

NCCN Clinical Practice Guidelines in Oncology (NCCN Guidelines®)

Gastric Cancer

Version 1.2014

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Gastric Cancer

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¶ Surgery/Surgical oncology	≠ Pathology
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✕ Gastroenterology
¶ Surgery/Surgical oncology
♢ Internal medicine
§ Radiotherapy/Radiation oncology
‡ Hematology/Hematology oncology
≠ Pathology

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[Staging \(ST-1\)](#)

Clinical Trials: NCCN believes that the best management for any cancer patient is in a clinical trial. Participation in clinical trials is especially encouraged.

To find clinical trials online at NCCN member institutions, [click here: nccn.org/clinical_trials/physician.html](#).

NCCN Categories of Evidence and Consensus: All recommendations are Category 2A unless otherwise specified.

See [NCCN Categories of Evidence and Consensus](#).

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NCCN Guidelines Version 1.2014 Updates

Gastric Cancer

Updates in version 1.2014 of the NCCN Guidelines for Gastric Cancer from version 2.2013 include:

Global Changes

- The title of the Guidelines was revised, “Gastric Cancer (~~Including the proximal 5cm of the stomach~~)”.
- “Principles of Genetic Risk Assessment for Gastric Cancer” is a new section that provides screening recommendations for individuals with hereditary cancer syndromes with increased risk for gastric cancer ([GAST-D](#))
- The following terms were revised throughout the Guidelines.
 - ▶ “Endoscopic mucosal resection (EMR)” changed to “endoscopic resection (ER)”.
 - ▶ “Palliative Therapy” changed to “Palliative *Management*”.
 - ▶ “Adjunctive Treatment” changed to “*Additional Management*”.
 - ▶ “Observe” changed to “*Surveillance*”.
 - ▶ “Postoperative Treatment” changed to “Postoperative *Management*”
 - ▶ “Palliative/Salvage therapy” changed to “Palliative/Salvage *Management*”.
 - ▶ “Best supportive care” changed to “*Palliative*/Best supportive care”.
- Footnotes defining the tumor classifications were removed from the algorithm and were replaced by the following footnote
“[See Staging \(ST-1\)](#) for tumor classification” that references the AJCC Staging Tables.
- The Discussion section has been updated to reflect the changes in the algorithm ([MS-1](#)).

GAST-1

- Workup:
 - ▶ Third bullet revised: “Chest/abdomen/*pelvic* CT with oral and IV contrast”.
 - ▶ Fourth bullet revised, “PET-CT evaluation if no evidence of M1 disease *and if clinically indicated.*”
 - ▶ New bullet added: “Assess Siewert category” with corresponding footnote to the “Principles of Surgery” page.
 - ▶ New bullet added: “Screen for family history” with corresponding footnote linking to the new “Principles of Genetic Risk Assessment...” section and the [NCCN Guidelines for Colorectal Cancer Screening](#) and [Genetic/Familial High-Risk Assessment: Breast and Ovarian](#).
 - ▶ The following bullet was deleted, “Pelvic CT as clinically indicated”.
- Footnote “j” revised: “...Laparoscopy is not indicated if a palliative resection is planned. *Laparoscopy is indicated for clinical stage T1b or higher.*”

GAST-2

- The column heading “Post Laparoscopy Findings” was removed and incorporated into the first column of the algorithm as “*Laparoscopic findings of Locoregional disease (M0)*”.
- Far right column: Recommendation revised, “~~Periodic~~ Endoscopic surveillance”.

GAST-5

- Post Treatment Assessment: Under “Restaging,” two bullets “Abdominal/pelvic CT” and “Chest CT as clinically indicated” were combined as follows: “*Chest/abdomen/pelvic CT*”.

GAST-6

- Column heading revised: “Follow-up/*Surveillance*”.
- ▶ “HER2-neu testing, if not done previously” was removed.



NCCN Guidelines Version 1.2014 Updates

Gastric Cancer

GAST-A: Principles of Endoscopic Staging and Therapy

1 of 4

- **Diagnosis:** Third bullet revised, “Endoscopic mucosal resection (EMR) *or endoscopic submucosal dissection (ESD)* can be performed in the evaluation of small lesions. EMR *or ESD* of focal nodules ≤ 3 2 cm can be safely performed to provide a larger specimen which can be better assessed by the pathologist, providing greater information on degree of differentiation, the presence of lymphovascular invasion and the depth of infiltration, thereby providing accurate T-staging....”

2 of 4

- **Staging:** First bullet; last sentence revised as follows, “This is especially important in patients who are being considered for **EMR endoscopic resection (endoscopic mucosal resection [EMR] or endoscopic submucosal dissection [ESD]).**”

3 of 4

• **Treatment:**

- ▶ First bullet revised: “EMR *or ESD* of early gastric cancer can be considered adequate therapy when the lesion is ~~less than 1.5~~ ≤ 2 cm in diameter, is shown on histopathology to be well or moderately well differentiated, ~~and does not~~ penetrate beyond the superficial submucosa, ~~and does not~~ exhibit lymphovascular invasion, *and has clear lateral and deep margins*. En-bloc excision of small gastric lesions by ~~endoscopic submucosal dissection (ESD)~~ has been shown to be more effective than EMR in curing *small* early gastric cancer, but requires greater skills and instrumentation to perform and has a significant risk of complications including perforation.”
- ▶ The second and third bullets were separated from the first bullet and revised as follows:
 - ◊ “Japanese Gastric Cancer guidelines recommend *that* EMR *or ESD* should be considered for early gastric cancer lesions ≤ 3 2 cm in diameter without associated ulcer formation.”
 - ◊ “EMR or ESD treatments of gastric ~~lesions-cancers~~ that are poorly differentiated, harbor evidence of lymphovascular invasion, *invade into the deep submucosa*, have *positive lateral or deep margins or* lymph node metastases, ~~or invade into the deep submucosa~~, should be considered to be incomplete, and additional therapy by gastrectomy with lymphadenectomy should be considered.”

GAST-B 2 of 4: Principles of Pathologic Review and HER2-neu Testing

- **Assessment of treatment response:** Paragraph revised, “... Although ~~grading-scoring~~ systems for tumor response in gastric cancer have not been uniformly adopted, in general, three-category systems provide good reproducibility among pathologists....”
- **Table 2 revised:**
 - ▶ First column heading changed to “Tumor Regression ~~Grade-Score~~”.
 - ▶ After “0 (Complete response)” wording revised, “No cancer cells, *including lymph nodes*”.



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GAST-C: Principles of Surgery

- A new section regarding “Siewert Classification” was added for clarification as follows:
 - ▶ “Siewert tumor type should be assessed in all patients with adenocarcinomas involving the esophagogastric junction (EGJ).
 - ◊ Siewert Type I: adenocarcinoma of the lower esophagus (often associated with Barrett’s esophagus) with the center located within 1 cm to 5 cm above the anatomic EGJ.
 - ◊ Siewert Type II: true carcinoma of the cardia at the EGJ, with the tumor center within 1 cm above and 2 cm below the EGJ.
 - ◊ Siewert Type III: subcardial carcinoma with the tumor center between 2 and 5 cm below EGJ, which infiltrates the EGJ and lower esophagus from below.
- The treatment of Siewert types I and II is as described in the [NCCN Guidelines for Esophageal and EGJ cancers](#).
- Siewert type III lesions are considered gastric cancers, and thus should be treated as described in the [NCCN Guidelines for Gastric Cancer](#). In some cases additional esophageal resection may be needed in order to obtain adequate margins.”

GAST-F: Principles of Systemic Therapy

1 of 13

- Second bullet revised: “Regimens should be chosen in the context of performance status, medical comorbidities, and toxicity profile, ~~and HER2-neu expression (for adenocarcinoma only).~~”
- Eighth bullet revised: “Infusional fluorouracil and capecitabine may be used interchangeably *without compromising efficacy* (except as indicated). Infusion is the preferred route compared with bolus fluorouracil.”
- New bullet added: “For metastatic adenocarcinoma, trastuzumab can be added to chemotherapy if tumor overexpresses HER2-neu.”

2 of 13:

- “Preoperative Chemoradiation (EGJ and gastric cardia)”:
 - ▶ The following bullet added: “*Infusional 5-FU can be replaced with capecitabine.*”
 - ▶ Other Regimens: “Docetaxel and fluoropyrimidine” removed as an option.
- Perioperative Chemotherapy including EGJ adenocarcinoma: “ECF modifications” changed from category 1 to category 2A.
- A new footnote was added regarding treatment with Preoperative Chemoradiation, Perioperative Chemotherapy, and Postoperative Chemoradiation: “*Cancers that arise within 5 cm of the EGJ should be staged as esophageal adenocarcinoma, but treatment should be based upon the origin of the cancer (i.e. Siewert III should be staged as esophageal, but treated as a gastric cancer.)*”

3 of 13:

- Chemotherapy for Metastatic or Locally Advanced Cancer:
 - ▶ First-Line Therapy; Preferred Regimens: Dose modified DCF (docetaxel, cisplatin, and fluorouracil) is now listed under “DCF modifications”.
 - ▶ Second-Line Therapy
 - ◊ Preferred Regimens
 - “Ramucirumab for gastric and EGJ adenocarcinoma (category 1)” was added as an option.
 - “Ramucirumab + paclitaxel for gastric and EGJ adenocarcinoma” was added as an option.
 - The single agents docetaxel, paclitaxel, and irinotecan changed from category 2B to category 2A.
 - ▶ Alternative regimens for consideration: Etoposide was removed as an option.
 - ▶ New footnote added: “*Ramucirumab produced better results when combined with paclitaxel (RAINBOW trial) than it did as a single agent (REGARD trial); therefore, ramucirumab in combination with paclitaxel is preferred. The results of the RAINBOW trial have been presented only in abstract form and await full publication.*”



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GAST-F:—continued

4 of 13: Principles of Systemic Therapy—Regimens and Dosing Schedules

- The dosing schedules were revised to reflect the changes on pages **2 of 13** and **3 of 13**.

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- **First-Line Therapy: Preferred Regimens:** New statement added regarding DCF dosing schedule: “The panel does not recommend the above specified doses or schedule of cytotoxic agents because of concerns regarding toxicity. The panel recommends one of the following DCF modifications...”

GAST-G: Principles of Radiation Therapy

- **Simulation and Treatment Planning:** First bullet revised, “Use of CT simulation or *IMRT* treatment planning is strongly encouraged.”

GAST-H: Principles of Palliative/Best Supportive Care

- Page title revised, “Principles of *Palliative*/Best Supportive Care.”
- New footnote linking to the **NCCN Guidelines for Palliative Care** added.

