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Nursing Care of the Patient Undergoing Gastric Resection for Malignancy

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Abstract

Background: Gastric cancer remains the fifth most common malignancy worldwide and the third leading cause of cancer-related mortality. Despite advances in multimodal therapy, surgical resection continues to be the cornerstone of curative treatment. However, the complexity of gastric anatomy and the high morbidity associated with gastrectomy necessitate meticulous planning and multidisciplinary care.

Aim: To review the principles, indications, techniques, and complications of gastric resection for malignancy, emphasizing nursing and interprofessional roles in optimizing outcomes.

Methods: A comprehensive synthesis of current evidence and guidelines was undertaken, covering surgical approaches (open, laparoscopic, robotic), lymphadenectomy strategies, endoscopic alternatives, and perioperative management.

Results: Minimally invasive techniques, including laparoscopic and robotic-assisted gastrectomy, demonstrate oncologic equivalence to open surgery with reduced morbidity and faster recovery in experienced centers. Endoscopic submucosal dissection offers organ-preserving treatment for early-stage disease. D2 lymphadenectomy remains the gold standard for staging and local control. Postoperative complications—such as anastomotic leak, dumping syndrome, and nutritional deficiencies—significantly impact survival and quality of life, underscoring the need for vigilant nursing care and multidisciplinary coordination.

Conclusion: Gastric resection for malignancy is a complex, high-risk intervention requiring individualized surgical planning, evidence-based perioperative strategies, and robust interprofessional collaboration to minimize complications and optimize patient outcomes.

Keywords: Gastric cancer, gastrectomy, laparoscopic surgery, robotic-assisted surgery, lymphadenectomy, endoscopic submucosal dissection, nursing care, complications.

Introduction

Gastric cancer continues to constitute a formidable global health burden and remains among the most consequential malignancies confronting contemporary healthcare systems. Epidemiologically, it is recognized as the fifth most frequently diagnosed cancer worldwide and the third leading cause of cancer-related death, a ranking that reflects both its high incidence in many regions and its often aggressive clinical trajectory.[1] The magnitude of the problem is further emphasized by the sheer volume of newly diagnosed cases each year: more than one million individuals are estimated to develop gastric cancer annually across the globe, and in the United States alone approximately 27,500 new cases are reported in a typical year.[2][3] Such figures underscore the ongoing need for robust prevention strategies, timely detection, and optimized therapeutic approaches. When considered through the lens of population-level outcomes, the reported incidence of 5.6% and a mortality rate of 7.7% highlight a persistent disparity between diagnosis and survival that remains difficult to reconcile, particularly in settings where advanced health services are readily available.[4] This imbalance between disease frequency and mortality is a hallmark of gastric cancer and is closely tied to diagnostic delays, tumor biology, and the complexities inherent in achieving durable disease control. A major clinical challenge in gastric cancer care is the substantial proportion of patients who present with advanced disease. Advanced gastric cancer is estimated to comprise between 50% and 80% of all cases, indicating that for many patients the disease is already locally extensive or systemically disseminated by the time it is identified.[5][6] This reality profoundly influences treatment planning and prognostication, as advanced-stage disease often

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necessitates intensive multimodal therapy and is associated with higher rates of recurrence and reduced overall survival. Even in patients who are eligible for contemporary neoadjuvant chemotherapy regimens, a significant fraction do not achieve the anticipated therapeutic response. Reported data indicate that 35% to 51% of individuals fail to attain desired responses to neoadjuvant chemotherapy, while approximately 15% experience tumor progression despite treatment.[5][6] These outcomes reveal important limitations in current systemic therapies and reinforce the need to refine patient selection, develop more predictive biomarkers, and strengthen integrated treatment pathways that can adapt to heterogeneous tumor behavior [1][2][3][4][5][6].

In many Western healthcare contexts, the standard approach to these challenges has evolved toward a multimodal treatment paradigm, reflecting a broader shift in oncologic care toward individualized, evidence-based strategies. Rather than relying solely on surgery or single-modality therapy, contemporary management typically incorporates combinations of chemotherapy, radiotherapy, and increasingly, immunomodulatory agents, with the specific regimen tailored to patient characteristics and tumor-specific factors.[7][8] This tailored approach is not merely an abstract ideal; it is driven by pragmatic objectives, including the reduction of treatment-associated toxicity, the mitigation of avoidable complications, and the enhancement of therapeutic efficacy by aligning interventions with disease biology.[9] Personalized multimodal therapy therefore serves a dual purpose: it attempts to maximize oncologic control while also preserving the patient's physiological reserve, functional status, and quality of life. Nonetheless, even amid rapid advances in systemic and targeted therapies, surgical treatment retains a central position in curative-intent management. Radical en bloc resection of the primary tumor combined with appropriate lymph node dissection remains widely regarded as the cornerstone of care, forming the definitive component around which other therapies are organized.[10][11] This enduring role of surgery reflects the predominantly locoregional nature of many gastric cancers at the time of diagnosis and the well-established association between complete resection and long-term survival. Surgical management of gastric malignancy encompasses a spectrum of operative procedures designed to achieve oncologic clearance while maintaining or restoring gastrointestinal continuity. Established resection options include total gastrectomy, proximal gastrectomy, distal gastrectomy, and pylorus-preserving distal gastrectomy, each selected according to tumor location, anatomic extent, and anticipated functional outcomes. The determination of the most appropriate operative approach for gastric adenocarcinoma is inherently complex and typically requires integration of multiple variables, including the tumor's epicenter, the extent of gastric wall involvement, histopathologic subtype, and increasingly, genomic etiology that may influence response to therapy and metastatic potential. Because gastric cancer is often conceptualized as a locoregional disease—particularly in patients without distant metastasis—the primary oncologic aim of surgery is complete removal of the primary lesion with adequate longitudinal and circumferential resection margins. A commonly referenced principle is to secure a margin of at least 5 cm from the palpable edge of the tumor, reflecting the goal of reducing residual microscopic disease and improving the probability of curative resection. Achieving an R0 resection, meaning no residual microscopic tumor, remains a key determinant of prognosis and may require a willingness to undertake combined organ resection when local invasion is present. This may occur when adjacent structures are involved or when achieving clear margins is not feasible with gastric resection alone. Equally important to oncologic clearance is the performance of lymph node dissection, which contributes both to accurate staging and to local disease control. After successful resection and nodal management, the operative plan must also account for safe restoration of alimentary continuity, ensuring that the reconstruction supports adequate nutritional intake and preserves, as much as possible, physiologic digestion and absorption [7][8][9][10][11].

For selected patients with more extensive locoregional disease or specific patterns of spread, advanced surgical strategies may be considered. Multivisceral resection (MVR) can be appropriate when the tumor directly invades adjacent organs but remains potentially resectable with curative intent. In more advanced contexts, cytoreductive surgery (CRS) combined with hyperthermic intraperitoneal chemotherapy (HIPEC) has emerged as a potential option for carefully selected individuals, particularly when peritoneal involvement is present and complete or near-complete cytoreduction appears achievable. These approaches exemplify the expanding boundaries of surgical oncology in gastric cancer, where operative intervention may be integrated with regional chemotherapy delivery in an attempt to improve outcomes for patient subsets historically associated with poor prognosis. However, the complexity of such procedures and the significant perioperative demands they impose reinforce the necessity of meticulous selection criteria, multidisciplinary evaluation, and performance within appropriately resourced centers. Historically, open gastrectomy has served as the dominant operative method for gastric cancer resection, largely due to its technical feasibility across varied clinical scenarios and its long-standing role in oncologic surgery. Over recent decades, however, minimally invasive surgical (MIS) techniques—including laparoscopic gastrectomy and robotic-assisted gastrectomy—have gained increasing acceptance.[12] The growing interest in MIS reflects broader surgical trends favoring approaches that can reduce operative trauma while maintaining oncologic rigor. Advocates emphasize several potential advantages of MIS, including reductions in postoperative morbidity, faster functional recovery, shorter hospital stays, and improved cosmetic outcomes.[13] From a patient-centered perspective, such benefits are not trivial; accelerated recovery and reduced complication rates may facilitate earlier initiation of adjuvant therapy, preserve functional independence, and enhance overall treatment tolerability. Nevertheless, the choice between an open and minimally invasive approach remains multifactorial and is shaped by patient physiology, tumor features, stage and extent of disease, and the experience and capabilities of the treating institution. While MIS may offer compelling advantages, open gastrectomy continues to play a crucial role in specific clinical contexts, including complex resections, extensive local disease, and scenarios where institutional expertise in advanced minimally invasive gastric surgery is limited.[14] The continued relevance of open techniques therefore reflects a pragmatic recognition that individualized, context-sensitive decision-making is essential for optimal outcomes [12][13][14].

Laparoscopic gastrectomy, first introduced in 1994, has undergone substantial evolution and is now widely regarded as an established modality for early gastric carcinoma. The maturation of this technique has been supported by a growing body of evidence, including multicenter, prospective, randomized clinical trials demonstrating long-term oncologic outcomes and survival rates comparable to those achieved with open gastrectomy.[15][16] Such findings have contributed to the legitimization of laparoscopic approaches as not merely cosmetically advantageous or recovery-oriented alternatives, but as oncologically sound procedures within appropriate indications. Over time, the indications for laparoscopic gastrectomy have expanded, and the procedure is increasingly recognized as feasible, safe, and effective for radical resection of locally advanced distal gastric cancer.[17][18] This expansion reflects improved surgical instrumentation, enhanced perioperative protocols, accumulation of surgeon expertise, and refined patient selection. Even so, the field continues to engage in active debate regarding the extent to which laparoscopic gastrectomy consistently matches open surgery across diverse patient populations and tumor stages. Concerns persist about potential differences in postoperative outcomes and oncologic endpoints, and these discussions are compounded by the technical demands of laparoscopic lymphadenectomy, intracorporeal reconstruction, and the steep learning curve associated with mastering advanced laparoscopic gastric surgery.[19][20] These considerations highlight that while the technique is well-established, its implementation must be accompanied by careful training, quality assurance, and outcome monitoring. Robotic-assisted surgery has been proposed as a technological response to several limitations associated with conventional laparoscopy, particularly in the context of complex upper gastrointestinal oncologic procedures. The robotic platform offers three-dimensional visualization, enhanced instrument articulation, improved dexterity, and potentially more ergonomic operating conditions for surgeons, factors that may translate into improved precision during lymph node dissection and reconstruction.[14] From a training perspective, such features may facilitate skill acquisition and improve the reproducibility of technically demanding steps. Despite these theoretical and practical advantages, robotic-assisted gastrectomy has not been adopted as rapidly in upper gastrointestinal surgery as in certain other surgical domains. One important reason for this slower uptake is the relative scarcity of high-quality, prospective evidence. Much of the existing literature evaluating robotic-assisted gastrectomy for gastric cancer has been retrospective, limiting definitive conclusions regarding its comparative efficacy, cost-effectiveness, and long-term oncologic outcomes.[21] Consequently, while the robotic approach remains a promising development, the need for further robust research remains substantial, particularly studies designed to clarify whether the technological advantages of robotic systems translate into meaningful and consistent clinical benefits across varied patient populations [21].

