



Original article

Confirmation of the posterior gastric artery using multi-detector row computed tomography

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Abstract

Background. The blood supply of the stomach is well characterized. Although the posterior gastric artery (PGA) is the second most important artery supplying the upper third of the stomach, the main features and clinical importance of the PGA have not been established. The aim of this study was to use multi-detector row computed tomography (MD-CT) to investigate the features of the PGA with respect to its incidence, location and size, and to correlate the findings with clinical practice.

Methods. In August 2004, 50 preoperative patients (33 men and 17 women) were evaluated prospectively by MD-CT. Informed consent for the present study was accepted at Kochi Medical School. The length of the PGA, from the root of the splenic artery, and the internal diameter of the PGA were examined. Correlations between body mass index (BMI) and the observed features of the PGA were investigated.

Results. The PGA was recognized in all patients. In 49 (98%) patients, the PGA branched from the splenic artery. In 1 (2%) patient, the PGA originated from the root of the celiac trunk. The PGA was discernible for a length of 4.2–14.3 cm (mean, 9.1 cm) from the root of the splenic artery, and the internal diameter of the PGA was 0.5–2.1 mm (mean, 1.0 mm). BMI did not correlate with PGA length or internal diameter.

Conclusion. Our current study suggested that the anatomical and clinical features of the PGA can be shown by clinical methods, and that these features are useful in planning surgical treatment.

Key words Posterior gastric artery (PGA) · Multi-detector row computed tomography (MD-CT) · Gastric carcinoma · Lymph node metastasis

Introduction

The blood supply of the stomach is well characterized [1–3]. The upper third of the stomach is vascularized by four well-anastomosed main arteries, the left gastric artery, which is the main blood supply of the upper stomach; the posterior gastric artery (PGA); which branches from the splenic artery; the short gastric artery; and the gastroepiploic artery. Although the PGA is the second most important artery supplying the upper third of the stomach, the main features and clinical importance of the PGA are not well established [1,3–9].

The incidence of carcinoma of the gastric cardia is increasing in Japan and in the West [10]. To understand the mechanisms determining the prognosis of gastric carcinoma of the upper third of the stomach, it is important to establish the features and clinical importance of the PGA, as lymphatic drainage vessels connect to the left gastric artery and branches of the splenic artery [11]. The reported incidence of the PGA ranges from 36% to 84% [1,3–9]. Contrary to these reports, our previous study, using digital subtraction angiography (DSA), indicated that almost all men had a PGA [12].

The purpose of the present study was to clarify the features of the PGA, including its incidence, location, and size, using multi-detector row computed tomography (MD-CT), and to correlate the findings with clinical practice [13–19].

Patients, materials, and methods

In August 2004, 50 preoperative patients at our department (33 men and 17 women) were evaluated prospectively by MD-CT. Patients selected for this study had not undergone previous surgical procedures and had provided informed consent to Kochi Medical School. Of these 50 patients, 18 had primary liver carcinoma, 16 had gastric carcinoma, 5 had carcinoma of the biliary

tract, 4 had pancreatic carcinoma, 4 had colorectal carcinoma, 2 had renal cell carcinoma, and 1 had hepatolithiasis. In the 18 patients with liver carcinoma, the incidence of viral liver cirrhosis was 83.3% (14 patients had serum hepatitis C antibody and 1 had serum hepatitis B surface antigen).

Imaging analyses were performed using MD-CT technology, as it has superior diagnostic capability compared with earlier angiography systems. Three-dimensional reconstructions of MD-CT images were made and used to prospectively search for features of the PGA. A radiologist and surgeons provided confirmation of the PGA. The length of the PGA, from the root of the splenic artery, and the internal diameter of the PGA were examined. The body mass index (BMI) was calculated by dividing the weight in kilograms by the square of the height in meters. Correlations between BMI and the observed features of the PGA were investigated.

The findings were compared by the χ^2 test. A level of $P < 0.05$ was considered significant. Correlations between the BMI and the length or internal diameter of the PGA were calculated using the Pearson product moment.

Results

Of the 50 patients evaluated in this study, 33 were men and 17 were women, ranging in age from 29 to 90 years (mean, 68.8 years). The PGA was recognized in all patients. In 49 (98%) patients, the PGA branched from the splenic artery (Fig. 1). In 1 (2%) patient, the PGA originated from the root of the celiac trunk (Fig. 2).

