Theodor Billroth performed the first successful gastric resection (a distal subtotal gastrectomy for stomach cancer) in 1881. Billroth operated on a 43-year-old woman with gastric outlet obstruction caused by pyloric carcinoma. Despite tolerating the surgical procedure well and having a benign hospital course, the patient died of recurrent gastric cancer 14 months later. Nevertheless, the new surgical technique proved to be a great success for Billroth, whose clinic would later report 257 gastric resections for stomach cancer in 1894. In 1889, Mikulicz began to espouse lymph node dissection in addition to gastrectomy and (if required) distal pancreatectomy for the treatment of gastric cancer. In 1898, Charles B. Brigham performed the first successful gastric resection in the United States, a total gastrectomy, on a 66-year-old woman using a Murphy button in the reconstruction phase of the operation, to help create an esophagoduodenal anastomosis. The contributions of these surgeons and others in the late nineteenth century provided the cardinal foundations for current surgical management of patients with gastric cancer.

Resection remains the only potentially curative treatment for localized gastric cancer. The basic surgical approach for stomach cancer that is amenable to potential cure has essentially remained the same since Billroth’s time. In the early 1940s, Coller and colleagues recommended radical resection, including regional lymphadenectomy, for all gastric cancers since lymph node metastasis could be insidious and because identification of the correct resection plane is difficult. However, other contemporaries were not convinced of Coller’s assertions and found the high postoperative mortality rate associated with radical gastrectomy unacceptable. Since that time, there has been an ongoing discourse as to which surgical procedure is associated with the most optimal outcome and the least postoperative morbidity and mortality. Efforts to enhance the surgical cure of patients have focused on defining the appropriate extent of lymphadenectomy. The principal areas addressed in this chapter include the extent of both gastric resection and lymph node dissection, the adequacy of proximal and distal margins, the role of adjacent-organ resection and splenectomy in localized disease, and the surgical treatment of recurrent gastric cancer.

ANATOMIC CONSIDERATIONS

The stomach serves as a reservoir for the mechanical and chemical digestion of ingested foodstuffs and is anatomically defined proximally by the gastroesophageal junction and distally by the retroperitoneal duodenum. The organ is also bounded on the right by the liver and on the left by the spleen. The stomach is divided into anatomic regions based on these external landmarks (Figure 13–1). The gastric cardia includes the region of the stomach just distal to the gastroesophageal junction and is relatively stable due to the gastrophrenic ligament. At the gastroesophageal junction, the cardiac notch demarcates the esophagus and the gastric fundus. The cardiac notch, along with the decussating and circular fibers of the lower esophagus, forms the lower
esophageal sphincter that prevents gastroesophageal reflux in normal conditions. The gastric fundus includes the part of the stomach above and left of the gastroesophageal junction. The gastric corpus or body makes up the region between the fundus and pyloric antrum and is anatomically defined by a line from the incisura angularis on the lesser curvature to a point that is one-fourth the distance from the pylorus along the greater curvature. The incisura angularis is a sharp indentation line that serves to separate the body and pyloric portion of the stomach; it is surgically used as the proximal line of transection for antrectomy. The gastric pylorus includes the pyloric antrum and pyloric sphincter, consisting of a thickened ring of smooth muscle.

Blood Supply

The gastric blood supply is extensive and is derived primarily from the celiac trunk. The major vessels that supply the stomach include the right and left gastric arteries and the right and left gastroepiploic arteries (Figure 13–2). The right gastric artery, which usually branches off the common hepatic
artery, supplies the distal lesser curvature of the stomach and anastomoses with the left gastric artery. Less commonly, the right gastric artery may originate from the left hepatic, gastroduodenal, or proper hepatic artery. The left gastric artery, the smallest branch of the celiac trunk, supplies the cardia and upper lesser curvature of the stomach. The right gastroepiploic artery originates from the gastroduodenal artery that arises from the common hepatic artery. The right gastroepiploic artery courses from right to left along the greater curvature of the stomach and anastomoses with the left gastroepiploic artery, a branch of the splenic artery, to create a vascular arch along the greater curvature. Short gastric arteries that originate from the splenic artery also supply the gastric fundus. The rich blood supply of the stomach allows preservation of gastric viability after ligation of most arteries, thus simplifying gastric reconstructive procedures.

The venous drainage of the stomach parallels the arterial supply and drains into the portal venous system (Figure 13–3). The left gastric vein or “coronary” vein passes from left to right along the gastric cardia, where it receives esophageal veins, and onward to the right, where it courses beyond the celiac trunk to drain into the portal vein. The small right gastric vein forms from tributaries of the pylorus and passes from left to right, ending directly in the portal vein. The right gastroepiploic vein drains the inferior portions of the stomach and crosses the uncinate process of the pancreas to end in the superior mesenteric vein. The left gastroepiploic vein completes the venous arch along the greater curvature and ends in the origin of the splenic vein. The short gastric veins drain the fundus and superior part of the greater curvature of the stomach, where they terminate in the splenic vein. Most of these veins become clinically significant in cases of portal vein hypertension and splenic vein thrombosis as both conditions may lead to variceal formation.

**Lymphatic Supply**

The four major routes of lymphatic drainage normally parallel the gastric blood supply (Figure 13–4). First, lymph vessels drain the lesser curvature of the stomach to the left gastric nodes that extend to the cardia. These left gastric nodes eventually drain into the celiac nodes. A second group of suprapyloric nodes drains the gastric pylorus of the lesser curvature, runs along the right gastric artery, and drains into the hepatic and celiac nodes. A third group of lymphatic vessels drains the proximal part of the greater curvature of the stomach. These pancreaticosplenic nodes also drain the spleen and pancreas before draining into the celiac nodes. Finally, lymphatic vessels drain to right gastroepiploic nodes from the greater curvature of the distal portion of the stomach into the infrapyloric nodes. Secondary drainage from all of these lymphatic groups eventually traverses nodes at the base of the celiac axis.

![Figure 13–3. The venous drainage of the stomach.](image-url)
Of note, like the blood supply, the lymphatics of the stomach exhibit extensive intramural and extramural communications; in disease states, this allows for intramural spread beyond the site of origin and to distant nodal groups from the primary lymphatics.

**Nerve Supply**

The nerves of the stomach are both parasympathetic and sympathetic (Figure 13–5). The left (anterior) and right (posterior) vagal nerves of the parasympathetic system descend parallel with the esophagus to the gastroesophageal junction. At this anatomic site, the vagal nerves run along the lesser curvature of the stomach, sending nerve branches to accompany the blood supply of the lesser curvature. At the junction of the fundus and antrum of the stomach, the vagal nerves innervate the antrum. The sympathetic innervation of the stomach passes through the celiac ganglion, and the postganglionic fibers accompany the gastric blood supply.

**Primary Tumor Location**

The primary objectives of resection for gastric cancer are to provide the best chance for cure in patients
with localized disease, to optimize palliative treatment in those patients with incurable disease, and to minimize morbidity and mortality. Currently, no therapeutic modalities except resection provide any possibility for cure of stomach cancer. Therefore, it is of paramount importance to determine those patients who are suitable for curative resection and those patients who are not. This assessment is performed both preoperatively and at the time of surgery.