Notwithstanding the accumulation of randomized controlled trials and the proliferation of standard pairwise meta-analyses, a definitive consensus regarding the oncologic and surgical safety of laparoscopic and robotic-assisted gastrectomy, relative to open gastrectomy, has remained difficult to achieve.[22][23][24] This lack of consensus reflects the heterogeneity of study designs, differences in surgeon experience, variation in patient selection criteria, and differences in tumor stage distributions across trials. Moreover, oncologic outcomes in gastric cancer are influenced by multiple interconnected factors, including quality of lymph node dissection, margin status, perioperative care, and the effectiveness of systemic therapy. Recent trials reporting short-term postoperative outcomes and survival metrics following robotic-assisted gastrectomy have contributed to cautious optimism among gastroesophageal surgeons, reinforcing the hypothesis that minimally invasive approaches may enhance patient recovery and potentially improve overall treatment trajectories.[22][23] However, optimism must be accompanied by methodological rigor. Establishing a strong evidence base requires carefully designed investigations that can control for confounding variables and provide adequately powered comparisons of recurrence rates, disease-free survival, overall survival, and patient-centered outcomes. Until such data are widely available, the comparative positioning of laparoscopic and robotic-assisted approaches relative to open surgery will likely remain an area of active inquiry, shaped by evolving technology and institutional capabilities. In parallel with developments in surgical technique, endoscopic innovations have introduced additional minimally invasive options for carefully selected patients with early gastric cancer. Endoscopic submucosal dissection (ESD) has emerged as a particularly important modality when the risk of lymph node metastasis is considered low. Unlike gastrectomy, which entails partial or total removal of the stomach and necessitates gastrointestinal reconstruction, ESD enables en bloc resection of superficial lesions while preserving the entire organ. This organ-preserving strategy offers clinically meaningful advantages, including maintenance of gastric reservoir function and reduced disruption of digestion, thereby supporting quality of life. While ESD is not without limitations—such as restricted indications, dependence on precise staging, and procedural technical demands—it represents a significant advance in early gastric cancer management by offering effective local treatment with less physiologic sacrifice.[25] The integration of ESD into clinical practice exemplifies the broader trend toward tailoring interventions to disease stage and risk profile, aiming to avoid overtreatment while ensuring oncologic adequacy. Collectively, the progressive shift from traditional open operations toward minimally invasive and endoscopic strategies reflects an important evolution in the management of gastric malignancies. This evolution is not simply a matter of surgical preference; it represents a broader commitment to improving patient outcomes, reducing procedure-related morbidity, and preserving function where possible, without compromising oncologic principles. As surgical approaches diversify, the contemporary challenge becomes one of appropriate selection and integration—choosing the right approach for the right patient at the right time, within systems capable of delivering high-quality multidisciplinary care. Against this background, the ongoing exploration of surgical options for gastric cancer, including their relative advantages, limitations, and future directions, remains central to advancing clinical practice and improving survival and quality of life for patients confronting this disease.

Anatomy and Physiology

A detailed and clinically oriented understanding of gastric anatomy and physiology is indispensable for safe and effective gastric resection, particularly when surgery is performed for malignancy, where oncologic adequacy depends not only on removal of the primary lesion but also on meticulous management of vascular structures and regional lymphatic pathways. The stomach is not merely a hollow viscus devoted to food storage; it is a complex organ with specialized regions, layered architecture, extensive peritoneal attachments, and an intricate blood and lymphatic supply. Each of these features has direct implications for surgical planning, intraoperative decision-making, and postoperative outcomes. When surgeons mobilize the stomach, divide its attachments, ligate arteries, and undertake lymphadenectomy, they are operating within a three-dimensional anatomic environment where variations are common and where injury to adjacent structures can lead to substantial morbidity. Consequently, mastery of gastric structure, vascularization, and lymphatic drainage is essential for achieving clear resection margins, controlling hemorrhage, preserving perfusion to remaining tissues, and delivering an oncologically sound lymph node dissection (see Image. Stomach Anatomy). From an anatomic standpoint, the stomach is conventionally divided into four primary regions that differ in position, function, and surgical relevance. The cardia constitutes the proximal entry point where ingested material passes from the esophagus into the stomach. This region is closely related to the gastroesophageal junction and is therefore particularly important in proximal gastric cancers or lesions with junctional involvement. Superior and to the left of the cardia lies the fundus, a dome-shaped portion that often serves as a reservoir for swallowed air and contributes to accommodation of meals. Below the fundus is the body, which represents the largest segment and is responsible for much of the stomach’s secretory and mechanical activity, including acid production, enzymatic secretion, and churning of food to form chyme. Distally, the pylorus forms the terminal gastric segment and acts as a conduit to the duodenum. The pyloric region is commonly described as funnel-shaped, reflecting its tapering architecture as it transitions into the small intestine. Within this distal segment, the pyloric antrum connects proximally to the body and gradually narrows into the pyloric canal, which then communicates directly with the duodenum. Critically, the pyloric sphincter—composed of smooth muscle—serves as a physiologic gatekeeper that regulates gastric emptying by controlling the passage of chyme into the duodenum, coordinating with neural and hormonal signals to optimize digestion and prevent excessive duodenal acid load [19][20][21][22].

Beyond its macroscopic divisions, the stomach’s wall is organized into five distinct layers, each with characteristic structural and clinical significance. The mucosa is the innermost layer and the site where the vast majority of gastric cancers arise, a fact that underscores its importance in both early detection and surgical pathology.

Histologically, the mucosa comprises epithelial cells that line the gastric lumen, the lamina propria (a connective tissue layer that supports the epithelium and contains immune cells and capillaries), and the muscularis mucosa, a thin band of smooth muscle that separates the mucosa from deeper layers and contributes to subtle mucosal movement. Immediately beneath lies the submucosa, a supportive layer that contains larger blood vessels, lymphatics, and connective tissue elements, thereby serving as a major conduit for both vascular perfusion and lymphatic spread. Deeper still is the muscularis propria, a robust smooth muscle layer that generates the peristaltic and mixing movements essential for mechanical digestion. This layer is particularly important in oncologic staging because tumor invasion into or beyond the muscularis propria often signifies more advanced disease and correlates with increased risk of nodal involvement. External to the muscularis propria is the subserosa, and finally, the serosa, which is the outermost peritoneal covering of the stomach. The serosa is surgically significant because it is contiguous with peritoneal reflections and represents a barrier whose involvement may be associated with peritoneal dissemination. In the relaxed state, the mucosa and submucosa form prominent folds known as rugae, which allow the stomach to expand substantially during feeding while maintaining a compact profile when empty. The stomach is anchored within the upper abdomen by a series of peritoneal ligaments that are not only mechanical supports but also important conduits for blood vessels and lymphatics. The gastrocolic ligament, which is part of the greater omentum, connects the greater curvature of the stomach to the transverse colon. This structure helps form the anterior boundary of the lesser sac and is routinely divided during many gastric resections to facilitate mobilization of the stomach and access to posterior structures. The gastrosplenic ligament, also part of the greater omentum, extends from the greater curvature to the splenic hilum and carries key vessels, including the left gastroepiploic artery and the short gastric arteries. Its division must be performed with caution, as injury to these vessels can cause bleeding or compromise perfusion. On the lesser curvature side, the gastrohepatic ligament connects the liver to the lesser curvature of the stomach. It forms part of the anterior wall of the lesser sac and contains the right and left gastric arteries, structures of major relevance during ligation and lymphadenectomy. The gastrophrenic ligament, which attaches the superior portion of the stomach to the diaphragm, contributes to stabilization of the proximal stomach and is particularly relevant when operating near the fundus and gastroesophageal junction. Collectively, these ligamentous attachments define operative planes, influence routes of tumor spread, and guide safe mobilization during resection [21].

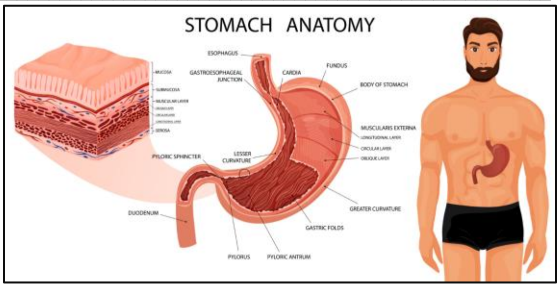

Fig. 1: Stomach Anatomy.

The vascular supply of the stomach is extensive and characterized by rich anastomotic networks that provide redundancy but also create technical demands during operative ligation. The principal arterial inflow arises from the celiac trunk, a major branch of the abdominal aorta that divides into three key arteries: the left gastric, common hepatic, and splenic arteries. The left gastric artery typically originates directly from the celiac trunk and courses along the superior aspect of the lesser curvature. It forms an anastomosis with the right gastric artery and supplies portions of the proximal lesser curvature and adjacent regions. The right gastric artery most often arises from the proper hepatic artery and runs along the inferior segment of the lesser curvature, where it joins the left gastric artery, forming a continuous vascular arcade. Along the greater curvature, the left gastroepiploic artery arises from the splenic artery and travels along the superior portion of the greater curvature, while the right gastroepiploic artery originates from the gastroduodenal artery and runs along the inferior portion of the greater curvature. These vessels anastomose, forming a second major arcade that supplies the greater curvature. Additional perfusion, particularly to the fundus and upper greater curvature, is provided by the short gastric arteries, which arise from the splenic artery and sometimes from the left gastroepiploic artery. Because these short vessels are relatively fragile and variable, their management is an important step during mobilization of the fundus and during total gastrectomy, where careful ligation is required to prevent bleeding and protect splenic integrity. Understanding these arterial pathways is fundamental to preserving adequate blood supply to remaining gastric segments when partial gastrectomy is performed and to preventing ischemic complications at anastomotic sites [23][24][25][26].

Equally crucial to surgical oncology is an appreciation of the stomach's lymphatic drainage, which is anatomically complex and highly relevant to staging and disease control. Gastric lymphatic pathways are organized into 16 regional lymph node stations, reflecting a detailed topographic system that maps nodal basins relative to gastric subregions and major vascular structures. Lymph node stations are further categorized into N1, N2, N3, and N4 groups based on their anatomical relationship to the primary tumor.[26][27] This classification is not merely descriptive; it informs operative strategy, pathological assessment, and prognostic interpretation. N1 nodes include the perigastric lymph nodes corresponding to stations 1 through 6. These are situated immediately adjacent to the stomach and represent the first echelon of nodal drainage for many gastric tumors. N2 nodes encompass stations 7 through 11 and are distributed along major vessels arising from the celiac trunk, including nodal tissue associated with the left gastric artery, common hepatic artery, and splenic artery. These nodes are particularly relevant in more advanced locoregional disease and often constitute a key target in extended lymphadenectomy. N3 nodes include stations 12 through 14, which are located in the hepatoduodenal ligament, within retropancreatic regions, and at the root of the mesentery, representing more distant regional drainage pathways that may be involved in more extensive disease patterns. N4 nodes correspond to stations 15 and 16 and include lymphatic tissue along the middle colic vein and within the paraaortic region, which may reflect broader dissemination and have important prognostic implications. The extent of lymph node dissection in gastric cancer surgery is commonly described using standardized terms that correspond to the node stations removed. A D1 lymphadenectomy entails resection of nodal tissue in stations 1 through 6, focusing on the perigastric nodes. In contrast, a D2 lymphadenectomy includes removal of stations 1 through 11, extending dissection to nodes along the principal celiac trunk branches.[28][29] A D2+ lymphadenectomy further expands the field to include stations 1 through 16, incorporating more distant regional nodes and, in certain contexts, reflecting an effort to enhance staging accuracy and locoregional control in carefully selected patients.[28][29] The decision regarding the appropriate extent of lymphadenectomy is influenced by tumor stage, location, patient factors, and institutional expertise, and it must balance potential oncologic benefit against increased operative complexity and risk of complications. For surgical teams, a precise understanding of nodal station anatomy supports safe dissection around major vessels and adjacent organs and facilitates accurate pathological evaluation, which is essential for guiding adjuvant therapy and estimating prognosis.

