transient vasospasm of the surgically protected vessels causing hypoxic liver injury. Histopathological examination of the surgical specimen revealed pancreatic ductal adenocarcinoma.
supply when CA is stenosed or occluded slowly. Under normal circumstances, many of these collateral vessels might not be visible even on angiography, but these collaterals have the potential to increase in size in response to chronic ischemia [Figure 1]. If a prominent and thickened gastroduodenal artery is detected during EUS, CA stenosis should be investigated. To the best of our knowledge, significance of a prominent gastroduodenal artery detected by EUS as a sign of CA stenosis has not been reported in medical literature in English.

To avoid ischemic complications, preoperative stenting of the CA or intraoperative preservation of the collaterals or vascular reconstruction/bypass is needed, as most of these collaterals are ligated and cut during PD.\textsuperscript{[4]} Gastroduodenal artery preserving PD has the advantage of maintaining blood supply without the need for revascularization by maintaining retrograde collateral flow from the SMA.

Contrast-enhanced multidetector CT (MDCT) is the standard examination method for the detection of pancreatic tumors, and for the evaluation of resectability.\textsuperscript{[5]} Although, CA stenosis itself or collaterals in the pancreatic head region can be identified by CT, in a recent study, the sensitivity of MDCT without arterial reconstruction to detect CA stenosis was reported as 58%.\textsuperscript{[6]} Beside the usefulness of EUS for the identification of small tumors that have gone undetected by other imaging modalities, a good working knowledge of vascular anatomy during EUS examination can identify vascular diseases that can optimize patient management, and guide perioperative decisionmaking.

Financial support and sponsorship
Nil.

Conflicts of interest
There are no conflicts of interest.

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