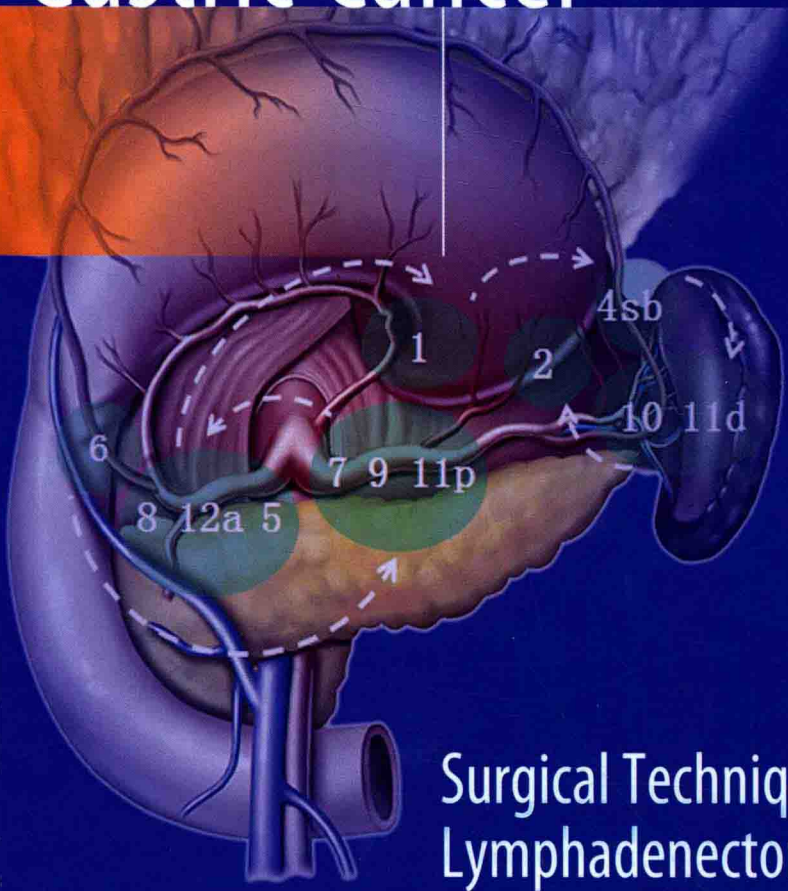
Chang-Ming Huang
Chao-Hui Zheng
Editors

Laparoscopic Gastrectomy for Gastric Cancer



Surgical Technique and Lymphadenectomy

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Preface

We are delighted to witness the publication of the English edition of *Laparoscopic Gastrectomy for Gastric Cancer: Surgical Technique and Lymphadenectomy*.

Gastric cancer is the fourth most common malignancy and second most common cause of cancer-related death worldwide. Surgical treatment has proven to be an important approach to improve the long-term prognosis, and radical gastrectomy with D2 lymphadenectomy has become the standard surgery for advanced gastric cancer. Since laparoscopic gastrectomy (LG) for early gastric cancer was initially reported by Kitano et al. in 1994, laparoscopic techniques for early gastric cancer have gradually developed and progressed worldwide in the past 20 years. Moreover, the therapeutic range of these laparoscopic techniques has been extended to include locally advanced gastric cancer. Surgical treatment for gastric cancer has gradually stepped into the era of minimal invasiveness.

The incidence of gastric cancer is relatively high in China, and most affected patients develop advanced disease. Successful performance of LG for advanced gastric cancer requires not only proficient surgical techniques, but also standardized and programmed surgical procedures. We first began to perform LG 7 years ago and have continuously summarized the experiences of the practice in our untiring pursuit to establish a standardized and programmed strategy for this surgery. To date, we have performed more than 2500 LG procedures for gastric cancer and have thus gained extensive experience. In 2010, we completed the first laparoscopic spleen-preserving splenic hilar lymphadenectomy, and we are now able to routinely perform this procedure for advanced middle- or upper-third gastric cancer. We also summarized the operative procedure as Huang's three-step maneuver, allowing increasingly more surgeons to easily master this technique. In 2012, delta-shaped gastroduodenostomy following totally laparoscopic distal gastrectomy was first performed in China in our center, and we have performed the largest number of these surgeries in China.