Physiologically, the stomach functions as a reservoir, a mixer, and a regulator of controlled emptying into the duodenum, and these roles are intimately linked to its regional anatomy and muscular structure. Gastric peristalsis and antral grinding, powered by the muscularis propria, contribute to the mechanical breakdown of food, while secretions from specialized mucosal glands initiate chemical digestion. The pylorus coordinates with duodenal feedback mechanisms to modulate the rate of emptying, ensuring appropriate exposure of chyme to pancreatic enzymes and bile. These physiologic processes become especially relevant after gastric resection, when altered anatomy can disrupt coordinated emptying and nutrient absorption. Therefore, the anatomic and physiologic principles outlined above not only guide the technical execution of resection and reconstruction but also shape anticipatory postoperative management, including nutritional planning, monitoring for complications, and patient education. By integrating a meticulous understanding of stomach structure with its vascular and lymphatic organization, clinicians can better support safe surgery, achieve oncologic goals, and optimize functional recovery in patients undergoing gastric resection for malignancy [27][28][29].

Indications

The selection of an appropriate operative or endoscopic approach for gastric malignancy is fundamentally determined by a careful synthesis of tumor biology, anatomic location, stage at presentation, patient physiology, and the anticipated balance between oncologic benefit and procedure-related risk. Because gastric cancer encompasses a broad clinicopathologic spectrum—ranging from superficial mucosal lesions with negligible nodal risk to infiltrative tumors with locoregional invasion or peritoneal dissemination—no single intervention is universally applicable. Instead, contemporary practice relies on stratified indications for endoscopic therapy, partial gastrectomy variants, total gastrectomy, lymphadenectomy extent, and, for selected advanced cases, multivisceral resection or cytoreductive strategies. The overarching aim across these modalities remains consistent: to achieve durable disease control through complete tumor eradication, accurate staging, and restoration or preservation of gastrointestinal function, while minimizing morbidity and supporting quality of life. Endoscopic therapy, particularly endoscopic submucosal dissection, has become an important curative option for carefully selected patients with early gastric cancer when the probability of lymph node metastasis is exceedingly low.[30][31] In this context, endoscopic resection represents a paradigm of organ-preserving oncologic therapy: it seeks to eradicate the lesion while leaving the stomach structurally intact and functionally capable. Historically, the principal endoscopic techniques used for curative intent have included endoscopic mucosal resection and ESD, with ESD increasingly favored due to its capacity for en bloc resection of larger lesions and its superior ability to provide a comprehensive pathological specimen.[32] By enabling the removal of larger tumors in a single piece and facilitating accurate evaluation of resection margins, depth of invasion, and potential vascular involvement, ESD addresses several limitations inherent to EMR, where piecemeal resection may impede precise histopathologic assessment and increase recurrence risk.[32] The clinical implications of these technical differences are substantial: accurate determination of invasion depth and lymphovascular involvement directly affects whether endoscopic therapy is definitively curative or whether additional surgical intervention is required. Relative to surgical gastrectomy, ESD is minimally invasive and offers meaningful patient-centered advantages, particularly preservation of the entire stomach and, consequently, maintenance of nutritional function and quality of life.[25] These benefits are especially salient given the long-term physiologic consequences that can follow partial or total gastrectomy, including altered gastric emptying, reduced reservoir capacity, and nutritional deficiencies.

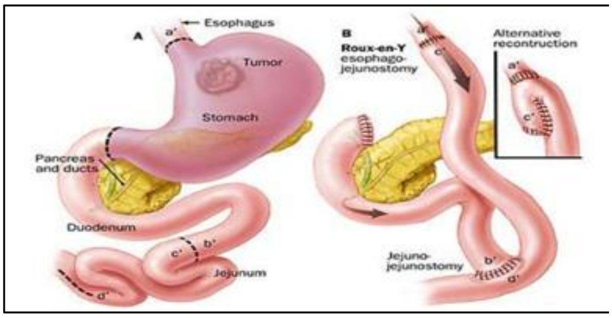

Fig. 2: Total Gastrectomy.

Despite its importance, the role of ESD differs markedly across global regions, reflecting variation in disease detection patterns and clinical infrastructure. In Western populations, thin, early-stage gastric cancers that are appropriate for endoscopic resection are detected relatively infrequently, limiting the pool of eligible cases and, consequently, the opportunities for endoscopists to acquire and sustain advanced procedural proficiency.[11] This epidemiologic reality can create a practical barrier to widespread adoption, because ESD is technically demanding and requires sustained procedural volume to maintain expertise. Conversely, the burden of gastric cancer is considerably higher in many Asian countries, where screening practices and disease incidence yield a larger cohort of early-stage, endoscopically treatable lesions. Indeed, Asia—particularly China—recorded the highest number of gastric cancer cases in 2020, with an incidence of 22.4 per 100,000 individuals.[33] The higher disease frequency and clinical experience in this region have shaped the development of evidence and guideline frameworks for endoscopic resection, leading to a substantial proportion of international recommendations originating from Asian expert bodies. Within this guideline landscape, the Japanese Gastric Cancer Treatment Guidelines 2018 (5th edition) articulate well-defined criteria for ESD candidacy, including absolute and expanded indications that are anchored in histologic differentiation, depth of invasion, ulceration status, and lesion size.[34] Absolute indications encompass differentiated intramucosal carcinoma without ulcerative findings when the tumor diameter is 3 cm or less, as well as differentiated intramucosal carcinoma with ulcerative findings, likewise limited to 3 cm or less.[34] These criteria reflect an effort to identify lesions with an exceptionally low risk of nodal metastasis and a high likelihood of complete local cure through endoscopic resection alone. The same guidelines also describe expanded indications, including undifferentiated intramucosal carcinoma without ulceration and with a diameter of 2 cm or less.[34] Such expanded criteria acknowledge that, in carefully selected cases, endoscopic therapy may remain oncologically appropriate even when histologic features are less favorable, provided that the lesion remains intramucosal and small. More broadly, lesions characterized by a predicted lymph node metastasis risk below 1%—for which endoscopic resection is considered comparably effective to radical surgery—are classified as absolute indications for ESD therapy.[35] This risk-threshold framing illustrates the central principle underpinning endoscopic curative intent: ESD is not simply a less invasive alternative but is adopted when oncologic equivalence can be reasonably assured based on metastasis risk [35].

Nevertheless, the achievement of technical success does not invariably equate to definitive cure. Although ESD can accomplish en bloc or R0 resection in more than 90% of cases, a cure is not guaranteed in up to 20% of patients.[25] This gap between technical completeness and biological cure underscores the limits of preprocedural staging and the possibility that adverse features may only become evident after histopathologic analysis of the resected specimen. Non-curative outcomes may occur due to previously undetected submucosal invasion, unrecognized horizontal spread beyond the apparent lesion boundary, or shifts in histopathological characterization—particularly when the lesion is found to exhibit an undifferentiated-predominant mixed pattern.[25] Additionally, the detection of lymphovascular invasion on pathology substantially alters risk stratification, often indicating a need for additional surgical management due to elevated nodal metastasis risk.[25] These realities reinforce the necessity of rigorous preprocedural evaluation, including careful assessment of tumor size, invasion depth, lateral extent, and suspected histologic subtype, as accurate patient selection remains the primary determinant of whether ESD will be both safe and definitively curative.[25] When disease characteristics exceed endoscopic indications or when the risk of nodal metastasis becomes non-negligible, surgical gastrectomy remains the primary curative modality, with the extent and configuration of resection tailored to tumor location and stage. Distal gastrectomy is generally considered the preferred operation for cancers arising in the middle and distal third of the stomach, provided that an adequate proximal margin—typically 4 to 6 cm—can be achieved while preserving a remnant pouch of sufficient size to support postoperative function.[36] This emphasis on margin adequacy reflects the core surgical oncologic requirement of complete gross and microscopic tumor clearance. However, the specific indications for conventional distal gastrectomy are not static and may vary depending on whether the patient presents with early-stage disease, where organ-preserving strategies may be prioritized, or with more advanced tumors that may necessitate wider resection and more extensive nodal clearance.[26] In practical terms, distal gastrectomy represents a balance between oncologic control and functional preservation, as it removes the diseased portion of the stomach while maintaining some reservoir capacity and facilitating reconstruction that can support nutritional recovery [26].

A refinement of distal resection is pylorus-preserving distal gastrectomy, a technique adopted by some surgeons to reduce postoperative functional disturbances. By preserving the pylorus and reconstructing with gastro-gastrostomy, this approach is associated with a lower incidence of bile reflux, dumping syndrome, gallstone formation, and excessive weight loss.[37] Such outcomes have meaningful implications for patient quality of life, as bile reflux and dumping syndrome can be difficult to manage and can substantially impair dietary tolerance and wellbeing. Nonetheless, pylorus-preserving strategies introduce oncologic and technical considerations, particularly regarding lymphadenectomy completeness. Preserving the infrapyloric vessels—a key component of maintaining pyloric function—may limit surgical access to infrapyloric lymph node stations, potentially affecting both staging accuracy and oncologic thoroughness. The infrapyloric region is clinically important because it may contain nodal disease, and inadequate clearance could theoretically compromise outcomes in patients with occult nodal metastasis. Reflecting these concerns, Japanese guidelines recommend pylorus-preserving distal gastrectomy in a selective and constrained clinical scenario: cases where the tumor has begun to invade the stomach wall but remains without nodal involvement or distant metastasis, specifically cT1N0M0 lesions located in the middle stomach, and only when a macroscopically negative distal margin of 4 cm can be achieved.[38] This recommendation illustrates the careful risk containment that governs pylorus-preserving indications, privileging functional benefit only when oncologic compromise is unlikely. Ongoing investigations continue to examine the trade-offs of pylorus preservation, including whether nodal clearance remains sufficient and whether long-term oncologic endpoints match those of conventional distal gastrectomy. For tumors located in the upper third of the stomach, proximal gastrectomy offers a function-preserving alternative to total gastrectomy in selected cases. The rationale for proximal resection is grounded in physiology: by preserving the distal stomach and pylorus, proximal gastrectomy may maintain more normal gastric emptying dynamics and reduce some nutritional complications associated with total gastrectomy. Both American and Japanese guidelines support proximal gastrectomy for early gastric cancer in patients staged as cT1N0M0.[39] This shared recommendation underscores an international consensus that, in carefully staged early disease confined to the proximal stomach without nodal involvement, organ preservation can be pursued without sacrificing oncologic integrity. Nevertheless, the technical complexity of reconstruction after proximal gastrectomy and the risk of postoperative reflux symptoms are important considerations, and these factors often influence institutional preferences and the choice between proximal and total gastrectomy. Still, when appropriately applied, proximal gastrectomy represents an effort to align surgical treatment with the patient's long-term functional outcomes, particularly in early-stage disease where survival is favorable and quality-of-life consequences become especially salient.

