Autopsy study of anatomical features of the posterior gastric artery for surgical contribution

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Abstract

AIM: To investigate features of the posterior gastric artery (PGA) with respect to incidence, location and size by using autopsy subjects.

METHODS: Autopsies were performed on 72 cadavers of adults with no history of abdominal operations. The localization of the PGA, the distance between the root of the splenic artery and the origin of the PGA, and the external diameter of the PGA were examined.

RESULTS: The PGA was recognized in all patients. In 70 (97.2%) cadavers, the PGA branched from the splenic artery, and one female in this group had two PGAs. In 1 (1.4%) patient, the PGA originated from the root of the celiac trunk and in another (1.4%) patient, the PGA branched from the superior polar artery. Overall, the PGA extended for a length of 5.8-12.2 (mean, 8.4) cm from the root of the splenic artery, and the external diameter of the PGA was 1.2-3.2 (mean, 2) mm.

CONCLUSION: The anatomical features of the PGA can be readily observed and characterized by autopsy. This study has provided valuable information on the features of the PGA useful in the planning of surgical treatment.

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Key words: Posterior gastric artery; Gastric carcinoma; Autopsy

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INTRODUCTION

Blood is supplied to the stomach via four main arteries including the right/left gastric artery, the right/left gastroepiploic artery, the short gastric artery, and the posterior gastric artery (PGA)\textsuperscript{[1,2]}. While surgeons pay a great deal of attention during upper gastric operations to the PGA, due to the technical attending point and potential for cancer metastasis to lymph nodes, their knowledge of PGA features and characteristics stems from experience only\textsuperscript{[1,3-10]}. Traditional or anatomical charts lack information on the anatomical features of the PGA\textsuperscript{[11-14]}. Therefore, the aim of the present study was to investigate features of the PGA with respect to incidence, location and size using autopsy subjects.

MATERIALS AND METHODS

Subjects

Autopsies were performed on 72 cadavers of adults with no history of abdominal operations. Of the 72 cadavers evaluated in this study, 33 were men and 39 were women, ranging in age from 45 to 98 (mean, 77.6) years. Cadavers were preserved by injection of 40 g/L formaldehyde solution.

Methods

Once the abdominal cavity was opened, the celiac trunk was identified following tissue dissection of the hepatoduodenal ligament in the direction of the pancreatic head along the common hepatic artery. The splenic artery was then carefully dissected from its origin to the hilum of the spleen and its branches, including the superior and inferior polar arteries, which were identified. Special attention was paid to the vessels of the posterior wall of the stomach. For each of these arteries, the origin, caliber, length, branching, and distribution were observed and measured directly. We determined the length of the splenic artery from the root to the hilum of the spleen.
to its branching point into the superior and inferior polar arteries. Identification of the PGA was performed by experienced upper digestive tract surgeons from the Kochi Medical School.

**Statistical analysis**

The findings were compared by the unpaired *t*-test. *P* < 0.05 was considered significant.

**RESULTS**

The PGA was recognized in all cadavers. In 70 (97.2%) of 72 cadavers, the PGA branched from the splenic artery, except for 2 cadavers (2.8%). One female cadaver had two PGAs that branched from the splenic artery. The PGA originated from the root of the celiac trunk in one (1.4%) cadaver, and originated from the superior polar artery in another (1.4%). The length of the splenic artery was 11.8-18.8 (mean, 15.3) cm. Thus, there were no significant differences in the length of the splenic artery according to gender or age (Table 1).

The features of branching of the PGA from the splenic artery are summarized in Table 1. The length between the root of the splenic artery and the point of branching of the PGA ranged between 5.8-12.2 (mean, 8.4) mm, the shortest being about half the length of the longest. The length of the PGA from its origin at the splenic artery in males and females was 5.8-12.2 (mean, 9.0) cm and 6.2-10.8 (mean, 8.3) mm, respectively. The external diameter of the PGA in males and females was 1.5-3.2 (mean, 2.1) mm and 1.2-3.0 (mean, 2.0) mm, respectively. Overall, the external diameter of the PGA ranged between 1.2-3.2 (mean, 2.0) mm. There was no significant difference in the length or external diameter of the PGA with respect to gender or age.

