


Safety and Feasibility of No.12a Lymph Node Dissection by Portal Vein Approach in Radical Laparoscopic Gastrectomy for Gastric Cancer

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Abstract

Background: Traditional laparoscopic No.12a lymph node dissection in radical gastrectomy for gastric cancer may damage the peripheral blood vessels, and is not conducive to the full exposure of the portal vein and the root ligation of the left gastric vein. We recommend a new surgical procedure, the portal vein approach, to avoid these problems. **Methods:** 25 patients with advanced gastric cancer underwent radical laparoscopic gastrectomy and No.12a lymph node were dissected by portal vein approach, including 7 cases with total gastrectomy, 18 cases with distal gastric resection, 14 males and 11 females. Operative time, intraoperative blood loss, time to first flatus, postoperative hospital stay, number of total lymph node dissection and No.12a lymph node dissection, No.12a lymph node metastasis rate and postoperative complications were statistically observed. **Results:** All the patients were operated successfully and No.12a lymph node were cleaned by portal vein approach. A total of 683 lymph nodes were dissected, with the average number of lymph nodes dissection and positive lymph nodes were (27.3 ± 12.7) and (3.8 ± 5.6) respectively. The average number of No.12a lymph node dissection was (2.4 ± 1.95) and the metastasis rate of No.12a lymph node was 16% (4/25). The average operation time of radical laparoscopic distal and total gastrectomy were (239.2 ± 51.4) min and (295.1 ± 27.7) min respectively. The mean intraoperative blood loss was (134.0 ± 65.7) ml, and postoperative first anal exhaust time was (2.24 ± 0.86) d. The mean time to fluid intake was (4.2 ± 1.7) d, and postoperative hospitalization time was (9.6 ± 5.0) d. Without portal vein injure, anastomotic leakage, gastrointestinal bleeding, intestinal obstruction and other complications were observed in all patient. **Conclusion:** Our results show that the laparoscopic No.12a lymph node dissection by portal vein approach for gastric cancer is safe, feasible and has certain clinical application value.

Keywords

No.12a lymph node, portal vein approach, gastric cancer, lymphadenectomy, laparoscopic surgery

Abbreviations

GC, gastric cancer; AGC, advanced gastric cancer; CHA, common hepatic artery; GDA, gastroduodenal artery; SD, standard deviation; AJCC, American Joint Cancer Commission.

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Introduction

Despite the rapid development of medical diagnosis and treatment technology in recent decades, gastric cancer (GC) is still one of the most common malignant tumors in the world, with approximately 950,000 new cases (high morbidity) and 720,000 deaths (high mortality) each year.^{1,2} Except for a few countries, such as Japan and South Korea, most countries have a low diagnosis rate of early GC due to lack of regular

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screening. Once diagnosed, the vast majority of patients have advanced gastric cancer (AGC) with high lymph nodes metastasis rate.³ For a long time, radical gastrectomy is the most important method to treat GC and achieve long-term survival. In recent years, laparoscopic technology has developed rapidly, and laparoscopic gastrectomy with D2 lymphadenectomy has been recognized by the world medical community.⁴⁻⁷ How to regularly, thoroughly and safely perform laparoscopic lymphadenectomy for GC is crucial for the therapeutic effect and prognosis of patients.

Superior pancreatic lymph nodes dissection, including No. 7, 8a, 9, 11p and 12a lymph nodes, are the focus and difficulty of radical laparoscopic gastrectomy with D2 lymphadenectomy due to their complex anatomical structure and many important blood vessels, such as celiac artery, common hepatic artery (CHA) and portal vein.⁸ For the dissection of No.12a lymph node, there are different opinions between eastern and western countries.⁹⁻¹¹ No. 12a lymph node refer to the lymph nodes located in the hepatoduodenal ligament and distributed along the proximal side of the proper hepatic artery. Because of the complex local anatomical relationship, there is no unified understanding of the exact boundary of No.12a lymph node. According to the Japanese gastric cancer treatment guidelines and Japanese classification of gastric carcinoma,^{11,12} the recognized borders are as follows: the anterior lobe of the hepatoduodenal ligament is the anterior border, the anterior wall of the portal vein is the posterior border, the confluence of the left and right hepatic ducts is the upper border, the beginning of the gastroduodenal artery (GDA) is the lower border (the upper edge of the pancreas), the left border of the common bile duct is the right border, and the left border is the left margin of hepatoduodenal ligament.