Total gastrectomy is indicated when tumor distribution or histopathologic characteristics make partial resection oncologically inadequate. Tumors involving a large portion of the proximal stomach, particularly those extending along most of the lesser or greater curvature, often require total gastrectomy to ensure a negative proximal margin and to eliminate multifocal or extensive mucosal disease.[36] Similarly, large or expansive tumors that prevent attainment of an adequate macroscopic margin—commonly described as 4 to 6 cm—necessitate total removal of the stomach to achieve complete resection.[36] Beyond anatomic extent, histology plays a decisive role. Signet ring cell carcinoma, for example, often exhibits diffuse infiltration and submucosal spread that can be difficult to delineate intraoperatively, creating a risk of residual microscopic disease if limited resection is attempted.[36] In such contexts, total gastrectomy may be required to reliably achieve an R0 resection. Additionally, hereditary cancer syndromes introduce prophylactic indications. Individuals with inactivating germline CDH1 mutations, which are associated with hereditary diffuse gastric cancer and multifocal tumor development, may undergo prophylactic total gastrectomy as a risk-reducing intervention, reflecting the aggressive biology and occult multifocality often seen in this genetic context.[36] Thus, total gastrectomy indications are driven not only by what is visible anatomically but also by what is anticipated biologically, especially when diffuse submucosal seeding or multifocality undermines confidence in partial resections. Regardless of the extent of gastric resection, lymphadenectomy remains a pivotal component of surgical management because it is essential for accurate pathological staging and may contribute to locoregional control. Historically, lymphadenectomy in gastric cancer has been described in gradations based on the lymph node stations removed. A D1 lymphadenectomy entails circumferential dissection along the stomach to retrieve nodes from stations 1 to 6, representing perigastric nodal basins. D2 lymphadenectomy extends beyond this to include nodes along the celiac trunk and its major branches—namely the common hepatic, left gastric, and splenic arteries—capturing stations 7 to 11. D3 lymphadenectomy further incorporates additional nodal tissue along the portal tract, hepatic artery region, and paraaortic vicinity, including stations 12 through 16. This escalating framework reflects an effort to match the extent of nodal clearance to the risk of regional spread, while acknowledging that more extensive dissections can increase operative complexity and morbidity. Importantly, multiple retrospective analyses have reported an association between improved survival and a higher number of lymph nodes retrieved during gastrectomy.[40] While such findings may partially reflect stage migration and improved staging accuracy, they also suggest that more comprehensive nodal clearance may confer therapeutic benefit in selected cases [40].

Evidence from trials evaluating D3 lymphadenectomy indicates that this more extensive approach may offer a survival advantage compared with D1 dissection; however, no survival benefit has been demonstrated when D3 is compared with D2 dissection.[41] These findings support the contemporary emphasis on D2 lymphadenectomy as an oncologically appropriate balance between adequate staging and acceptable operative risk, particularly when performed with pancreas-sparing techniques. For the purpose of adequate pathological staging, it is widely recommended that a pancreas-sparing D2 lymphadenectomy be performed, consistent with American Joint Committee on Cancer guidance, with an aim of retrieving at least 15 lymph nodes in the gastrectomy specimen.[42] The specification of a numeric threshold underscores the clinical recognition that staging accuracy depends on sufficient nodal sampling and that inadequate node retrieval can compromise prognostic stratification and subsequent treatment planning. The emphasis on pancreas-sparing techniques also reflects an evolution in surgical practice away from older approaches that involved routine pancreatosplenectomy, which increased morbidity, toward more refined dissections that preserve organs while maintaining nodal clearance. For patients with locally advanced gastric cancer characterized by direct invasion into adjacent organs, multivisceral resection may be indicated as a means of achieving negative margins and maintaining curative intent. MVR is inherently complex, requiring coordinated resection of the stomach along with contiguous structures involved, and historically it has been associated with substantial perioperative morbidity and mortality. Early reports described wide variability in outcomes, reflecting differences in patient selection, surgical experience, and perioperative care. More contemporary evidence, however, suggests that outcomes have improved over time, potentially due to learning curve effects, better operative techniques, and enhanced perioperative management. A Taiwanese study, for instance, documented reductions in postoperative morbidity and mortality across a 12-year period, suggesting that growing institutional experience can translate into safer and more effective MVR.[43] Similarly, a multicenter Italian cohort reported comparatively lower perioperative morbidity and mortality, lending further support to the feasibility and safety of MVR in appropriately selected patients.[44] These findings collectively indicate that while MVR remains high-risk, it can be undertaken with acceptable safety profiles within experienced centers.

Nevertheless, the morbidity associated with MVR is not uniform and is strongly influenced by the extent and nature of organ resection. Extensive procedures such as pancreatectomy increase perioperative complication risk, reflecting the physiologic and technical demands of pancreatic surgery.[45] Notably, available data suggest that perioperative mortality may remain comparable across different extents of resection, even as morbidity increases.[45] However, long-term outcomes appear more sensitive to resection extent. Five-year overall survival rates have been observed to decline significantly as the extent of resection increases, with MVR that includes pancreatectomy identified as an independent predictor of poorer survival on multivariate analysis.[45] This relationship may reflect both the biological aggressiveness of tumors requiring such extensive resection and the downstream consequences of increased surgical stress and complications. Despite these risks, MVR may provide a potentially curative option for select patients who demonstrate responsiveness to neoadjuvant therapy and whose disease remains anatomically resectable with the prospect of negative margins. In this setting, extensive preoperative counseling is indispensable. Patients must be supported to understand not only the potential for cure but also the heightened risks of complications, prolonged recovery, and uncertain long-term benefit, enabling shared decision-making that respects patient values and goals while aligning expectations with clinical reality. In the setting of metastatic gastric cancer, peritoneal dissemination is a frequent and particularly challenging pattern of spread that has motivated the development of locoregional treatment strategies. Approximately 40% of patients newly diagnosed with gastric cancer are found to have metastatic disease, and among these cases, roughly one-third involve peritoneal metastases.[46] Even after gastrectomy, peritoneal recurrence or lesion development may occur in a substantial proportion of patients, reported in up to 46% in certain series. This high burden of peritoneal involvement reflects both the biologic propensity of gastric cancer for peritoneal seeding and the limitations of systemic therapy in controlling microscopic peritoneal disease. One major barrier to effective adjuvant management is the peritoneal-blood barrier, which restricts penetration of conventional systemic agents into the peritoneal cavity, thereby limiting therapeutic concentration at the sites of peritoneal implants. These constraints have provided a rationale for more direct approaches, including cytoreductive surgery combined with hyperthermic intraperitoneal chemotherapy.[47]

CRS is designed to remove visible peritoneal tumor deposits, while HIPEC delivers heated chemotherapy directly into the peritoneal cavity, aiming to eradicate microscopic residual disease and reduce recurrence risk. This combined modality has been explored in several oncologic contexts and has increasingly been investigated in gastric cancer with peritoneal metastases.[47] Evidence from multiple randomized trials has contributed to understanding the potential roles of CRS and HIPEC, suggesting that the combined approach may improve survival outcomes and reduce peritoneal recurrences compared with CRS alone or systemic chemotherapy alone in selected patients. However, the benefits of CRS and HIPEC are not uniform, and the procedure carries substantial morbidity; thus, identifying the patients most likely to benefit remains a central clinical challenge. In this evolving landscape, ongoing prospective research is critical. The PERISCOPE II trial, for example, is designed to further evaluate combined treatment strategies that incorporate systemic chemotherapy, gastrectomy, CRS, and HIPEC in patients with limited peritoneal dissemination and positive peritoneal cytology. The results of such trials are anticipated to clarify whether aggressive multimodal regional strategies can meaningfully alter the natural history of peritoneal metastatic gastric cancer and, importantly, which selection criteria—such as peritoneal cancer index thresholds, cytology status, and response to systemic therapy—best predict favorable outcomes. As the evidence base continues to mature through ongoing trials, including PERISCOPE II, it is reasonable to anticipate refinement of patient selection frameworks and treatment algorithms for advanced therapies such as CRS and HIPEC. These developments are likely to emphasize precision in staging, response assessment, and risk stratification, recognizing that the potential advantages of aggressive regional therapy must be balanced against substantial perioperative demands. Ultimately, progress in this domain will depend not only on technical capability but also on multidisciplinary integration, rigorous trial design, and careful ethical consideration of burdens and benefits. If these elements coalesce, advanced locoregional therapies may offer meaningful improvements for a subset of patients historically characterized by limited options and poor prognoses, thereby expanding the therapeutic horizon for gastric cancer complicated by peritoneal metastases [47].

Contraindications

Contraindications to gastric resection must be understood within a framework that prioritizes patient safety while preserving the possibility of oncologic benefit. Although gastrectomy can be curative for appropriately staged gastric malignancy, it is a physiologically demanding operation that imposes substantial cardiopulmonary, metabolic, and nutritional stress. Consequently, the most definitive barrier to proceeding is an inability to safely undergo general anesthesia. Absolute contraindications, therefore, center on patients who are deemed unfit for general anesthesia, whether due to irreversible hemodynamic instability, profound frailty with an inability to tolerate ventilatory support, or severe organ dysfunction that creates an unacceptably high probability of perioperative mortality. In such circumstances, the ethical and clinical imperative is to avoid exposing the patient to a risk profile that is disproportionate to any realistic chance of meaningful survival benefit or recovery, and alternative palliative or nonoperative strategies should be pursued. Relative contraindications are more nuanced and require individualized interpretation rather than rigid exclusion. Advanced age is frequently cited as a relative contraindication, not because chronological age alone predicts poor outcomes, but because aging is often associated with reduced physiologic reserve, increased burden of comorbid illness, impaired mobility, and heightened vulnerability to postoperative complications such as delirium, pulmonary infection, and functional decline. Severe cardiopulmonary dysfunction similarly represents a relative contraindication, as major abdominal surgery can precipitate myocardial ischemia, arrhythmias, decompensated heart failure, or respiratory failure in patients with marginal baseline function. Additionally, a diminished life expectancy driven by comorbidities—such as advanced chronic obstructive pulmonary disease, end-stage renal disease, decompensated cirrhosis, or refractory malignancy elsewhere—may render the potential benefits of gastrectomy less compelling, especially if surgery is unlikely to improve either longevity or quality of life. In these contexts, decision-making should not default to exclusion; rather, it should be grounded in a comprehensive risk–benefit assessment that incorporates functional status, nutritional state, anticipated oncologic outcomes, patient preferences, and the feasibility of perioperative optimization [36].

The extent of gastric resection also influences contraindication profiles. Total gastrectomy, in particular, may be contraindicated when oncologic objectives—specifically, achieving wide negative margins of approximately 4 to 6 cm—can be met through partial gastrectomy. In such cases, total gastrectomy would represent an unnecessarily extensive operation that increases the likelihood of postoperative nutritional compromise, weight loss, micronutrient deficiencies, and long-term functional limitations. Partial gastrectomy is often associated with superior safety and more favorable functional outcomes, making it especially attractive for vulnerable groups such as older adults, patients with preoperative malnutrition, and individuals with extensive comorbidities.[36] This principle reflects a broader surgical ethic of proportionality: the procedure selected should be the least physiologically disruptive option capable of achieving oncologic adequacy. Ultimately, contraindications to gastric resection should be evaluated through multidisciplinary deliberation, ensuring that operative intent is aligned with realistic outcomes and that treatment decisions remain patient-centered, evidence-informed, and contextually appropriate.

