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Analysis of anatomic variants of mesenteric veins by 3-dimensional portography using multidetector-row computed tomography

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3-D portography;
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Surgical anatomy

Abstract

BACKGROUND: It is important to be aware of mesenteric venous variants to perform peripancreatic surgery. We investigated the usefulness of 3-dimensional (3-D) portography.

METHODS: Vessels were reconstructed using computer software in 102 patients undergoing multidetector-row computed tomography (MDCT) scheduled for gastrointestinal or hepatobiliary-pancreatic surgery.

RESULTS: The superior mesenteric vein (SMV) was composed of single and double trunks around the splenoportal confluence in 78 and 24 patients, respectively. The inferior mesenteric vein joined the splenic vein (68.5%), SMV (18.5%), and splenoportal confluence (7.6%). The left gastric vein joined the splenic vein (46.3%), portal vein (39.0%), and splenoportal confluence (14.7%). Seventy-nine patients showed a gastrocolic trunk, mostly composed of the right gastroepiploic vein and veins from the colonic hepatic flexure. Intraoperative findings were identical to 3-D diagnosis in 68 gastrectomized and 9 pancreatectomized patients.

CONCLUSION: Although mesenteric venous tributaries are complex, 3-D portography is helpful for surgeons to safely perform peripancreatic surgery.

Surgeons sometimes encounter bleeding during the approach to the peripancreatic head area. This bleeding is caused by the laceration of small portal veins by inappropriate traction.[1,2] Such problems would be avoidable if the anatomy of the portal venous tributaries were known.[1,2] Information on the left gastric vein (LGV) and the inferior mesenteric vein (IMV) is also useful to avoid gastric congestion when the superior mesenteric vein (SMV) needs to be compromised and reconstructed in pancreatoduodenectomy (PD).[3,4] Because small vessels are sometimes invisible under the fat tissue, it is very important to preoperatively know the portal venous anatomy around the pancreatic head.

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Until recently, surgeons have required conventional angiography to obtain spatial vascular information, although the observation angle is restricted. With advances in radiographic modalities and computer-assisted graphic analysis, we can easily obtain 3-dimensimal angiography (3-DA) using multidetector-row computed tomography (MDCT).[5] Using 3-DA, we can evaluate the vascular architecture from any angle and avoid interference from overlapping.[6] Although there have been some reports about the anatomic analysis of peripancreatic arteries by MDCT,[6,7] studies of mesenteric veins have been restricted.[8–10] Some reports have described the precise anatomic tributaries of SMV in cadavers, with special emphasis on the gastrocolic trunk (GCT).[1,11] Considering that major bleeding is mainly from laceration of the fragile veins, the anatomy of mesenteric veins may be more important than that of arteries.

The aim of this study was to identify the variations of mesenteric veins around the pancreatic head by 3-DA using MDCT and to examine whether preoperative information about anatomic tributaries can help surgeons to safely approach that area.

Materials and Methods

Patients

This study included 107 consecutive patients undergoing MDCT between April 2007 and November 2008 before gastrointestinal or hepatobiliary-pancreatic surgery. The patient population consisted of 64 men and 43 women from 19 years to 85 years old (median age 65 years). Eighty patients had gastrointestinal malignancies (76 gastric cancers, 1 ascending colon cancer, 1 duodenal carcinoma, 1 ampullary cancer, and 1 gastric gastrointestinal stromal tumor). Four had hepatic tumors (2 hepatocellular carcinomas, 1 intrahepatic cholangioma, and 1 hemangioma), 11 had biliary diseases (4 cholecystitis, 4 extrahepatic cholangiomas, and 3 gallbladder cancers), and 12 had pancreatic neoplasms (6 adenocarcinomas, 2 neuroendocrine tumors, 2 intraductal papillary mucinous neoplasms, 1 mucinous tumor, and 1 lymphoepithelial cyst). Patients showing obvious encasement of mesenteric veins by neoplasms were excluded.

Computed tomography protocol

Images were obtained using the Aquillion MULTI 64-MDCT scanner (Toshiba Medical Systems, Tokyo, Japan). A 20-G intravenous catheter was inserted from the medial cubital vein. The range of contrast-enhanced computed tomography (CT) scans was set to cover the area from the dome of the liver to the aortic bifurcation. With contrast-enhanced CT images, nonionic contrast agent (370 mg or 300 mg I/mL, Omnipaque; Daiichi Pharmaceutical, Tokyo, Japan) was infused rapidly at a rate of 40 mg I/kg for 25 seconds using an automated injector. Early arterial phase images were obtained using the bolus tracking method. In brief, early arterial phase scanning started when the Hounsfield units reached 200 in the abdominal aorta at the level of bifurcation of the celiac artery. The average scanning delay between the start of contrast material injection and the start of early arterial phase scanning was 20 seconds (range 15–28 seconds). Late arterial phase scanning and early venous phase scanning were started 10 seconds and 30 seconds after early arterial phase scanning, respectively.

3-DA by Workstation

The volume data were transferred to a workstation (ZIOSTATION; Zio Software, Tokyo, Japan). Arteriography was obtained from early arterial phase scanning data. Portography was prepared either from the late arterial phase or the early venous phase. The arterio- and Porto-graphy were subsequently fused. It took between 35 and 78 minutes to obtain the 3-D images.

Imaging interpretation of mesenteric vein tributaries

According to the reports of Yamaguchi et al[11] and Jin et al,[1] the right colic vein (RCV), superior right colic vein, and middle colic vein (MCV) were defined as those drained from the marginal vein of the ascending colon, right flexure of the colon, and the transverse colon, respectively.

The vein running along the right gastroepiploic artery was defined as the right gastroepiploic vein (RGEV). The GCT was defined as the confluent trunk composed of RGEV and drainage veins of each ascending colon, colonic right flexure, or transverse colon (RCV/SRCV/MCV).[11,12] The vein arising from the upper lesser curvature of the stomach was defined as the LGV. The vein draining the left-side colon and running in the retroperitoneal area was defined as the IMV.

Results

Five patients with gastric cancers were excluded from further analysis because visualization of the mesenteric arteries and veins was unsatisfactory. The reasons for unsatisfactory visualization were uneven enhancement, probably because of systemic atherosclerosis in 3 patients and severe obesity in 2.

The SMV trunk

The SMV was seen as a single major trunk around the splenoportal confluence in 78 patients (76.5%) (Fig. 1A and B, designated as type I). In such cases, only small veins such as the MCV or the IMV drained into the SMV between the splenoportal confluence and the GCT junction. As shown in Fig. 1A, the first jejunal vein (FJV) ran along the ventral side of the superior mesenteric artery (SMA) in 10 of 78