The location of the primary tumor and its pattern of spread determine the selection of the most appropriate operative procedure for gastric cancer. The stomach has been divided into thirds for classification. The proximal third consists of the gastroesophageal junction and extends to the fundus. Such tumors of the gastroesophageal junction have recently been classified into three types, based solely on topographic and anatomic criteria (Table 13–1). The middle third of the stomach includes the body of the stomach and extends from the fundus to the incisura angularis of the lesser curvature. The distal third of the stomach consists of the pyloric antrum and originates from the incisura angularis to the pylorus. Although there is some controversy regarding which surgical procedure to apply, in general, proximal-third tumors that include the gastric cardia require a total gastrectomy, with resection of up to 10 cm of distal esophagus. Likewise, large tumors of the middle third and fundus of stomach are treated by total gastrectomy. Distal-third and small midcorpus tumors, however, are treated surgically with a radical (75 to 85%) subtotal gastrectomy (Figure 13–6). Past studies have suggested that the incidence of proximal gastric cancers has risen over the years while that of distal gastric cancers has decreased. This shift from distal tumors to proximal tumors may reflect a relative increase or the stabilization of actual numbers of proximal tumors with a concurrent decrease in the incidence of distal tumors. More important, because of the borderline location of the distal esophagus and proximal stomach, many discrepancies are found in the literature describing the etiology and classification of these proximal gastric tumors. The varied surgical approaches and long-term survival rates after resection that are reported in the literature reflect the confusion in categorizing these proximal tumors as either esophageal or gastric, which may also influence the incidence data of these tumors. Nevertheless, such trends are of some significance as most distal gastric cancers are related to diet and may arise from dysplastic mucosa whereas proximal cancers are not related to diet. Furthermore, the postoperative morbidity and mortality rates for patients with proximal gastric cancers are higher than those for patients with middle and distal gastric tumors. Of equal importance, the long-term prognosis in patients with proximal gastric tumors is also worse. Since the location of the primary tumor does have an influence on nodal metastasis and prognosis, the choice of a specific surgical procedure according to tumor location remains of paramount importance in the management of gastric cancer.

**Preoperative Evaluation**

The diagnosis of gastric cancer is usually made by upper gastrointestinal (GI) endoscopy, with biopsy or barium studies. Although they provide visualization of the gastric mucosa, these diagnostic modalities cannot determine the depth of tumor invasion or the extent of metastasis that is important for preoperative tumor staging. In recent years, computed tomography (CT) and endoscopic ultrasonography (EUS) have been used primarily to stage gastric tumors since both modalities are able to determine (with varying accuracy) depth of wall invasion, extragastric tumor spread, lymph node involvement, and distant metastases (Figure 13–7).

After tissue diagnosis has been established, initial staging procedures involve a thorough physical examination, routine blood tests, and abdominal/pelvis and chest CT. Computed tomography can

<table>
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<th>Table 13–1. Classification of Tumors of the Gastroesophageal Junction</th>
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<tr>
<td><strong>Type I</strong></td>
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<tr>
<td><strong>Type II</strong></td>
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<td><strong>Type III</strong></td>
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detect carcinomatosis with diffuse peritoneal seeding, malignant ascites, and pelvic metastasis. Although the stomach, perigastric nodes, and such distant sites as the liver and lung are visualized, up to 50% of patients will be found to have gross disease (missed by preoperative CT) at the time of laparotomy.\textsuperscript{17–19} Endoscopic ultrasonography is more accurate than CT for determining lymph node involvement in the perigastric region. The advantages of EUS reside with its ability to visualize all layers of the gastric wall, perigastric lymph nodes, and surrounding tissues. Since CT is able to identify distant metastatic sites (eg, liver, lungs, and ovaries), CT and EUS are considered complementary tests. Studies with pathologic specimens have shown EUS to be very accurate in determining depth of invasion and lymph node involvement.\textsuperscript{20,21} The overall accuracy for tumor staging ranges from 80 to 90%. The diagnostic accuracy of EUS in determining nodal status ranges from 70 to 90%. Endoscopic ultrasonography not only detects malignant lymph nodes by size but also by shape, homogeneity, and hypoechoigenicity of the lymph node and by tumor proximity.\textsuperscript{20,21} Recent technologic advances allow EUS-guided tissue sampling of lymph nodes. One limitation, however, is the ability of EUS to detect lymph nodes that are \( \geq 3 \) cm from the gastric wall. More recently, laparoscopic ultrasonography (LUS) has been a valuable modality for identifying missed metastases to the liver and peritoneum and may prove more accurate in detecting lymph node metastasis and tumor stage.\textsuperscript{22}

Although highly accurate, EUS will not necessarily change the overall surgical approach to gastric cancer. This diagnostic modality, however, may be useful in identifying patients who are candidates for preoperative chemotherapy and radiotherapy trials. We routinely use CT and endoscopy (with or without ultrasonography) as part of our preoperative staging work-up in patients with gastric cancer.

**SURGICAL MANAGEMENT**

**Preoperative Preparation**

After the decision for surgery has been made, the preoperative preparation should include optimization of cardiac and respiratory status. Patients should be typed and screened, in case blood transfusion during surgery is necessary. Patients with gastric cancer often have an increased pH and bacterial colonization of the stomach and therefore have a higher risk for wound infection. At the time of intubation, a single dose of a first-generation cephalosporin should be given to cover such common organisms as *Streptococcus viridans*, *Streptococcus fecalis*, *Escherichia coli*, *Clostridium* species, and *Bacteroides* species.\textsuperscript{23}
For patients with gastric cancer who have significant weight loss (> 15% of predisease body weight) and low serum albumin (< 2.9 mg/dL), some surgeons advocate preoperative nutrition support. If such patients can tolerate preoperative nasoenteral tube feedings, this route of delivery is preferred. In patients with obstructing gastric cancer, hospitalization for preoperative total parenteral nutrition (TPN) may benefit those who have severe malnutrition. However, for patients with mild or moderate malnutrition, the role of preoperative TPN is limited, and this nutritional support may actually prolong overall hospital stay and predispose patients to infection such as central venous line sepsis.

**Resection Techniques for Gastric Cancer**

After distant metastasis or unresectable tumor has been excluded by a thorough preoperative work-up, the patient should undergo diagnostic laparoscopy (Figure 13–8; Table 13–2). Should the laparoscopic examination results prove negative, an upper midline or upper transverse (chevron) incision is made (Figure 13–9). The abdominal contents are initially

![Figure 13–7](image-url). An algorithm for the management of gastric cancer. (CT = computed tomography; EUS = endoscopic ultrasonography.)
explored for any evidence of metastatic disease. Inspection for the presence of ascites, peritoneal seeding, and “drop” metastasis in the pelvis should be performed to confirm the previous laparoscopic observations. In the upper abdomen, examination should be directed to the liver, greater omentum, and origin of the mesentry below the transverse colon and periaortic lymph nodes (Figure 13–10). The stomach itself should be inspected to determine the location and extent of the primary tumor (Figure 13–11). Careful palpation of the primary tumor is necessary to determine whether there is direct invasion into adjacent structures such as the pancreas. If no liver metastasis or peritoneal seeding has occurred, gastrectomy should be performed with curative intent.