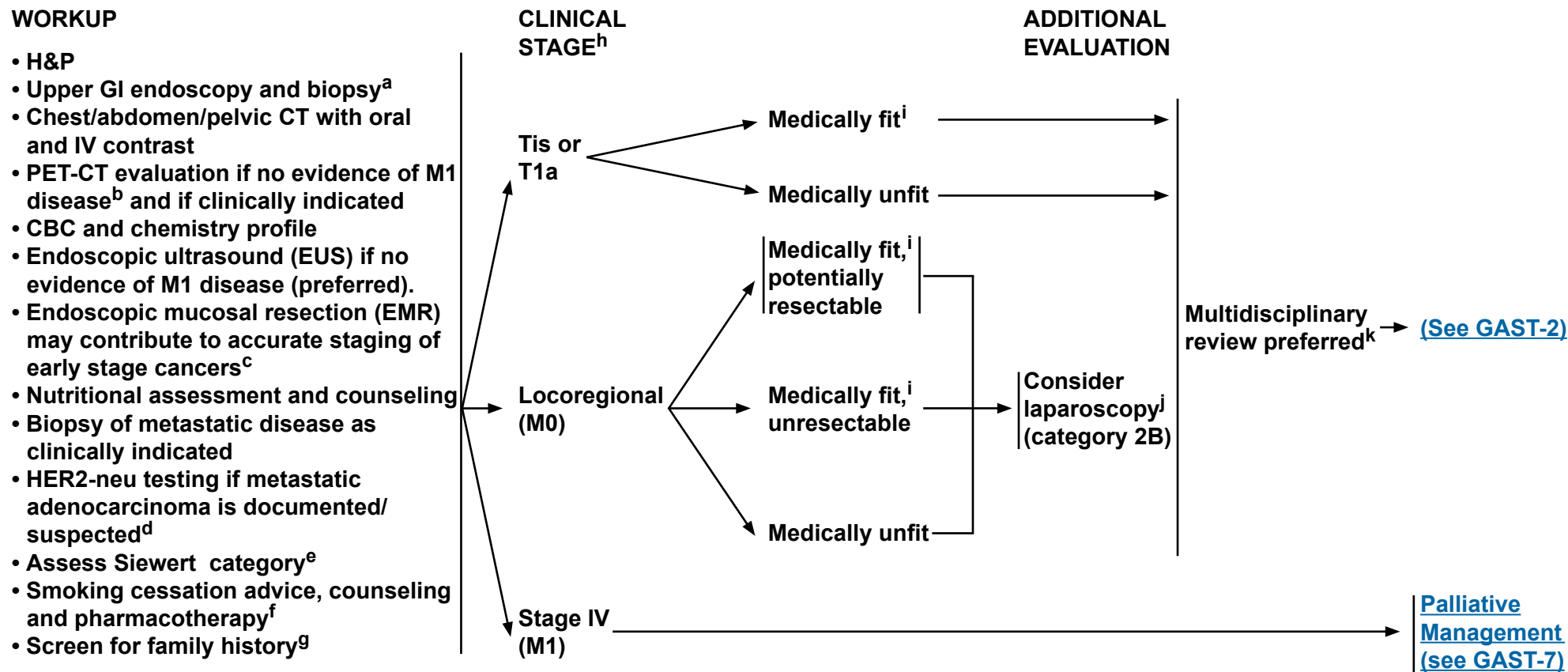


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^a[See Principles of Endoscopic Staging and Therapy \(GAST-A\).](#)

^bMay not be appropriate for T1 patients.

^cEMR may also be therapeutic for early stage disease/lesions.

^d[See Principles of Pathologic Review and HER2-neu Testing \(GAST-B\).](#)

^e[See Principles of Surgery \(GAST-C\).](#)

^fSmoking cessation guidelines are available from the Public Health Service at: http://www.ahrq.gov/professionals/clinicians-providers/guidelines-recommendations/tobacco/clinicians/update/treating_tobacco_use08.pdf

^g[See Principles of Genetic Risk Assessment for Gastric Cancers \(GAST-D\).](#) Also see [NCCN Guidelines for Colorectal Cancer Screening](#) and [Genetic/Familial High-Risk Assessment: Breast and Ovarian](#).

^h[See Staging \(ST-1\)](#) for tumor classification.

ⁱMedically able to tolerate major abdominal surgery.

^jLaparoscopy is performed to evaluate for peritoneal spread when considering chemoradiation or surgery. Laparoscopy is not indicated if a palliative resection is planned. Laparoscopy is indicated for clinical stage T1b or higher.

^k[See Principles of Multidisciplinary Team Approach \(GAST-E\).](#)

Note: All recommendations are category 2A unless otherwise indicated.

Clinical Trials: NCCN believes that the best management of any cancer patient is in a clinical trial. Participation in clinical trials is especially encouraged.

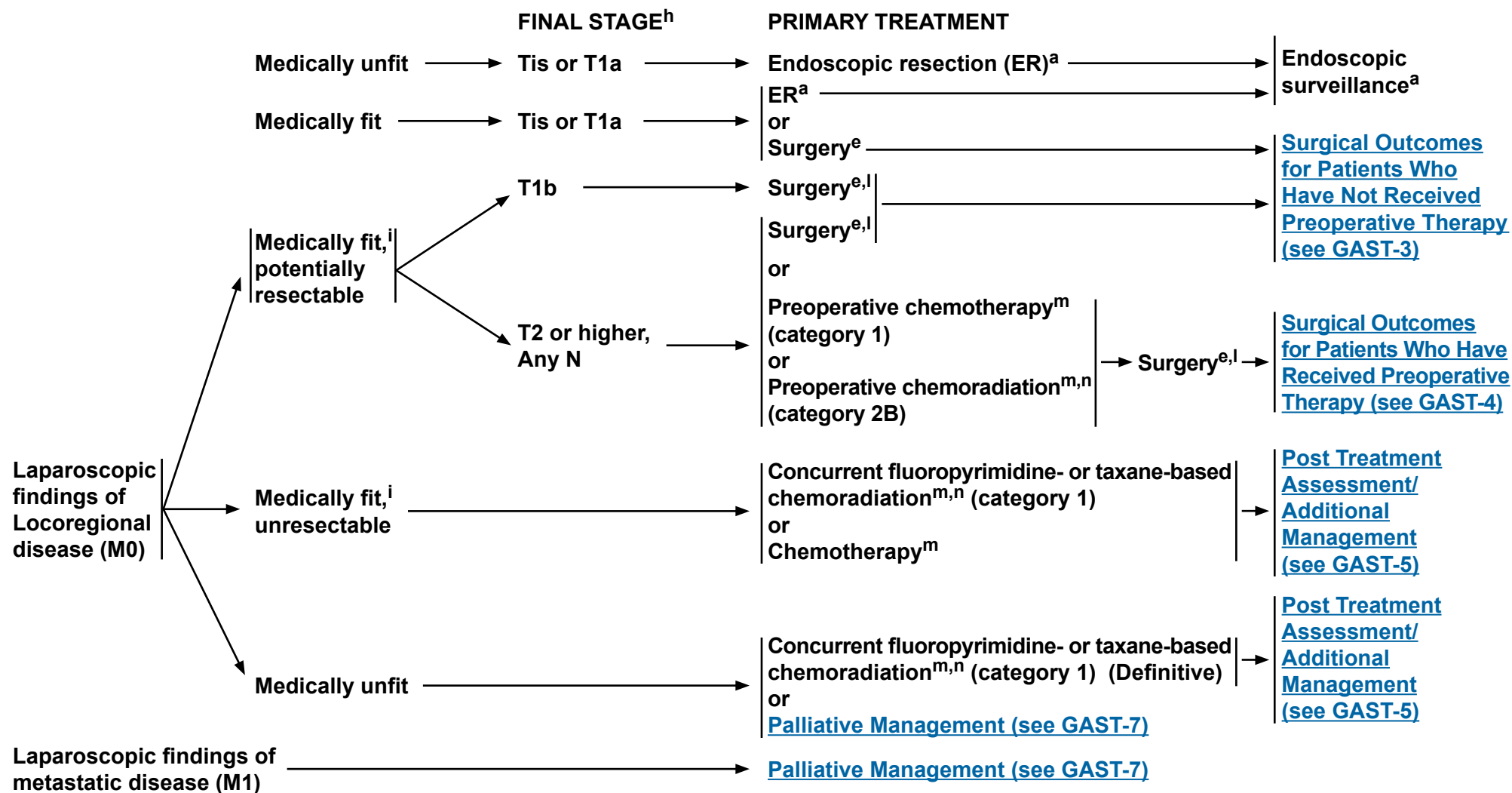


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^a[See Principles of Endoscopic Staging and Therapy \(GAST-A\).](#)

^e[See Principles of Surgery \(GAST-C\).](#)

^h[See Staging \(ST-1\)](#) for tumor classification.

ⁱMedically able to tolerate major abdominal surgery.

^lSurgery as primary therapy is appropriate for ≥T1b cancer or actively bleeding cancer, or when postoperative therapy is preferred.

^m[See Principles of Systemic Therapy \(GAST-F\).](#)

ⁿ[See Principles of Radiation Therapy \(GAST-G\).](#)

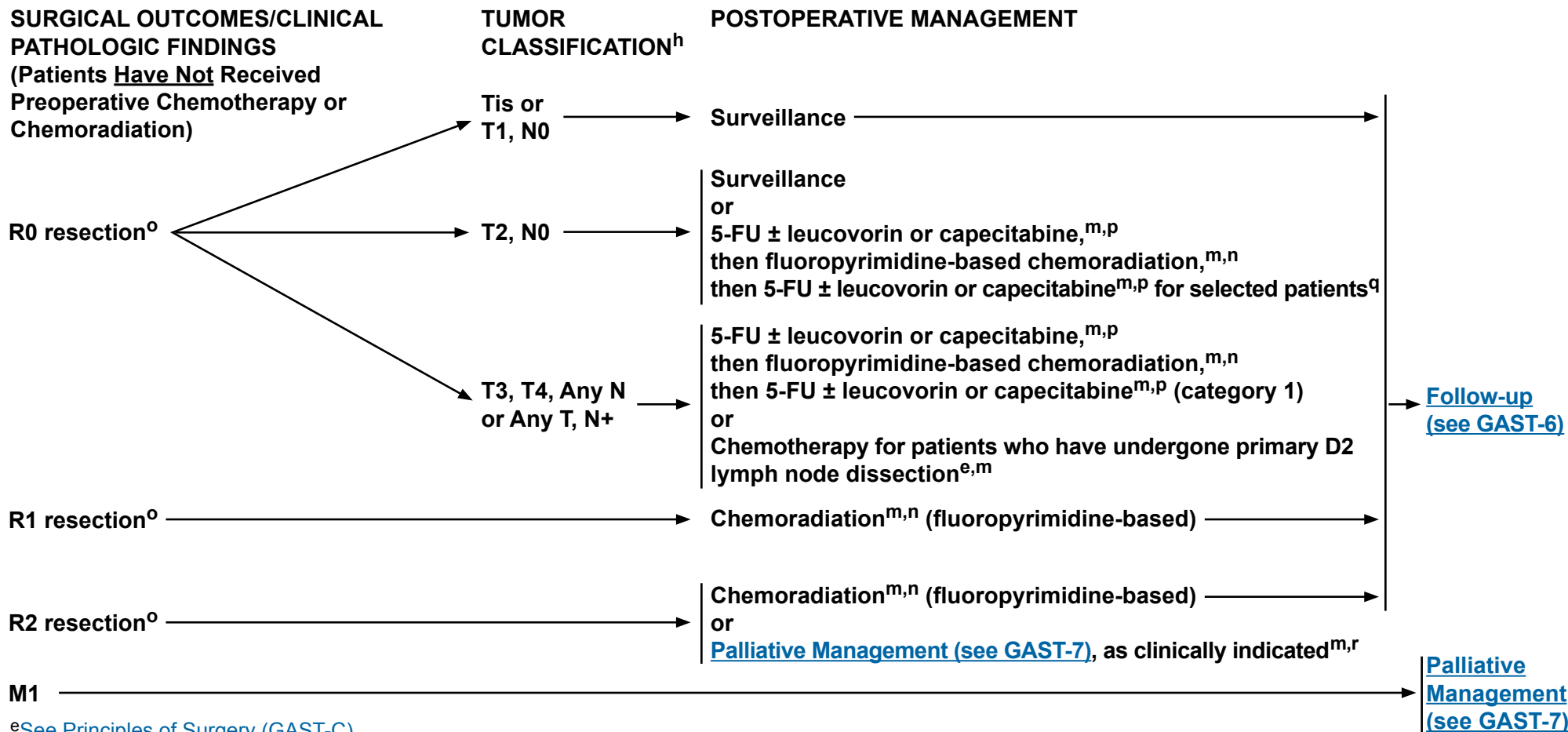
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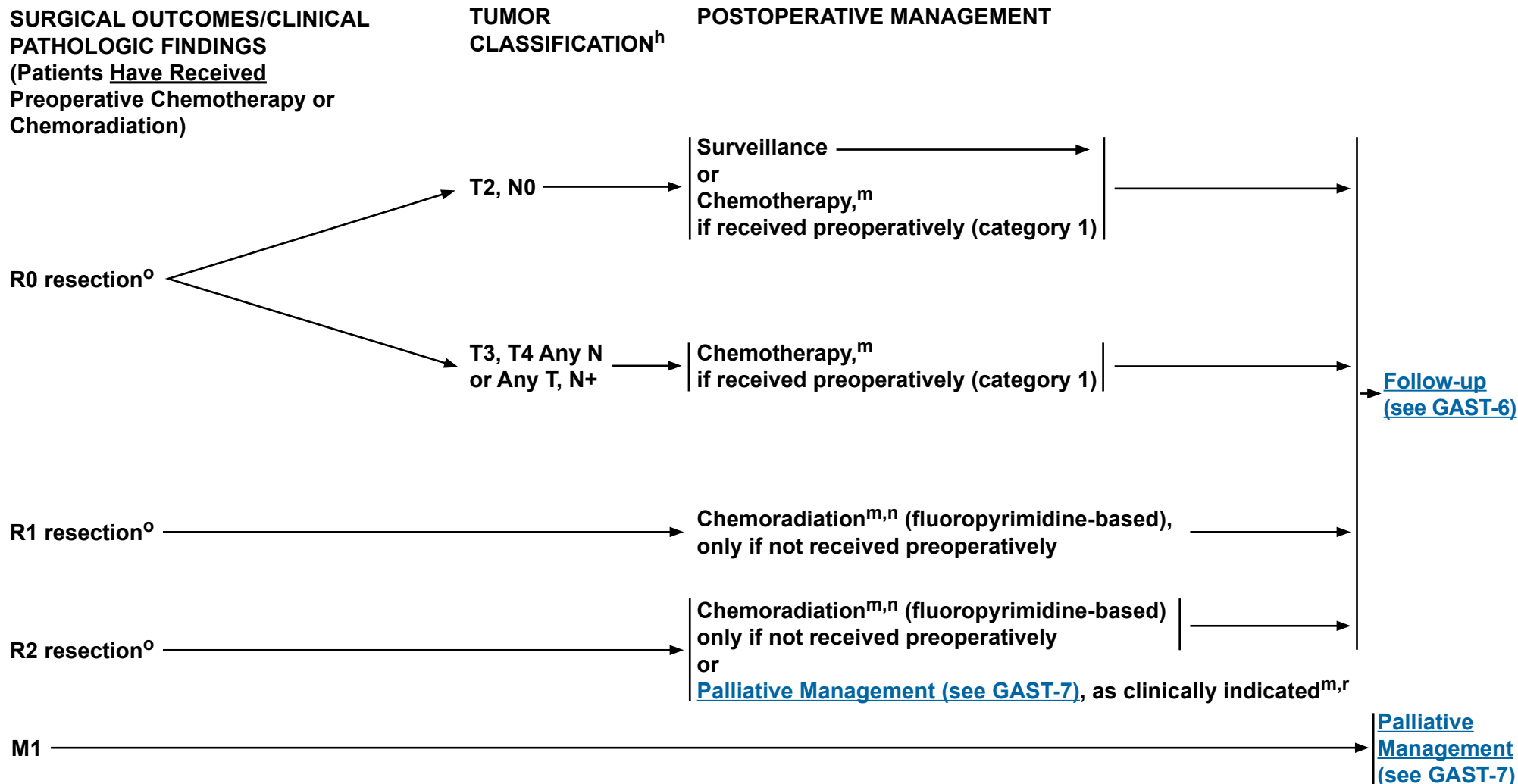
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^eSee [Principles of Surgery \(GAST-C\)](#).^hSee [Staging \(ST-1\)](#) for tumor classification.^mSee [Principles of Systemic Therapy \(GAST-F\)](#).ⁿSee [Principles of Radiation Therapy \(GAST-G\)](#).^oR0= No cancer at resection margins, R1= Microscopic residual cancer, R2= Macroscopic residual cancer or M1B.^pMacdonald JS, Smalley SR, Benedetti J, Hundahl SA, et al. Chemoradiotherapy after surgery compared with surgery alone for adenocarcinoma of the stomach or gastroesophageal junction. N Engl J Med 2001;345(10):725-730. 5-FU/Leucovorin as described in this reference is no longer recommended. See [Principles of Systemic Therapy \(GAST-F\)](#).^qHigh risk features include poorly differentiated or higher grade cancer, lymphovascular invasion, neural invasion, or <50 years of age.^rSee [Principles of Palliative/Best Supportive Care \(GAST-H\)](#).**Note:** All recommendations are category 2A unless otherwise indicated.**Clinical Trials:** NCCN believes that the best management of any cancer patient is in a clinical trial. Participation in clinical trials is especially encouraged.