Equipment

The technical complexity of gastric resection necessitates a comprehensive and procedure-specific inventory of surgical equipment, with the operative approach—open versus laparoscopic—dictating both the nature and configuration of required tools. Regardless of technique, the overarching objective of the equipment set is to enable safe exposure, precise dissection, reliable hemostasis, secure division of tissue planes, and durable reconstruction. Because gastrectomy frequently involves major vascular ligation, lymphadenectomy around critical arterial trunks, and construction of gastrointestinal anastomoses, the equipment must be capable of supporting meticulous operative technique while allowing rapid response to bleeding or unexpected anatomic variation. Additionally, institutional protocols, surgeon preference, and the complexity of the planned resection—such as whether extended lymphadenectomy or combined organ resection is anticipated—will further influence equipment preparation. Inadequate equipment availability can prolong operative time, compromise precision, and increase complication risk; therefore, standardization and preoperative verification of equipment readiness are essential components of operative safety. For open gastrectomy, the equipment requirements reflect the need for wide exposure and manual operative control. A self-retaining, table-mounted retractor system is fundamental, as it facilitates sustained and stable visualization of the operative field, particularly in the upper abdomen where deep exposure is often required to access the lesser sac, the celiac axis region, and the esophageal hiatus. Standard surgical instruments form the core operative toolkit and typically include a range of scalpels, forceps, retractors, scissors, and clamps, each chosen to accommodate varied tissue types and dissection planes. Because lymphadenectomy and vessel ligation are integral to oncologic gastrectomy, clamps and vascular instruments must allow secure handling of arteries and veins of differing calibers. An electrocautery device is essential for dissection and hemostasis, enabling controlled tissue division and reduction of blood loss. Sutures of varying sizes and materials are required for vessel ligation, reinforcement of anastomoses, and closure of tissue layers. Stapling devices are also commonly employed, especially to expedite transection and reconstruction steps and to standardize anastomotic integrity. Finally, the maintenance of sterility remains non-negotiable; sterile drapes, gowns, and gloves must be prepared in accordance with institutional infection prevention protocols and adapted to the anticipated duration and complexity of the procedure [45][46][47].

Laparoscopic gastrectomy requires an expanded and more technologically intensive equipment ecosystem, reflecting the need to translate the principles of open surgery into a minimally invasive environment. Core laparoscopic instruments include trocars to establish access ports, graspers and dissectors to manipulate tissue, laparoscopic scissors for division, and retractors designed to maintain exposure within a constrained workspace. High-quality laparoscopes, typically both 0-degree and 30-degree scopes, are required to optimize visualization across different viewing angles; these must be paired with an appropriate light source and camera system to provide a clear operative image. Monitors are essential to display the operative field and must be positioned to support ergonomic alignment for the surgical team. An insufflation system is needed to establish and maintain pneumoperitoneum, providing the working space necessary for laparoscopic manipulation, while a CO_2 absorption system supports safe anesthetic management by mitigating hypercarbia. Laparoscopic staplers are frequently used for gastric transection and reconstruction, and laparoscopic suturing devices and sutures enable intracorporeal closure and anastomotic reinforcement when required. Advanced energy devices, such as vessel sealing systems, facilitate efficient and secure division of vascular structures and lymphatic tissue, which is particularly valuable during lymphadenectomy. Electrocautery also remains a key tool in laparoscopic dissection. As with open surgery, stringent sterile technique is maintained through appropriate drapes, gowns, and gloves. Overall, laparoscopic equipment must be not only available but also functionally verified, because equipment malfunction in minimally invasive surgery can necessitate conversion to an open approach or increase operative risk [47].

Personnel

Successful gastric resection depends on an integrated surgical team whose collective expertise spans oncologic principles, foregut anatomy, anesthetic physiology, and perioperative nursing practice. The operating surgeon must possess substantial experience in foregut and oncologic surgery, as gastrectomy for malignancy frequently requires technically demanding maneuvers such as dissection along the celiac axis, meticulous lymph node clearance, and complex gastrointestinal reconstruction. Beyond technical competence, the surgeon must demonstrate decision-making proficiency, including the ability to interpret intraoperative findings, adapt the operative plan, and determine when conversion from a minimally invasive to open approach is warranted for safety or oncologic adequacy. Because patient outcomes are influenced by operative efficiency, hemostatic control, and complication avoidance, surgeon experience is a determinant not only of technical execution but also of the broader perioperative trajectory. In addition to the primary surgeon, a surgical assistant is essential, particularly in cases involving extensive lymphadenectomy, challenging exposure, or laparoscopic technique. The assistant contributes to retraction, suction, tissue handling, and, in minimally invasive surgery, camera navigation and instrument exchange. Effective collaboration between surgeon and assistant enhances precision and reduces operative time. The anesthesiologist plays a central role in ensuring physiologic stability, managing airway and ventilation, maintaining hemodynamic parameters during periods of manipulation near major vessels, and addressing fluid shifts and blood loss. Gastrectomy patients often have compromised nutritional status and may be physiologically fragile; therefore, anesthetic planning must include strategies for optimizing oxygenation, preventing aspiration, and supporting postoperative pain control and early mobilization [47].

A surgical technician is equally critical, responsible for preparing instruments, ensuring equipment functionality, anticipating operative needs, and maintaining sterile technique. Given the complexity of gastrectomy, the technician must be familiar with the sequence of operative steps, the use of stapling devices, and the deployment of advanced energy instruments. The circulating nurse provides essential logistical and patient-safety support, coordinating supplies, documenting intraoperative events, managing specimen handling, and ensuring adherence to safety checklists. In oncologic surgery, proper specimen labeling and communication with pathology are vital for accurate margin assessment and lymph node evaluation. Moreover, the nursing team contributes directly to infection prevention and to the timely provision of resources during critical intraoperative moments. Although not always explicitly listed, many institutions also involve perioperative nursing specialists, postoperative critical care teams, and nutrition services as part of the broader personnel framework supporting gastrectomy patients, especially given the high prevalence of malnutrition and the importance of postoperative nutritional rehabilitation. Thus, gastric resection is best conceptualized not as a single-operator undertaking but as a coordinated interprofessional endeavor where each role is indispensable to safe, efficient, and patient-centered care [47].

Preparation

Preoperative preparation for gastric resection is a comprehensive process that begins with recognition of the clinical reality that many gastric carcinomas are diagnosed at advanced stages. Patients frequently present with systemic and gastrointestinal manifestations such as weight loss, cachexia, anorexia, early satiety, dyspepsia, gastric outlet obstruction, or clinically significant malnutrition, all of which can adversely affect surgical tolerance and postoperative recovery. Accordingly, preparation must extend beyond confirming diagnosis; it must incorporate staging, assessment of resectability, evaluation of physiologic reserve, and optimization of modifiable risks. The diagnostic workup is designed to determine whether the patient is an appropriate candidate for resection and, if so, which operative approach and perioperative therapies will most likely achieve oncologic benefit. Baseline laboratory assessment typically includes hemoglobin measurement to detect anemia, platelet count to assess coagulation potential and marrow reserve, and a complete metabolic profile to evaluate renal and hepatic function, electrolyte balance, and overall metabolic stability. Nutritional biomarkers such as serum albumin and prealbumin are frequently used to approximate nutritional status and protein reserves, supporting risk stratification and the planning of nutritional interventions. Although these markers are influenced by inflammation and do not provide a complete nutritional assessment in isolation, they can be valuable when interpreted alongside clinical findings, weight trends, and functional measures. In patients with significant malnutrition, early involvement of nutrition specialists and implementation of prehabilitation strategies may be necessary to improve operative resilience and reduce complication rates [48].

The diagnostic evaluation commonly begins with esophagogastroduodenoscopy when a gastric neoplasm is suspected. EGD is indispensable because it enables direct visualization of the lesion, biopsy sampling for histopathologic confirmation, and assessment of tumor location and endoscopic extent.[48] Accurate mapping of the tumor's position within the stomach influences operative planning, including the feasibility of partial gastrectomy and the anticipated reconstruction method. Endoscopic ultrasound is used to further refine staging by evaluating tumor depth of invasion, corresponding to T stage, and by identifying possible nodal involvement.[48] This information is pivotal because early-stage lesions may be eligible for endoscopic therapy or limited surgery, whereas deeper invasion and nodal suspicion generally warrant more extensive resection and consideration of neoadjuvant therapy. Cross-sectional imaging is essential to assess distant spread and regional anatomy. Computed tomography of the chest, abdomen, and pelvis with oral and intravenous contrast is recommended to detect distant metastatic disease, bulky lymphadenopathy, and involvement of adjacent organs that could influence resectability or the need for multivisceral resection.[48] Positron emission tomography can serve as an adjunct staging modality in selected cases, potentially identifying metabolically active metastases not clearly visible on CT and supporting a more accurate assessment of disease extent.[48] Together, these investigations inform whether surgery is likely to be curative or whether systemic and palliative strategies are more appropriate.

Because gastric cancer management is inherently multidisciplinary, an interprofessional approach is essential during preparation to determine surgical resectability, coordinate preoperative planning, and evaluate the role of neoadjuvant chemotherapy or radiotherapy. This collaborative framework typically involves surgeons, medical oncologists, radiation oncologists, gastroenterologists, radiologists, pathologists, anesthesiologists, and nutrition professionals, each contributing specialized expertise. Equally important is a thorough appraisal of comorbidities and performance status to ensure medical optimization. Preparation includes assessing the patient’s capacity to tolerate major surgery, anticipating postoperative support needs, and addressing modifiable risk factors in advance. For example, smoking cessation prior to surgery has been associated with improved outcomes after gastrectomy for malignancy, reinforcing the importance of targeted preoperative behavioral interventions as part of risk reduction.[49] Ultimately, effective preparation integrates diagnostic precision with physiologic optimization, aligning operative intent with patient-centered goals and maximizing the probability of safe surgery and meaningful recovery [49].

Technique or Treatment

Across gastric resection modalities, foundational operative principles remain consistent even as the technical execution varies according to whether the procedure is performed endoscopically, through an open incision, or using minimally invasive platforms. For all operative approaches to gastric resection, the patient is positioned supine on the operating room table, with appropriate padding to protect pressure points and facilitate subsequent positioning changes as needed for exposure. The abdomen is prepared and draped using standard sterile technique, and perioperative antibiotic prophylaxis is administered in accordance with institutional protocols to reduce the risk of surgical site infection. A nasogastric tube is commonly inserted for gastric decompression to improve operative visualization, reduce gastric distension, and assist in intraoperative handling of the stomach. These shared preparatory elements establish a controlled environment in which oncologic objectives can be pursued safely. The essential steps outlined below reflect widely accepted procedural sequences and are aligned with established surgical references.[36][48][50]

The choice between minimally invasive surgical techniques and open procedures is one of the most consequential decisions in contemporary gastric cancer surgery, as it influences operative exposure, physiologic stress, postoperative recovery, and sometimes the technical feasibility of lymph node dissection and reconstruction. Gastric resection may be performed through a conventional open approach, by laparoscopy, or with robotic assistance. Evidence from randomized controlled trials comparing laparoscopic and open gastrectomy has shown oncologic equivalency, with minimally invasive approaches often associated with more favorable postoperative recovery profiles.[48] In particular, minimally invasive gastrectomy has been linked to shorter hospital length of stay, fewer perioperative complications, and reduced intraoperative blood loss relative to open surgery.[48][50] These benefits are clinically meaningful because early recovery can support faster mobilization, reduce pulmonary complications, and potentially facilitate timely initiation of adjuvant therapy when indicated. However, the selection of open gastrectomy remains relevant and may be influenced by surgeon preference, increased operative difficulty in certain anatomic or oncologic scenarios, concerns about port-site recurrence, and the perception—particularly in earlier eras of minimally invasive surgery—that lymph node dissection might be less adequate through laparoscopic platforms.[51] In practice, these considerations are intertwined with institutional volume, team familiarity with advanced minimally invasive lymphadenectomy, tumor stage and location, and patient-specific factors such as prior surgery or body habitus.

