



Open Surgery for Gastric Cancer: Distal Subtotal Gastrectomy with D2 Lymph Node Dissection

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Introduction

Gastric cancer is a major cancer worldwide but particularly in East Asia, where two-thirds of the cases were reported. This area includes Korea, Japan, and China [1]. Gastrectomy with lymph node dissection has been a standard treatment for gastric cancer [2]. The rationale behind this treatment option is two-fold. Small tumors should be excised as they will progress to large tumors and invade other organs. Second, surgical resection of the primary tumors should effectively reduce the risk of metastatic relapse [3]. Outcomes of surgical resection for early stage of gastric cancer are quite good, with a greater

than 90% 5-year overall survival, even without adjuvant chemotherapy or radiotherapy [4]. These statistics highlight the important role of surgeons in the treatment of gastric cancer.

D2 Lymph Node Dissection

The necessity for radical surgery following diagnosis of gastric cancer is not under question, but practitioners were often less sure about the ideal number of lymph nodes to remove. The stomach is supplied with blood mainly from five vessels: the right and left gastric arteries, the right and left gastroepiploic arteries, and the short gastric artery. It also has an abundant, complex lymphatic network. Consequently, cancer can spread in many directions from the stomach, and it can be difficult to predict metastases that may originate from the lymphatic system. Lymph node dissection has been the subject of the long debate in the medical community and

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was addressed in randomized controlled trials [5–8]. The results of these trials have led to the recommendation by medical professionals in both the western and eastern hemispheres that the D2 lymph nodes be dissected in patients with advanced gastric cancer [2, 9, 10]. At present, distal subtotal gastrectomy and D2 lymph node dissection are the recommended basic procedure for gastric cancer.

The definition of the D2 lymph nodes has been modified by Japanese Gastric Cancer Association [11]. In this chapter, the procedures for D2 lymph node dissection are mainly based on the current Japanese treatment guidelines [2].

Oncologic Principles for Gastric Cancer Surgery

There are fundamental differences between surgery performed in patients with cancer and in patients with other benign conditions. Protocols based on oncological principles must be followed throughout surgical procedures on cancer patients to prevent contamination with, or dissemination of, the cancer cells. The fundamental goal of cancer surgery is complete surgical resection of tumor, en bloc lymph node dissection, and careful hemostasis. If this goal is not achieved, cancer cells can be disseminated through broken lymphatics and vessels. The extent of gastric resection should be decided upon based on the location of tumor in the stomach and the safety resection margin so that microscopic tumors are not left in remaining stomach. The “no-touch” technique should be used during the entire procedure. The no-touch technique entails wrapping the primary tumor. This is especially important in cases of serosa-positive gastric cancer, in which it is of utmost importance to prevent iatrogenic peritoneal seeding through the surgeon’s hands. Unnecessary manipulation and dissection should be avoided as mitogenic factors for wound healing could be produced in response to the surgery; these could stimulate the proliferation of undetected micrometastatic tumors that remained after surgery [3].

Omentectomy and Bursectomy

Omentectomy and bursectomy are procedures that can be performed during gastric cancer surgery.

The omentum, part of the visceral peritoneum, controls the inflammation in the abdominal cavity [12]. Total omentectomy is recommended during surgery for advanced gastric cancer because the omentum can act as a gateway for metastasis [2, 13]. It is not a time-consuming procedure in open surgery (as it would be in laparoscopic surgery.) It is, in fact, easier to perform total omentectomy than partial omentectomy in open surgery as it is easy to access the avascular plane.

Bursectomy, removing the anterior membrane of the transverse mesocolon and the capsule of the pancreas, has been widely performed for advanced gastric cancer in Korea and Japan [14]. The rationale behind this procedure is that microscopic cancer cells could exist in the membranes that cover the posterior stomach cavity if the tumor invades the serosa layer of the stomach and removing this membrane may reduce the risk of cancer relapse in the peritoneal cavity [15]. The efficacy of bursectomies was assessed in a randomized, controlled trial that compared the long-term outcomes of D2 dissection alone or with bursectomy. In this study, bursectomies were the independent prognostic factors [16]. Bursectomies can be performed with minimal complication [17] and can provide an avascular plane in conjunction with omentectomy. Considering all the data, it appears that bursectomies should be recommended during surgeries for advanced gastric cancer, especially for serosa-positive gastric cancer located in posterior wall of the stomach.

Surgical Procedure for Distal Subtotal Gastrectomy with D2 Lymph Node Dissection

The specifics for this procedure are identified and explained below.

Indication

The procedure is indicated when distal stomach adenocarcinoma has been diagnosed.