We herein summarize and share our 7-year experience of LG without reservation. This academic monograph can be used for clinical practice, scientific research, and education. This book contains a large amount of comprehensive material, and areas of particular importance are highlighted. Wonderful pictures are included to enhance understanding and interest. All material is original and based on clinical practice. The text describes our

understanding about what we have gained and lost from massive surgeries and summarizes our accumulated experience throughout years of clinical practice. We particularly focus on both the common and rare anatomy around the stomach in minimally invasive surgery, describe in detail the procedures and issues that require attention during the performance of radical LG for gastric cancer, and present the techniques of lymphadenectomy with both text and graphics. This information is both clinically useful and innovative. We hope that this book will eventually provide new inspirations and become a standard source of knowledge for all of our colleagues who have devoted themselves to the surgical treatment for gastric cancer, and that it will facilitate the promotion and development of LG.

This book is written by the team members of the Department of Gastric Surgery in Fujian Medical University Union Hospital, China. I would like to thank everyone in my team, who has heavy clinical work and academic activities but still sacrificed plenty of his or her spare time to put an incredible effort into publishing this book.

Fuzhou, China
December 2014

Chang-Ming Huang

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Introduction of Chief Editors

Professor Chang-Ming Huang, chief physician, doctoral supervisor, an expert entitled to Government Special Allowance (GSA) the Director of Department of Gastric Surgery of Fujian Medical University Union Hospital, China, is the vice-chairman of Surgical Oncology Committee of Surgery Branch of China Medical Doctor Association, a member of the standing committee of Gastric Cancer Profession of China Anti-Cancer Association, and a member of the Minimally Invasive Surgery Committee of Surgery Branch of China Medical Doctor Association. He is also an editorial board member of *Chinese Journal of Gastrointestinal Surgery*, a corresponding editor of *Chinese Journal of Surgery*, and a reviewer of *Chinese Medical Journal*, *Chinese Medical Journal: English edition* and *World Journal of Gastroenterology*. Till now, he has published more than 100 articles in the source of SCI journals, Chinese medicine magazines and other professional

journals. As an editor-in-chief, he compiled *Laparoscopic Radical Gastrectomy for Gastric Cancer: Technique of Lymphadenectomy*. Moreover, he has been awarded Fujian Provincial Science and Technology Achievement Award many times and is undertaking currently a number of national and provincial scientific research projects.

Chao-Hui Zheng, associate professor, associate chief physician, at present works in the Department of Gastric Surgery of Fujian Medical University Union Hospital, China. He is a member of the youth committee of Gastric Cancer Profession of China Anti-Cancer Association, Surgical Oncology Committee of Surgery Branch of China Medical Doctor Association, and Obesity and Diabetes Surgery Committee of Surgery Branch of China Medical Doctor Association. Till now he has published more than 10 articles in the source of SCI journals, Chinese medicine magazines and other professional journals. He is also the deputy editor of *Laparoscopic Radical Gastrectomy for Gastric Cancer: Technique of Lymphadenectomy*. He has won Fujian Provincial Science and Technology Achievement Award many times and is undertaking currently a number of national and provincial scientific research projects.

Our team: Department of Gastric Surgery, Fujian Medical University Union Hospital, China.

Left→Right: Long-Long Cao, Ping Li, Jia-Bin Wang, Jun Lu, Chang-Ming Huang, Qi-Yue Chen, Chao-Hui Zheng, Jian-Wei Xie, Jian-Xian Lin, Mi Lin