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^hSee [Staging \(ST-1\)](#) for tumor classification.

^mSee [Principles of Systemic Therapy \(GAST-F\)](#).

ⁿSee [Principles of Radiation Therapy \(GAST-G\)](#).

^oR0= No cancer at resection margins, R1= Microscopic residual cancer, R2= Macroscopic residual cancer or M1B.

^rSee [Principles of Palliative/Best Supportive Care \(GAST-H\)](#).

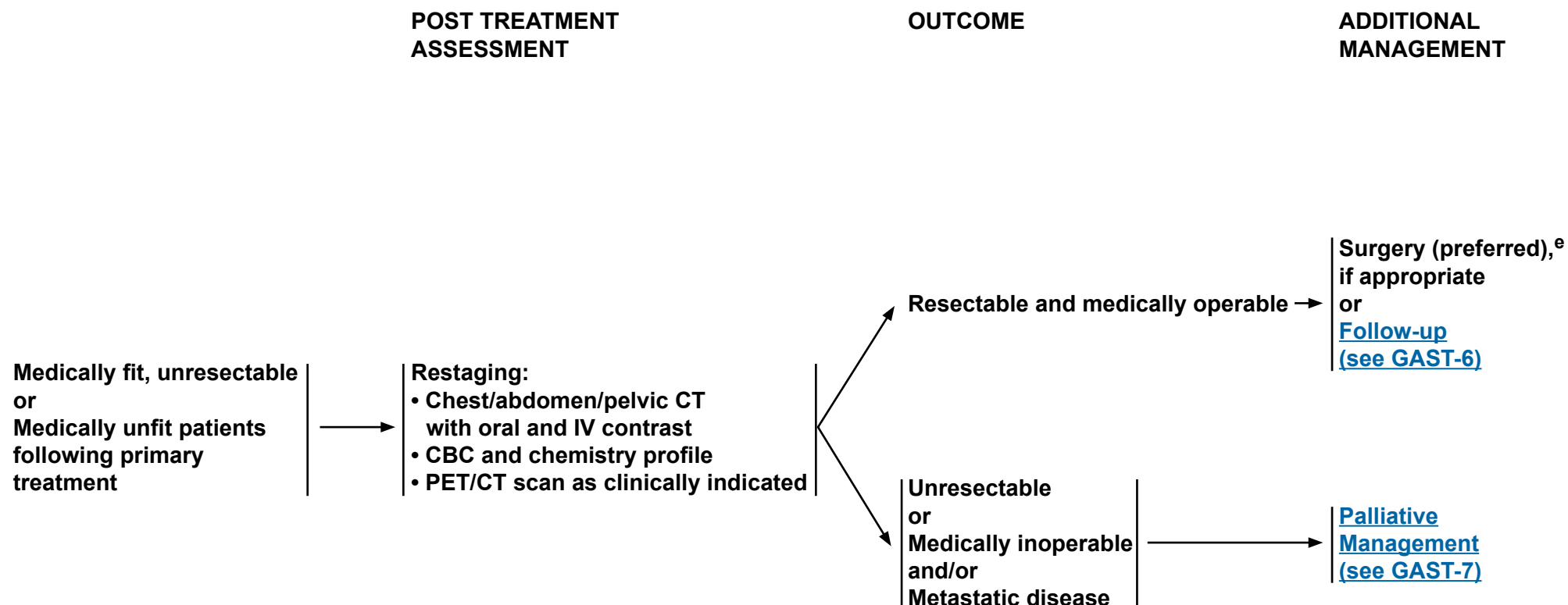
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^e[See Principles of Surgery \(GAST-C\).](#)

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FOLLOW-UP/SURVEILLANCE

RECURRENCE

- H&P every 3-6 mo for 1-2 y, every 6-12 mo for 3-5 y, then annually
- CBC and chemistry profile as indicated
- Radiologic imaging or endoscopy, as clinically indicated
- Monitor for nutritional deficiency (eg, B₁₂ and iron) in surgically resected patients and treat as indicated.

Locoregional recurrence^t

Resectable and medically operable

Consider surgery^e
or
[Palliative Management \(GAST-7\)](#)

Unresectable or medically inoperable

[See Palliative Management \(GAST-7\)](#)

Metastatic disease

[See Palliative Management \(GAST-7\)](#)

^e[See Principles of Surgery \(GAST-C\).](#)

^tReview if surgery is appropriate for patients with isolated local recurrences. Surgery should be considered as an option for locoregional recurrence in medically fit patients.

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PERFORMANCE STATUS

PALLIATIVE MANAGEMENT

Unresectable locally
advanced, Locally
recurrent or metastatic
disease

Karnofsky performance score $\geq 60\%$
or
ECOG performance score ≤ 2

Chemotherapy^m
or
Clinical trial
or
Palliative/Best supportive care^r

Karnofsky performance score $< 60\%$
or
ECOG performance score ≥ 3

Palliative/Best supportive care^r

^mSee Principles of Systemic Therapy (GAST-F).

^rSee Principles of Palliative/Best Supportive Care (GAST-H).

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PRINCIPLES OF ENDOSCOPIC STAGING AND THERAPY

Endoscopy has become an important tool in the diagnosis, staging, treatment and palliation of patients with gastric cancer. Although some endoscopy procedures can be performed without anesthesia, most are performed with conscious sedation administered by the endoscopist or assisting nurse or deeper anesthesia (monitored anesthesia care) provided by the endoscopist and nurse, a nurse anesthetist, or an anesthesiologist. Some patients who are at risk of aspiration during endoscopy may require general anesthesia.

DIAGNOSIS

- Diagnostic and surveillance endoscopies are performed with the goal of determining the presence and location of neoplastic disease and to biopsy any suspicious lesion. Thus, an adequate endoscopic exam addresses both of these components. The location of the tumor in the stomach (cardia, fundus, body, antrum, and pylorus) and relative to the esophagogastric junction (EGJ) for proximal tumors should be carefully recorded to assist with treatment planning and follow up examinations.
- Multiple (6-8) biopsies using standard size endoscopy forceps should be performed to provide adequate sized material for histologic interpretation, especially in the setting of an ulcerated lesion.^{1,2} Larger forceps may improve the yield.
- Endoscopic mucosal resection (EMR) or endoscopic submucosal dissection (ESD) can be performed in the evaluation of small lesions. EMR or ESD of focal nodules ≤ 2 cm can be safely performed to provide a larger specimen which can be better assessed by the pathologist, providing greater information on degree of differentiation, the presence of lymphovascular invasion and the depth of infiltration, thereby providing accurate T-staging.³ Such excisional biopsies have the potential of being therapeutic.⁴
- Cytologic brushings or washings are rarely adequate in the initial diagnosis, but can be useful in confirming the presence of cancer when biopsies are not diagnostic.

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[Continued](#)



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PRINCIPLES OF ENDOSCOPIC STAGING AND THERAPY

STAGING

- Endoscopic ultrasound (EUS) performed prior to any treatment is important in the initial clinical staging of gastric cancer.⁵ Careful attention to ultrasound images, provides evidence of depth of tumor invasion (T-stage), presence of abnormal or enlarged lymph nodes likely to harbor cancer (N-assessment), and occasionally signs of distant spread, such as lesions in surrounding organs (M-stage) or the presence of ascites.⁶ This is especially important in patients who are being considered for endoscopic resection (endoscopic mucosal resection [EMR] or endoscopic submucosal dissection [ESD]).⁷
- Hypoechoic (dark) expansion of the gastric wall layers identifies the location of tumor, with gradual loss of the layered pattern of the normal stomach wall corresponding with greater depths of tumor penetration, correlating with higher T-stages. A dark expansion of layers 1-3 correspond with infiltration of the superficial and deep mucosa plus the submucosal, T1 disease. A dark expansion of layers 1-4, correlates with penetration into the muscularis propria, T2 disease, and expansion beyond the muscularis propria resulting in an irregular outer border correlates with invasion of the subserosa, T3 disease. Loss of the bright line recognized as the serosa is now staged as T4a, and extension of the mass into surrounding organs such as the liver, pancreas, spleen is staged T4b disease.
- Perigastric lymph nodes are readily seen by EUS, and the identification of enlarged, hypoechoic (dark), homogeneous, well circumscribed, rounded structures around the stomach correlates with the presence of malignant or inflammatory lymph nodes. The accuracy of this diagnosis is significantly increased with the combination of features, but also may be confirmed with the use of fine needle aspiration (FNA) biopsy for cytology assessment.⁸ FNA of suspicious lymph nodes should be performed if it can be achieved without traversing an area of primary tumor or major blood vessels, and if it will impact on treatment decisions. Furthermore, an attempt should be made to identify the presence of ascites and FNA considered to rule out peritoneal spread of disease.