Contraindication

The procedure is contraindicated in these circumstances:

- When it is not possible to secure the distal resection margin due to stomach pylorus invasion
- When there are enlarged lymph nodes around the head of the pancreas and the right gastroepiploic vessels, so that the cancer is unresectable

Preoperative preparation

Routine nasogastric tube insertion pre-/postoperatively is not recommended. However, when there is preoperative gastric outlet obstruction due to advanced gastric cancer, the gastric contents need to be removed through a nasogastric tube and gastric lavage before operation to avoid contamination of the surgical site by the gastric contents. In addition, if there is an electrolyte imbalance or malnutrition before operation, it should be corrected before the operation is performed. For early gastric cancer, preoperative endoscopic clipping on the proximal part of tumor is useful to detect the location of tumor and determine the secure resection margin for the operation.

Anesthesia

General anesthesia via an endotracheal tube is used routinely. After endotracheal tube insertion, prophylactic antibiotics should be injected.

Position of Patient During Surgery

The patient should be positioned in supine on the flat table with the legs fastened to the table

with a belt. Usually, the patient is situated the right side of the table, and the operator stands on patient's right.

Incision, Exposure, and Preparation of Main Procedures

Although either upper midline or subcostal incisions are acceptable for distal subtotal gastrectomy, a midline incision extending from the xiphoid process to the umbilicus is the most common (Fig. 6.1a). An incision below the umbilicus is not usually necessary; however, the original incision can be extended to achieve a better operative field. After making the skin incision by knife, the linea alba should be divided, with careful hemostasis, using an electrocautery device such as Bovie. The open abdominal wall can be protected with a wound protector device to reduce the risk of cancer cell and bacterial contamination. During surgery, applying the wound retractor can provide better operative field (Fig. 6.1b). In cases in which peritoneal metastasis is suspected, it is useful to perform staging laparoscopy through a potential incision site before laparotomy. The surgeon should initially make small midline incisions, sufficient to permit the insertion of one hand so that the resectability of the stomach can be determined from the pancreas invasion and rectal shelf. The incisions can be expanded later, during the regular gastrectomy.

Exposure and dissection of the area of the #4sb lymph node is easier if the spleen is moved aside. This can be done by lifting the spleen up gently with the left hand and inserting one or two rolled surgical tapes behind it (Fig. 6.2). The tape roll(s) should be counted and removed before closing the abdominal wall. Sometimes dissecting the spleno-phrenic or splenorenal ligament is necessary for this procedure, and care should be taken not to injure the parenchyma of the spleen. If there are severe adhesions around the spleen from previous abdominal surgery, it would be better not to perform this procedure.

Fig. 6.1 Incision for open surgery of gastric cancer. (a) 15 cm of incision from xiphoid process to umbilicus for open surgery. (b) The open abdominal wall is protected by wound protector device

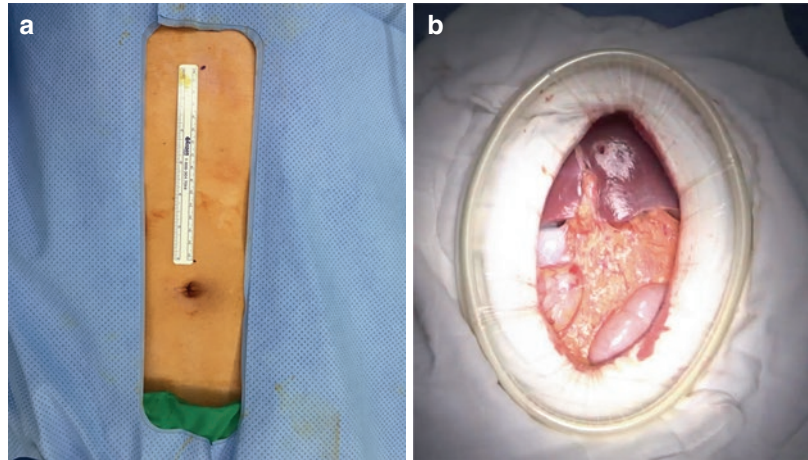
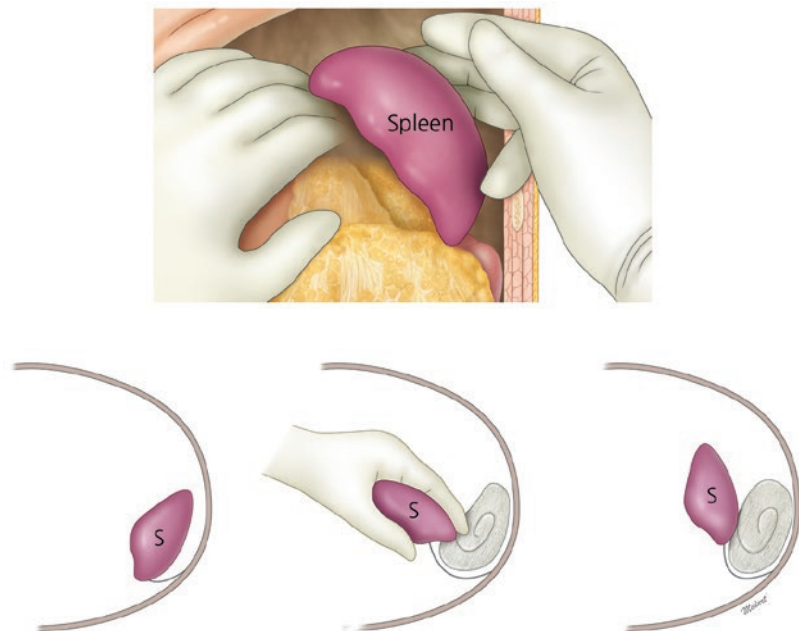