The traditional method of laparoscopic No.12a lymph node dissection is guided by the GDA, first exposing the CHA and the proper hepatic artery, cut off the right gastric artery at the root, then expose the left wall of the portal vein, and perform the anterior lymph nodes dissection of the portal vein. This method may damage the peripheral blood vessels near the proper hepatic artery and the origin of GDA, and is not conducive to the full exposure of the portal vein and the root ligation of the left gastric vein. Based on the clinical data and practice of laparoscopic No.12a lymph node dissection in 25 patients with AGC from May 2018 to February 2019 in our hospital, we summarized the safety, feasibility and clinical application value of No.12a lymph node dissection through portal vein approach, which facilitated the operation and reduced the incidence of surgical accidents.

Materials and Methods

Patients

From May 2018 to February 2019, 25 patients with AGC who underwent laparoscopic No.12a lymph node dissection through portal vein approach in Department of Gastrointestinal Surgery of Guangdong hospital of traditional Chinese medicine were

Table 1. Patient Characteristics.

Variables	Statistical value
Gender	
Male	14 (56%)
Female	11 (44%)
Age, years	57.6 ± 9.1
BMI	22.8 ± 2.1 kg/m ²
ASA scope	
I	18 (72%)
II	5 (20%)
III	2 (8%)
Operative method	
Distal gastrectomy	18 (72%)
Total gastrectomy	7 (28%)

eligible for the study, including 7 cases of total gastrectomy and 18 cases of distal gastrectomy, 14 males and 11 females, with an average age of 57.6 ± 9.1 years, a body mass index of 22.8 ± 2.1 kg/m² and an ASA score of preoperative anesthesia ranging from I to III (Table 1). All patients were diagnosed as adenocarcinoma by gastroscopic pathological biopsy before operation, and no distant metastasis was found by preoperative auxiliary examination. The study was approved by the Ethics Committee of Guangdong hospital of Traditional Chinese medicine. The patients and their families were fully communicated and signed the informed consent before operation.

Inclusion and Exclusion Criteria

Inclusion criteria: (1) The patients' clinical stage was cT2-4NxM0 by preoperative imaging evaluation. (2) Patients underwent radical laparoscopic gastrectomy with D2 lymphadenectomy (total or distal gastrectomy). No.12a lymph node dissection was performed by portal vein approach (3) Postoperative pathological examination confirmed that the specimen was AGC. (4) The clinicopathological data were complete.

Exclusion criteria: (1) Postoperative pathology was non-AGC. (2) Unable to tolerate laparoscopic surgery. (3) Lack of clinicopathological data.

Technical Points

Portal vein approach: When dissecting No.12 lymph node in the superior pancreatic region, the portal vein should be exposed preferentially in the non-vascular area between the CHA, GDA and pancreas. Then the anterior lymph nodes of the portal vein were dissected and the left gastric vein was cut off at the root.

No.12a Lymph Node Dissection

The patients' position, operators' stance and position of trocars consistent with traditional laparoscopic D2 lymphadenectomy for GC.⁴ The portal vein is preferentially exposed during

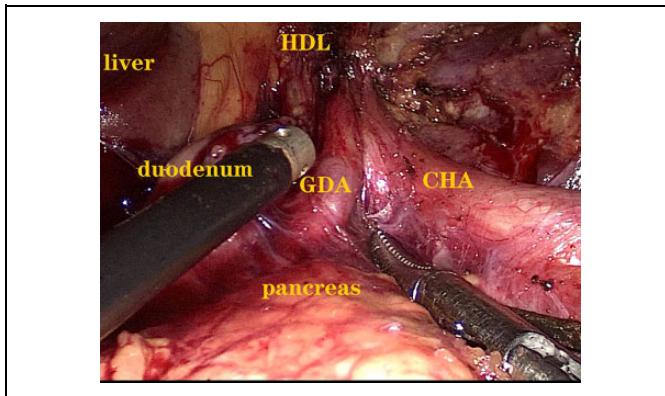


Figure 1. Anatomical exposure of portal vein in the avascular area between the common hepatic artery, gastroduodenal artery and pancreas. CHA: Common hepatic artery, GDA: Gastroduodenal artery, HDL: hepatoduodenal ligament.