**Total Gastrectomy**

Retracting the greater omentum upward and gently withdrawing the transverse colon from the peritoneal cavity may allow the determination of tumor extension involving the underlying pancreas or regional major vessels by manual palpation. The transverse colon is freed from the omentum. The greater omentum is then retracted upward and the transverse colon caudad to allow for the dissection of the anterior leaf from the posterior leaf of the mesocolon with electrocautery. The plane between the anterior and posterior folds of the mesocolon is usually bloodless. As the omentum is mobilized, the venous branch between the right gastroepiploic and middle colic veins is identified and ligated. The lesser colic veins is then dissected from the inferior edge of the liver and reflected downward. If present, a replaced left hepatic artery will be identified at this time and should be preserved.

Since metastasis may spread to the infrapyloric lymph nodes, this basin should be included in the

### Table 13–2. FUNCTIONS OF DIAGNOSTIC LAPAROSCOPY FOR GASTRIC CANCER

<table>
<thead>
<tr>
<th>Function</th>
<th>Description</th>
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<tr>
<td>Identifies tumor extension into contiguous organs (eg, liver, colon, pancreas, spleen)</td>
<td>Identifies tumor extension into contiguous organs (eg, liver, colon, pancreas, spleen)</td>
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<tr>
<td>Identifies bloodborne metastasis (eg, liver)</td>
<td>Identifies bloodborne metastasis (eg, liver)</td>
</tr>
<tr>
<td>Identifies peritoneal dissemination (serosal penetration by tumor, ascites, carcinomatosis)</td>
<td>Identifies peritoneal dissemination (serosal penetration by tumor, ascites, carcinomatosis)</td>
</tr>
<tr>
<td>Identifies lymphatic spread involving local and distant lymph nodes</td>
<td>Identifies lymphatic spread involving local and distant lymph nodes</td>
</tr>
<tr>
<td>Enables lymph node sampling</td>
<td>Enables lymph node sampling</td>
</tr>
<tr>
<td>Enables peritoneal lavage for identification of intra-abdominal free cancer cells (cytology)</td>
<td>Enables peritoneal lavage for identification of intra-abdominal free cancer cells (cytology)</td>
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total gastric resection. The right gastroepiploic artery is identified originating from the gastroduodenal artery, is doubly ligated, and is divided away from the duodenal wall with 2-0 silk sutures, to include adjacent lymph nodes. The right gastric vessels are also identified and doubly ligated away from the superior margin of the second portion of the duodenum with 2-0 silk sutures. For adequate margins, the mobilized duodenum is divided approximately 1 to 3 cm distal to the pyloric ring, using a GIA or TA stapling device (Figure 13–12).

The avascular triangular ligament that supports the left lateral segment of the liver is divided. The left lobe is gently mobilized upward with a moist pack and a manual retractor. The remaining gastrohepatic ligament is then divided close to the liver, which includes a branch of the inferior phrenic artery. The stomach is next retracted upward and to the left,
The left gastroepiploic vessels are doubly ligated. The greater curvature of the stomach is then mobilized up to the esophagus (Figure 13–15). If tumor is adherent to the spleen, pancreas, liver, diaphragm, or mesocolon, the involved structures are removed en bloc. If the spleen is to remain, the gastrosplenic ligament is divided. Short gastric vessels are also ligated up to the GE junction with 3-0 silk sutures or surgical clips. Alternatively, the short gastric vessels may be divided with a harmonic scalpel or a similar coagulating device. The peritoneum over the esophagus is divided, and all bleeding points are ligated. The distal esophagus is then dissected free, and the vagal nerves are divided, which facilitates mobilization of the esophagus for 10 to 12 cm into the peritoneal cavity. Since the esophagus tends to retract upward when divided, two stay sutures are placed to provide downward traction.

After mobilization of the entire stomach and lower esophagus, the nasogastric tube is retracted; an automatic purse-string applier is placed approximately 6 to 10 cm above the GE junction, and the esophagus is then divided (Figures 13–16 and 13–17). The specimen, which consists of stomach, proximal duodenum, greater omentum, and regional lymph nodes, is sent to pathology to confirm the adequacy of the resected margins before reconstruction. Various reconstructive techniques have been used in an attempt to ensure better postoperative nutrition and fewer symptoms following total gastrectomy. A large jejunal loop with an enteroenterostomy has been described. Reflux esophagitis secondary to regurgitation may be alleviated by a Roux-en-Y procedure. Once the margins are cleared, reconstruction is performed either by stapled or hand-sewn anastomosis, depending on the preference of the operating surgeon. Although both reconstructive techniques are used, we prefer the stapling method since this approach simplifies the anastomosis and lessens the overall time for this procedure.

**Stapled Anastomosis**

After the removal of the specimen and after disease-free margins are confirmed histologically, a Roux-en-Y end-to-side esophagojejunostomy is performed. A 28 EEA anvil is placed into the lumen of the divided esophagus, and the purse-string suture is
Figure 13–13. The stomach is retracted upward and to the left for en bloc dissection of the anterior pancreatic capsule along with lymph nodes along the common hepatic and splenic artery.

Figure 13–14. The forceps point out the celiac axis. The left gastric artery is doubly ligated and divided. Inadvertent division of an aberrant or accessory left hepatic artery originating from the left gastric artery may cause significant postoperative hepatic ischemia. The forceps point to the left gastric pedicle.

Figure 13–15. The greater curvature of the stomach is mobilized up to the esophagus, using a Ligasure® or a similar coagulating device to divide the short gastric vessels.
tied (Figures 13–18 and 13–19). Once this is accomplished, the jejunum is divided distal to the ligament of Treitz, with a GIA stapler. The jejunum is mobilized, and its mesenteric blood supply is examined to confirm that it is intact. The divided distal loop of jejunum is then brought up through an opening in the mesocolon just left of the middle colic vessels. This retrocolic approach enables the jejunal limb to reach the end of the esophagus in a tension-free manner. The jejunal staple line is removed, and an EEA instrument is placed into the jejunum. The trocar from the EEA is brought through the side of the jejunum, and the instrument is then attached to the anvil, closed, and fired (Figure 13–20). The EEA is opened, slightly rotated, and then removed. The opened end of the jejunal limb is closed with a TA-30 stapler. The nasogastric tube is then passed beyond the anastomosis (Figure 13–21). To examine for air leaks, air is insufflated with the esophagojejunal anastomosis submerged under sterile saline.

A side-to-side jejunoojejunostomy 40 cm from the esophagojejunalostomy completes the Roux-en-Y reconstruction and re-establishes alimentary continuity beyond the ligament of Treitz (Figure 13–22). The side-to-side anastomosis is performed with a GIA stapler introduced into the antimesenteric sides of the jejunum. The enteroenterotomy is then closed with a TA-60 stapler. The jejunum is anchored to the margins of the mesocolon opening, which must be closed to avoid internal herniation, with interrupted

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**Figure 13–16.** After the stomach and esophagus are mobilized, an automatic purse-string applier is placed about 6 to 10 cm above the gastroesophageal junction.

**Figure 13–17.** The esophagus is divided. Stay sutures are used to prevent the retraction of the remaining distal esophagus into the mediastinum and to ensure easy approximation with the jejunum.
Figure 13–18. A 28 EEA anvil is inserted into the lumen of the divided esophagus.

Figure 13–19. The purse-string suture is tightened to hold the anvil of the circular stapler in place.

Figure 13–20. The shaft of the EEA circular stapling device is introduced into the divided jejunal limb, and the trocar from the EEA is brought through the jejunal wall, attached to the anvil, and fired.
Surgical Treatment of Localized Gastric Cancer

At this time, a needle catheter feeding jejunostomy is placed just past the enteroenterostomy and is secured to the abdominal wall with 3-0 silk sutures.