Fig. 6.2 The process of lifting the spleen up for achieving good operative field for #4sb lymph node dissection. The spleen is gently lifted up, and the rolled surgical tapes are inserted behind the spleen



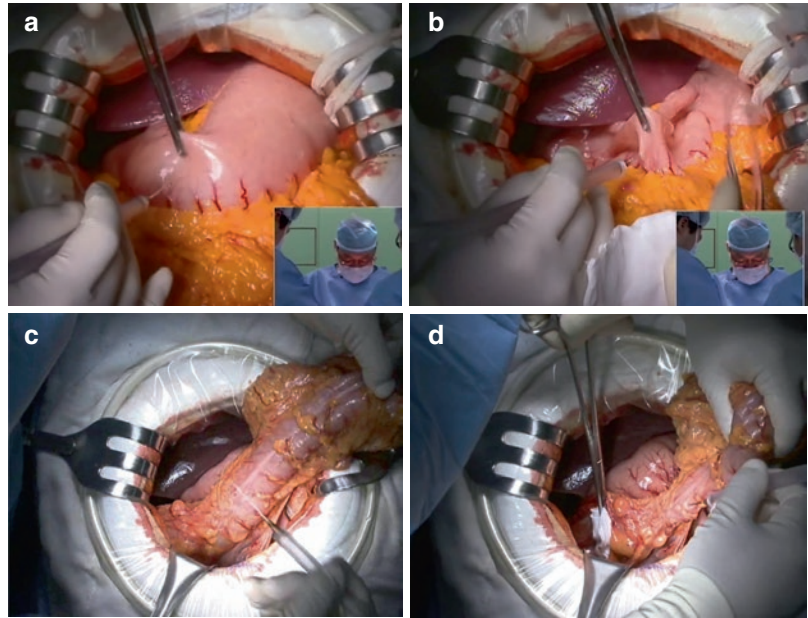
The dilated stomach and colon hinder surgery, and this problem should be addressed before the main procedure. Decompression of the dilated stomach and colon by applying suction with an 18G-needle is one way to accomplish this (Fig. 6.3). The location of the puncture site in the stomach should not be near the tumor site or the proximal part of the stomach that will remain after gastrectomy.

Details of Procedure for D2 Lymph Node Dissection

Total Omentectomy and Bursectomy

Total omentectomy and bursectomy are recommended for advanced gastric cancer, especially when the tumor is located in the posterior wall of stomach (Fig. 6.4a). The first assistant should grasp the transverse colon firmly with both

Fig. 6.3 Decompressing the dilated stomach and colon can provide good operative field during surgery. (a) The dilated stomach was punctured by 18G-needle with suction. (b) The stomach is decompressed. (c) The dilated colon was punctured by 18G-needle with suction. (d) The colon is decompressed



hands and spread it out so that the anatomy can be observed. The omentum should be wrapped and held gently upward and toward the patient's head by the second assistant (Fig. 6.4b). If this procedure is performed through the appropriate anatomical plane, the operation should proceed without bleeding (Fig. 6.4c).

Dissection of Lymph Node #6

This dissection should begin by dividing the greater omentum and dissecting it to the duodenum, head of the pancreas, and pylorus. The superior mesenteric vein is located below the inferior border of the pancreas. The adipose tissue surrounding this vein should not be dissected as it is part of the dissection of lymph node #14v, not part of a routine D2 lymph node dissection. Dissecting the peripancreatic fascia from the inferior border of the pancreas to the duodenum through the head of the pancreas will expose the right gastroepiploic vein and artery. The ideal level for transecting the right gastroepiploic vein is above the anterior superior pancreaticoduodenal vein (Fig. 6.5). The right gastroepiploic vein should be dissected and ligated, at the level of its root, from the gastroduodenal artery and between

the duodenum and pancreas. Sufficient exposure of the gastroduodenal ligament is helpful in the subsequent dissection of lymph node #5.