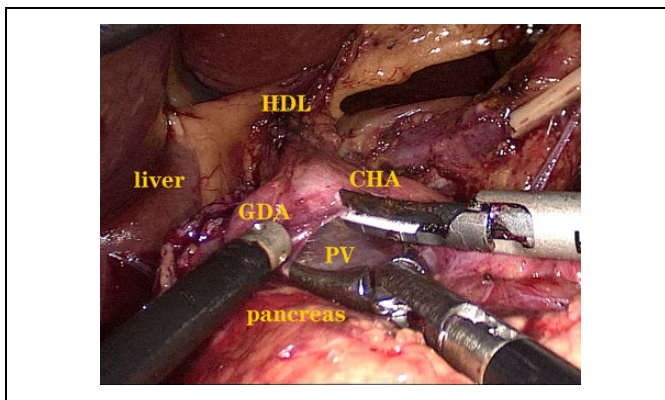


Figure 2. Exposure of portal vein. PV: portal vein.

dissection of the superior pancreatic lymph nodes. Surgical procedures were as follows: after the right gastroepiploic artery was severed, the CHA was exposed upward along the GDA, and the portal vein was exposed in the non-vascular area between the CHA, GDA and the pancreas (Figures 1 and 2). The space between the portal vein and the CHA and the proper hepatic artery was extended to the cephalic side, and the lymph nodes anterior to the portal vein were cleared (Figure 3A, B). When exposing the left wall of the portal vein, if the left gastric vein is visible here entering the portal vein, root ligation (visible in some patients) should be performed (Figure 4A, B). Then the hepatoduodenal ligament was dissected in the upper the CHA to penetrated the anterior space of the portal vein, and the No.12 lymph nodes were thoroughly cleaned (Figure 5) (Supplementary video 1).

Specimen Processing

Lymph nodes were collected and managed according to Japanese classification of gastric carcinoma, fixed with 10% neutral formaldehyde, and pathological examination was performed.

Statistical Analysis

Data are presented as the mean \pm standard deviation for continuous variables (for those with non-normal distributions, medians and ranges are shown) and as numbers (%) for categorical variables. Statistical analyses were performed using SPSS version 20.0 (SPSS, Chicago, IL, USA).

Results

In this study, all 25 patients with AGC underwent radical laparoscopic gastrectomy, and no patients were transferred to laparotomy or died after surgery. Postoperative pathology showed a total of 683 lymph nodes were dissected, with the average number of lymph nodes dissection and positive lymph nodes were (27.3 ± 12.7) and (3.8 ± 5.6) respectively. The average number of No.12a lymph node dissection was (2.4 ± 1.95) and the metastasis rate of No.12a lymph node was 16% (4/25). The mean diameter of the tumor was (4.6 ± 2.8) cm. The tumor stage was 15 cases in stage II and 10 cases in stage III. The mean operative time of distal gastrectomy was (239.2 ± 51.4) min, and total gastrectomy was (295.1 ± 27.7) min. The mean intraoperative blood loss was (134.0 ± 65.7) ml, and postoperative first anal exhaust time was (2.24 ± 0.86) d. The mean time to resume the liquid diet was (4.2 ± 1.7) d, and postoperative hospital stay was (9.6 ± 5.0) d. There were 2 cases of pulmonary infection after operation in 25 patients (the complication rate was 8%) and they were cured after conservative treatment. No portal vein injure, anastomotic leakage, gastrointestinal bleeding and intestinal obstruction were recorded in all patient (Table 2).