High-quality trial evidence has strengthened the role of laparoscopy, particularly for locally advanced disease in experienced centers. The KLASS-02 randomized control trial demonstrated that laparoscopic surgery was noninferior to open surgery based on three-year recurrence-free survival and was associated with a lower complication rate in patients with locally advanced gastric cancers.[18] Importantly, extended follow-up at five years revealed no significant differences in recurrence-free survival or overall survival between laparoscopic and open groups, while the laparoscopic cohort experienced fewer late complications, reinforcing the clinical relevance of laparoscopy beyond short-term recovery metrics.[52] These findings collectively suggest that, when performed with oncologic rigor and technical proficiency, laparoscopic gastrectomy can provide long-term outcomes that match open surgery while delivering tangible advantages in postoperative morbidity.[52] Nonetheless, minimally invasive procedures require advanced technical capabilities, particularly for D2 lymphadenectomy and intracorporeal reconstruction, and the learning curve remains a significant determinant of outcomes, underscoring the importance of structured training and institutional support. Regardless of the operative platform, thorough staging is integral to ensuring that resection is pursued only when it is oncologically justified. Staging laparoscopy, in particular, has assumed a prominent role in modern gastric cancer practice because it can identify occult metastatic disease not reliably detected on preoperative imaging. The initial diagnostic laparoscopy is performed to exclude gross peritoneal carcinomatosis, small-volume liver metastases, or other metastatic deposits in the peritoneum that would preclude curative resection. If no macroscopic metastatic disease is observed, definitive gastric resection may proceed. To optimize exposure, a liver retractor can be employed to elevate the left lobe of the liver and enhance visualization of the proximal stomach and gastroesophageal junction. This step is especially important in tumors involving the upper stomach, where the left lateral segment of the liver can obstruct access to the hiatus and lesser curvature. Staging laparoscopy therefore functions as a critical gatekeeper, preventing non-beneficial laparotomy and enabling early redirection toward systemic therapy or palliative strategies when metastatic spread is present.

In selected cases of early gastric cancer, endoscopic submucosal dissection offers an alternative curative pathway that is fundamentally different from gastrectomy in both invasiveness and physiologic impact. Patients undergoing ESD may receive conscious sedation or general anesthesia depending on lesion complexity, anticipated procedure duration, and patient factors. The procedure begins with careful delineation of the lesion borders. Margins are marked using argon plasma coagulation or electrocautery to provide a visual roadmap that guides the operator toward complete removal while preserving negative margins. This preparatory marking is particularly valuable when lesions have subtle boundaries or when mucosal changes are difficult to distinguish from surrounding tissue. After marking, a lifting solution is injected into the submucosal layer beneath the lesion. Common injectates include saline combined with epinephrine or viscous agents such as glycerol, which create a protective cushion by separating the mucosa and submucosa from the muscularis propria. This submucosal lift is central to procedural safety because it reduces the risk of inadvertent injury and perforation while enabling more controlled dissection planes. Once adequate lift is achieved, an initial mucosal incision is made outside the marked margin using specialized electrosurgical knives, such as needle knives or insulated-tip knives. This incision establishes entry into the submucosal space and defines the starting point for circumferential cutting. Subsequently, the operator proceeds with submucosal dissection, separating the lesion-bearing mucosal layer from the muscularis propria using alternating cutting and coagulation techniques. Dissection is performed progressively, layer by layer, and requires continuous reassessment of tissue planes to avoid deep thermal injury. Throughout the procedure, hemostasis is maintained with electrocautery and hemostatic forceps to control bleeding from submucosal vessels. Because bleeding can obscure visualization and compromise safety, hemostatic technique is integral to success rather than an ancillary step. After the lesion is freed, the specimen is inspected to confirm en bloc removal and assess gross margin adequacy, and then retrieved with snares or specialized devices for histopathologic examination. If defects or microperforations are identified, endoscopic clips may be applied to close the mucosal breach, while smaller defects may be managed through careful observation and natural healing depending on institutional practice. After completion, close monitoring is essential, as delayed bleeding and perforation remain key complications. Many patients require observation or hospitalization for supportive care, including fasting protocols, proton pump inhibitor therapy, and staged reintroduction of oral intake [48][49][50][51][52].

When oncologic requirements necessitate removal of the entire stomach, total gastrectomy is performed using an approach designed to maximize exposure of the upper abdomen and distal esophagus. Traditional open access is achieved through either an upper midline incision or a left thoracoabdominal incision, with selection driven by tumor location and extension. The upper midline incision, extending from the xiphoid toward the umbilicus, provides broad access to the upper abdominal cavity and is sufficient for many gastric tumors. However, tumors involving the cardia or fundus with proximal extension toward the esophagus may require a left thoracoabdominal incision, which begins at the seventh intercostal space and extends to the upper midline. This approach improves exposure of the supradiaphragmatic distal esophagus up to the level of the inferior pulmonary ligament, facilitating safe proximal control and margin acquisition. In such cases, deflation of the left lung using a double-lumen endotracheal tube may assist dissection by increasing operative space and reducing tension during mobilization of the esophagus. After entry into the abdomen, a systematic exploration is performed to identify metastatic disease, with careful inspection of the liver, peritoneal surfaces, hepatoduodenal ligament, and root of the mesentery. The discovery of metastases may alter treatment intent, and in many cases would preclude curative gastrectomy. In high-risk or locally advanced tumors, diagnostic laparoscopy may already have been performed to assess for occult dissemination, reinforcing the importance of staging in guiding operative commitment. If resection proceeds, patient positioning can be modified by tilting the operating table to create a right semi-lateral decubitus orientation. This facilitates exposure of the gastroesophageal junction and allows division of the left triangular ligament of the liver to mobilize the left lateral hepatic segment, improving access to the hiatus and proximal stomach [52].

The resection phase of total gastrectomy involves sequential mobilization and vascular ligation that corresponds to the stomach's anatomic attachments and arterial arcades. The greater omentum is separated from the transverse colon and epiploic appendages to open the gastrocolic plane and enter the lesser sac. The right gastroepiploic vessels are ligated at their origins from the gastroduodenal artery and the gastrocolic trunk of the superior mesenteric vein. Short gastric arteries are divided close to the spleen, and the left gastroepiploic artery is divided near its origin from the splenic artery. Along the lesser curvature, the right gastric artery is ligated prior to duodenal transection, which is typically performed with a linear stapler. The gastrohepatic ligament is divided with particular caution to avoid injury to a replaced or accessory left hepatic artery, an anatomic variant that can be clinically significant. The stomach is retracted superiorly to facilitate lymph node dissection near the porta hepatis, hepatic artery, and celiac trunk. Tissues lateral to the left hepatic artery are thinned and cleared before division of the left gastric artery near its celiac origin, a step that is central to D2 lymphadenectomy. Division of the phrenoesophageal ligament enables circumferential mobilization of the distal esophagus. Paracardial lymph nodes are excised, and the distal esophagus is divided to complete specimen removal. Reconstruction after total gastrectomy is necessary to restore alimentary continuity and support long-term nutritional intake. Several reconstructive options exist, including Roux-en-Y esophagojejunostomy and creation of a Hunt-Lawrence jejunal pouch.[36] In many institutions, Roux-en-Y esophagojejunostomy is favored, and randomized controlled trials have reported decreased rates of long-term postoperative complications following Roux-en-Y reconstruction after gastric resection.[53] The physiologic rationale is to reduce alkaline reflux into the esophagus and optimize functional outcomes by diverting biliopancreatic secretions distally. Typically, a Roux limb of approximately 40 to 60 cm is constructed from the jejunojejunostomy to minimize reflux proximal to the esophagojejunal anastomosis. The jejunum is divided 30 to 50 cm distal to the ligament of Treitz using a linear stapler, creating a proximal Roux limb and distal biliopancreatic limb. A jejunojejunostomy is then fashioned 60 to 70 cm along the Roux limb, aligning the antimesenteric borders and creating enterotomies that accommodate a linear stapler. The anastomosis is completed and the common enterotomy closed, often with stapling followed by suture reinforcement depending on preference. Mesenteric defects are closed with absorbable suture to reduce the risk of internal hernia, a complication that can be catastrophic if unrecognized. The Roux limb is then brought to the esophageal stump either antecolic or retrocolic, and an esophagojejunostomy is created using either stapled or hand-sewn techniques [53].

Several approaches to constructing the esophagojejunostomy are widely used. A hand-sewn anastomosis may be performed with interrupted or continuous absorbable sutures, allowing tailored tissue approximation and the opportunity to adjust tension. Alternatively, an EEA circular stapler may be used, often by placing the anvil into the distal esophagus and securing it with a purse-string suture. In some methods, the anvil can be introduced with assistance from the anesthesiologist via an orogastric delivery system. After the anastomosis is completed, an intraoperative leak test such as a water bubble test may be performed to assess integrity. Postoperatively, anastomotic protection is emphasized by keeping the anastomosis relatively defunctionalized early, allowing passage of saliva but restricting oral intake until healing is more secure. This cautious approach reflects recognition that anastomotic leaks carry high morbidity and can be life-threatening. Postoperative adjuncts such as drains and feeding access represent areas of evolving practice. The routine use of surgical drains after total gastrectomy has been extensively studied, with multiple trials indicating no clear benefit.[54][55] Consequently, some institutions reserve drains for selected cases, particularly when extravisceral extension requires pancreatectomy or when operative concerns suggest elevated leak risk.[39] Feeding jejunostomy placement has historically been common to support prolonged enteral feeding, especially in patients at risk of anastomotic leak or those with significant preoperative weight loss. However, emerging evidence has questioned universal application, suggesting that routine feeding jejunostomy may increase infectious complications without reliably improving receipt of adjuvant therapy.[48][56] Many centers perform a fluoroscopic upper gastrointestinal study around postoperative day five to evaluate for anastomotic leaks prior to initiating oral intake, providing an objective assessment that can guide safe dietary advancement.[36]

Distal gastrectomy is performed for tumors of the middle or distal stomach and differs from total gastrectomy in both vascular priorities and reconstruction objectives. Unlike total gastrectomy, where short gastric arteries are divided, distal gastrectomy often requires preservation of some short gastric vessels because perfusion of the remaining proximal stomach may depend on them. This vascular consideration is critical: inadequate blood supply to the gastric remnant can predispose to ischemia, impaired healing, and anastomotic failure. From an oncologic staging standpoint, dissection of the cephalad branch of the left gastric artery is emphasized because it bifurcates high along the lesser curvature and provides access to adjacent lymph nodes, including nodes near the distal two to three centimeters of the esophagus. Such nodal retrieval is important for accurate staging and for ensuring that potentially involved basins are cleared. Reconstruction after distal gastrectomy is commonly achieved through Billroth II or Roux-en-Y gastrojejunostomy. Billroth I reconstruction, although physiologically appealing because it preserves duodenal continuity, is often not feasible because the duodenum is relatively fixed and may not reach the gastric stump without tension. Therefore, Billroth II is frequently selected. In Billroth II, a jejunal loop is brought to the gastric remnant, either antecolic over the transverse colon or retrocolic through a defect in the transverse mesocolon. The anastomosis must be constructed without tension, torsion, or angulation, and attention must be paid to avoiding an excessively long afferent limb. A long afferent limb can kink or become obstructed, producing afferent loop syndrome with pain, distension, and biliary vomiting. Thus, reconstruction is not merely a technical endpoint but a functional design exercise aimed at minimizing long-term complications [56].