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Gastric Cancer

PRINCIPLES OF ENDOSCOPIC STAGING AND THERAPY

TREATMENT

- EMR or ESD of early gastric cancer can be considered adequate therapy when the lesion is ≤ 2 cm in diameter, is shown on histopathology to be well or moderately well differentiated, does not penetrate beyond the superficial submucosa, does not exhibit lymphovascular invasion, and has clear lateral and deep margins. En-bloc excision of small gastric lesions by ESD has been shown to be more effective than EMR in curing *small* early gastric cancer, but requires greater skills and instrumentation to perform and has a significant risk of complications including perforation.⁹
- Japanese Gastric Cancer guidelines recommend that EMR or ESD should be considered for early gastric cancer lesions ≤ 2 cm in diameter without associated ulcer formation.³
- EMR or ESD treatments of gastric cancers that are poorly differentiated, harbor evidence of lymphovascular invasion, invade into the deep submucosa, have positive lateral or deep margins or lymph node metastases, should be considered to be incomplete, and additional therapy by gastrectomy with lymphadenectomy should be considered.¹⁰
- EUS exams performed after chemotherapy or radiation therapy have a reduced ability to accurately determine the post-treatment stage of disease.¹¹ Similarly, biopsies performed after chemotherapy or radiation therapy may not accurately diagnose the presence of residual disease but still provide useful information.¹²
- Endoscopic tumor ablation can be performed for the short-term control of bleeding. Endoscopic insertion of expandable metal stents is effective in long-term relief of tumor obstruction at the EGJ or the gastric outlet, though surgical gastrojejunostomy may be more efficacious for those with longer-term survival (see [Principles of Palliative/Best Supportive Care \[GAST-H\]](#)).^{13,14}
- Long-term palliation of anorexia, dysphagia or malnutrition may be achieved with endoscopic or radiographic assisted placement of feeding gastrostomy (PEG) in carefully selected cases where the distal stomach is uninvolved by tumor, or the placement of a feeding jejunostomy (PEJ).¹⁵

POST-TREATMENT SURVEILLANCE

- Endoscopic surveillance following definitive treatment of gastric cancer requires careful attention to detail for mucosal surface changes, and multiple (4-6) biopsies of any visualized abnormalities. Strictures should be biopsied to rule-out neoplastic cause. EUS performed in conjunction with endoscopy exams has a high sensitivity for recurrent disease.¹⁶ EUS-guided FNA should be performed if suspicious lymph nodes or areas of wall thickening are seen.

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Gastric Cancer

PRINCIPLES OF ENDOSCOPIC STAGING AND THERAPY **(References)**

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Gastric Cancer

PRINCIPLES OF PATHOLOGIC REVIEW AND HER2-NEU TESTING

Pathologic Review

TABLE 1

Specimen Type	Analysis/Interpretation/Reporting ^a
Endoscopic mucosal resection	Include in pathology report: <ul style="list-style-type: none"> • Invasion, if present • Histologic type^b • Grade • Depth of tumor invasion • Vascular invasion • Status of mucosal and deep margins
Gastrectomy, without prior chemoradiation	For pathology report, include all elements as for endoscopic mucosal resection plus <ul style="list-style-type: none"> • Location of tumor midpoint in relationship to EGJc • Whether tumor crosses EGJ • LN status and number of lymph nodes recovered
Gastrectomy, with prior chemoradiation	Tumor site should be thoroughly sampled for specimens s/p neoadjuvant therapy without grossly obvious residual tumor For pathology report, include all elements as for resection without prior chemoradiation plus assessment of treatment effect

^aUse of a standardized minimum data set such as the College of American Pathologists Cancer Protocols (available at <http://www.cap.org>) for reporting pathologic findings is recommended.

^bSubclassification of gastric adenocarcinomas as intestinal or diffuse type may have implications for therapy, as intestinal type cancers may be more likely to overexpress HER2-neu.¹

^cTumors arising in the proximal stomach and crossing the EGJ are classified for purposes of staging as esophageal carcinomas.²

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Gastric Cancer

PRINCIPLES OF PATHOLOGIC REVIEW AND HER2-NEU TESTING

Assessment of treatment response

Response of the primary tumor to previous chemotherapy or radiation therapy should be reported. Although scoring systems for tumor response in gastric cancer have not been uniformly adopted, in general, three-category systems provide good reproducibility among pathologists. The following system developed for rectal carcinoma is reported to provide good interobserver agreement, but other systems may also be used. Sizable pools of acellular mucin may be present after chemoradiation but should not be interpreted as representing residual tumor.

TABLE 2

Tumor Regression Score	Description
0 (Complete response)	No cancer cells, including lymph nodes
1 (Moderate response)	Single cells or small groups of cancer cells
2 (Minimal response)	Residual cancer outgrown by fibrosis
3 (Poor response)	Minimum or no treatment effect; extensive residual cancer cells

Number of lymph nodes retrieved

- While there is no universally accepted minimum number of lymph nodes necessary for accurate staging of gastric cancer, retrieval of at least 15 lymph nodes is recommended to avoid stage migration.^{4,5}

Reproduced and adapted with permission from Tang LH, Berlin J, Branton P, et al. Protocol for the examination of specimens from patients with carcinoma of the stomach. In: Washington K, ed. Reporting on Cancer Specimens: Case Summaries and Background Documentation. Northfield, IL: College of American Pathologists; 2012. (available at <http://www.cap.org>).

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Gastric Cancer

PRINCIPLES OF PATHOLOGIC REVIEW AND HER2-NEU TESTING

Assessment of Overexpression of HER2-neu in Gastric Cancer

For patients with inoperable locally advanced, recurrent, or metastatic adenocarcinoma of the stomach or esophagogastric junction for whom trastuzumab therapy is being considered, assessment for tumor HER2-neu overexpression using immunohistochemistry (IHC) and fluorescence in situ hybridization (FISH) or other in situ hybridization method is recommended. The following criteria used in the ToGA trial⁶ are recommended:

TABLE 3: Immunohistochemical Criteria for Scoring HER2-neu Expression in Gastric and Esophagogastric Carcinoma^{#,*}

	Surgical Specimen Expression Pattern, Immunohistochemistry	Biopsy Specimen Expression Pattern, Immunohistochemistry	HER2-neu Overexpression Assessment
0	No reactivity or membranous reactivity in <10% of cancer cells	No reactivity or no membranous reactivity in any cancer cell	Negative
1+	Faint or barely perceptible membranous reactivity in ≥10% of cancer cells; cells are reactive only in part of their membrane	Cancer cell cluster with a faint or barely perceptible membranous reactivity irrespective of percentage of cancer cells positive	Negative
2+	Weak to moderate complete, basolateral or lateral membranous reactivity in ≥10% of cancer cells	Cancer cell cluster with a weak to moderate complete, basolateral, or lateral membranous reactivity irrespective of percentage of cancer cells positive	Equivocal
3+	Strong complete, basolateral or lateral membranous reactivity in ≥10% of cancer cells	Cluster of five or more cancer cells with a strong complete, basolateral, or lateral membranous reactivity irrespective of percentage of cancer cells positive	Positive

[#]The NCCN Guidelines panel recommends that cases showing 2+ expression of HER2-neu by immunohistochemistry should be additionally examined by FISH or other in situ hybridization methods. Cases with 3+ overexpression by IHC or FISH positive (HER2:CEP17 ratio ≥2) are considered positive.

^{*}Reprinted and adapted from The Lancet, 376(9742), Bang Y-J, Van Cutsem E, Feyereislova A, et al. Trastuzumab in combination with chemotherapy versus chemotherapy alone for treatment of HER2-neu-positive advanced gastric or gastro-oesophageal junction cancer (ToGA): a phase 3, open-label, randomised controlled trial. pages 687-697, 2010, with permission from Elsevier.

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[Continued](#)



PRINCIPLES OF PATHOLOGIC REVIEW AND HER2-NEU TESTING **(References)**

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Gastric Cancer

PRINCIPLES OF SURGERY

N Staging

- Determine extent of disease by CT scan (chest, abdomen, and pelvic) ± EUS (if no metastatic disease seen on CT)
- In patients being considered for surgical resection without pre-operative therapy, laparoscopy¹ may be useful in detecting radiographically occult metastatic disease in patients with T3 and/or N+ disease seen on preoperative imaging. If laparoscopy is performed as a separate procedure, peritoneal washings should be performed as well.
- In patients receiving pre-operative therapy, a baseline laparoscopy along with peritoneal washings should be considered.
- Positive peritoneal cytology (performed in the absence of visible peritoneal implants), is associated with poor prognosis and is defined as M1 disease.²

Siewert Classification

- Siewert tumor type should be assessed in all patients with adenocarcinomas involving the esophagogastric junction (EGJ).^{3,4}
 - Siewert Type I: adenocarcinoma of the lower esophagus (often associated with Barrett's esophagus) with the center located within 1 cm to 5 cm above the anatomic EGJ.
 - Siewert Type II: true carcinoma of the cardia at the EGJ, with the tumor center within 1 cm above and 2 cm below the EGJ.
 - Siewert Type III: subcardial carcinoma with the tumor center between 2 and 5 cm below EGJ, which infiltrates the EGJ and lower esophagus from below.
- The treatment of Siewert types I and II is as described in the [NCCN Guidelines for Esophageal and EGJ cancers](#).
- Siewert type III lesions are considered gastric cancers, and thus should be treated as described in the [NCCN Guidelines for Gastric Cancer](#). In some cases additional esophageal resection may be needed in order to obtain adequate margins.^{3,5,6}

Criteria of unresectability for cure

- Locoregionally advanced
 - Level N3 (hepatoduodenal and root of mesentery) or N4 (para-aortic) lymph node highly suspicious on imaging or confirmed by biopsy
 - Invasion or encasement of major vascular structures (excluding the splenic vessels)
- Distant metastasis or peritoneal seeding (including positive peritoneal cytology)

Resectable tumors

- Tis or T1⁷ tumors limited to mucosa (T1a) may be candidates for endoscopic mucosal resection (in experienced centers)⁸
- T1b-T3⁵: Adequate gastric resection to achieve negative microscopic margins (typically ≥4 cm from gross tumor).
 - Distal gastrectomy
 - Subtotal gastrectomy
 - Total gastrectomy
- T4 tumors require en bloc resection of involved structures
- Gastric resection should include the regional lymphatics—perigastric lymph nodes (D1) and those along the named vessels of the celiac axis (D2), with a goal of examining at least 15 or greater lymph nodes¹⁰⁻¹²
 - Definition of D1 and D2 lymph node dissections
 - ◊ D1 dissection entails gastrectomy and the resection of both the greater and lesser omenta (which would include the lymph nodes along right and left cardiac, along lesser and greater curvature, suprapyloric along the right gastric artery, and infrapyloric area);
 - ◊ D2 dissection is a D1 plus all the nodes along the left gastric artery, common hepatic artery, celiac artery, splenic hilum and splenic artery.
- Routine or prophylactic splenectomy is not required.¹³ Splenectomy is acceptable when the spleen or the hilum is involved.
- Consider placing feeding jejunostomy tube in select patients (especially if postoperative chemoradiation appears a likely recommendation)

Palliative procedures

- Gastric resections should be reserved for the palliation of symptoms (eg, obstruction or uncontrollable bleeding) in patients with incurable disease.
- Lymph node dissection not required
- In patients fit for surgery and who have a reasonable prognosis, gastrojejunostomy (open or laparoscopic) is preferable to endoluminal stenting in patients with gastric outlet obstruction.¹⁴
- Venting gastrostomy and/or jejunostomy tube may be considered

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[Continued](#)

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Gastric Cancer

PRINCIPLES OF SURGERY **(References)**

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Gastric Cancer

PRINCIPLES OF GENETIC RISK ASSESSMENT FOR GASTRIC CANCERS

Criteria for Further Genetic Risk Evaluation:

- Referral to cancer genetics professional is recommended for an affected individual with one or more of the following:
 - ▶ A known mutation in a gastric cancer susceptibility gene within the family
 - ▶ Early-age-onset gastric cancer (age ≤50y)
 - ▶ Personal or family history of diffuse gastric cancer and lobular breast cancer, one diagnosed before age 50 years
 - ▶ Two gastric cancer cases in family, one individual under age 50 years with confirmed diffuse gastric cancer
 - ▶ Three confirmed diffuse gastric cancer cases in first- or second-degree relatives independent of age
 - ▶ Simplex case (i.e., a single occurrence in a family) of diffuse gastric cancer occurring before age 40 years

Hereditary Cancer Predisposition Syndromes Associated with an Increased Risk of Gastric Cancers

While most gastric cancers are considered sporadic, it is estimated that 5% to 10% have familial component and 3 to 5% are associated with inherited cancer predisposition syndromes.

