Case Report
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Preoperative CT Navigation of Perigastric Vessel Anatomy for Gastrectomy

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The aim of this report is showing the case that we could give exact navigation of perigastric vessels for gastrectomy with 3D CTA. A 74-year-old male patient visited hospital with gastric cancer. Early gastric cancer, type IIb was found at stomach antrum great curvature side. Before surgery, he underwent 3D CT angiography. 3D volume rendering images and MIP images were made by post processing. He had replaced Lt. hepatic artery arising from Lt. gastric artery. Surgeon could get patient's specific vascular anatomy before surgery including surgically relevant anatomical distance and direction and could finish gastrectomy within 4 hours and just 53ml blood loss.

Key Words MDCT · Laparoscopic gastrectomy · 3D CT angiography · Gastric cancer.

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Introduction

The complete resection of a gastric tumor and adjacent lymph nodes dissection is considered the only proven, effective curative treatment option.[1,2] For complete resection of the tumor, preoperative surgical planning is very important. Diagnoses through various imaging technology are replacing or supplementing invasive endoscopic and angiographic procedures.[3] By using images from computed tomography (CT), not only the disease extent, but also patient-specific anatomy can be obtained before the surgical procedure.[4] The introduction of image-guided procedures has allowed the application of image-guided surgery in accordance with the desire for minimally invasive procedures.[4,5] Recently, technical development of multidetector-row helical CT (MDCT) and 3-dimensional (3D) display represent significant advancement for preoperative staging and CT angiography for evaluation of perigastric vascular anatomy. Surgeon could get detail information about the patient's vascular anatomy and design of minimal invasive surgery with minimal unexpected bleed loss.[6]

Case Report

A 74-year-old male was visited out hospital with gastric cancer. He was referred to our hospital due to abnormal finding at stomach that was found at routine health check-up. He had no symptom related stomach. He underwent esophagogastroduodenoscopy (EGD). Early gastric cancer, type IIb was found at

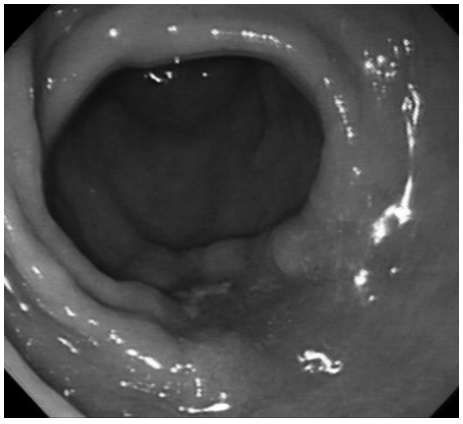

Fig. 1. A 74-year-old male underwent EGD and early gastric cancer, type IIb was found at stomach antrum great curvature side.

stomach antrum great curvature side (Fig. 1).

Computed tomographic (CT) scan was performed for accurate staging and preoperative planning. 64-detector row CT scanning (SOMATOM Sensation 64; Siemens Medical Solutions, Forchheim, Germany) was used. Before CT scanning, he received 10 mg butylscopolamine bromide (Buscopan; Boehringer Ingelheim, Ingelheim, Germany) intravenously through an antecubital vein to minimize bowel peristalsis and facilitate hypotonia. One and a half packs of gas-producing crystals (total 6 g) with a minimal amount of water (<10 mL) were administered orally immediately before CT scanning to obtain gastric distention. He received 150 mL contrast material (Omnipaque 300; GE Healthcare, Princeton, NJ, USA) intravenously using an automatic power injector at a rate of 3 mL/s. Scans were acquired in a craniocaudal direction with the following parameters: detector collimation of 64 rows× 0.6 mm, 0.5-s gentry rotation speed, pitch 1.0, and tube current of 120 kV (peak) and 160 mAs. A bolus-tracking program was used to commence diagnostic CT data acquisition after the intravenous injection of a contrast agent. The region-of-interest cursor for bolus tracking was placed in the descending aorta at the level of the first lumbar vertebra for real-time serial monitoring. Early arterial and portal phase images were commenced at 6 and 55 s, respectively after the trigger (trigger threshold level, 100 HU). Axial CT images were reconstructed with a 1-mm section thickness and a 1-mm interval for 3D reconstruction, and maximum intensity projection (MIP) images were also generated from the source images.

For 3D rendering and display, 1-mm section CT datasets were transferred to a workstation. Perigastric vessels encountered during gastrectomy were reconstructed using 3D software (Aquarius NET thin-client viewer, TeraRecon, San Mateo, CA, USA). The measurement of the distance from the reference points to specific vessels was made according to previous study.[6] The 3D volume set was manipulated using a different orientation and cut planes by adjusting the window level, center, brightness, and opacity to best demonstrate vascular structures around the stomach according to the operative view. MIP images were also used. Radiologist gave the information of location relation for perigastric vessels (Fig. 2).