Despite technical success, Billroth II reconstruction is often associated with alkaline reflux gastritis, as bile and pancreatic secretions can reflux into the gastric remnant. The loss of duodenal continuity also has nutritional implications, including potential malabsorption of fat-soluble vitamins due to altered mixing of chyme with biliary and pancreatic secretions. These functional drawbacks have driven many institutions to favor Roux-en-Y gastrojejunostomy after distal gastrectomy. By constructing a Roux limb of approximately 40 to 50 cm, biliopancreatic secretions are diverted distally, reducing bile reflux into the remnant stomach and esophagus. Comparative observations have suggested superior long-term outcomes with Roux-en-Y gastrojejunostomy, including reduced bile reflux and esophagitis, improved quality of life metrics, and fewer abnormal findings on follow-up endoscopy. These differences reinforce that reconstruction choice can meaningfully shape postoperative symptom burden, nutritional status, and patient wellbeing long after oncologic treatment is complete. Pylorus-preserving distal gastrectomy shares many steps with conventional distal gastrectomy but is distinguished by transection proximal to the pylorus and deliberate preservation of infrapyloric vessels. The physiologic intent is to maintain pyloric function and thereby reduce postoperative dumping, bile reflux, and weight loss. However, the very maneuvers that preserve pyloric perfusion and function can constrain the extent of lymph node dissection in the infrapyloric and suprapyloric regions. Reports describing fewer lymph nodes retrieved from these stations have generated concerns about whether oncologic staging and clearance are compromised in certain patients. For this reason, pylorus-preserving distal gastrectomy is generally considered appropriate only in carefully selected early-stage tumors where nodal metastasis risk is low and margin targets can be met. The technique therefore exemplifies a recurrent theme in gastric cancer surgery: functional preservation is desirable, but it must not erode the oncologic completeness that determines long-term disease control [56].

Proximal gastrectomy is indicated for selected upper-third gastric tumors and is followed by reconstruction methods designed to balance reflux prevention with maintenance of gastric reservoir function. Several reconstructive strategies are described, including esophagogastrostomy, jejunal interposition, and double-tract reconstruction. Esophagogastrostomy remains the most frequently used method, and among its variants, anterior gastric wall end-to-side esophagogastrostomy is often favored because it has been associated with reduced reflux, improved meal intake, and greater postoperative weight compared with some other techniques. However, a major limitation of esophagogastrostomy is the increased risk of bile reflux relative to other reconstructions, which can lead to esophagitis, discomfort, and diminished quality of life.[57] This trade-off has motivated exploration of alternative approaches that may better divert bile while retaining function. Jejunal interposition is performed by placing a segment of jejunum between the esophagus and the gastric remnant. Typically, a 10- to 20-cm jejunal limb is mobilized and delivered antecolic or retrocolic, enabling an end-to-side esophagojejunal anastomosis and a gastrojejunostomy to the anterior gastric wall. In some approaches, a longer jejunal limb of 25 to 35 cm can be fashioned and reversed to create a U-shaped jejunal pouch of approximately 10 to 15 cm, aiming to provide a reservoir function and improve postoperative intake. Double-tract reconstruction represents another physiologically oriented design. This method involves constructing a Roux-en-Y esophagojejunostomy, creating a side-to-side gastrojejunostomy approximately 10 cm distal to the esophagojejunostomy, and then completing an end-to-side jejunojejunostomy about 20 cm distal to the gastrojejunostomy. The conceptual advantage is that food can pass through both the jejunal limb and the preserved gastric remnant, potentially supporting better nutritional outcomes while reducing reflux. Selection among these reconstructions depends on tumor location, remnant size, institutional expertise, and the priority assigned to reflux prevention versus technical simplicity [57].

Central to oncologic gastrectomy is lymphadenectomy, most commonly performed to a D2 extent, which is widely regarded as the gold standard in many guideline frameworks. D2 dissection proceeds systematically through nodal basins that correspond to perigastric stations and major arterial pathways. Stations 1 through 7 include perigastric nodes that are removed en bloc with the gastric specimen. Dissection then extends along the proper hepatic artery and continues along the common hepatic artery to include station 8, proceeding toward the celiac axis for station 9 and along the splenic artery for stations 11p and 11d. The lymphadenectomy then progresses into the hepatoduodenal ligament to harvest nodes associated with station 12a. This structured approach is designed to optimize staging accuracy and locoregional disease control while avoiding unnecessary organ sacrifice. In modern practice, D2 dissection is typically performed in a pancreas-sparing manner, reflecting evidence that routine pancreatic resection increases morbidity without providing clear survival benefit in most patients. For locally advanced tumors that invade adjacent structures, multivisceral resection may be undertaken to achieve negative margins. In this context, MVR extends beyond the stomach to include organs or tissues involved by direct extension or at substantial risk of involvement. The specific components of MVR vary according to tumor anatomy and may include partial pancreatic resection if the tumor abuts or invades the pancreatic capsule or head region, splenectomy when the greater curvature or splenic hilum is involved, and hepatic resection for direct invasion or limited hepatic metastases amenable to complete clearance. Partial colectomy may be necessary if the tumor extends into the transverse colon or involves the gastrocolic ligament to a degree that prevents safe separation. Duodenal resection may be required when proximal tumors extend distally or when tumor proximity undermines the safety of duodenal preservation. Resection may also involve tissues within the pancreaticoduodenal ligament when these structures are infiltrated, and portions of the peritoneum may be excised when peritoneal metastasis or carcinomatosis is present. Because MVR increases operative time, blood loss risk, and postoperative complication burden, it is reserved for selected patients in whom complete oncologic clearance is plausible and physiologic reserve is sufficient. Thorough preoperative planning and multidisciplinary coordination are essential, and intraoperative judgment must continually weigh the feasibility of R0 resection against escalating risk [57].

In patients with peritoneal metastases, cytoreductive surgery combined with hyperthermic intraperitoneal chemotherapy represents an aggressive locoregional strategy designed to reduce tumor burden and eradicate microscopic disease within the peritoneal cavity. CRS involves meticulous excision of visible peritoneal tumor nodules from peritoneal surfaces and, when necessary, resection of involved organs such as the omentum, spleen, and segments of gastrointestinal tract. The goal is maximal macroscopic clearance, ideally achieving complete cytoreduction. This procedure is technically demanding and requires careful mapping of peritoneal disease distribution to guide the extent of peritonectomy and organ resection. After CRS, HIPEC is administered by perfusing the peritoneal cavity with heated chemotherapy, commonly using agents such as mitomycin C, 5-fluorouracil, oxaliplatin, cisplatin, or doxorubicin. The perfusate is heated, typically to 41–43 °C, to enhance cytotoxicity, improve drug penetration into residual tumor nodules, and potentiate chemotherapy efficacy while limiting systemic exposure. The perfusion is maintained for a defined period, often 60 to 90 minutes, with continuous circulation to ensure even distribution. After completion, the chemotherapy solution is drained and definitive closure is performed. The combined CRS and HIPEC approach aims to achieve two complementary objectives: elimination of gross disease through cytoreduction and eradication of microscopic residual deposits through high-concentration intraperitoneal chemotherapy. Potential benefits include improved local control, reduced peritoneal recurrence, and the possibility of prolonged survival in carefully selected patients. However, this strategy is associated with substantial physiologic burden and perioperative risk, necessitating rigorous selection criteria, specialized surgical expertise, and comprehensive postoperative monitoring. The multidisciplinary nature of CRS and HIPEC is particularly pronounced, requiring coordination among surgical oncologists, anesthesiologists, medical oncologists, intensive care teams, and nutrition specialists. When integrated appropriately, these techniques represent the expanding frontier of gastric cancer treatment, illustrating how operative and regional therapies can be combined to address disease patterns that have historically been difficult to control with systemic therapy alone [57].

Complications

Complications following gastric resection represent a major determinant of both short-term recovery and long-term oncologic outcomes, particularly in patients undergoing surgery for malignancy who may subsequently require adjuvant therapy. The probability and severity of postoperative morbidity are not evenly distributed; rather, they concentrate in patients with established risk factors and reduced physiologic reserve. High-risk patients are therefore disproportionately vulnerable to adverse events that may culminate in prolonged hospitalization, reoperation, organ failure, or death. Several variables have been associated with heightened morbidity, including tobacco use, preoperative malnutrition, total gastrectomy, resections performed for nonmalignant indications, and perioperative blood transfusion.[49] Each of these factors is biologically and clinically plausible. Tobacco exposure increases pulmonary and wound complications through impaired mucociliary clearance, heightened inflammatory responses, and microvascular dysfunction. Malnutrition undermines wound healing, compromises immune function, and reduces the capacity to withstand catabolic stress. Total gastrectomy imposes a broader physiologic insult and creates more complex reconstruction than partial resections, thereby increasing operative time, blood loss, and the potential for anastomotic failure. Blood transfusions, while sometimes necessary, may correlate with substantial intraoperative bleeding or complexity and have been linked to increased infection risk and inflammatory modulation. These baseline vulnerabilities interact with the inherent risks of major upper abdominal surgery. Intraoperatively, gastrectomy carries risks of hemorrhage and inadvertent injury to surrounding organs, including iatrogenic splenic injury, which can occur during division of short gastric vessels, mobilization of the fundus, or dissection near the splenic hilum.[58] Such injuries may necessitate splenectomy or lead to postoperative bleeding, abscess formation, or immunologic consequences.

Notwithstanding notable progress in operative technique, anesthetic management, perioperative care, and interventional radiology, gastrectomy continues to carry a meaningful risk of severe postoperative complications. Among the most consequential are anastomotic leakage and intraabdominal abscess, both of which can derail recovery and substantially increase morbidity. These complications are not confined to immediate postoperative discomfort; they may precipitate sepsis, necessitate reoperation or percutaneous drainage, prolong reliance on parenteral or enteral nutrition, and delay the initiation of adjuvant chemotherapy. In oncology, treatment delays are not trivial, because the timing of systemic therapy can influence recurrence risk and survival. Furthermore, postoperative complications have been shown to negatively affect both overall survival and recurrence-free survival in patients undergoing curative gastrectomy for gastric cancer, underscoring that perioperative events can exert downstream effects well beyond the initial hospitalization. In population terms, recently reported overall morbidity rates after gastric cancer resection range from 17.4% to 24.5% in East Asia and from 13.6% to 46% in Western countries.[59] The wider range in Western contexts likely reflects heterogeneity in patient characteristics, comorbidity burden, disease stage at diagnosis, institutional volume, and variation in operative practice and perioperative pathways. Regardless of geographic setting, these figures emphasize that complications remain common enough to warrant systematic prevention strategies, vigilant surveillance, and rapid escalation protocols [58][59].

Postgastrectomy morbidity encompasses both functional disturbances and structural complications. The most frequently encountered long-term sequelae include nutritional deficiencies, dumping syndrome, a small gastric remnant syndrome, postvagotomy diarrhea, delayed gastric emptying, afferent and efferent loop syndromes, Roux stasis, and bile reflux gastritis.[60] While these conditions differ in pathophysiology, they share a common origin in altered anatomy and physiology following resection and reconstruction. Removal of gastric reservoir capacity, disruption of vagal innervation, bypass of duodenal continuity, and modified exposure of the small intestine to hyperosmolar chyme and biliopancreatic secretions all contribute to symptom complexes that can persist for months or years. Clinically, it is useful to conceptualize complications as early events—typically arising within days to weeks—and late events—more frequently manifesting after six weeks, once the acute recovery period has passed and functional adaptation begins. This temporal distinction supports targeted surveillance: early monitoring emphasizes surgical integrity and infection prevention, whereas later follow-up focuses on functional rehabilitation, nutritional status, and recognition of structural complications such as strictures or internal hernias. Early postoperative complications include anastomotic leak, bowel obstruction, postoperative ileus, duodenal stump blowout, delayed gastric emptying, surgical site infection, and intraabdominal infection. Anastomotic leak is among the most feared complications because it can rapidly progress to sepsis and multi-organ dysfunction. The clinical presentation may include fever, tachycardia, abdominal pain, leukocytosis, increased drain output (if drains are present), respiratory compromise, or hemodynamic instability. Leaks may occur at the esophagojejunostomy after total gastrectomy, at the gastrojejunostomy after distal gastrectomy, or at jejunojejunostomy sites in Roux-en-Y reconstructions. Contributing factors include poor tissue perfusion, tension at the anastomosis, technical failure, contamination, and patient-specific vulnerability such as malnutrition or immunosuppression. Intraabdominal abscesses often arise secondary to leaks or localized contamination and may present with persistent fever, abdominal pain, ileus, or failure to progress in recovery. Modern management often relies on cross-sectional imaging to diagnose collections, followed by targeted antibiotics and percutaneous drainage when feasible, reserving reoperation for uncontrolled sepsis or non-drainable sources [60].