Dissection of Lymph Nodes #4d and #4sb

The greater omentum should be divided and dissected toward the lower pole of the spleen along the region of the anterior taenia of the transverse colon (Fig. 6.6). As the dissection progresses, the left side of the gastrocolic ligament and splenocolic ligament should be dissected. Once the gastrosplenic ligament has been dissected, the left gastroepiploic artery (LGEA) and vein can be identified and should be ligated in the root. Sometimes infarction in the lower spleen occurs when the LGEA is ligated in its root; however, this seems to have little clinical consequence. Careful dissection from the root of LGEA to its branches should permit identification of a branch artery directed to the lower pole of the spleen. Preserving this artery can prevent the infarction of the lower spleen. After ligating the LGEA, adipose tissue between it and the short gastric artery should be dissected. For gastric resection, the terminal branches of the LGEA to the stomach

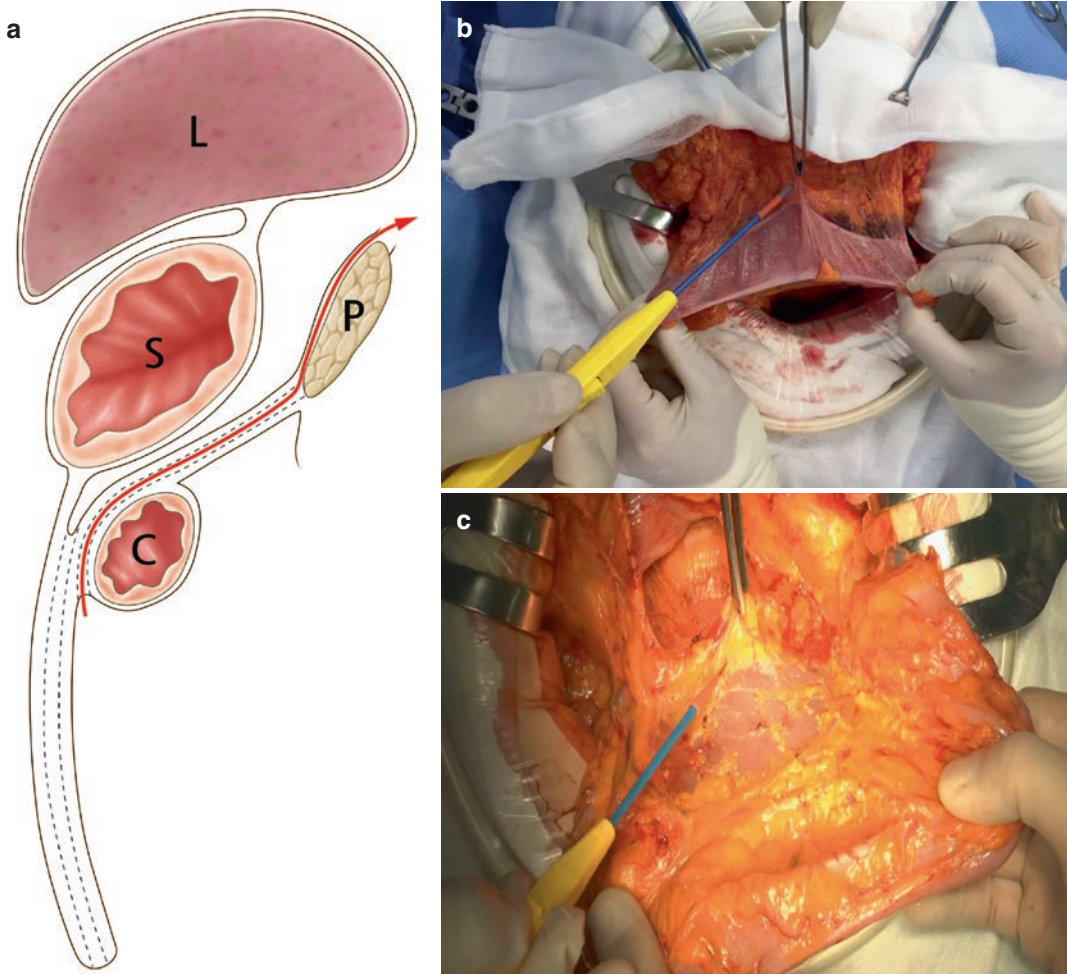


Fig. 6.4 Illustrations for omento-bursectomy for gastric cancer surgery. (a) The anatomy around the stomach with the plane for bursectomy (red line). (b) First assistant grasps the transverse colon with both hands and spread it out. Second assistant wraps omentum and holds it upward

and toward the patients' head for omentectomy. (c) Dissecting anterior leaf of transverse mesocolon for bursectomy can be done through avascular anatomical plane. (L liver, S stomach, P pancreas, C colon)

in its greater curvature side should be dissected and ligated. This procedure can be performed by electric devices, clip, or tie ligation, but it also can be performed by an electrocautery device only (see video clip).