Contents

1 Summary of Anatomy and Physiology of Perigastric Lymphatic System

Abstract

At the end of the nineteenth century, the medical community realized that lymph node metastasis (LNM) is the most common pattern of metastatic spread in gastric cancer. Satisfactory results will not be achieved if gastrectomy alone is performed for patients with gastric cancer. Many European and American researchers began to study the lymphatic flow of the stomach and explore the characteristics of LNM. Dissection of the relevant lymph nodes (LNs) revealed that metastasis was not limited to the LNs around the stomach. Those located at the superior border of the pancreas and other sites were also frequently involved. In 1944, Kajitani indicated that LNs positioned along the celiac artery system were closely involved in metastasis of gastric cancer according to the outcomes of 166 patients with gastric cancer who underwent lymph node dissection. He also proposed the concepts of systemic lymph node dissection. According to these concepts, Kajitani led the Japanese Research Society in the first detailed anatomical study of gastric cancer, in which the researchers divided the perigastric LNs into groups and described the lymphatic drainage routes of the stomach. He then observed the distribution of the metastatic LNs and studied the tendencies of LNM from a histological viewpoint. These discoveries helped to establish the theory supporting systemic lymph node dissection for gastric cancer. This anatomical description of the lymphatic system of the stomach by Japanese researchers was a key step in the study of LNM in gastric cancer.

1.1 Lymphatic Drainage Routes of the Stomach

At the end of the nineteenth century, the medical community realized that lymph node metastasis (LNM) is the most common pattern of metastatic spread in gastric cancer. Satisfactory results will not be achieved if gastrectomy alone is performed for patients with gastric cancer. Many European and American researchers began to study the lymphatic flow of the stomach and explore the characteristics of LNM. Dissection of the relevant

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lymph nodes (LNs) revealed that metastasis was not limited to the LNs around the stomach. Those located at the superior border of the pancreas and other sites were also frequently involved. In 1944, Kajitani indicated that LNs positioned along the celiac artery system were closely involved in metastasis of gastric cancer according to the outcomes of 166 patients with gastric cancer who underwent lymph node dissection. He also proposed the concepts of systemic lymph node dissection. According to these concepts, Kajitani led the Japanese Research Society in the first detailed anatomical study of gastric cancer, in which the researchers divided the perigastric LNs into groups and described the lymphatic drainage routes of the stomach. He then observed the distribution of the metastatic LNs and studied the tendencies of LNM from a histological viewpoint. These discoveries helped to establish the theory supporting systemic lymph node dissection for gastric cancer. This anatomical description of the lymphatic system of the stomach by Japanese researchers was a key step in the study of LNM in gastric cancer.

The lymphatic networks in the gastric walls communicate with one another and flow in a certain direction, draining into the perigastric lymphatic system in close proximity to the corresponding veins. However, lymphadenectomy is performed along the corresponding arteries, and the perigastric LNs are grouped and named according to the arteries. Therefore, the lymphatic drainage of the stomach is customarily divided into four areas according to the four feeding arteries of the gastric walls.

District I (right gastroepiploic artery (RGEA) group): This lymphatic network mainly drains the greater curvature of the lower half of the gastric body and the pylorus. Lymphatic vessels are abundant in this area. They drain into the infrapyloric LNs along the RGEA. Their efferent lymphatic vessels drain into the retropyloric and suprapyloric LNs, then into the hepatic LNs, and finally into the celiac artery LNs. Some of the lymphatic vessels along the gastroepiploic veins in front of the pancreatic head drain into the LNs located at the root of the middle colic vein (MCV) and superior mesenteric vein (SMV).

District II (left gastroepiploic and short gastric arteries group): This lymphatic network mainly drains the greater curvature of the left half of the gastric fundus and the greater curvature of the upper half of the gastric body. Lymphatic vessels are rare in this area. They drain into the splenic hilar LNs and pancreaticosplenic LNs located at the pancreatic tail along the gastrosplenic ligament. Most lymphatic vessels of the left half of the gastric fundus flow left and drain into the splenic hilar LNs, while those located at the posterior wall of the gastric fundus flow directly into the pancreaticosplenic LNs. Most lymphatic vessels of the left half of the gastric body at the greater curvature turn left along the left gastroepiploic artery (LGEA) and drain directly into the splenic hilar LNs. A few lymphatic vessels drain into the inferior left gastric LNs, then into the splenic hilar LNs, and finally into the celiac artery LNs.