The features of the PGA branching from the splenic artery are shown in Table 1. The PGA was discernible for a length of 4.2–14.3 cm (mean, 9.1 cm) from the root of the splenic artery, and the internal diameter of the PGA was 0.5–2.1 mm (mean, 1.0 mm). The length of the PGA from the root of splenic artery in males and females was 4.2–14.3 cm (mean, 9.0 cm) and 6.1–13.8 cm (mean, 9.2 cm), respectively. The internal diameter of the PGA in males and females was 0.5–2.1 mm (mean, 1.0 mm) and 0.5–2.1 mm (mean, 0.9 mm), respectively. There was no significant difference in either the length or the internal diameter of the PGA with respect to sex or age.

Consistent with our previous report [12], BMI did not correlate with the PGA length ($r = 0.092$) or internal diameter ($r = 0.018$).

Discussion

Blood supply to the stomach is well characterized [1–3]. The key nutritional blood vessel of the upper third of

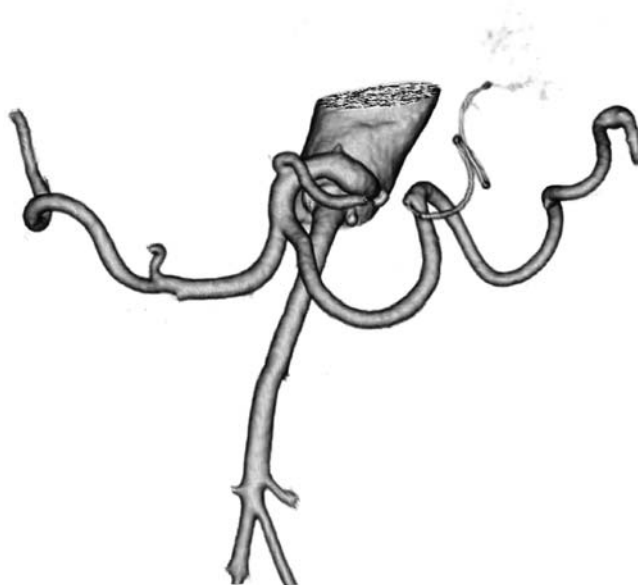


Fig. 1. Posterior gastric artery has branched from the splenic artery

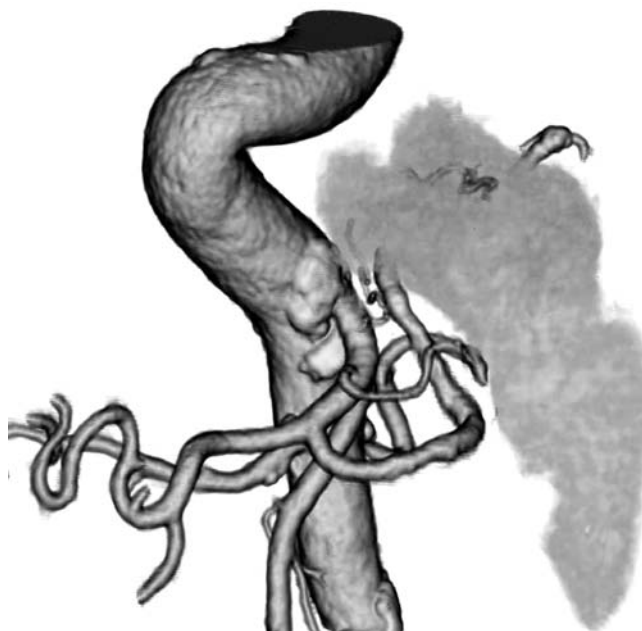


Fig. 2. Posterior gastric artery originated from the root of the celiac trunk

the stomach is the left gastric artery, followed by the PGA, the short gastric artery, and the left gastroepiploic artery. Although the PGA is the second most important artery supplying the upper third of the stomach, the main features and clinical importance of the PGA are not well established, and reports on the incidence of PGA are limited and inconsistent, ranging from 36% to

Table 1. Features of PGA, using MD-CT

Characteristics	No. of patients	Mean distance from root of SA (cm)	Mean internal diameter of PGA (mm)	<i>P</i> value
Overall	49	9.1 (4.2–14.3)	1.0 (0.5–2.1)	
Sex				
Male	33	9.0 (4.2–14.3) ¹⁾	1.0 (0.5–2.1) ³⁾	¹⁾⁻²⁾ 0.4154
Female	16	9.2 (6.1–13.8) ²⁾	0.9 (0.5–2.1) ⁴⁾	³⁾⁻⁴⁾ 0.2373
Age (years)				
≤70	30	9.3 (4.2–14.0) ⁵⁾	1.0 (0.5–2.0) ⁷⁾	⁵⁾⁻⁶⁾ 0.5137
>70	19	8.7 (4.8–14.3) ⁶⁾	1.0 (0.5–2.1) ⁸⁾	⁷⁾⁻⁸⁾ 0.8507

Figures in parentheses are ranges

SA, splenic artery; PGA, posterior gastric artery

84% [1,3–9]. Historically inaccurate detection of the PGA may account for these findings. In the present study, the PGA was detected using MD-CT imaging analysis technology, due to its superior diagnostic capability compared with earlier angiography systems.