Next, a clean surgical tape should be applied anterior to the head of the pancreas and posterior to the stomach. Wrapping the stomach with a surgical towel will prevent the surgeon from touching the tumor during the next step (Fig. 6.7a–c). Clean surgical tape should next be inserted into the right subhepatic space, and the liver should

be covered with surgical tape. The liver should be retracted by having the first assistant pull the stomach toward the feet and the second assistant retracts it.

Dissection of Lymph Node #5 and Duodenal Transection

The lesser sac should be incised and opened and the visceral peritoneum of hepatoduodenal ligament dissected (Fig. 6.8). If the aberrant left hepatic artery from the left gastric artery is encountered, it should be incised vertically in the right side of

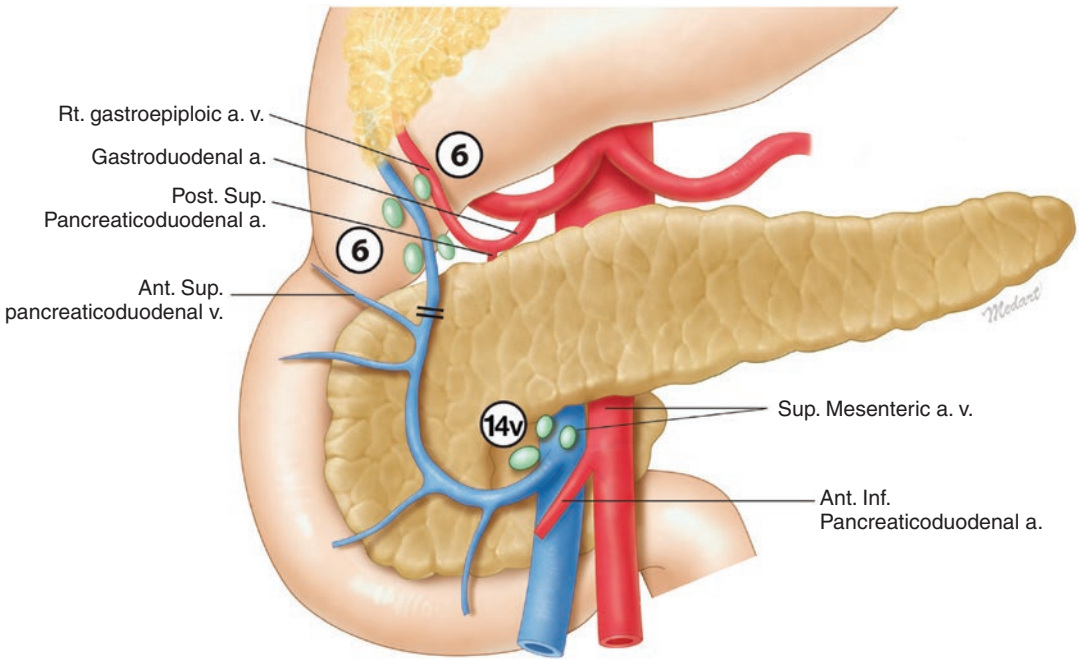
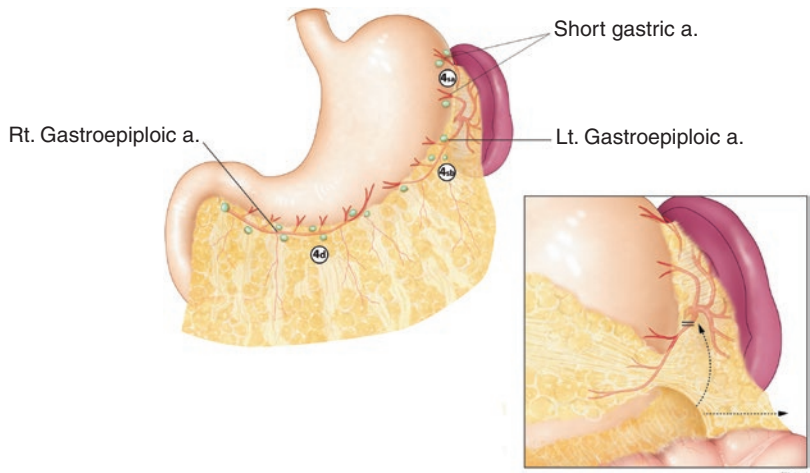


Fig. 6.5 Anatomy around infra-pylorus of the stomach and the range for #6 lymph node dissection

Fig. 6.6 Anatomy and anatomical plane for dissecting left gastroepiploic vessels (#4sb)



the proper hepatic artery and dissected from the right side to the left. At this point, the surgical tape that had been inserted in the superior border of the duodenum will be exposed, and the right gastric artery can be identified and ligated in the root. The small vessels around the pylorus should be cleared and the duodenum transected. The length of the duodenum to be transected should be determined according the planned type

of reconstruction. If gastrodudenostomy with a circular staple is intended, a detachable anvil, 28–29 mm in diameter, should be inserted into the duodenal stump and a purse-string suture tied over the purse-string tying notch of the anvil. For other reconstruction, such as loop or Roux-en-Y gastrojejunostomy, the duodenum should be transected by a linear staple, and the staple line should be inverted by interrupted seromus-