- Familial Gastric Cancer/Hereditary Diffuse Gastric Cancer
 - ▶ This is an autosomal dominant syndrome characterized by the development of diffuse (signet ring cell) gastric cancers at a young age.^{1,2} Truncating mutations in CDH1, the gene encoding the cell adhesion molecular E-cadherin, are found in 30% to 50% of cases.³ Women with CDH1 mutations are at higher risk of developing lobular carcinoma of the breast. The lifetime risk of gastric cancer is estimated at 67% by age 80 for men, and 83% for women.⁴ Average age at diagnosis of gastric cancer is 37. Because of the difficulty in identifying precursor lesions in diffuse gastric cancer at endoscopy, endoscopic surveillance is ineffective and is not recommended for CDH1 gene mutation carriers. Such patients should be referred to a center with a multidisciplinary team focusing on this condition. The team should include a surgeon specializing in upper gastrointestinal cancer surgery, a gastroenterologist, a clinical genetics expert, a nutritionist, and a counselor or psychiatrist.
- Lynch Syndrome
 - ▶ Patients with Lynch syndrome have a 1% to 13% risk of developing gastric cancer and the risk is higher in Asian compared to Western kindreds. Gastric cancer is the second most common extracolonic cancer in these patients, after endometrial cancer, with the standardized incidence ratios of 5.65 to 9.78. [See NCCN Colorectal Cancer Screening Guidelines.](#)
- Juvenile polyposis Syndrome
 - ▶ Juvenile polyposis Syndrome (JPS) carries a lifetime risk of 21% for developing gastric cancer, when involvement of the upper gastrointestinal tract is present. [See NCCN Guidelines for Colorectal Cancer Screening.](#)
- Peutz-Jeghers Syndrome
 - ▶ Peutz-Jaegers Syndrome (PJS) carries a 29% lifetime risk for developing gastric cancer. [See NCCN Colorectal Cancer Screening Guidelines.](#)

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Gastric Cancer

PRINCIPLES OF GENETIC RISK ASSESSMENT FOR GASTRIC CANCER

Screening and Surveillance Recommendations

Insufficient evidence exists for surveillance and screening for the cancer syndromes associated with gastric cancer, but the following guidelines have been proposed for patients with some of the hereditary cancer predisposition syndromes as indicated below.

<u>Syndrome</u>	<u>Gene(s)</u>	<u>Inheritance Pattern</u>	<u>Screening and Surveillance Recommendations</u>
Hereditary diffuse gastric cancer ¹⁻⁴	<i>CDH1</i>	Autosomal dominant	<p>A baseline endoscopy with multiple random biopsies is indicated. Screening endoscopy should be initiated 5 to 10 years before the earliest cancer diagnosis in the family. Surveillance endoscopy should not be offered because of lack of effectiveness due to sampling bias and the difficulty in identifying subtle early lesions of diffuse gastric cancer.</p> <p>Prophylactic gastrectomy is recommended between ages 20 and 40 for <i>CDH1</i> mutation carriers, and is not recommended for patients younger than 20 years of age unless the youngest family member having gastric cancer was diagnosed before age 20. A D2 lymph node dissection is not necessary for prophylactic total gastrectomy; intraoperative frozen sections should be performed to verify that the proximal margin contains esophageal squamous mucosa and the distal margin duodenal mucosa, to ensure complete removal of gastric tissue.</p> <p>Annual breast MRI is recommended for female patients. Patients carrying <i>CDH1</i> mutations should be counseled to inform family members who may be at risk.</p>
Lynch syndrome*	Mismatch repair (<i>MMR</i>) genes, most commonly <i>MLH1</i> , <i>MSH2</i> , <i>MSH6</i> , <i>PMS2</i>	Autosomal dominant	<p>Surveillance upper endoscopy may be considered at age 35 and repeated at 3 to 5 year intervals. Selected individuals or families or those of Asian descent may consider EGD with extended duodenoscopy (to distal duodenum or into the jejunum) every 3-5 years beginning at age 30-35 years.</p>
Juvenile polyposis syndrome*	<i>SMAD4</i> , <i>BMPR1A</i>	Autosomal dominant	<p>Surveillance upper endoscopy may be considered, beginning in the mid-teens and repeated annually if polyps are found and if no polyps are found every 2-3 year intervals.</p>
Peutz-Jeghers syndrome*	<i>STK11</i>	Autosomal dominant	<p>Surveillance upper endoscopy may be considered, beginning in late teens. Repeat upper endoscopy every 2 to 3 years should be considered based on gastric polyp burden.</p>

*See [NCCN Colorectal Cancer Screening Guidelines](#).

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Gastric Cancer

PRINCIPLES OF GENETIC RISK ASSESSMENT FOR GASTRIC CANCER

Other hereditary cancer predisposition syndromes listed below are also associated with a risk of developing gastric cancer. However, insufficient evidence exists for surveillance and screening.

<u>Syndrome</u>	<u>Gene(s)</u>	<u>Inheritance Pattern</u>
Ataxia- telangiectasia Adult male patients, particularly those with IgA deficiency, have 70% increased risk of gastric cancer.	<i>ATM</i>	Autosomal recessive
Familial adenomatous polyposis (FAP)	<i>APC</i>	Autosomal dominant
Bloom syndrome	<i>BLM/RECQL3</i>	Autosomal recessive
Hereditary breast and ovarian cancer syndrome The reported relative risk of developing gastric cancer is 2.26. Mutations in <i>CHEK2</i> gene may also convey increased risk.	<i>BRCA1, BRCA2</i>	Autosomal dominant
Li-Fraumeni syndrome	<i>TP53</i>	Autosomal dominant
Xeroderma pigmentosum	7 different genes	Autosomal recessive

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PRINCIPLES OF GENETIC RISK ASSESSMENT FOR GASTRIC CANCER **(References)**

¹Fitzgerald RC, Hardwick R, Huntsman D, et al. Hereditary diffuse gastric cancer: updated consensus guidelines for clinical management and directions for future research. J Med Genet 2010;47:436-444. Erratum appears in J Med Genet. 2011;48(3):216; Note: Van Krieken, Nicola [corrected to Van Grieken, Nicola C].

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Gastric Cancer

PRINCIPLES OF MULTIDISCIPLINARY TEAM APPROACH FOR ESOPHAGOGASTRIC CANCERS

Category 1 evidence supports the notion that the combined modality therapy is effective for patients with localized esophagogastric cancer.^{1,2,3} The NCCN panel believes in an infrastructure that encourages multidisciplinary treatment decision-making by members of all disciplines taking care of this group of patients.

The combined modality therapy for patients with localized esophagogastric cancer may be optimally delivered when the following elements are in place:

- **The involved institution and individuals from relevant disciplines are committed to jointly reviewing the detailed data on patients on a regular basis. Frequent meetings (either once a week or once every two weeks) are encouraged.**
- **Optimally at each meeting, all relevant disciplines should be encouraged to participate and these may include: surgical oncology, medical oncology, gastroenterology, radiation oncology, radiology, and pathology. In addition, the presence of nutritional services, social workers, nursing, palliative care specialists, and other supporting disciplines are also desirable.**
- **All long-term therapeutic strategies are best developed after adequate staging procedures are completed, but ideally prior to any therapy that is rendered.**
- **Joint review of the actual medical data is more effective than reading reports for making sound therapy decisions.**
- **A brief documentation of the consensus recommendation(s) by the multidisciplinary team for an individual patient may prove useful.**
- **The recommendations made by the multidisciplinary team may be considered advisory to the primary group of treating physicians of the particular patient.**
- **Re-presentation of select patient outcomes after therapy is rendered may be an effective educational method for the entire multidisciplinary team.**
- **A periodic formal review of relevant literature during the course of the multidisciplinary meeting is highly encouraged.**

¹Cunningham D, Allum WH, Stenning SP, Thompson JN, et al. Perioperative chemotherapy versus surgery alone for resectable gastroesophageal cancer. *N Engl J Med* 2006;355(1):11-20.

²Cooper JS, Guo MD, Herskovic A, Macdonald JS, Martenson JA, Jr., Al-Sarraf M, et al. Chemoradiotherapy of locally advanced esophageal cancer: long-term follow-up of a prospective randomized trial (RTOG 85-01). Radiation Therapy Oncology Group. *JAMA* 1999;281(17):1623-1627.

³Macdonald JS, Smalley SR, Benedetti J, Hundahl SA, et al. Chemoradiotherapy after surgery compared with surgery alone for adenocarcinoma of the stomach or gastroesophageal junction. *N Engl J Med* 2001;345(10):725-730.

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PRINCIPLES OF SYSTEMIC THERAPY

- **Chemotherapy regimens recommended for advanced esophageal and esophagogastric junction (EGJ) adenocarcinoma, squamous cell carcinoma of the esophagus, and gastric adenocarcinoma may be used interchangeably (except as indicated).**
- **Regimens should be chosen in the context of performance status, medical comorbidities, and toxicity profile.**
- **For metastatic adenocarcinoma trastuzumab can be added to chemotherapy if tumor overexpresses HER2-neu.**
- **Two-drug cytotoxic regimens are preferred for patients with advanced disease because of lower toxicity. Three-drug cytotoxic regimens should be reserved for medically fit patients with good PS and access to frequent toxicity evaluation.**
- **Modifications of category 1 regimens or use of category 2A or 2B regimens may be preferred (as indicated), with evidence supporting more favorable toxicity profile without a compromise of efficacy.**
- **Doses and schedules for any regimen that is not derived from category 1 evidence is a suggestion, and subject to appropriate modifications depending on the circumstances.**
- **Alternate combinations and schedules of cytotoxics based on the availability of the agents, practice preferences, and contraindications are permitted.**
- **Infusional fluorouracil and capecitabine may be used interchangeably without compromising efficacy (except as indicated). Infusion is the preferred route compared with bolus fluorouracil.¹**
- **Cisplatin and oxaliplatin may be used interchangeably depending on toxicity profile.**
- **Preoperative chemoradiation is the preferred approach for localized EGJ adenocarcinoma.² Perioperative chemotherapy^{3,4} is an alternative but less preferred option.**
- **Perioperative chemotherapy,^{3,4} or postoperative chemotherapy plus chemoradiation⁵ is the preferred approach for localized gastric cancer.**
- **Postoperative chemotherapy is recommended following primary D2 lymph node dissection.^{6,7} ([See Principles of Surgery \[GAST-C\]](#)).**
- **Induction chemotherapy may be appropriate as clinically indicated.**
- **Upon completion of chemotherapy, patients should be assessed for response and monitored for any long-term complications.**
- **Please refer to the Principles of Radiation Therapy for the radiation therapy administration details ([GAST-G](#)).**

¹Wagner AD, Grothe W, Haerting J, et al. Chemotherapy in advanced gastric cancer: a systematic review and meta-analysis based on aggregate data. J Clin Oncol 2006;24:2903-2909.