Discussion

Laparoscopic surgery has been developed in GC for more than 20 years, with the advantages of minimally invasive, rapid recovery and less bleeding. With the maturity and standardization of laparoscopic technology, laparoscopic surgery for GC has become more and more popular.¹³ Radical laparoscopic gastrectomy for AGC is a research hotspot in minimally invasive surgery.^{5,14} However, due to the abundant supply vessels of the stomach, complicated anatomical layers and lymph node dissection, the operation is relatively difficult and with long-time learning curve. In order to achieve better clinical results and reflect the minimally invasive advantages of laparoscopic surgery, surgeons must master the technology of laparoscopic lymph node dissection of GC. It is the key issue to choose the right operative approach and perform lymph node dissection accurately and thoroughly for effective radical laparoscopic gastrectomy.¹⁵

TNM staging system is the most commonly used system to predict survival for GC patients. N staging has experienced significant changes. The latest N staging, which formulated by the American Joint Cancer Commission (AJCC), the International Alliance for Anti-Cancer (UICC) and the Japanese Gastric Cancer Association, was determined by the number of

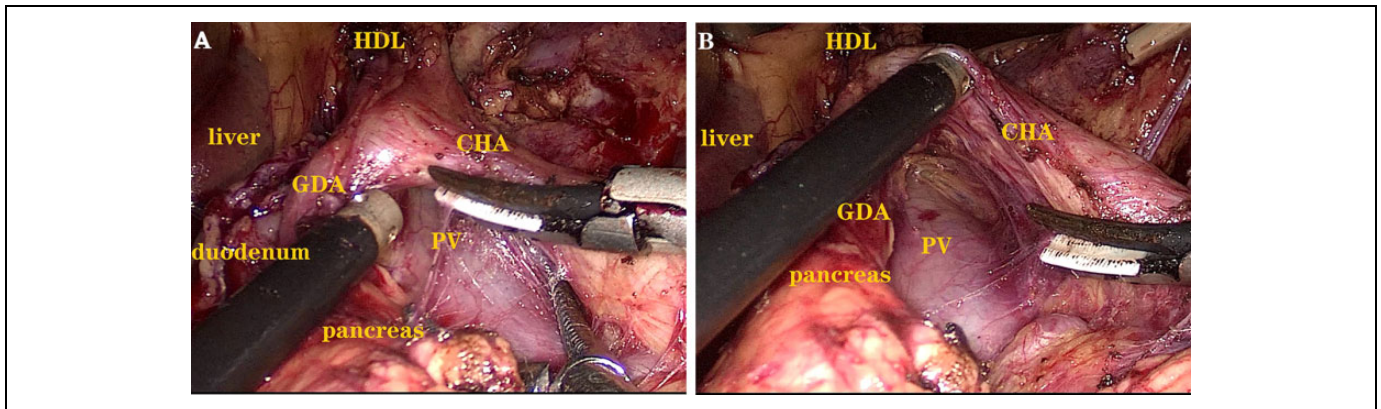


Figure 3. No.12a lymph node dissection in front of portal vein.