At CT scan, primary stomach cancer lesion was not revealed. There was no significantly enlarged lymph node (LN) at regional area except small sized LNs. He had replaced Lt. hepatic artery arising from Lt. gastric artery (Fig. 2C).

Surgeon got full information about the patient's vascular anatomy before surgery. Surgeon performed routine robot assisted radical subtotal gastrectomy with gastrojejunostomy with D-2

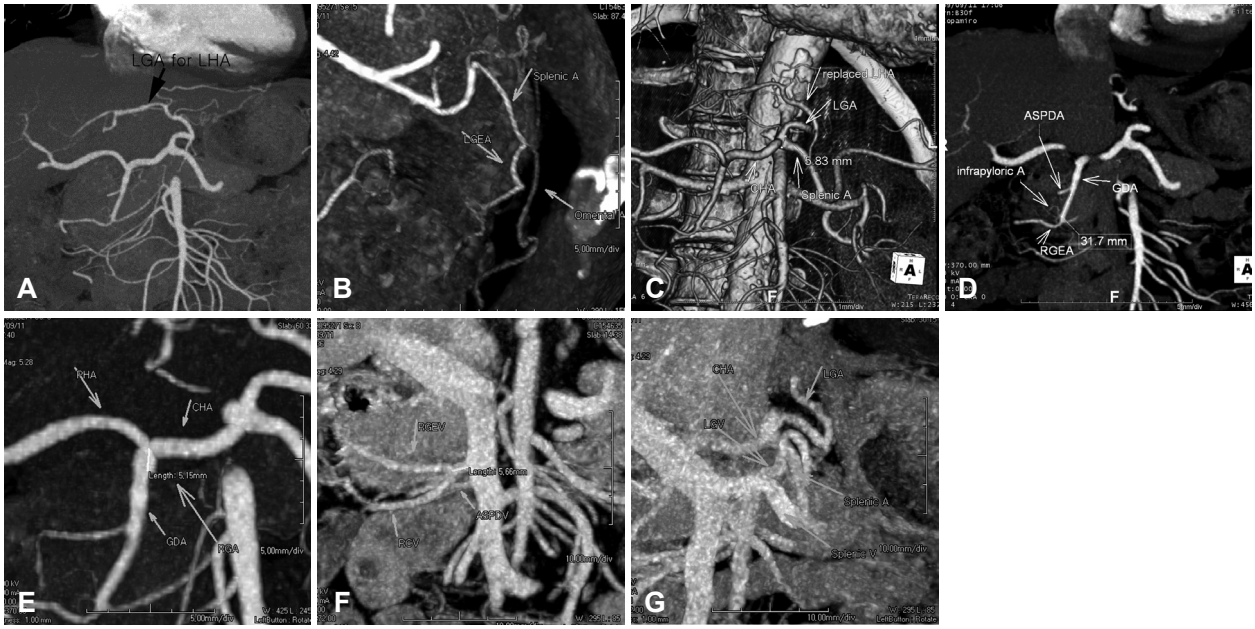

Fig. 2. A 74-year-old male with stomach cancer, CT scan image was reconstructed by 3D volume rendering reconstruction, and maximum intensity projection (MIP) images. Images were rotated for easy measurement of distance from reference point to interesting vessel. (A) MIP image that shows CHA branches and omental branch. (B) Omental branch origin. (C) 3D volume rendering image shows presence of replaced Lt. hepatic artery from Lt. gastric artery. This image shows also direction and distance from reference point (bifurcation of splenic artery and CHA) to origin of LGA. (D) Infrapyloric artery is small branch of ASPDA. MIP image shows well the origin of this artery and distance from GDA bifurcation. (E) RGA is also very small to recognaze the origin from usual CT scan. This MIP image shows origin of RGA and distnace from GDA origin. (F) Vein shows variable variation. Relation of gastrocolic trunk. (G) MIP image shows LGV drains to splenic vein in front of splenic artery.

LN dissection under the guidance of preoperative 3D CT images concurrent with the reconstruction of vascular images. During the operation, 3D reconstructed images from a preoperative CT scan integrated into the robot console and aligned with the real-time surgical view using the TilePro™ program. TilePro™ is a multi-input display mode of the Robotic surgical system (da Vinci®; Intuitive Surgical, Sunnyvale, CA, USA) that allows the surgeon to simultaneously view up to two additional images as a picture-on-picture on the robotic console screen and assistant monitors. In this way, the 3D reconstructed and/or MIP images were simultaneously presented on the surgeon console in the same direction of the real-time surgical view.

Surgery took 4 hours and total blood loss was just 53 mml. This stomach cancer was EGC type IIc+IIa, tubular adenocarcinoma, moderately differentiated, pT1b. There was no metastatic LN. Replaced Lt. hepatic artery was confirmed during operation.