²van Hagen P, Hulshof MC, van Lanschot JJ, et al. Preoperative chemoradiotherapy for esophageal or junctional cancer. N Engl J Med 2012;366:2074-2084.

³Cunningham D, Allum WH, Stenning SP, et al. Perioperative chemotherapy versus surgery alone for resectable gastroesophageal cancer. N Engl J Med 2006;355:11-20.

⁴Ychou M, Boige V, Pignon J-P, et al. Perioperative chemotherapy compared with surgery alone for resectable gastroesophageal adenocarcinoma: an FNCLCC and FFCD multicenter phase III trial. J Clin Oncol 2011;29:1715-1721.

⁵Macdonald JS, Smalley SR, Benedetti J, et al. Chemoradiotherapy after surgery compared with surgery alone for adenocarcinoma of the stomach or gastroesophageal junction. N Engl J Med 2001;345:725-730. 5-FU/Leucovorin as described in this reference is no longer recommended. [See GAST-F 6 of 13.](#)

⁶Bang Y-J, Kim Y-W, Yang H-K, et al. Adjuvant capecitabine and oxaliplatin for gastric cancer after D2 gastrectomy (CLASSIC): a phase 3 open-label, randomised controlled trial. The Lancet 2012;379:315-321.

⁷Lee J, Lim do H, Kim S, et al. Phase III trial comparing capecitabine plus cisplatin versus capecitabine plus cisplatin with concurrent capecitabine radiotherapy in completely resected gastric cancer with D2 lymph node dissection: the ARTIST trial. J Clin Oncol 2012;30:268-273.

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PRINCIPLES OF SYSTEMIC THERAPY

Preoperative Chemoradiation (EGJ and gastric cardia):†

- Infusional 5-FU can be replaced with capecitabine
- Preferred Regimens:
 - Paclitaxel and carboplatin (category 1)¹
 - Cisplatin and fluorouracil (category 1)^{2,3}
 - Oxaliplatin and fluorouracil (category 1)^{4,5}
- Other Regimens:
 - Irinotecan and cisplatin (category 2B)⁶
 - Paclitaxel and fluoropyrimidine (Fluorouracil or capecitabine)⁷ (category 2B)

Perioperative Chemotherapy (including EGJ adenocarcinoma)†

(3 cycles preoperative and 3 cycles postoperative):

- ECF (epirubicin, cisplatin and fluorouracil) (category 1)⁸
- ECF modifications⁹
 - Epirubicin, oxaliplatin and fluorouracil
 - Epirubicin, cisplatin and capecitabine
 - Epirubicin, oxaliplatin and capecitabine
- Fluorouracil and cisplatin (category 1)¹⁰

Postoperative Chemoradiation (including EGJ):†

- Fluoropyrimidine (infusional fluorouracil or capecitabine) before and after fluoropyrimidine-based chemoradiation¹¹

Postoperative Chemotherapy

(for patients who have undergone primary D2 lymph node dissection)

([See Principles of Surgery \[GAST-C\]](#))

- Capecitabine and oxaliplatin¹²
- Capecitabine and cisplatin¹³

†Cancers that arise within 5 cm of the EGJ should be staged as esophageal adenocarcinoma, but treatment should be based upon the origin of the cancer (i.e. Siewert III should be staged as esophageal, but treated as a gastric cancer).

††Leucovorin is indicated with certain fluorouracil-based regimens. For important information regarding the leucovorin shortage, please see [Discussion \(MS-28\)](#).

The selection, dosing, and administration of anticancer agents and the management of associated toxicities are complex. Modifications of drug dose and schedule and initiation of supportive care interventions are often necessary because of expected toxicities and because of individual patient variability, prior treatment, nutritional status, and comorbidity. The optimal delivery of anticancer agents therefore requires a health care delivery team experienced in the use of anticancer agents and the management of associated toxicities in patients with cancer.

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Gastric Cancer

PRINCIPLES OF SYSTEMIC THERAPY

Chemotherapy for Metastatic or Locally Advanced Cancer [where local therapy is not indicated]

- Trastuzumab can be added to chemotherapy for HER2-neu overexpressing adenocarcinoma [[See Principles of Pathologic Review and HER2-neu Testing \(GAST-B\)](#)]
 - Combination with cisplatin and fluoropyrimidine (category 1 for first-line therapy)¹⁴
 - Combination with other chemotherapy agents (category 2B)
 - Trastuzumab is not recommended for use with anthracyclines

First-Line Therapy

Two-drug cytotoxic regimens are preferred because of lower toxicity. Three-drug cytotoxic regimens should be reserved for medically fit patients with good PS and access to frequent toxicity evaluation.

- Preferred Regimens:
 - DCF (docetaxel, cisplatin and fluorouracil[†]) (category 1)¹⁵
 - DCF modifications
 - ◊ Docetaxel, cisplatin, and fluorouracil¹⁶
 - ◊ Docetaxel, oxaliplatin and fluorouracil^{†,17}
 - ◊ Docetaxel, carboplatin and fluorouracil (category 2B)¹⁸
 - ECF (epirubicin, cisplatin and fluorouracil) (category 1)¹⁹
 - ECF modifications (category 1)²⁰
 - ◊ Epirubicin, oxaliplatin and fluorouracil
 - ◊ Epirubicin, cisplatin and capecitabine
 - ◊ Epirubicin, oxaliplatin and capecitabine
 - Fluoropyrimidine (fluorouracil[†] or capecitabine) and cisplatin²¹⁻²⁴ (category 1)
 - Fluoropyrimidine (fluorouracil[†] or capecitabine) and oxaliplatin^{22,25,26}
 - Fluorouracil[†] and irinotecan²⁷⁻²⁹
- Other Regimens:
 - Paclitaxel with cisplatin or carboplatin³⁰⁻³²
 - Docetaxel with cisplatin^{33,34}
 - Docetaxel and irinotecan (category 2B)³⁵
 - Fluoropyrimidine (fluorouracil[†] or capecitabine)^{23,36,37}
 - Docetaxel^{38,39}
 - Paclitaxel^{40,41}

Second-Line Therapy

Dependent on prior therapy and performance status (PS):

- Preferred Regimens:
 - Ramucirumab for gastric and EGJ adenocarcinoma (category 1)^{*,42}
 - Ramucirumab + paclitaxel for gastric and EGJ adenocarcinoma^{*,43}
 - Docetaxel^{38,39}
 - Paclitaxel^{40,41,44}
 - Irinotecan^{28,44-46}
- Other Regimens:
 - Irinotecan and cisplatin^{25,47}
 - Irinotecan and fluoropyrimidine (fluorouracil[†] or capecitabine)^{48,49} (category 2B)
 - Docetaxel and Irinotecan(category 2B)³⁵

Alternative regimens for consideration (these may be combined with other agents when appropriate) (category 2B):

- Mitomycin and irinotecan⁵⁰⁻⁵²
- Mitomycin and fluorouracil^{†,53}

*Ramucirumab produced better results when combined with paclitaxel (RAINBOW trial) than it did as a single agent (REGARD trial); therefore, ramucirumab in combination with paclitaxel is preferred. The results of the RAINBOW trial have been presented only in abstract form and await full publication.

[†]Leucovorin is indicated with certain fluorouracil-based regimens. For important information regarding the leucovorin shortage, please see [Discussion \(MS-28\)](#).

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Gastric Cancer

PRINCIPLES OF SYSTEMIC THERAPY—REGIMENS AND DOSING SCHEDULES^{††}

PREOPERATIVE CHEMORADIATION (EG JUNCTION AND GASTRIC CARDIA)

PREFERRED REGIMENS

Paclitaxel and carboplatin

Paclitaxel 50 mg/m² IV on Day 1
Carboplatin AUC 2 IV on Day 1
Weekly for 5 weeks¹

Cisplatin and fluorouracil

Cisplatin 75-100 mg/m² IV on Days 1 and 29
Fluorouracil 750-1000 mg/m² IV continuous infusion
over 24 hours daily on Days 1-4 and 29-32
35-day cycle²

Cisplatin 15 mg/m² IV daily on Days 1-5
Fluorouracil 800 mg/m² IV continuous infusion
over 24 hours daily on Days 1-5
Cycled every 21 days for 2 cycles³

Oxaliplatin and fluorouracil

Oxaliplatin 85 mg/m² IV on Day 1
Leucovorin 400 mg/m² on Day 1
Fluorouracil 400 mg/m² IVP on Day 1
Fluorouracil 800 mg/m² IV continuous infusion
over 24 hours daily on Days 1 and 2
cycled every 14 days for 3 cycles with radiation
and 3 cycles after radiation⁴

Oxaliplatin 85 mg/m² IV on Days 1, 15, and 29 for
3 doses
Fluorouracil 180 mg/m² IV daily on Days 1-33⁵

PREFERRED REGIMENS

Cisplatin and capecitabine

Cisplatin 30 mg/m² IV on Day 1
Capecitabine 800 mg/m² PO BID on Days 1-5
Weekly for 5 weeks⁵⁴

Oxaliplatin and capecitabine

Oxaliplatin 85 mg/m² IV on Days 1, 15, and 29
for 3 doses
Capecitabine 625 mg/m² PO BID
on Days 1-5 for 5 weeks⁵⁵

OTHER REGIMENS

Irinotecan and cisplatin

Irinotecan 65 mg/m² IV
on Days 1, 8, 22, and 29
Cisplatin 30 mg/m² IV
on Days 1, 8, 22, and 29⁶

Taxane and fluoropyrimidine

Paclitaxel 45-50 mg/m² IV on Day 1 weekly
Fluorouracil 300 mg/m² IV continuous infusion
daily on Days 1-5
Weekly for 5 weeks⁷

Paclitaxel 45-50 mg/m² IV on Day 1
Capecitabine 625-825 mg/m² PO BID
on Days 1-5
Weekly for 5 weeks⁷

^{††}Chemotherapy regimen dosing and schedules are based on extrapolations from published literature and clinical practice.

The selection, dosing, and administration of anticancer agents and the management of associated toxicities are complex. Modifications of drug dose and schedule and initiation of supportive care interventions are often necessary because of expected toxicities and because of individual patient variability, prior treatment, nutritional status, and comorbidity. The optimal delivery of anticancer agents therefore requires a health care delivery team experienced in the use of anticancer agents and the management of associated toxicities in patients with cancer.

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Gastric Cancer

PRINCIPLES OF SYSTEMIC THERAPY—REGIMENS AND DOSING SCHEDULES^{††}

PERIOPERATIVE CHEMOTHERAPY (INCLUDING EG JUNCTION)

ECF (epirubicin, cisplatin, and Fluorouracil)

Epirubicin 50 mg/m² IV on Day 1

Cisplatin 60 mg/m² IV on Day 1

Fluorouracil 200 mg/m² IV continuous infusion
over 24 hours daily on Days 1-21

Cycled every 21 days for 3 cycles preoperatively
and 3 cycles postoperatively⁸

ECF modifications

Epirubicin 50 mg/m² IV on Day 1

Oxaliplatin 130 mg/m² IV on Day 1

Fluorouracil 200 mg/m² IV continuous infusion
over 24 hours daily on Days 1-21

Cycled every 21 days for 3 cycles preoperatively
and 3 cycles postoperatively⁹

Epirubicin 50 mg/m² IV on Day 1

Cisplatin 60 mg/m² IV on Day 1

Capecitabine 625 mg/m² PO BID on Days 1-21

Cycled every 21 days for 3 cycles preoperatively
and 3 cycles postoperatively⁹

Epirubicin 50 mg/m² IV on Day 1

Oxaliplatin 130 mg/m² IV on Day 1

Capecitabine 625 mg/m² PO BID on Days 1-21

Cycled every 21 days for 3 cycles preoperatively
and 3 cycles postoperatively⁹

Fluorouracil and cisplatin

Fluorouracil 800 mg/m² IV continuous infusion
over 24 hours daily on Days 1-5

Cisplatin 75-80 mg/m² IV on Day 1

Cycled every 28 days for 2-3 cycles preoperatively
and 3-4 cycles postoperatively for a total of 6 cycles¹⁰

^{††}Chemotherapy regimen dosing and schedules are based on extrapolations from published literature and clinical practice.