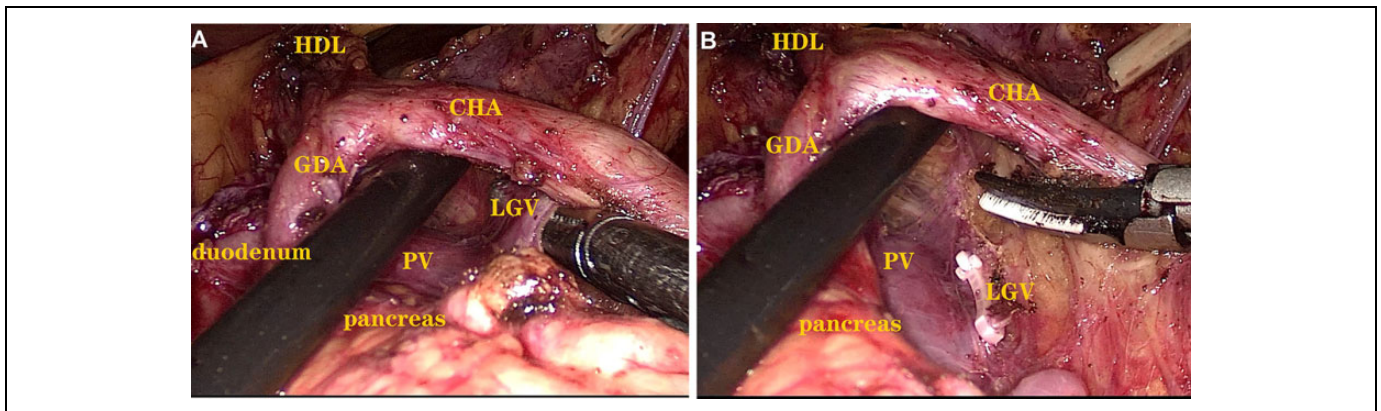


Figure 4. Exposure and root ligation of left gastric vein. LGV: Left gastric vein.

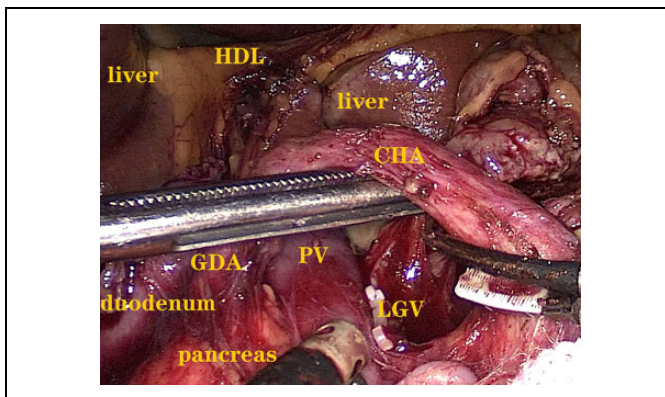


Figure 5. The scene after No.12a lymph node dissection.

metastatic lymph nodes instead of by the location of metastatic lymph nodes and the distance from the primary lesion.^{16,17} It requires surgeons and pathologists to pick and collect as many lymph nodes as possible in order to obtain accurate N staging and guide follow-up treatment. Therefore, standardized and thorough lymph nodes dissection of GC is of great importance to the treatment effect and prognosis of patients.

Table 2. Intraoperative and Postoperative Outcomes.

Variables	Statistical value
Operative time (min)	
Distal gastrectomy (18 cases)	239.2 ± 51.4
Total gastrectomy (7 cases)	295.1 ± 27.7
Intraoperative bleeding(ml)	134.0 ± 65.7
Anal exhaust time(d)	2.24 ± 0.86
Time to liquid intake(d)	4.2 ± 1.7
Postoperative hospital stay(d)	9.6 ± 5.0
Tumor size(cm)	4.6 ± 2.8
Number of total lymph node dissection	683
Average number of lymph node dissection	27.3 ± 12.7
Average number of No.12a lymph node dissection	2.4 ± 1.95
No.12a lymph node metastasis rate	16% (4/25)
Portal vein injure (case)	0
Postoperative staging of tumors (case)	
II	15 (60%)
III	10 (40%)
Postoperative complications (case)	
pulmonary infection	2 (8%)

In the 14th edition of Japanese gastric cancer classification, the gastric lymph nodes were partially revised, and No.1-12 lymph nodes was identified as the regional lymph nodes of the

stomach. No.12a lymph node were included in the second station, which belonged to the scope of D2 lymphadenectomy in radical gastrectomy.^{17,18} In addition, its lymph node metastasis rate in AGC was higher,¹⁹ indicating the importance of No.12a lymph node dissection. At present, the scope of No.12a is not clear enough. The Japanese classification of gastric cancer defines No. 12a lymph nodes as lymph nodes distributed along the proper hepatic artery from the confluence of left and right hepatic ducts to the upper edge of the pancreas.¹² Professor He Yulong defined it as located in connective tissue of hepatic pedicle and bounded by the upper margin of pancreas with No. 13 lymph node.²⁰ Because of the complex local anatomical relationship and the unclear definition of the scope, many surgeons have some randomness and irregularity in the dissection of No. 12a lymph node in clinical operations, such as the scope and timing of portal vein exposure. According to the D2 lymphadenectomy criteria for GC of KLASS-2 study in Korea, the left wall of the portal vein must be exposed and the soft tissue along the left wall of the portal vein must be thoroughly cleared when performing the No.12 lymph nodes dissection.²¹