Fig. 6.7 The procedures of no-touch technique for preventing the spillage of cancer cells during open surgery. The stomach is wrapped by surgical towel to prevent the surgeon from touching the tumor directly

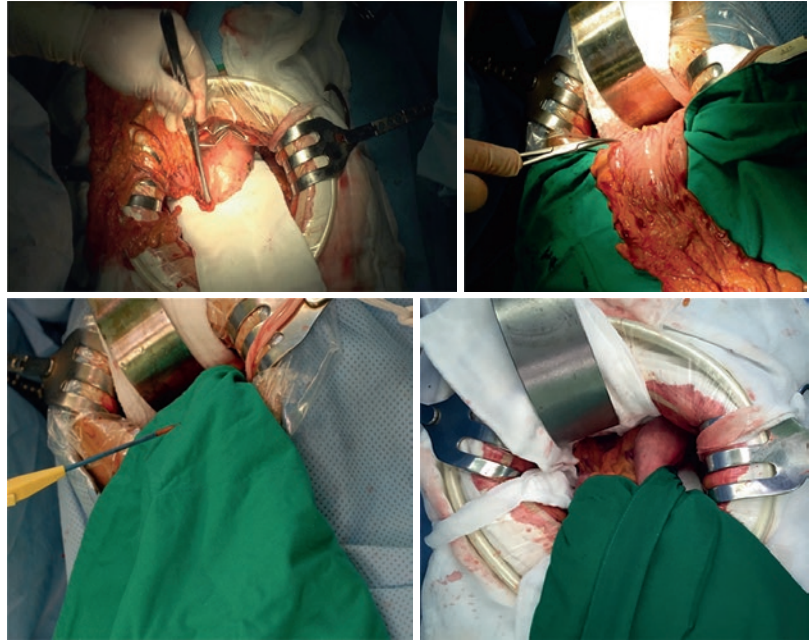
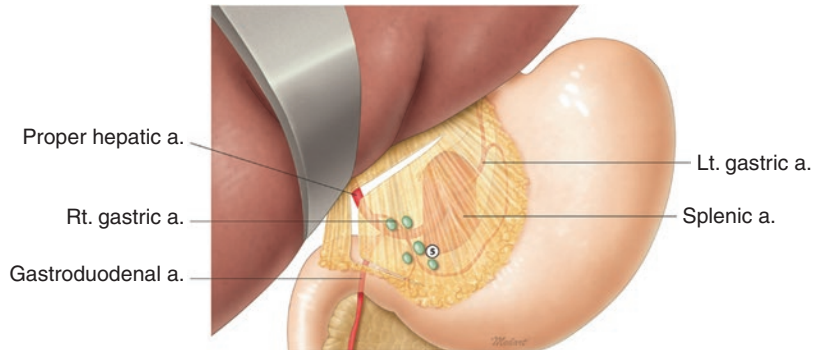


Fig. 6.8 Anatomy around supra-pylorus of the stomach and the range for #5 lymph node dissection



cular sutures. This will require putting the pyloric stump of the stomach into the surgical towel that was used earlier to wrap the stomach. The stomach should then be lifted up and retracted by the second assistant. The liver retraction should be maintained, and counter traction should be maintained by the first assistant, by gently pushing the pancreas toward the feet.

Suprapancreatic Lymph Node

Dissection (#12a, #8a, #7, #11p, and #9)

Figure 6.9 depicts the anatomy of the suprapancreatic lymph nodes. After careful exposure of the proper hepatic artery and common hepatic artery, the soft tissues and lymph nodes around the left

side of the portal vein should be dissected (lymph node #12a). The lymph nodes of the pancreas upper portion should be dissected along the anterior portion of the common hepatic artery (lymph node #8a). Because the left gastric vein usually drains into the portal vein or the splenic vein, it can be identified and ligated during the dissection of these areas. Lymph nodes along the celiac axis should be dissected and the left gastric artery exposed and ligated at the root after isolation from the surrounding soft tissues, which includes lymph nodes (lymph node #7). It is recommended that the left gastric artery be ligated twice and its stump suture-ligated to ensure secure ligation. Next, lymph node dissection (lymph node #11p) should be performed