Subtotal Gastrectomy

A subtotal gastrectomy, which includes regional lymphadenectomy, is the operation of choice for distal gastric cancers. This procedure is approached in a similar fashion as that previously described for total gastrectomy, except that only 75 to 85% of distal stomach is resected. About a 75% gastric resection can be performed when the line of division includes most of the lesser curvature, with the ligation of the left gastric and left gastroepiploic vessels. The stomach is divided with a TA-90 stapling device (Figure 13–23). A small stomach remnant supplied by the short gastric vessels provides some gastric reservoir to minimize postgastrectomy sequelae (Figure 13–24).

After negative margins are obtained, a Roux-en-Y gastrojejunostomy is our reconstructive method of choice. The distal limb of jejunum is brought up through the mesocolon in a retrocolic fashion, and an end-to-side gastrojejunostomy is made, using a running inner layer of 3-0 absorbable suture and an interrupted outer layer of 3-0 silk Lambert sutures (Figure 13–25). A 40-cm distal limb is measured, and a side-to-side jejunoojejunostomy is made, using either a stapled or hand-sewn method as previously described. An alternate technique involves using a Billroth II loop gastrojejunostomy.

Postoperative Management

After surgery has been completed, postoperative care begins, with the ultimate goal of optimizing and maintaining the patient in a normal physiologic state. Postoperative pain is controlled with the use of judicious narcotics in the form of an epidural catheter left in place for a few days or a patient-controlled analgesia (PCA) system administering morphine or meperidine. The use of a nasogastric tube is controversial, and such use is based on surgeon preference. During the initial postoperative period, fluid and electrolyte balance is maintained intravenously. Early ambulation is encouraged, usually on the first postoperative day. With the resumption of bowel function, the patient’s diet is gradually advanced. If the patient has...
difficulty with the oral consumption of foodstuffs, a previously placed feeding jejunostomy tube may be used for postoperative nutritional support.

Guidelines for follow-up after resection for gastric cancer have not been standardized. Nevertheless, patients should be monitored closely for the first 2 years as most recurrences fall within this period. Patients are seen every 3 months and are questioned about dysphagia, changes in bowel habits, abdominal pain, and weight loss. The physical examination should focus on the appearance of any abdominal tenderness, masses, or ascites, and a rectal examination should be performed to check for occult blood and pelvic peritoneal recurrence (Blumer’s shelf). Follow-up visits may be scheduled every 6 months for years 3 to 5 and yearly thereafter. No strict recommendations can be made for periodic chest radiography, CT, or routine blood tests. The development of symptoms, however, usually warrants imaging or endoscopic studies to rule out recurrence.

Other Surgery-Related Options:
The Role of Laparoscopy

The usefulness of laparoscopy lies in its ability to detect nodal metastases, subclinical peritoneal carcinomatosis, and occult hepatic metastases. Failure to detect these diseased states may ultimately affect the resectability rate and outcome. Several studies show that laparoscopy may be more accurate in assessing nodal involvement and detecting hepatic metastases than compared to ultrasonography and CT and that peritoneal carcinomatosis can be conclusively excluded by laparoscopy. In one report, laparoscopy detected nodal involvement with a diagnostic accuracy of 72%, compared to 52% for ultrasonography and 57% for CT. Laparoscopy detected hepatic metastases more accurately (96%) than ultrasonography (83%) and CT (85%). Furthermore, laparoscopy had an 83% sensitivity for the detection of peritoneal carcinomatosis.
Since many patients with gastric cancer have undetectable disseminated disease, resection is not likely to alter their outcome. Therefore, it would be important to accurately identify these patients for exclusion from surgery and for placement into protocols exploring new or novel therapeutic regimens. Laparoscopically obtained peritoneal washings and the use of Giemsa and Papanicolaou stains to identify intraperitoneal free cancer cells (IFCCs) are of great value in detecting microscopic intra-abdominal spread and in identifying that subset of patients who are at high risk of peritoneal recurrence. Furthermore, positive laparoscopic peritoneal-lavage cytology may be a good predictor of poor outcomes in patients with advanced disease and may be used in treatment planning, especially for patients who are entering either neoadjuvant or adjuvant treatment protocols.

In a report of 127 patients with gastric cancer, the prevalence of IFCCs was 0% (0 in 45) in patients with T1/T2 M0 disease, 10% (3 in 31) in patients with T3/T4 M0 disease, and 59% in patients with M1 disease. The three T3/T4 M0 patients with positive cytology had recurrences at a median follow-up of 8.5 months, and their survival was significantly decreased when compared to that of stage-matched controls with negative cytology who underwent resection for cure. There was also no difference in survival between the three stage III M0 patients and stage IV patients who did not undergo resection. The study suggested that patients with positive lavage cytology are equivalent to those with stage IV disease, even in the absence of macroscopic peritoneal disease or distant metastases, and that this technique identifies the subset of T3/T4 M0 patients who are unlikely to benefit from resection alone.

In a study of 49 patients with gastric cancer, laparoscopy with cytologic examination for staging revealed IFCCs in 41% of patients. In 8 cases, laparoscopy revealed carcinomatosis and liver metastases precluding laparotomy. All patients who tested positive for IFCCs developed peritoneal recurrence. The absence of IFCCs was associated with improved overall survival. The report concluded that laparoscopic peritoneal-lavage cytology is valuable in identifying patients at high risk of peritoneal recurrence and thereby improves the survival in those patients.

The value of laparoscopy in the management of gastric cancer is highlighted in two studies. In one report of preoperative CT and laparoscopy, subclinical peritoneal carcinomatosis and occult hepatic metastases were detected by laparoscopy in 28% of the patients with gastric cancer. The median survival of these patients was 5 months, and only one patient required reoperation for palliation. In another study of patients in whom laparoscopic exploration was performed following a reported normal CT scan, subclinical metastatic disease was found in 37% of these patients, with an 84% sensitivity and a 100% specificity. No patients who initially underwent only laparoscopy required reoperation for palliation.

Laparoscopy has also been shown to be a safe and useful method for examining occult disseminated gastric cancer through peritoneal-lavage cytology. Since many patients with gastric cancer have undetectable disseminated disease, resection is not likely to alter their outcome. Therefore, it would be important to accurately identify these patients for exclusion from surgery and for placement into protocols exploring new or novel therapeutic regimens. Laparoscopically obtained peritoneal washings and the use of Giemsa and Papanicolaou stains to identify intraperitoneal free cancer cells (IFCCs) are of great value in detecting microscopic intra-abdominal spread and in identifying that subset of patients who are at high risk of peritoneal recurrence. Furthermore, positive laparoscopic peritoneal-lavage cytology may be a good predictor of poor outcomes in patients with advanced disease and may be used in treatment planning, especially for patients who are entering either neoadjuvant or adjuvant treatment protocols.

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selection of patients suitable for curative or palliative resection. Furthermore, the study demonstrated that a positive cytologic test is a significant prognostic factor for survival.