Bowel obstruction and postoperative ileus may occur early due to adhesions, kinking at anastomoses, edema, hematoma, or impaired motility from surgical handling and opioid exposure. Although ileus is often transient, prolonged ileus can increase aspiration risk, delay nutrition, and prolong hospitalization. Duodenal stump blowout, particularly after distal gastrectomy with Billroth II reconstruction, is a severe complication where the closed duodenal stump dehisces, leading to bile and pancreatic leakage into the peritoneal cavity. This event can cause rapid peritonitis and sepsis and often requires urgent intervention. Delayed gastric emptying may be seen after various reconstructions and can manifest as persistent nausea, vomiting, intolerance of diet advancement, and gastric distension. While some cases resolve with supportive care and prokinetics, others may reflect mechanical problems at the anastomosis that require endoscopic or surgical correction. Surgical site infection, ranging from superficial wound infection to deep incisional infection, remains a relevant cause of morbidity and is influenced by operative duration, contamination, immune status, and glucose control. Intraabdominal infection is broader than abscess formation and may include peritonitis, infected collections, and catheter-associated infections related to nutritional support. Late complications arise after the initial recovery period and frequently relate to altered physiology and reconstruction anatomy. Bile reflux gastritis is a well-characterized late complication, particularly when pyloric function is lost and biliopancreatic secretions chronically bathe the gastric remnant.[60] Patients may experience epigastric pain, nausea with vomiting, and discomfort that is only partially related to meals, often leading to reduced intake and diminished quality of life. Diagnostic evaluation commonly includes endoscopy, which may reveal bile pooling and mucosal inflammation in the distal stomach, and in severe cases, a hepatobiliary iminodiacetic acid scan can demonstrate bile reflux or pooling.[60] While medical management may offer partial symptom relief, definitive treatment frequently requires surgical correction. Conversion to Roux-en-Y gastrojejunostomy with a sufficiently long Roux limb, typically at least 60 cm, is used to divert biliopancreatic contents away from the gastric remnant and reduce mucosal injury.[60] This example illustrates a broader principle: reconstruction choice has long-term functional consequences, and revision surgery may be necessary when symptoms are severe and refractory.

Dumping syndrome represents another prominent late complication and reflects rapid transit of hyperosmolar gastric contents into the proximal intestine, triggering fluid shifts, intestinal distension, and neurohormonal responses.[60] Early dumping occurs within approximately 30 minutes of eating and includes both gastrointestinal and vasomotor symptoms such as abdominal pain, diarrhea, bloating, nausea, flushing, palpitations, diaphoresis, tachycardia, syncope, and hypertension.[60] Late dumping occurs two to four hours after meals and is primarily driven by reactive hypoglycemia, producing vasomotor symptoms including weakness, tremor, diaphoresis, and dizziness.[60] The syndrome can be socially and nutritionally disabling, leading patients to fear eating and to restrict intake. Management typically begins with dietary modification—small frequent meals, reduced simple sugars, increased protein and fiber, and strategic fluid timing. When dietary approaches are insufficient, pharmacologic therapy such as somatostatin analogs may be employed, and in rare refractory cases, surgical intervention may be considered.[60] The clinical relevance of dumping syndrome extends beyond symptoms; it influences nutritional adequacy and patient adherence to postoperative dietary plans. Afferent and efferent limb syndromes are recognized complications after gastric resections, especially following Billroth II reconstruction.[60] Afferent loop syndrome, though uncommon, can result from internal hernia, marginal ulceration, adhesions, recurrent cancer, or intussusception. The clinical pattern often includes postprandial pain and cramping followed by vomiting that provides substantial relief, reflecting decompression of the obstructed afferent limb.[60] Identification of acute afferent loop syndrome within one to two weeks after surgery is particularly important because distension and pressure can contribute to duodenal stump leakage, compounding morbidity.[60] Efferent loop syndrome involves obstruction at or near the gastrojejunostomy, which may be due to stricture, ulceration, recurrent cancer, or adhesions, and often manifests as bilious vomiting, delayed gastric emptying, or intolerance of oral intake.[60] Both conditions require careful evaluation to differentiate functional dysmotility from mechanical obstruction, often relying on imaging and endoscopy to define anatomy and guide intervention [60].

Internal hernias, including Peterson hernia, constitute a potentially life-threatening late complication in patients with Roux-en-Y reconstruction. These hernias arise because surgically created mesenteric defects provide potential spaces into which bowel can herniate. Three major transmesenteric hernia types are described:

transmesocolic hernias through defects in the transverse mesocolon when a retrocolic route is used; Peterson hernias through the space between the Roux limb mesentery and the mesocolon behind the alimentary limb; and herniation through small bowel mesenteric defects, particularly around jejunostomy sites.[61] These events may present with intermittent or acute abdominal pain, nausea, vomiting, and sometimes nonspecific symptoms that can delay diagnosis. Because strangulation and ischemia can develop rapidly, a high index of suspicion is essential, and early imaging with CT can be lifesaving. Preventive strategies include meticulous closure of mesenteric defects during the index operation, but hernias may still occur, particularly as postoperative weight loss reduces mesenteric fat, enlarging potential spaces. Additional late complications include anastomotic stricture, marginal ulcers, malnutrition and nutritional deficiencies, and cancer recurrence.[61] Anastomotic stricture can develop due to ischemia, tension, scarring, or chronic inflammation and often presents as progressive dysphagia after esophagojejunal anastomosis or as postprandial fullness and vomiting after gastrojejunostomy. Endoscopic dilation is frequently effective, though refractory strictures may require repeat intervention. Marginal ulcers can arise near anastomoses due to acid exposure, bile reflux, ischemia, smoking, or NSAID use, and can lead to pain, bleeding, or perforation. Nutritional complications are pervasive after gastrectomy because the stomach's role in reservoir function, mechanical digestion, and intrinsic factor secretion is disrupted. Patients are at risk for iron deficiency anemia, vitamin B12 deficiency after total gastrectomy, folate deficiency, fat-soluble vitamin malabsorption in certain reconstructions, and protein-calorie malnutrition. These issues necessitate long-term monitoring, supplementation, and dietitian-led support. Cancer recurrence remains a separate but intertwined concern; postoperative complications may delay adjuvant therapy and thereby indirectly influence recurrence risk, highlighting the oncologic implications of surgical morbidity [61].

Clinical significance

The clinical significance of understanding and preventing gastrectomy complications is substantial because gastric resection remains a cornerstone intervention for gastric cancer, a malignancy associated with high global mortality. Curative resection aims to remove the primary tumor and associated lymph nodes, offering the possibility of cure in early-stage disease and meaningful survival benefit in locally advanced presentations. Even when cure is not achievable, resection may be undertaken for palliation of obstruction, bleeding, or pain, improving quality of life and enabling nutrition. Advances in endoscopic and surgical techniques, including minimally invasive platforms such as laparoscopic and robotic-assisted gastrectomy, have contributed to reductions in morbidity in many settings, reinforcing the role of gastric resection as both a curative and palliative modality. However, these advantages are realized only when patient selection is appropriate, perioperative planning is meticulous, and multidisciplinary collaboration is robust, ensuring that the benefits of surgery are not eclipsed by preventable harm [61].

Enhancing Healthcare Team Outcomes

Optimizing outcomes requires an interprofessional approach that coordinates technical excellence with comprehensive perioperative management. Physicians and advanced practitioners must be proficient in selecting and executing appropriate gastrectomy techniques, assessing tumor extent, and determining surgical candidacy. They also bear responsibility for implementing evidence-based perioperative measures such as nutritional optimization, thromboembolism prophylaxis, glycemic control, and multimodal analgesia. Just as critical is interprofessional communication, which enables seamless transitions across perioperative phases and ensures that evolving clinical concerns—such as subtle signs of leak, infection, or obstruction—are recognized and addressed promptly. Within this care ecosystem, nurses occupy a central role in translating operative plans into safe recovery trajectories. Nursing responsibilities include preoperative education, postoperative monitoring, early mobilization support, wound and drain care where applicable, and vigilant assessment for complications. Nurses are often the first to detect early warning signs such as tachycardia, fever, escalating pain, reduced urine output, increasing abdominal distension, or changes in nausea and vomiting patterns. Pharmacists contribute through medication stewardship, ensuring appropriate antimicrobial prophylaxis or therapy, optimizing pain control while minimizing ileus risk, and supporting management of reflux, nausea, and nutritional supplementation. Nutrition professionals guide dietary progression, identify deficiencies, and establish supplementation strategies that can prevent long-term morbidity [61].

Nursing, Allied Health, and Interprofessional Team Interventions

Within nursing, allied health, and interprofessional interventions, effective handoff communication is particularly important. Nursing staff must reliably communicate a history of gastric resection, the reconstruction type, and relevant comorbidities to ensure that subsequent caregivers interpret symptoms accurately and avoid contraindicated practices. Access to specialized nurses and structured education programs supports patient self-management after discharge, including recognition of dehydration, hypoglycemia symptoms related to dumping, and signs of obstruction. Nurses should maintain a strong conceptual understanding of serious complications such as bowel obstruction, anastomotic leak, postoperative bleeding, duodenal stump blowout, delayed gastric emptying, and malnutrition. Prompt identification of patients presenting with acute abdominal pain, persistent nausea, vomiting, fever, or hemodynamic changes should trigger timely escalation to surgical services for evaluation and intervention. Through coordinated teamwork, disciplined surveillance, and proactive prevention strategies, healthcare teams can reduce gastrectomy-related morbidity, protect oncologic treatment timelines, and improve both survival and quality of life for patients undergoing gastric resection for malignancy [61].

Conclusion:

Gastric resection remains a pivotal intervention in the management of gastric cancer, offering the potential for cure in early-stage disease and meaningful palliation in advanced cases. Despite technological advances, including minimally invasive and endoscopic techniques, the procedure continues to impose significant physiologic and nutritional challenges. Achieving optimal outcomes depends on meticulous surgical execution, adherence to oncologic principles such as adequate margins and D2 lymphadenectomy, and judicious selection of reconstruction methods to minimize long-term functional sequelae. Equally critical is the role of multidisciplinary care. Nursing professionals are central to perioperative safety, early detection of complications, and patient education on dietary adaptation and symptom management. Pharmacists, nutritionists, and allied health providers contribute to comprehensive recovery strategies, addressing pain control, nutritional deficiencies, and quality-of-life concerns. Future progress will hinge on refining patient selection for minimally invasive and organ-preserving approaches, integrating advanced imaging and staging modalities, and expanding evidence for robotic and regional therapies such as CRS and HIPEC. Ultimately, gastric resection should be approached as a patient-centered endeavor, balancing oncologic benefit against functional preservation and ensuring that technical excellence is matched by holistic care.

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