District III (left gastric artery (LGA) group): This lymphatic network mainly drains the right half of the fundus, left half of the lesser curvature, and cardia of the stomach. Most lymphatic vessels of the right half of the gastric fundus drain into the paracardial and pericardial LNs, while a few lymphatic vessels flow into the retrocardial and pancreaticogastric LNs. They occasionally flow into the left diaphragmatic LNs. Most lymphatic vessels of the left half of the lesser curvature of the stomach drain into the superior gastric LNs, while a few drain directly into the pancreaticogastric LNs. The lymphatic vessels of the gastric cardia mostly drain into the paracardial, retrocardial, and pericardial LNs, while a few flow into the superior gastric and pancreaticogastric LNs. The paracardial, retrocardial, pericardial, and superior gastric LNs all drain into the pancreaticogastric LNs, then into the celiac artery LNs. This area plays an important role in the lymphatic drainage of the stomach.

District IV (right gastric artery (RGA) group): The RGA is thin and contains little blood. Lymphatic vessels are rare in this area, and few suprapyloric LNs are present along the RGA. This area mainly drains the lesser

curvature of the gastric pylorus, and a few lymphatic vessels drain into the hepatic portal LNs along the hepatoduodenal ligament (HDL) in a reverse direction. However, most lymphatic vessels drain into the LNs around the common hepatic artery (CHA), then into the celiac artery LNs.

The lymph drainage routes differ between gastric stump cancer and general gastric cancer because these drainage routes and the anatomic structure of the remnant stomach are changed by the first operation. First, the LGA and/or its descending branch at the lesser gastric curvature is transected. This causes the flow of the lymph vessels along the LGA to change and course toward the right cardia, then drain into the celiac artery LNs. The lymph vessels at the greater curvature of the stomach mainly drain into the splenic hilar LNs and splenic artery LNs. Additionally, the lymph vessels in the remnant stomach communicate with one another and the surrounding organs. Lymph vessels of the gastric cardia and fundus can drain into the lower esophagus through the esophagogastric junction. Those in the distal gastric stump drain into the duodenal wall (Billroth I anastomosis) or jejunal wall (Billroth II anastomosis). Cancer cells can invade the LNs in the mesentery of the anastomotic site and metastasize to LNs located at the root of the mesentery, especially when distal gastrectomy with Billroth II anastomosis is performed. Studies have shown that if the LGA is preserved during the primary surgery, the lymph drainage routes of gastric stump cancer are identical to those of primary upper-third gastric cancer. The main lymph drainage of the remnant stomach begins at the lesser curvature of the stomach along the LGA. However, if the LGA is transected during the primary surgery, the lymph drainage of the remnant stomach mainly follows the greater curvature of the stomach instead of following the original route.

The lymph drainage of gastric stump cancer is classified into three routes: (1) The lymph drainage is along the LGA, posterior gastric artery, and splenic artery (SpA). (2) The lymph vessels drain into the duodenal wall or jejunal wall. (3) The lymph vessels drain into the intrathoracic LNs.

1.2 Lymph Node Groups in Gastric Cancer

The Japanese Research Society for the Study of Gastric Cancer anatomically divided the perigastric LNs into 16 nodal groups, as shown in the following table:

No.	Group/designation	Definition
1	Right paracardial LNs	LNs along the first branch of the ascending limb of the LGA and those located on the anterior and right sides of the gastric cardia
2	Left paracardial LNs	LNs along the esophagocardiac branch of the left subphrenic artery and its root, including left and posterior paracardial LNs
3	Lesser curvature LNs	LNs included in the two layers of the lesser omentum at the gastric lesser curvature, along the branches of the LGA and distal part of the RGA
4sa	Left greater curvature LNs along the short gastric arteries	LNs along the short gastric arteries and their roots
4sb	Left greater curvature LNs along the LGEA	LNs along the LGEA and its first branch feeding the gastric wall
4d	Right greater curvature LNs along the RGEA	LNs along the second branch and distal part of the RGEA
5	Suprapyloric LNs	LNs along the first branch and proximal part of the RGA
6	Infrapyloric LNs	LNs along the first branch and proximal part of the RGEA down to the confluence of the right gastroepiploic vein (RGEV) and anterosuperior pancreaticoduodenal vein (ASPDV)
7	LNs along the LGA	LNs along the trunk of the LGA between its root and the origin of its ascending branch