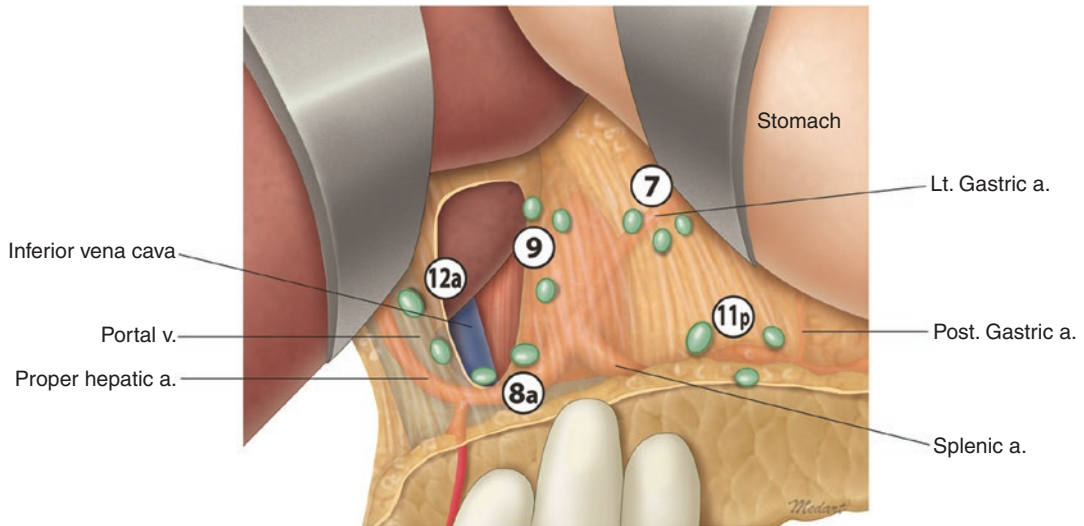


Fig. 6.9 Anatomy and the range of supra-pancreatic lymph nodes (#12a, #8a, #7, #9, #11p) for D2 lymph node dissection of subtotal gastrectomy

through the proximal splenic artery. One assistant should pull down the pancreas from the left of the ligated left gastric artery, exposing soft tissues on the superior border of the pancreas and along the splenic artery and permitting the #11p lymph node to be dissected. The left border of this node is usually posterior to the gastric artery, when it exists. The lymph node dissection (#9) should proceed cephalad to the esophagogastric junction from the ligated left gastric artery. After finalizing suprapancreatic lymph node dissection, a clean surgical tape should be placed above the area of the dissected lymph node #9 and behind the stomach.

Dissection of Lymph Nodes #1 and #3

A truncal vagotomy in esophagogastric junction area should be performed, and the lymph nodes along the lesser curvature of the stomach should be dissected (Fig. 6.10, video). The lymph nodes should be dissected to approximately 2–3 cm below the imaginary resection line of the lesser curvature of the stomach. The entire procedure is summarized in the video clip.

Gastric Resection to Achieve a Tumor-Free Proximal Margin

After dissection of all lymph nodes around the stomach, the resection line of the stomach should

be determined by confirming the distance from the tumor as approximately 60–70% of the stomach is transected. The proximal resection margin should be located 2–5 cm from the gastric cancer. In cases of non-palpable early gastric cancer, the clip applied during preoperative endoscopy is a useful indicator for determining the proximal resection line. When it is difficult to decide proximal margin that leaves tumor-free tissue, it should be confirmed by cryosection. If the tumor is identified in the frozen section, a total gastrectomy needs to be considered.

Checking the Status of Lymph Nodes According to Their Anatomical Location

The current pathological staging system (pN) from the American Joint Cancer Committee/Union Internationale Contre le Cancer (AJCC/UICC) is based only on the number of metastatic lymph nodes. Nonetheless, the anatomical extent of metastasis in the lymph nodes is still important for gastric cancer prognosis [18, 19]. Also, the location of metastatic lymph nodes relative to the location of the primary tumor in the stomach influences the probability and risk of lymph