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Gastric Cancer

PRINCIPLES OF SYSTEMIC THERAPY--REGIMENS AND DOSING SCHEDULES^{††}

POSTOPERATIVE CHEMORADIATION (INCLUDING EG JUNCTION)

5-FU (bolus) and leucovorin (category 1)¹¹

Cycles 1, 3, and 4 (before and after radiation)

Leucovorin 20 mg/m² IVP on Days 1-5

5-FU 425 mg/m² IVP daily on Days 1-5

Cycled every 28 days

Cycle 2 (with radiation)

Leucovorin 20 mg/m² IVP on Days 1-4 and 31-33

5-FU 400 mg/m² IVP daily on Days 1-4 and 31-33

35 day cycle

THE PANEL ACKNOWLEDGES THAT THE INTERGROUP 0116 TRIAL¹¹ FORMED THE BASIS FOR POSTOPERATIVE ADJUVANT CHEMORADIATION STRATEGY. HOWEVER, THE PANEL DOES NOT RECOMMEND THE ABOVE SPECIFIED DOSES OR SCHEDULE OF CYTOTOXIC AGENTS BECAUSE OF CONCERNS REGARDING TOXICITY. THE PANEL RECOMMENDS ONE OF THE FOLLOWING MODIFICATIONS INSTEAD:

- 1 cycle before and 2 cycles after chemoradiation
Capecitabine 750-1000 mg/m² PO BID on Days 1-14
Cycled every 28 days⁵⁶

- 1 cycle before and 2 cycles after chemoradiation
Leucovorin 400 mg/m² IV on Days 1 and 15 or Days 1, 2, 15, and 16
Fluorouracil 400 mg/m² IVP on Days 1 and 15 or Days 1, 2, 15, and 16
Fluorouracil 1200 mg/m² IV continuous infusion over 24 hours daily on Days 1, 2, 15, and 16
Cycled every 28 days⁵⁷

With radiation

Fluorouracil 200-250 mg/m² IV continuous infusion

over 24 hours daily on Days 1-5 or 1-7

Weekly for 5 weeks⁵⁸

With radiation

Capecitabine 625-825 mg/m² PO BID on Days 1-5 or 1-7

Weekly for 5 weeks⁵⁹

POSTOPERATIVE CHEMOTHERAPY

Capecitabine and oxaliplatin

Capecitabine 1000 mg/m² PO BID on Days 1-14

Oxaliplatin 130 mg/m² IV on Day 1

Cycled every 21 days for 8 cycles¹²

Capecitabine and Cisplatin

Capecitabine 1000 mg/m² PO BID on Days 1-14

Cisplatin 60 mg/m² IV on Day 1

Cycled every 21 days for 6 cycles¹³

^{††}Chemotherapy regimen dosing and schedules are based on extrapolations from published literature and clinical practice.

The selection, dosing, and administration of anticancer agents and the management of associated toxicities are complex. Modifications of drug dose and schedule and initiation of supportive care interventions are often necessary because of expected toxicities and because of individual patient variability, prior treatment, nutritional status, and comorbidity. The optimal delivery of anticancer agents therefore requires a health care delivery team experienced in the use of anticancer agents and the management of associated toxicities in patients with cancer.

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Gastric Cancer

PRINCIPLES OF SYSTEMIC THERAPY—REGIMENS AND DOSING SCHEDULES^{††}

CHEMOTHERAPY FOR METASTATIC OR LOCALLY ADVANCED CANCER (WHERE LOCAL THERAPY IS NOT INDICATED)

FIRST-LINE THERAPY

Trastuzumab (with chemotherapy)

Trastuzumab 8 mg/kg IV loading dose on Day 1 of Cycle 1, then

Trastuzumab 6 mg/kg IV every 21 days¹⁴ or

Trastuzumab 6 mg/kg IV loading dose on Day 1 of cycle 1, then 4 mg/kg IV every 14 days

PREFERRED REGIMENS

DCF (docetaxel, cisplatin, and fluorouracil)

Docetaxel 75 mg/m² IV on Day 1

Cisplatin 75 mg/m² IV on Day 1

Fluorouracil 1000 mg/m² IV continuous infusion over 24 hours daily on Days 1-5

Cycled every 28 days¹⁵

THE PANEL DOES NOT RECOMMEND THE ABOVE SPECIFIED DOSES OR SCHEDULE OF CYTOTOXIC AGENTS BECAUSE OF CONCERNS REGARDING TOXICITY.

THE PANEL RECOMMENDS ONE OF THE FOLLOWING MODIFICATIONS INSTEAD:

DCF modifications

Docetaxel 40 mg/m² IV on Day 1

Leucovorin 400 mg/m² IV on Day 1

Fluorouracil 400 mg/m² IV on Day 1

Fluorouracil 1000 mg/m² IV continuous infusion over 24 hours daily on Days 1 and 2

Cisplatin 40 mg/m² IV on Day 3

Cycled every 14 days¹⁶

PREFERRED REGIMENS—continued

DCF modifications

Docetaxel 50 mg/m² IV on Day 1

Oxaliplatin 85 mg/m² IV on Day 1

Fluorouracil 1200 mg/m² IV continuous infusion over 24 hours daily on Days 1 and 2

Cycled every 14 days¹⁷

Docetaxel 75 mg/m² IV on Day 1

Carboplatin AUC 6 IV on Day 2

Fluorouracil 1200 mg/m² IV continuous infusion over 24 hours daily on Days 1-3

Cycled every 21 days¹⁸

ECF

Epirubicin 50 mg/m² IV on Day 1

Cisplatin 60 mg/m² IV on Day 1

Fluorouracil 200 mg/m² IV continuous infusion over 24 hours daily on Days 1-21

Cycled every 21 days¹⁹

ECF modifications

Epirubicin 50 mg/m² IV on Day 1

Oxaliplatin 130 mg/m² IV on Day 1

Fluorouracil 200 mg/m² IV continuous infusion over 24 hours daily on Days 1-21

Cycled every 21 days²⁰

PREFERRED REGIMENS—continued

ECF modifications—continued

Epirubicin 50 mg/m² IV on Day 1

Cisplatin 60 mg/m² IV on Day 1

Capecitabine 625 mg/m² PO BID on Days 1-21

Cycled every 21 days²⁰

Epirubicin 50 mg/m² IV on Day 1

Oxaliplatin 130 mg/m² IV on Day 1

Capecitabine 625 mg/m² PO BID on Days 1-21

Cycled every 21 days²⁰

Fluoropyrimidine and cisplatin

Cisplatin 75-100 mg/m² IV on Day 1

Fluorouracil 750-1000 mg/m² IV continuous infusion over 24 hours daily on Days 1-4

Cycled every 28 days²¹

Cisplatin 50 mg/m² IV daily on Day 1

Leucovorin 200 mg/m² IV on Day 1

Fluorouracil 2000 mg/m² IV continuous infusion over 24 hours daily on Day 1

Cycled every 14 days^{22,23}

Cisplatin 80 mg/m² IV daily on Day 1

Capecitabine 1000 mg/m² PO BID on Days 1-14

Cycled every 21 days²⁴

^{††}Chemotherapy regimen dosing and schedules are based on extrapolations from published literature and clinical practice.

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Gastric Cancer

PRINCIPLES OF SYSTEMIC THERAPY--REGIMENS AND DOSING SCHEDULES^{††}

CHEMOTHERAPY FOR METASTATIC OR LOCALLY ADVANCED CANCER (WHERE LOCAL THERAPY IS NOT INDICATED)

FIRST-LINE THERAPY—continued

PREFERRED REGIMENS

Fluoropyrimidine and oxaliplatin

Oxaliplatin 85 mg/m² IV on Day 1
Leucovorin 400 mg/m² IV on Day 1
Fluorouracil 400 mg/m² IVP on Day 1
Fluorouracil 1200 mg/m² IV continuous infusion over 24 hours daily on Days 1 and 2
Cycled every 14 days²⁵

Oxaliplatin 85 mg/m² IV on Day 1
Leucovorin 200 mg/m² IV on Day 1
Fluorouracil 2600 mg/m² IV continuous infusion over 24 hours on Day 1
Cycled every 14 days²²

Capecitabine 1000 mg/m² PO BID on Days 1-14
Oxaliplatin 130 mg/m² IV on Day 1
Cycled every 21 days²⁶

Fluorouracil and irinotecan

Irinotecan 80 mg/m² IV on Day 1
Leucovorin 500 mg/m² IV on Day 1
Fluorouracil 2000 mg/m² IV continuous infusion over 24 hours on Day 1
Weekly for 6 weeks followed by 1 week off treatment²⁷

Irinotecan 150 mg/m² IV on Day 1
Leucovorin 20 mg/m² IV on Day 1
Fluorouracil 1000 mg/m² IV continuous infusion over 24 hours daily on Days 1 and 2
Cycled every 14 days²⁸

Irinotecan 80 mg/m² IV on Day 1
Leucovorin 500 mg/m² IV combined with Fluorouracil 2000 mg/m² IV continuous infusion over 24 hours on Day 1
Weekly for 6 weeks followed by 2 weeks off treatment²⁹

OTHER REGIMENS

Paclitaxel with cisplatin or carboplatin

Paclitaxel 135-200 mg/m² IV on Day 1
Cisplatin 75 mg/m² IV on Day 2
Cycled every 21 days³⁰

Paclitaxel 90 mg/m² IV on Day 1
Cisplatin 50 mg/m² IV on Day 1
Cycled every 14 days³¹

Paclitaxel 200 mg/m² IV on Day 1
Carboplatin AUC 5 IV on Day 1
Cycled every 21 days³²

Docetaxel and cisplatin

Docetaxel 70-85 mg/m² IV on Day 1
Cisplatin 70-75 mg/m² IV on Day 1
Cycled every 21 days^{33,34}

Docetaxel and irinotecan

Docetaxel 35 mg/m² IV on Days 1 and 8
Irinotecan 50 mg/m² IV on Days 1 and 8
Cycled every 21 days³⁵

OTHER REGIMENS—continued

Fluoropyrimidine

Leucovorin 400 mg/m² IV on Day 1
Fluorouracil 400 mg/m² IVP on Day 1
Fluorouracil 1200 mg/m² IV continuous infusion over 24 hours daily on Days 1 and 2
Cycled every 14 days²³

Fluorouracil 800 mg/m² IV continuous infusion over 24 hours daily on Days 1-5
Cycled every 28 days³⁶

Capecitabine 1000-1250 mg/m² PO BID on Days 1-14
Cycled every 21 days³⁷

Taxane

Docetaxel 75-100 mg/m² IV on Day 1
Cycled every 21 days^{38,39}

Paclitaxel 135-250 mg/m² IV on Day 1
Cycled every 21 days⁴⁰

Paclitaxel 80 mg/m² IV on Day 1 weekly
Cycled every 28 days⁴¹

^{††}Chemotherapy regimen dosing and schedules are based on extrapolations from published literature and clinical practice.

The selection, dosing, and administration of anticancer agents and the management of associated toxicities are complex. Modifications of drug dose and schedule and initiation of supportive care interventions are often necessary because of expected toxicities and because of individual patient variability, prior treatment, nutritional status, and comorbidity. The optimal delivery of anticancer agents therefore requires a health care delivery team experienced in the use of anticancer agents and the management of associated toxicities in patients with cancer.