Furthermore, the present study employed a strategy in which abdominal surgeons and a radiologist cooperated in the interpretation of results [13–19].

Our previous study, using DSA, indicated that almost all men had a PGA [12]. These findings are inconsistent with other previous reports on the incidence of the PGA [1,3–9]. In the present study, the average length of the PGA was found to be 9.1 cm, which is significantly longer than our previous finding of 5.4 cm, using DSA [12]. Because DSA measures the length of the PGA according to the direction of a tangent, the results obtained with this method are not considered to truly reflect the *in vivo* situation. The present study supported our previous findings that the PGA usually (in 98% of patients) branches from the splenic artery. However, according to previous researchers, several patterns of the PGA have been reported, showing that the PGA branched not only from the splenic artery but also from the celiac trunk or the superior polar artery [4,8]. These results are important, as an increase in the understanding of the features of PGA increases the success of operations involving the PGA. The length from the root of the splenic artery and the internal diameter of the PGA were not significantly different between males and females, and these measurements showed no correlations with height, weight, or BMI.

Of note, the flow of lymph is the route for lymph node metastasis in gastric cancer. Most major lymphatic vessels in the upper third of the stomach are found along the left gastric artery and then proceed along the PGA and short gastric artery [11]. One of the important issues about the PGA is the number of lymph nodes along the PGA, and metastasis along the PGA. Previous authors have reported that the incidence of lymph node metastasis along the splenic artery ranged from 19.1% to 31.3% [20,21]. At our institute, from 1981 to the end of

Table 2. Incidence (%) of lymph node metastases of gastric carcinoma

	n0	n1	n2	n3	Overall
t1	91.5	7.2	0.9	0.4	446
t2	49.3	30.3	12.7	7.7	221
t3	15.3	31.5	32.3	20.9	124
t4	20.7	27.6	31.0	20.7	29
Overall	542	146	81	51	820

n0, n1, n2, and n3 were defined according to the *Japanese classification of gastric carcinoma* by the Japanese Gastric Cancer Association (13th edition) [22]

t1, tumor is confined to the mucosa and/or submucosa; t2, tumor invades muscularis propria or subserosa; t3, tumor invades and penetrates serosa without invasion of adjacent structures; t4, tumor invades adjacent structures

2003, 820 patients with gastric carcinoma underwent gastrectomy with D2 or D3 lymph node dissection for curative resection. The incidence of lymph node metastasis in these patients is summarized in Table 2. The incidence of lymph node metastasis along the splenic artery (no. 11) in the current study was 17.9%. The lymph nodes of the domain located along the proximal splenic artery are classified as n2 according to the *Japanese classification of gastric carcinoma* [22] or TNM.

Interestingly, the PGA of only one of our patients (2%) originated directly from the root of the celiac trunk, and this can be considered an anatomical variation (Fig. 2). Of the patients with confirmed lymph node metastases, five had lymph node metastases at the n2 lymph node station, and not at the n1 lymph node station, according to the *Japanese classification of gastric carcinoma* [22]. Lymph node metastases were observed along the proximal splenic artery (no. 11) in two patients, along the left gastric artery (no. 7) in two patients, and along the common hepatic artery (no. 8) in one patient. Lymph node metastases located at the n2 lymph node station and not at the n1 station may involve anatomical variation. The incidence of lymph node metastases in patients with an advanced stage of

gastric carcinoma (t2, t3, or t4 tumor) was 64.2%. As lymph node metastasis is one of the main factors determining the prognosis of patients with gastric carcinoma, it is considered important that standard gastrectomy with D2 lymph node dissection be performed for patients with gastric carcinoma where the sentinel lymph node cannot be identified, and for those with advanced-stage gastric carcinoma [23–29].

The capacity for early detection of gastric carcinoma has increased gradually according to progress in diagnostic techniques and equipment. Early gastric carcinoma accounts for 4%–16% of all gastric carcinoma cases in the West, and 30%–50% in Japan [30–32]. The findings from the present study are important, as less invasive and more successful surgery for early gastric carcinoma is possible with both an accurate knowledge of sentinel lymph node location in gastric carcinoma and an understanding of anatomical variation. Findings from this study also highlight the importance of sophisticated technology, such as MD-CT, to allow the identification of sentinel lymph node location [33–35].

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