Laparoscopic techniques are useful for confirming the absence or presence of incurable disease. Laparoscopy allows easy access to intra-abdominal structures for biopsy and for determining local resectability, thereby avoiding unnecessary high-risk surgical procedures. Furthermore, laparoscopic peritoneal-lavage cytology may play an important role in staging, evaluating, and classifying patients with gastric cancer for appropriate treatment. This approach may be especially valuable in the diagnosis of occult abdominal M1 disease missed by standard ultrasonography or CT. For all of the above reasons, we routinely perform laparoscopy prior to attempting curative gastric resection.

**SURGICAL ISSUES IN GASTRIC CANCER**

**Extended Lymph Node Dissection**

The role of extended lymphadenectomy for gastric cancer is a controversial issue that continues to receive much attention. Radical lymph node dissection was embraced as an integral part of gastrectomy procedures, based on an initial report from Japan that demonstrated a survival benefit for patients with serosal or involved regional lymph nodes who underwent D2 lymphadenectomy.32 The Japanese have made significant contributions to the classification of regional lymph nodes, which is essential to the understanding of extended lymph node resection. The Japanese staging of lymph node involvement is different from the American Joint Committee on Cancer (AJCC) system in that it describes four major nodal groups (N1 to N4) that comprise 16 separate locations of nodal tissue. Group 1 (N1) nodes are located closest to the primary tumor and within the perigastric tissue along the greater and lesser curvature of the stomach. Group 2 (N2) nodes are found along the major vessels from the celiac axis, including the common hepatic, splenic, and left gastric arteries. Group 3 (N3) nodes are located at the celiac axis, near the origin of the superior mesenteric artery, near the hepatoduodenal ligament, and behind the pancreas. Group 4 (N4) nodes reside in the periaortic tissue. The N3 and N4 locations would be the equivalent of distant metastatic disease (M1) in the AJCC system. Importantly, the location of lymph nodes in relation to the primary tumor, rather than number of nodes, is used to define the stage of lymph node disease and is ultimately used to determine the extent of lymph node dissection.

In Japan, gastric resection with extended lymphadenectomy is classified into five types. A D0 resection includes a gastrectomy with the incomplete resection of N1 nodes whereas a D1 gastric resection includes the complete dissection of N1 nodes. A D2 resection includes the removal of both the N1 and N2 nodes. A D3 resection includes the dissection of N1 to N3 nodes. A D4 resection is the most extensive and includes the removal of all nodal groups. The Japanese Research Society for Gastric Cancer defines a curative resection as a resection that involves a gastric resection with lymph node dissection one level beyond that of pathologic lymph node involvement in a patient without peritoneal or hepatic metastasis.33 In Japan, the meticulous surgical dissection and pathologic staging of specific nodal basins in relation to the primary tumor are based on the premise of an orderly progression in the spread of metastasis from primary tumor to regional lymph nodes and then to the next higher echelon of nodes. From this assumption, the Japanese believe that more extensive surgery involving the removal of progressively higher echelons of lymph nodes will result in improved survival rates per stage of disease.34,35 Thus, for positive N1 nodes, a D2 dissection would be required for adequate resection.

According to one Japanese study, the 5-year survival rates for patients with nodal involvement at N0, N1, N2, N3, and N4 nodes are 81.5%, 49.7%, 24%, 5.9%, and 1.9%, respectively.34 These findings suggest that a greater number of involved nodes indicates a higher incidence of positive nodes at multiple levels and therefore a lower 5-year survival rate. As extended lymph node resection for gastric cancer has become more universally accepted in Japan, the operative mortality for such radical dissections has declined while 5-year survival rates after curative resection have increased. In another
nonrandomized study, Japanese patients who underwent D3 resection had a 5-year survival rate of 21.4%, compared to 10.0% for those patients who underwent D2 resection for N2 gastric cancer. Other studies from Japan reported 5-year survival rates approaching 50% in node-positive patients after extended lymphadenectomy. These impressive survival outcomes from Japan have not been reliably reproduced in Western reports and have undoubtedly contributed to the controversy over whether or not extended lymphadenectomy confers a survival advantage. A more aggressive surgical approach involving a total gastrectomy with en bloc resection of adjacent organs with standard extended lymphadenectomy is believed by Japanese surgeons to be the main reason for such good stage-specific survival. Other factors that may explain such results include the younger age of Japanese patients, less comorbidity in this population, earlier detection due to mass screening programs, and stage migration (described below). Finally, there may exist the possibility that gastric cancers in Japan are inherently different from gastric cancers in other Western countries and that the Japanese have developed a less aggressive form of the intestinal type of disease. In the last two decades, D2 resections have become more commonplace in Western countries. Nonrandomized studies from Germany, Norway, and the United States have reported postoperative morbidity rates of around 30%, mortality rates between 4 and 5%, and 5-year survival rates between 26.3 and 47% for D2 resections (Table 13–3). This variability in outcome is probably due to the varied definitions of D2 resections.

On the basis of the aforementioned retrospective data, four randomized studies comparing D1 to D2 resections have been performed (Table 13–4). In a small study from South Africa, no survival differences were reported in patients who underwent either D1 or D2 resection for T1–3 N0–1 M0 gastric cancer. Furthermore, the patients who underwent D2 resections had longer operative times, longer hospital stays, and higher complication rates. In a report from Hong Kong, no benefit in morbidity, mortality, or survival was demonstrated in patients undergoing more extended D3 resections when compared to patients undergoing D1 resections.

In a prospective randomized trial from Great Britain, patients undergoing D1 resections were compared to patients undergoing D2 resection. Postoperative complications were significantly higher in the D2 group than in the D1 group (46% vs. 28%, \( p \leq 0.001 \)). Postoperative mortality rates were also significantly higher in the D2 group (13% vs. 6.5% in the D1 group, \( p \leq 0.05 \)). There were no significant differences in 5-year survival rates between the D2 group and the D1 group (33% vs. 35%, respectively). Likewise, a phase III clinical trial from the Netherlands reported that patients who underwent more extensive D2 resections experienced more postoperative complications than those who underwent D1 resections (43% vs. 25%, respectively, \( p \leq 0.001 \)) and had a significantly higher operative mortality (10% vs. 4% for the D1 patients, \( p \leq 0.0005 \)). The 5-year survival rates for patients undergoing D1 and D2 resections were 45% and 47%, respectively.

Some conclusions can be drawn from these randomized trials. Although there were substantial differences in the design and conduct of these studies, the postoperative morbidity and mortality were significantly higher in the D2 resection group than in the D1 resection group. Furthermore, in all studies,

<table>
<thead>
<tr>
<th>Study, Year (Country)</th>
<th>D1 Gastrectomy</th>
<th>D2 Gastrectomy</th>
</tr>
</thead>
<tbody>
<tr>
<td>n</td>
<td>Morbidity (%)</td>
<td>Mortality (%)</td>
</tr>
<tr>
<td>Siewert et al, 1993 (Germany)</td>
<td>558</td>
<td>29</td>
</tr>
<tr>
<td>Viste et al, 1994 (Norway)</td>
<td>78</td>
<td>37</td>
</tr>
<tr>
<td>Wanebo et al, 1996 (United States)</td>
<td>1,529</td>
<td>—</td>
</tr>
</tbody>
</table>

\( n \) = sample size.
there was no 5-year survival advantage for D2 resections. Thus, the adopted practice of D2 resection for Western patients with N1 gastric cancers warrants reconsideration as this surgical approach is associated with higher postoperative morbidity and mortality rates and no apparent survival benefit.