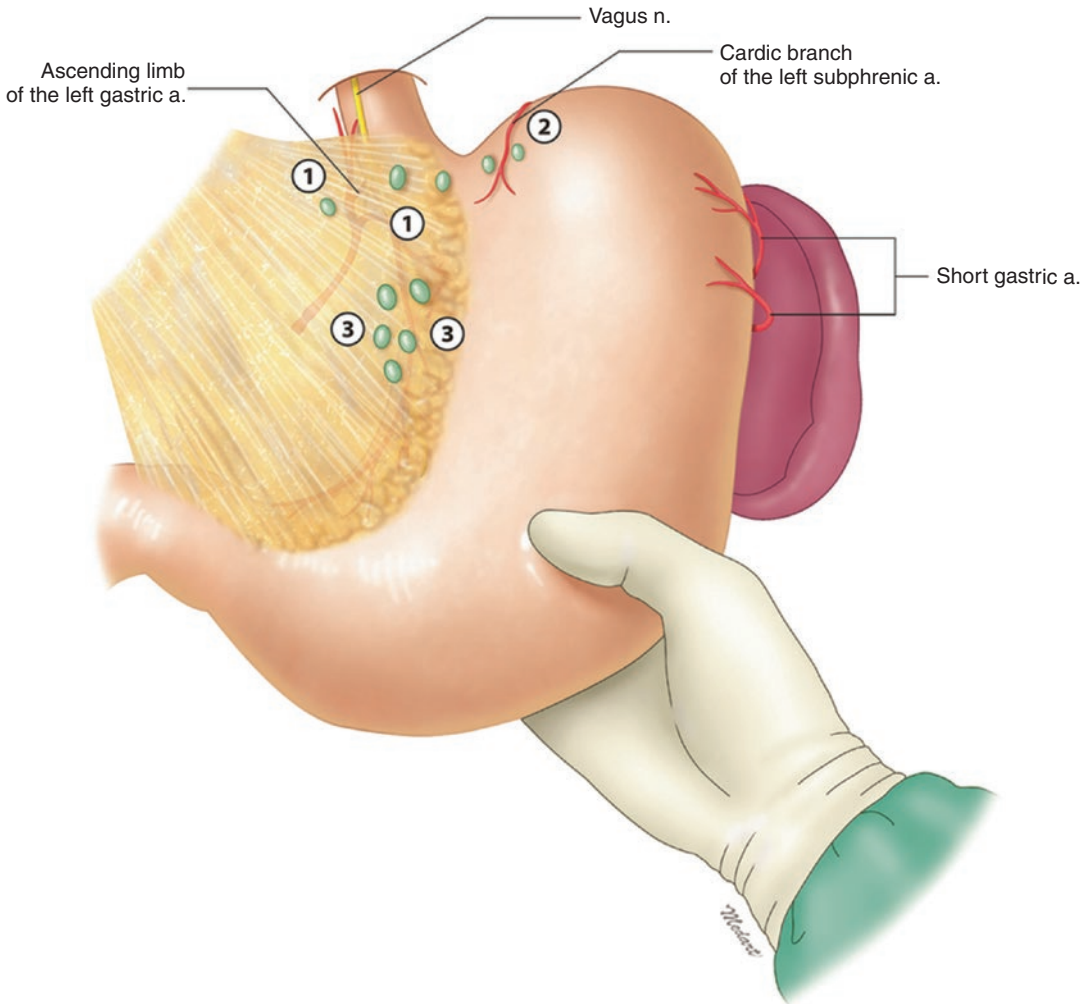


Fig. 6.10 Anatomy and the range for #1 and #3 lymph node dissection

node metastasis. This information will influence the decision on the surgical extent of lymph node dissection for gastric cancer.

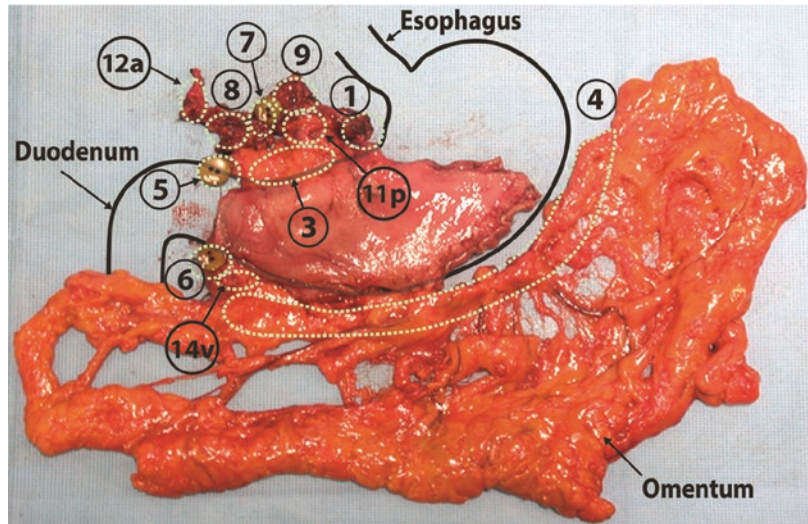
Dividing lymph nodes according to their anatomical location in the specimen and recording their status is highly recommended. Figure 6.11 depicts the location of lymph nodes in the specimen.

Discussion

Good surgery for gastric cancer can be summarized in the mnemonic “**OPERATIONS**”: **O**nco-logic **P**riniples, **G**ood **E**xposure, **U**nderstanding

Anatomy, **C**omprehensive **T**otal Approach, **M**eticulous **L**ymph **N**ode **D**issection, and **P**atients’ **S**afety. Surgery is as much an art as a technique, and the surgeon’s philosophy is an important component of practice. The surgeon should see the surgery, first and foremost, as for the patient’s benefit and have the same concern and regard for the patient as for a family member. The patient with gastric cancer has only one chance to be cured by surgery. Often this requires innovation and the adaptation of new technology by the surgeon. However, innovations must always honor accepted oncologic principles and practices and be based on sound scientific rationale.

Fig. 6.11 The locations of each lymph node station in D2 level in the specimen after subtotal gastrectomy with D2 lymph node dissection



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