**DISCUSSION**

The blood supply of the stomach is well described. In the upper part of the stomach, the most important nutritional blood vessel is the left gastric artery, followed by the PGA, short gastric artery, and left gastroepiploic artery. Although the PGA is one of the most important vessels supplying the upper third of the stomach the anatomical features of the PGA are not well established. Based on diagnostic imaging the incidence of the PGA is reported to range from 36% to 86%. These results are inconsistent with our previous findings using digital subtraction angiography (DSA) and multi-detector row computed tomography (MD-CT) which indicate that almost all men have a PGA. In the present study, the incidence of the PGA was further investigated together with features of the PGA, including location and size, using autopsy investigations by experienced upper digestive tract surgeons.

We found that all men had a PGA and the average distance between the root of splenic artery and the origin of the PGA, was 8.4 cm, which is not significantly shorter than our previous findings of 9.1 cm using MD-CT (*P* = 0.1057). The present results support our previous finding that the PGA usually (97.2% of humans) branches from the splenic artery. According to previous reports, there are several different branching patterns of the PGA with PGA branching not only from the splenic artery but also from the celiac trunk or superior polar artery. In our previous study, using DSA and MD-CT, it was not possible to examine the relationship between the PGA and the superior polar artery. In the present study anatomical variation of the PGA was revealed by autopsy examination. In one person (1.4%) the PGA originated directly from the root of the celiac trunk and in another person (1.4%) the PGA originated from the superior polar artery.

The average external diameter of the PGA was 2.0 mm with a range of 1.2-3.2 mm, which is significantly larger than our previous finding of 1.0-1.4 mm for the internal diameter using DSA or MD-CT (*P* < 0.01). Due to its significant size, the PGA was recognized by surgeons during operation of the upper digestive tract. It is important for surgeons to be aware of the anatomical variations of the PGA, including those identified in the present study in which the PGA originated from the root of the celiac trunk or from the superior polar artery.

The incidence of adenocarcinoma of gastric cardia and/or the upper third of the stomach has recently increased in Japan as in the West. Of note, lymph node metastasis in gastric cancer is via the major lymphatic vessels in the upper third of the stomach along the left gastric artery, the PGA, and the short gastric artery. Since lymph node metastasis is one of the main factors determining the prognosis of patients with gastric carcinoma, it is considered important that lymph nodes along the left gastric artery and the PGA be carefully observed and dissected when gastrectomy with regional lymphadenectomy is performed for patients with gastric carcinoma. In gastric carcinoma it is important to identify the PGA, not only to perform an accurate lymphadenectomy, but especially to avoid vascular complications. The high incidence of the PGA (as here reported) and its hidden origin create a significant risk of dangerous bleeding if damaged. Awareness of this anatomical structure during stomach surgery would help minimize vascular complications. Although we did not clarify the contribution of lymph nodes associated with the PGA in this case, it is likely that lymph node metastases

| Characteristic | n | Length of SA (cm) | Distance from root of SA (cm) | External diameter of PGA (mm) | P |
|---------------|---|-------------------|-----------------------------|-----------------------------|---|
| Overall       | 80 | 15.3 (11.8-18.8)  | 8.4 (5.8-12.2)              | 2.0 (1.2-3.2)               | 0.0963 |
| Gender        |    |                   |                             |                             | 0.2274 |
| Male          | 40 | 15.6 (12.7-18.8)  | 8.6 (5.8-12.2)              | 2.1 (1.5-3.2)               | 0.2462 |
| Female        | 40 | 15.1 (11.8-18.2)  | 8.3 (6.2-10.8)              | 2.0 (1.2-3.0)               | 0.6897 |
| Age (yr)      |    |                   |                             |                             | 0.3485 |
| < 80          | 31 | 15.3 (12.7-18.8)  | 8.5 (6.2-12.2)              | 2.0 (1.2-3.0)               | 0.4985 |
| ≥ 80          | 49 | 15.4 (11.8-17.9)  | 8.3 (5.8-10.1)              | 2.1 (1.3-3.2)               | 0.7876 |

SA: Splenic artery; PGA: Posterior gastric artery. All *P* values were non-significant between males and females, between < 80 yr and ≥ 80 yr for length of SA (cm), distance from root of SA (cm), and external diameter of PGA (mm). Data are expressed as mean (range).
are associated with the PGA. Findings from the present study provide valuable information towards understanding anatomical variation of the PGA. To fully investigate the features of the PGA requires further collection and evaluation of data.

In conclusion, the present study shows that anatomical features of the PGA can be observed and evaluated efficiently by autopsy investigations and has provided valuable information on the features of the PGA useful in the planning of surgical treatment.

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