### Extent of Gastric Resection

For proximal gastric tumors, surgical management remains controversial in regard to the extent of gastric and esophageal resection and in regard to the optimal surgical approach. The options include performing a total gastrectomy through a transabdominal approach versus performing a proximal gastrectomy through an Ivor Lewis or transabdominal approach. In general, proximal tumors often have an advanced presentation and have a poorer prognosis than distal tumors. In one report, a survival advantage and a lower recurrence rate have been shown for patients with stage I and II disease of the proximal stomach who undergo a radical total gastrectomy with esophagojejunal anastomosis.44 This procedure can be accomplished with minimal morbidity and a mortality of < 5%.45 The advantages of total gastrectomy when compared to proximal gastrectomy include the increased probability of achieving negative histologic distal margins and the relative ease of complete perigastric lymph node removal. Furthermore, total gastrectomy with Roux-en-Y reconstruction for proximal gastric lesions also precludes the possibility of alkaline reflux esophagitis that is frequently associated with disabling symptoms after proximal subtotal gastrectomy. However, in a recent study of 391 patients with proximal gastric cancers, the extent of resection did not affect the long-term outcome.46 The report concluded that both total and proximal gastrectomy could equally be safely accomplished and that they had similar times for recurrence, similar recurrence rates, and similar 5-year survival rates.

Midbody lesions account for approximately 15 to 30% of all gastric cancers, and these tumors tend to remain asymptomatic until they are locally advanced. Although the decision to perform a radical total gastrectomy versus a subtotal gastrectomy (75 to 85%) remains controversial, most midstomach tumors are large and invade adjacent structures that may require a radical total gastrectomy or an extended total gastrectomy (en bloc splenectomy and distal pancreatectomy) to achieve negative margins. In a comparative study, there were no convincing data regarding the superiority of one procedure over another.47 This finding may reflect the fact that the majority of patients in the study had stage III and IV disease and that no surgical procedure was therefore likely to have a favorable impact on survival. The lowest local recurrence rate (16%) was achieved in patients who underwent extended total gastrectomy. Overall, these data suggest that tumor biology, rather than the extent of gastrectomy, dictates the eventual outcome.

Approximately 35% of all remaining gastric cancers occur in the distal third of the stomach. These lesions are detected earlier than the more proximal lesions in the stomach because they have the tendency to cause symptoms of gastric outlet obstruction even when relatively small. For distal gastric cancers, radical subtotal gastrectomy is the surgical procedure of choice. This operation requires the resection of

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#### Table 13–4. RANDOMIZED STUDIES OF D1 AND D2 GASTRECTOMIES

<table>
<thead>
<tr>
<th>Study, Year (Country)</th>
<th>D1 Gastrectomy</th>
<th>D2 Gastrectomy</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>n</td>
<td>Morbidity (%)</td>
</tr>
<tr>
<td>Dent et al, 1988 (South Africa)</td>
<td>22</td>
<td>22</td>
</tr>
<tr>
<td>Robertson et al,* 1994 (Hong Kong)</td>
<td>25</td>
<td>0</td>
</tr>
<tr>
<td>Cuschieri et al, 1999 (Great Britain)</td>
<td>200</td>
<td>28</td>
</tr>
<tr>
<td>Bonenkamp et al, 1999 (The Netherlands)</td>
<td>380</td>
<td>25</td>
</tr>
</tbody>
</table>

n = sample size.

*Study involved extended D3 resections vs. D1 resections.
approximately 75% or more of the distal stomach, including most of the lesser curvature. At least 1 cm of the first portion of the duodenum and 5 to 7 cm of normal gastric tissue proximal to the tumor should be resected to ensure adequate margins. As with all gastric resections, removal of the omental bursa with regional lymph node dissection is routinely performed if the surgeon subscribes to the concept that D2 resection improves survival. For posterior tumors, extended distal subtotal gastrectomy with en bloc resection of the pancreatic tail and spleen may be necessary if the primary tumor is adherent or invades surrounding tissues. In comparative studies, patients undergoing distal resection have the lowest incidence of postoperative complications and mortality, compared to other patients undergoing other surgical procedures for gastric cancer. In a study of 55 patients with antral cancers, patients treated with a D1 subtotal gastrectomy had better overall survival and lower postoperative morbidity when compared to patients who underwent D3 total gastrectomy.41 Although it had a low operative mortality rate, D3 total gastrectomy was also associated with increased postoperative intra-abdominal sepsis. The report concluded that such findings did not support the routine use of D3 total gastrectomy in distal-third cancers.

**Adequacy of Proximal and Distal Margins**

The importance of adequate margins of resection is apparent and was highlighted by a study that reported a 5-year survival rate of 28% for patients with positive proximal margins after gastrectomy.48 Local recurrence was a cause of death in 23% of these patients. The patients had a 6-cm or larger gross margin of resection from the primary tumor. Further studies suggest that local recurrences usually are not due to disease in the mucosa but rather to infiltration of cancer in the surrounding lymphatic vessels and adjacent organs.

Distal margins are usually histologically negative when the duodenum is divided 2 to 3 cm or more distal to the gastric pylorus. Proximal resections, in contrast, require larger margins of resection from the gross primary tumor. Furthermore, re-excision to obtain negative margins is rarely indicated. For tumors of the GE junction, up to 10 cm of distal esophagus should be included within the resected specimen since these cancers tend to spread throughout the submucosa.

**Splenectomy and Resection of Adjacent Organs**

Routine splenectomy during resection for gastric cancer has not been shown to improve patient outcome. In a retrospective study of 392 patients undergoing potentially curative resection, splenectomy in association with extended resections caused significantly more complications than did those procedures without splenectomy.49 Importantly, patients who underwent splenectomy had a higher percentage of infectious complications than patients who did not undergo the procedure. No survival benefit was attributed to splenectomy. The report concluded that splenectomy increased the morbidity of curative gastrectomy and should be reserved for tumors that invade the spleen or require splenectomy to facilitate gastrectomy. Another recent report attributed no survival benefit to splenectomy for any given stage of gastric cancer.50

Advanced gastric cancer with direct invasion into adjacent organs indicates a poor prognosis. Although there have been studies of extended en bloc resection that includes the spleen, distal pancreas, and transverse colon in patients with advanced gastric cancer, no data support an improved 5-year survival in those patients undergoing such an approach if adjacent organs are uninvolved with tumor. En bloc resection that does not remove all gross disease is not indicated for gastric cancer.

**Surgical Treatment of Locally Recurrent Gastric Cancer**

Despite complete resection of all gross tumor with negative margins, recurrence of gastric cancer is nevertheless common. Certain patterns of locoregional failure and distant metastasis are apparent. The disease spreads by local extension into contiguous structures, metastasizes to regional lymph nodes, seeds throughout the peritoneal cavity, and metastasizes to distant sites such as the liver and lungs. Locoregional recurrences occur at the site of anasto-
miosis, within the bed of gastric resection, or in the adjacent lymph nodes, and occur in approximately 20 to 50% of patients after gastrectomy.\textsuperscript{51–54} Approximately 90% of all recurrences appear within the first 2 years after the initial resection.\textsuperscript{55} The patients who are at highest risk of locoregional failure are those with (1) locally advanced tumors penetrating through the gastric serosa, (2) lymph node involvement, and (3) invasion of adjacent organs. Histologic studies suggest that locoregional failure occurs in about 45% of patients who have primary lesions that extend through the stomach wall and in 19% of those without stomach-wall infiltration.\textsuperscript{54}

There is some evidence to suggest that re-excision may be appropriate and potentially beneficial for a select group of patients with locoregional recurrence after initial surgical resection. In a retrospective study from Japan of 51 patients with recurrent gastric cancer following partial or subtotal gastrectomy, 25% of patients underwent re-excision for recurrent lesions; 92% of those patients underwent total resection of the gastric remnant, with en bloc removal of the distal pancreas, spleen, transverse colon, and liver segment.\textsuperscript{56} The operative mortality rate was 7.6%, and the 1-year survival rate was 41.7%. The authors of the study concluded that aggressive surgical re-excision might be indicated for locally recurrent disease, which histologically proved to be stage I and II disease after the initial operation.