Discussion

Laparoscopic surgery is technically challenging and requires a more detailed understanding of local anatomy than conventional open surgery. It may be helpful to preoperatively identify the perigastric vascular anatomy, including the right and left gastric artery, gastroepiploic artery, gastric vein and gastroepiploic vein for laparoscopic gastrectomy.[7-9] It is essential that the perigastric vessels should be confirmed first and ligated before dissecting lymph nodes. In this case, patient have replaced Lt. hepatic artery from Lt. gastric artery. We could know the presence of variation, distance and direction by 3D volume rendering image and MIP image, so surgeon could prevent accidental remove replaced Lt. hepatic artery that can cause hepatic ischemia (Fig. 2C). Vein have more variable variations at gastrocolic trunk than artery. In this case MIP image shows the distance and direction of gastrocolic trunk (Fig. 2F). So surgeon could expect the operation field and prevent unexpected bleeding during dissection. If the ligation of perigastric vessels is not performed in advance, the vessels can be erroneously injured during the nodal dissection, leading to massive bleeding that will prevent the surgeon from having a good view of the operative field.[10] Therefore, to safely ligate the arterial origins and veins and to dissect the lymph nodes under laparoscopic guidance, 3D CTA before laparoscopic gastrectomy is considered to be useful.[7,9,11] With conventional 2D reformat images we could know the presence of vessel variation, but these have limitation that cannot clearly show the direction of complex vessels. Furthermore, Lee et al. demonstrated that the mean operative time, mean blood loss and the rate of conversion to laparotomy due to uncontrollable hemorrhage tended to be lower in the preoperative 3D CT simulation group in comparison with the control group without the CT simulation.[12] In this case, blood loss was just 53 ml.

Conclusion

2D conventional CT scan is routine process for preoperative evaluation of stomach cancer. This method has some limitations of perigastric vascular anatomy evaluation. Preoperative 3D CTA could show the presence of vascular variation and also show direction and distance of personalized vascular structure. Therefore, preoperative 3D CT angiography could navigate the perigastric vessel anatomy for surgical planning. With this, surgeon could know what will see at op felid and design sophisticated complete resection with minimal bleed loss and without time consuming. These results would lead to rapid patient's recovery after surgery and less complication. Performing preoperative 3D CT angiography could be more effective and necessary process.

REFERENCES

1. Gore RM. Gastric cancer. Clinical and pathologic features. Radiologic clinics of North America 1997;35:295-310
2. Kim JP. Surgical results in gastric cancer. In: Seminars in surgical oncology: Wiley Online Library, 1999; 132-138.
3. Vannier MW, Haller JW. Navigation in diagnosis and therapy. European journal of radiology 1999;31:132-140
4. Benabid A, Hoffmann D, Le Bas J, Lavallee S. [value of image guided neurosurgery in neuro-oncology]. Bulletin du cancer 1995;82:573s-580s
5. Lim JS, Hyung WJ, Park M-S, Kim M-J, Noh SH, Kim KW. Imaging-guided minimally invasive laparoscopic resection of intraluminal small-bowel tumor: Report of two cases. American Journal of Roentgenology 2007;189:56-60
6. Kim YM, Baek S-E, Lim JS, Hyung WJ. Clinical application of image-enhanced minimally invasive robotic surgery for gastric cancer: A prospective observational study. Journal of Gastrointestinal Surgery 2013;17:304-312
7. Takiguchi S, Sekimoto M, Fujiwara Y, Yasuda T, Yano M, Hori M et al. Laparoscopic lymph node dissection for gastric cancer with intraoperative navigation using three-dimensional angio computed tomography images reconstructed as laparoscopic view. Surg Endosc 2004;18:106-110
8. Matsuki M, Kani H, Tatsugami F, Yoshikawa S, Narabayashi I, Lee SW, et al. Preoperative assessment of vascular anatomy around the stomach by 3d imaging using mdct before laparoscopy-assisted gastrectomy. AJR Am J Roentgenol 2004;183:145-151
9. Lee SW, Shinohara H, Matsuki M, Okuda J, Nomura E, Mabuchi H, et al. Preoperative simulation of vascular anatomy by three-dimensional computed tomography imaging in laparoscopic gastric cancer surgery. J Am Coll Surg 2003;197:927-936
10. Uyama I, Sugioka A, Fujita J, Komori Y, Matsui H, Soga R et al. Completely laparoscopic extraperigastric lymph node dissection for gastric malignancies located in the middle or lower third of the stomach. Gastric Cancer 1999;2:186-190
11. Matsuki M, Tanikake M, Kani H, Tatsugami F, Kanazawa S, Kana-

moto T, et al. Dual-phase 3d ct angiography during a single breath-hold using 16-mdct: Assessment of vascular anatomy before laparoscopic gastrectomy. AJR Am J Roentgenol 2006;186:1079-1085
12. Lee IJ, Lee JM, Kim SH, Shin C-I, Lee JY, Kim SH et al. Diagnostic performance of 64-channel multidetector ct in the evaluation of gastric cancer: Differentiation of mucosal cancer (t1a) from submucosal involvement (t1b and t2)1. Radiology 2010;255:805-814