Because of the local anatomical relationship, No.12a lymph nodes dissection during radical gastrectomy can cause adjacent vascular injury, biliary tract injury, liver injury and so on. Especially, due to its thin venous wall, the portal vein is easy to be damaged when it is poorly exposed or pulled excessively during operation.²² Oderich retrospectively reported 40 cases of iatrogenic vascular injury caused by abdominal and pelvic surgery, including 7 cases of portal vein injury, and anatomical exposure difficulty accounted for 63% of the injury factors.²³ Huerta reported 3 patients with intraoperative portal vein injury, all of whom received emergency liver transplantation, but died of sepsis and multiple organ failure after surgery.²⁴ It indicates that intraoperative portal vein injury is of great harm and the importance of full exposure of portal vein.

The traditional No.12a lymph node dissection during laparoscopic gastrectomy is along the GDA, first exposing the CHA and the proper hepatic artery, then the left lateral wall of the portal vein was exposed.²⁵ This method has the possibility of damaging peripheral blood vessels near the bifurcation of the proper hepatic artery and GDA. In addition, because the CHA is located in front of the portal vein, it is not conducive to the full exposure of the portal vein and the cutting of the root of the left gastric vein. Through clinical practice and understanding of the safety of No.12a lymph node dissection in GC, our surgical team summarized the portal vein approach method: when dissecting No.12a lymph node in the superior pancreatic region, first to anatomical expose the portal vein in the non-vascular triangle area between the CHA, GDA and pancreas, and to clean the lymph nodes in front of the portal vein. This method is beneficial to the priority and full exposure of the portal vein and the root ligation of the left gastric vein, which can make the dissection of No.12a lymph node more safe and complete, and is conducive to the whole resection of lymph nodes in the superior pancreatic region. The approach is applicable for AGC because No.12a lymph node metastasis rate is high in AGC,²⁶

particularly for patients whose portal vein were difficult to expose. For early gastric cancer, because of the low lymph node metastasis rate, the practicability of this technique may not be necessary.

In this study, 25 patients with AGC underwent laparoscopic No.12a lymph node dissection via portal vein approach, and 58 No.12a lymph nodes were detected finally, with average 2.32 pieces/case. The No.12a lymph nodes metastasis rate was 16% (4/25). And it is worth noting that the number of retrieved lymph nodes affects the likelihood of detecting metastatic lymph nodes and the assessment of N stage for gastric cancer.²⁷⁻³⁰ While the accurate node status is helpful to make tailored and personalized management for gastric cancer after surgery.³¹ Thus, the moderate number of No.12a lymph node retrieved is beneficial to the management of gastric cancer. For the GC patients included in this study, the number of No.12a lymph node detected, lymph node metastasis rate and postoperative recovery time of gastrointestinal function and complications were not statistically different from the cases reported in the literature.

Conclusions

in terms of the operative experience and the data of this study, the operation of laparoscopic No.12a lymph node dissection by portal vein approach is relatively simple, and the preliminary results show that it is safe and feasible, and in line with the principles of surgical oncology. It is helpful in improving surgical safety and has certain clinical practical value. However, the number of cases with this approach is small, and more clinical evidence is needed to further verify.

Authors' Note

Wen-Jun Xiong and Wei Wang contributed equally to this work and should be both considered as co-corresponding authors. The study was approved by the Ethics Committee of Guangdong hospital of Traditional Chinese medicine (Z2016-074-01). The patients and their families were fully communicated and signed the informed consent before operation.

Declaration of Conflicting Interests

The author(s) declared no potential conflicts of interest with respect to the research, authorship, and/or publication of this article.

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Supplemental Material

Supplemental material for this article is available online.

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