In another report, re-excision was possible in 53.5% of 75 patients who were explored for locally recurrent gastric cancer.\textsuperscript{53} Total gastrectomy with reconstruction was performed in 55% of the patients who underwent re-excision, and gastrectomy combined with en bloc adjacent organ resection was performed in 45% of patients, with an overall mortality rate of 15%. Of those patients who underwent re-excision for recurrent gastric cancer, 31.2% received preoperative radiation whereas 28.2% underwent postoperative systemic chemotherapy. The 2-year survival rates for those patients who underwent re-excision were as follows: re-excision alone, 20%; preoperative radiation and re-excision, 31.3%; and re-excision with postoperative chemotherapy, 66.4%. The report concluded that re-excision benefits select patients with recurrent gastric cancer and that preoperative radiation or postoperative chemotherapy may provide some additional benefit.

**RESULTS OF SURGERY**

As a consequence of the advanced disease stage at presentation, the overall 5-year survival rate in most Western countries ranges from 10 to 20% for all patients with gastric cancer and from 24 to 58% for patients who undergo curative resection. In contrast, the Japanese consistently report higher survival rates, which they attribute to increased detection and to the subsequent treatment of early gastric cancer with more extensive lymph node dissections.\textsuperscript{57} Although earlier diagnosis, a higher incidence of intestinal-type tumors, and more extensive surgeries in Japan may account for such disparity, a major contributing factor may be the differences between Japan and most Western countries in regard to the surgical and pathologic staging of gastric cancer. The differing classifications of lymph node dissection used in the United States and in Japan suggest a stage migration bias that may confound the interpretation of comparative surgical results between the two countries.

Within the Japanese system of meticulous surgical dissection and staging of nodal basins in relation to the primary tumor, a so-called stage migration may arise. In stage migration, a subset of patients may be assigned to a more advanced disease stage.\textsuperscript{58} This migration may lead to statistical improvements in stage survival, as depicted in Table 13–5. For example, a subset of staged patients from group A are assigned (or migrate to) more advanced stages according to group-B staging criteria, as shown in the middle column. The combined staged results of group B are shown on the right of the table. Twenty-four stage I patients from group A migrate to an advanced stage under group B. All except two patients migrate to stage III of group B. The 22 patients now considered to have stage III disease have a 5-year survival rate (59%) that is lower than the original survival rate in stage I (79%) but higher than the original survival rate in stage III (31%). Thus, the number of patients increases in more advanced stages, and the survival results within each stage improve under group B. The overall survival
rate of those patients under group B, however, remains the same as that of group A (52%).

This apparent increase in stage-specific survival without an influence on overall survival or stage migration is caused by a reclassification of staging by lymph node dissection and may explain the difference in survival between Japanese and Western patients. The controversy regarding the role of extended lymph node dissection and the observed stage migration in the staging system used in the United States versus that used in Japan not only can be difficult to interpret but also raises concerns about the accuracy of staging and the appropriate selection of surgical treatment. Currently, no distinct advantage to staging gastric cancer according to the Japanese system has been shown in Western patients. Until proven otherwise, the tumor-node-metastasis (TNM) staging system advocated by the AJCC remains the standard in the United States.

To further add to this confusion, the terminology used to characterize the various types of surgical resections has changed. Resections that remove N1, N1 to N2, and N1 to N3 nodes were previously termed R1, R2, and R3 resections, respectively. Presently, they are respectively termed D1, D2, and D3 resections. The term R0 represents curative resection with no residual tumor whereas the term R1 indicates incomplete tumor resection.

To identify specific variables that might correlate with a poor prognosis and long-term survival following gastrectomy, Shiu and colleagues performed a retrospective prognostic study of 246 patients undergoing curative resection for gastric cancer. Lesions of the gastric cardia and GE junction were excluded. Of nine clinicopathologic variables, three were found to have independent prognostic significance by multivariate analysis. These variables were advanced TNM stage, metastatic involvement of four or more lymph nodes, and histologic evidence of poorly differentiated tumors. Of six treatment variables, only two variables—splenectomy and inadequate scope of lymphadenectomy—were independent predictors of outcome. Both variables proved to have a negative impact on survival.

In a study of 211 gastric cancer patients from the United States, 83% underwent laparotomy, and of these patients, 34% underwent gastrectomy with curative intent whereas 24% underwent palliative surgery. Although the overall survival rate for all 211 patients was 21%, those patients who underwent resection had a 5-year survival rate of 36%. For those patients who underwent surgery with curative intent, the 5-year survival increased significantly to 58%. The survival rate of patients with distal tumors undergoing curative resection was twice that of patients with proximal tumors. Of all patients, 15% had linitis plastica, with a median survival of 12 months. The report recommended that resection be avoided in this patient group unless palliation of an obstructing or bleeding tumor was necessary. The report concluded that the appropriate selection of patients for resection with curative intent consistently improved outcomes, as shown by higher median and 5-year survival rates.

In a review of 1,710 cases of gastric cancer over a 35-year period, the 5-year survival rates after resection according to stage were as follows: stage 0 or I, 27%; stage II, 25%; and stages III and IV, 6%. The
report emphasized that regional lymph node spread
did not always equate with aggressive tumor biology.
Also, the report revealed that stage III and IV patients
who underwent resection during a 20-year period
made up 48% of all 5-year survivors in the study. In
addition, antral tumors proved to be more common
than proximal gastric tumors, and most 5-year sur-
vivors were those patients who were surgically treated
for antral lesions. The long-term survival rate for
patients with proximal lesions did, however, improve
from 0% in the first 25 years to 14% during the last
decade. The study also suggested that the morphology
of the lesions related to 5-year survival, ulcerating
tumors having the worst prognosis.

In a review of 5-year survival rates for gastric
cancer in English-language publications from 1960
to 1990, results from Japan, Europe, and the United
States were combined and analyzed separately.36 The
5-year survival rate following all reported gastric
resections increased from 20.7% before 1970 to
28.4% in 1990. During this period, the 5-year sur-
vival rate for patients undergoing curative or radical
resection increased from 37.6 to 55.4%. When the
Japanese experience was analyzed separately from
the Western experience, the 5-year survival rate after
curative resection was 60.5% in Japan and 39.4% in
the Western countries. Other findings included a
decreased incidence of exploratory laparotomies
(due to improved staging methods prior to surgery)
and decreased operative mortality during this
period. The report concluded that the outcome for
patients with gastric cancer improved due to earlier
diagnosis, better preoperative staging, more exten-
sive resections, and better perioperative care.

The experience with gastric cancer in the United
States was reported in a comprehensive study of
18,365 patients that was conducted by the American
College of Surgeons. As expected, survival after sur-
gical treatment was stage dependent.61 Patients with
stage I and II disease had an overall 5-year survival
rate of 50% and 29%, respectively, after resection.
Patients with stage III and IV disease had survival
rates of 13% and 3%, respectively. Approximately
66% of patients presented with either stage III or
stage IV disease. Patients rarely underwent extensive
lymphadenectomy. Tumor recurrence was shown to
be 40% locoregional and 60% distant. Adjuvant radi-
ation, chemotherapy, or both yielded no survival ben-
efit when compared to surgical resection alone.
When the findings from this study were compared to
experiences reported from 56 Japanese hospitals, a
higher incidence of stage I gastric cancer was noted
among patients from Japan (33.7%), compared to
patients from the United States (17.1%). The overall
survival rate of patients who underwent resection
was 19% in the United States, compared to 56.3% in
Japan. The stage-for-stage 5-year survival rate was
also better in Japan. The reasons for such discrep-
ancy may be due to the understaging of patients in
the American series whereas in the Japanese series, a
more aggressive surgical approach to lymph node
dissection may have provided more accurate staging.
Although the results of surgery for gastric cancer in
the United States are less favorable than those
reported by the Japanese and by centers in other
Eastern countries, the report concluded that earlier
diagnosis and appropriate surgical technique for con-
trolling locoregional disease are essential for opti-
mizing outcomes.

In a subsequent study conducted by the American
College of Surgeons and the American Cancer Soci-
ety, the demographics, grade, subsite, treatment, and
rate of survival of Japanese Americans were investi-
gated to explain the international differences in
stage-stratified survival for gastric cancer patients.62
The stage-stratified 5-year and 10-year survival rates
based on the fifth edition of the AJCC staging system
were as follows, respectively: stage 1A, 78% and
65%; stage IB, 58% and 42%; stage II, 34% and
26%; stage IIIA, 20% and 14%; stage IIIB, 8% and
3%; and stage IV, 7% and 5%. The report revealed
that Japanese Americans had a superior stage-for-
stage survival, which was attributed partly to this
group’s predilection for fewer proximal tumors, a
lower male-female ratio, and fewer adjacent-organ
resections. Furthermore, the fifth edition of the
AJCC system, which stages lymph nodes according
to number rather than location, proved to be a supe-
rior prognostic tool. Finally, the report asserted that
the consideration of proximal tumors as being
located at a separate disease site might improve the
current TNM staging system and concluded that sur-
gical undertreatment of patients with gastric cancer
remains a problem in the United States.
EARLY GASTRIC CANCER

In 1962, the Japanese first characterized early gastric cancer as adenocarcinoma that was limited to the mucosa or submucosa, regardless of lymph node involvement. This histologic classification is distinguished by a high cure rate associated with patients who are surgically treated for this disease. Because of aggressive screening programs, a greater incidence of early gastric cancer has been reported in Japan (from 5 to 30% of all stomach cancers) whereas the incidence has increased only slightly (from 5 to 15%) in the United States during the past two decades. The diagnosis of early gastric cancer is made by endoscopic biopsy that demonstrates adenocarcinoma superficial to the muscularis propria. Therefore, by TNM classification, all T1 tumors with any N stage of disease are considered early gastric cancers.

In a Japanese study of 396 patients, the 10-year survival rate for patients with T1 tumors ranged from 82 to 97% when there were no involved nodes but decreased with nodal involvement, from 57 to 87%. Approximately 10% of patients with T1 tumors present with nodal metastases. Multivariate analysis identified large tumor size (> 2 cm) and submucosal invasion as independent risk factors for lymph node involvement in patients with early gastric cancer. For patients with early gastric cancer and no involved nodes, extended lymph node resection has not proved to be beneficial. For early gastric cancer patients with large tumors, lymphatic involvement, or submucosal invasion, however, extended lymphadenectomy may be indicated due to the increased risk of nodal metastases.

In a retrospective study of 60 patients with early gastric cancer from the United States, the disease-free 5-year survival rate after gastrectomy was 76.4% and did not correlate with sex, tumor site, macroscopic tumor appearance, extent of gastric resection, or histologic type. Lower survival rates, however, were associated with larger (> 1.5 cm) early gastric tumors that invaded the submucosa or involved regional lymph nodes. The authors of the study concluded that a high index of suspicion was necessary for earlier detection of early gastric cancers and that gastrectomy with extended D2 lymphadenectomy was necessary to achieve the highest rate of cure. In another study from the same institution, of 165 patients with early gastric cancer staged as T1, the 5-year survival rate after surgical resection was 91% in those patients with negative nodes, compared to 78% in those patients with positive nodes. Although multivariate analysis showed that nodal disease and tumors > 4.5 cm in size were associated with decreased survival, only the presence of nodal disease predicted decreased survival. Moderately or well-differentiated tumors < 4.5 cm and limited to the mucosa had no incidence of nodal metastasis. The authors of the study concluded that early gastric cancer patients with T1 tumors in the United States have a prognosis that is as good as that of similar patients in Japan after surgical resection and that favorable pathologic tumors should be considered for limited resection without lymphadenectomy.

Current surgical treatment for early gastric cancer should therefore consist of subtotal gastrectomy with regional lymph node dissection. Patients with multifocal and proximal lesions should be treated with total gastrectomy. Although extended lymphadenectomy for more advanced lesions remains controversial, the majority of patients with early gastric cancers do well with limited lymphadenectomy, and extended dissections may not be indicated. A limited resection without lymphadenectomy may be considered in patients with small T1 tumors who have comorbid conditions that would put these patients at prohibitive risk if subjected to a more formal and conventional gastrectomy.

In Japan, endoscopic treatment for early gastric cancer has been evaluated in elderly or other poor-risk patients as well as in those patients who refuse gastric resection. In one report, endoscopic therapy in the form of laser ablation, multiple or strip biopsies, or chemical injections followed by careful monitoring resulted in a disease-free survival rate of close to 100%. The best results are obtained when tumors are < 2 cm and less likely to be metastatic. Patients with small elevated tumors found to be limited to the gastric mucosa by EUS evaluation are the best candidates for endoscopic treatment. Although short-term survival has been promising thus far in poor-risk patients and in those who refuse gastrectomy, more experience with this “minimally invasive” treatment modality is needed before endo-
scopic treatment can replace surgical resection as standard therapy for early gastric cancer.

CONCLUSION

Gastric cancer remains a deadly disease worldwide. Resection remains the only potentially curative treatment for localized stomach cancer. With the exception of early gastric cancer, overall 5-year survival rates for gastric cancer remain dismal (10 to 20% in most Western countries). Recent studies from the United States show that 5-year survival rates for patients undergoing resection with curative intent range from 20 to 58%, indicating occult microscopic metastatic spread in a large number of patients. Although studies show that extended D2 resections can be performed safely and likely be indicated in cases of locoregional lymph node involvement, more extensive resections may not provide any further survival benefit. The Japanese have demonstrated the effectiveness of mass screening and meticulous staging in high-risk patients, with impressive results. If such favorable outcomes are to be duplicated in the West, greater efforts at earlier detection and prevention must be made. Further investigations into the nature of the disease are ongoing and may ultimately lead to better strategies for the diagnosis and treatment of gastric cancer in the future.

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