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Gastric Cancer

PRINCIPLES OF SYSTEMIC THERAPY—REGIMENS AND DOSING SCHEDULES^{††}

CHEMOTHERAPY FOR METASTATIC OR LOCALLY ADVANCED CANCER (WHERE LOCAL THERAPY IS NOT INDICATED)

SECOND-LINE THERAPY

Trastuzumab (with chemotherapy)

Trastuzumab 8 mg/kg IV loading dose
on Day 1 of Cycle 1, then
Trastuzumab 6 mg/kg IV every 21 days¹⁴
or

Trastuzumab 6 mg/kg IV loading dose on
Day 1 of cycle 1, then 4 mg/kg IV every 14 days

PREFERRED REGIMENS

Ramucirumab for gastric and EGJ adenocarcinoma

Ramucirumab 8 mg/kg IV on Day 1
Cycled every 14 days⁴²

Ramucirumab and paclitaxel for gastric and EGJ adenocarcinoma

Ramucirumab 8 mg/kg IV on Days 1 and 15
Paclitaxel 80 mg/m² on Days 1, 8, and 15
Cycled every 28 days⁴³

Taxane

Docetaxel 75-100 mg/m² IV on Day 1
Cycled every 21 days^{38,39}

Paclitaxel 135-250 mg/m² IV on Day 1
Cycled every 21 days⁴⁰

Paclitaxel 80 mg/m² IV on Day 1 weekly
Cycled every 28 days⁴¹

Paclitaxel 80 mg/m² IV on Days 1, 8, 15
Cycled every 28 days⁴⁴

PREFERRED REGIMENS—continued

Irinotecan

Irinotecan 250-350 mg/m² IV on Day 1
Cycled every 21 days⁴⁵

Irinotecan 150-180 mg/m² IV on Day 1
Cycled every 14 days^{28,44}

Irinotecan 125 mg/m² IV on Days 1 and 8
Cycled every 21 days⁴⁶

OTHER REGIMENS

Irinotecan and cisplatin

Irinotecan 65 mg/m² IV on Days 1 and 8
Cisplatin 25-30 mg/m² IV on Days 1 and 8
Cycled every 21 days^{25,47}

Irinotecan and fluoropyrimidine

Irinotecan 250 mg/m² IV on Day 1
Capecitabine 1000 mg/m² PO BID
on Days 1-14
Cycled every 21 days⁴⁸

Irinotecan 180 mg/m² IV on Day 1
Leucovorin 400 mg/m² IV on Day 1
Fluorouracil 400 mg/m² IVP on Day 1
Fluorouracil 600-1200 mg/m² IV continuous
infusion over 24 hours daily on Days 1 and 2
Cycled every 14 days⁴⁹

Docetaxel and irinotecan

Docetaxel 35 mg/m² IV on Days 1 and 8
Irinotecan 50 mg/m² IV on Days 1 and 8
Cycled every 21 days³⁵

^{††}Chemotherapy regimen dosing and schedules are based on extrapolations from published literature and clinical practice.

The selection, dosing, and administration of anticancer agents and the management of associated toxicities are complex. Modifications of drug dose and schedule and initiation of supportive care interventions are often necessary because of expected toxicities and because of individual patient variability, prior treatment, nutritional status, and comorbidity. The optimal delivery of anticancer agents therefore requires a health care delivery team experienced in the use of anticancer agents and the management of associated toxicities in patients with cancer.

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Gastric Cancer

PRINCIPLES OF SYSTEMIC THERAPY—REGIMENS AND DOSING SCHEDULES^{††}

CHEMOTHERAPY FOR METASTATIC OR LOCALLY ADVANCED CANCER (WHERE LOCAL THERAPY IS NOT INDICATED) ALTERNATIVE REGIMENS FOR CONSIDERATION

Mitomycin and irinotecan

Mitomycin 6 mg/m² IV on Day 1

Irinotecan 125 mg/m² IV on Days 2 and 9

Cycled every 28 days⁵⁰

Irinotecan 150 mg/m² IV on Days 1 and 15

Mitomycin 8 mg/m² IV on Day 1

Cycled every 28 days⁵¹

Irinotecan 125 mg/m² Day 1

Mitomycin 5 mg/m² IV on Day 1

Cycled every 14 days⁵²

Mitomycin, leucovorin, and fluorouracil

Mitomycin 10 mg/m² IV on Days 1 and 22

Leucovorin 500 mg/m² IV on Day 1

Fluorouracil 2600 mg/m² IV continuous infusion over 24 hours on Day 1

Weekly for 6 weeks followed by 2 weeks off treatment⁵³

^{††}Chemotherapy regimen dosing and schedules are based on extrapolations from published literature and clinical practice.

The selection, dosing, and administration of anticancer agents and the management of associated toxicities are complex. Modifications of drug dose and schedule and initiation of supportive care interventions are often necessary because of expected toxicities and because of individual patient variability, prior treatment, nutritional status, and comorbidity. The optimal delivery of anticancer agents therefore requires a health care delivery team experienced in the use of anticancer agents and the management of associated toxicities in patients with cancer.

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Gastric Cancer

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Gastric Cancer

PRINCIPLES OF RADIATION THERAPY

General Guidelines

- Prior to simulation, pertinent radiographs, procedure notes and pathology reports should be reviewed by a multidisciplinary team including surgical, radiation, medical oncologists, gastroenterologists, radiologists and pathologists. This will allow an informed determination of treatment volume and field borders prior to simulation.
- In general, Siewert I and II tumors should be managed with radiation therapy guidelines applicable to esophageal cancers. Depending on the clinical situation, Siewert III tumors, may be more appropriately managed with radiation therapy guidelines applicable to either esophageal or gastric cancers. These recommendations may be modified depending on where the bulk of the tumor is located.

Simulation and Treatment Planning

- Use of CT simulation and 3D or IMRT treatment planning is strongly encouraged.
- The patient should be instructed to avoid intake of a heavy meal for 3 hours before simulation and treatment. When clinically appropriate, use of IV and/or oral contrast for CT simulation may be used to aid in target localization.
- Use of an immobilization device is strongly recommended for reproducibility of daily set-up.
- All patients should be simulated and treated in the supine position.
- Although AP/PA fields can be weighted anteriorly to keep the spinal cord dose at acceptable levels using only parallel-opposed techniques, a 4-field technique (AP/PA and opposed laterals), if feasible, can spare spinal cord with improved dose homogeneity. Patients with a stomach that is sufficiently anterior to allow treatment via laterals to the target volume and draining lymph nodes with 1.5-2 cm margin while sparing spinal cord may have more liberal use of lateral beams with multiple-field techniques. The uncertainties arising from variations in stomach filling and respiratory motion should also be taken into consideration.
- With the wide availability of 3D treatment-planning systems, it may be possible to target more accurately the high-risk volume and to use unconventional field arrangements to produce superior dose distributions. To accomplish this without marginal misses, it will be necessary to both carefully define and encompass the various target volumes because the use of oblique or non-coplanar beams could exclude target volumes that would be included in AP/PA fields or multiple-field techniques.
- Intensity modulated radiation therapy (IMRT) is appropriate in selected cases to reduce dose to normal structures such as heart, lungs, kidneys and liver. As discussed above, target volumes need to be carefully defined and encompassed while designing IMRT plans. Uncertainties from variations in stomach filling and respiratory motion need to be taken into account. For structures such as the lungs, attention should be given to the volume receiving low to moderate doses, as well as the volume receiving high doses.

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Gastric Cancer

PRINCIPLES OF RADIATION THERAPY

Target Volume (General Guidelines)

- **Preoperative¹**
 - ▶ Pre-treatment diagnostic studies (EUS, UGI, EGD, and CT scans) should be used to identify the tumor and pertinent nodal groups.^{2,3} The relative risk of nodal metastases at a specific nodal location is dependent on both the site of origin of the primary tumor and other factors including width and depth of invasion of the gastric wall.
- **Postoperative⁴**
 - ▶ Pre-treatment diagnostic studies (EUS, UGI, EGD, and CT scans) and clip placement should be used to identify the tumor/gastric bed, the anastomosis or stumps, and pertinent nodal groups.^{2,3} Treatment of the remaining stomach should depend on a balance of the likely normal tissue morbidity and the perceived risk of local relapse in the residual stomach. The relative risk of nodal metastases at a specific nodal location is dependent on both the site of origin of the primary tumor and other factors including width and depth of invasion of the gastric wall.⁵

Proximal one-third/Cardia/Esophagogastric Junction Primaries

- **Preoperative and Postoperative**
 - ▶ With proximal gastric lesions or lesions at the EG junction, a 3- to 5-cm margin of distal esophagus, medial left hemidiaphragm and adjacent pancreatic body should be included. Nodal areas at risk include: adjacent paraesophageal, perigastric, suprapancreatic, and celiac lymph nodes.

Middle one-third/Body Primaries

- **Preoperative and Postoperative**
 - ▶ Body of pancreas should be included. Nodal areas at risk include: perigastric, suprapancreatic, celiac, splenic hilar, porta hepatic, and pancreaticoduodenal lymph nodes.

Distal one-third/Antrum/Pylorus Primaries

- **Preoperative**
 - ▶ Head of pancreas, 1st and 2nd part of duodenum should be included if the gross lesion extended to the gastroduodenal junction. Nodal areas at risk include: perigastric, suprapancreatic, celiac, porta hepatic, and pancreaticoduodenal lymph nodes.
- **Postoperative**
 - ▶ Head of pancreas, a 3- to 5-cm margin of duodenal stump should be included if the gross lesion extended to the gastroduodenal junction. Nodal areas at risk include: perigastric, suprapancreatic, celiac, porta hepatic, and pancreaticoduodenal lymph nodes.

Blocking

- Custom blocking is necessary to reduce unnecessary dose to normal structures including liver (60% of liver <30 Gy), kidneys (at least 2/3 of one kidney <20 Gy), spinal cord (<45 Gy), heart (1/3 of heart <50 Gy, effort should be made to keep the left ventricle doses to a minimum) and lungs.^a

Dose

- 45-50.4 Gy (1.8 Gy/day)

^aLung Dose Volume Histogram (DVH) parameters as predictors of pulmonary complications in gastric/esophagogastric junction cancer patients treated with concurrent chemoradiotherapy should be strongly considered, though consensus on optimal criteria has not yet emerged. Every effort should be made to keep the lung volume and doses to a minimum. Treating physicians should be aware that the DVH reduction algorithm is hardly the only risk factor for pulmonary complications. DVH parameters as predictors of pulmonary complications in gastric/esophagogastric junction cancer patients are an area of active development among the NCCN institutions and others.

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PRINCIPLES OF RADIATION THERAPY

Supportive Therapy

- Treatment interruptions or dose reductions for manageable acute toxicities should be avoided. Careful patient monitoring and aggressive supportive care are preferable to treatment breaks.
- During radiation treatment course, patients should be seen for status check at least once a week with notation of vital signs, weight and blood counts.
- Antiemetics should be given on a prophylactic basis, and antacid and antidiarrheal medications may be prescribed when needed.
- If estimated caloric intake is <1500 kcal/day, oral and/or enteral nutrition should be considered. When indicated, feeding jejunostomies (J-tube) or nasogastric feeding tubes may be placed to ensure adequate caloric intake. During surgery, a J-tube may be placed for postoperative nutritional support.
- B₁₂, iron, and calcium level should be closely monitored, especially for postoperative patients. Monthly B₁₂ shots may be needed because of loss of intrinsic factor. Iron absorption is reduced without gastric acid. Oral supplementation, given with acid such as orange juice, can often maintain adequate levels. Calcium supplementation should also be encouraged.
- Adequate enteral and/or IV hydration is necessary throughout chemoradiation and early recovery.

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PRINCIPLES OF RADIATION THERAPY **(References)**

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PRINCIPLES OF PALLIATIVE/BEST SUPPORTIVE CARE^a

The goal of best supportive care is to prevent and relieve suffering and to support the best possible quality of life for patients and their families, regardless of the stage of the disease or the need for other therapies. For gastric cancer, interventions undertaken to relieve major symptoms may result in prolongation of life. This appears to be particularly true when a multimodality interdisciplinary approach is pursued, and therefore, a multimodality interdisciplinary approach to palliative care of the gastric cancer patient is encouraged.

Bleeding

- Bleeding is common in patients with gastric cancer and may directly arise from the tumor, or as a consequence of therapy. Patients with acute severe bleeding (hematemesis or melena) should undergo prompt endoscopic assessment.¹
 - Endoscopic hemostatic interventions appropriate to the findings should be carried out
 - Interventional radiology angiographic embolization techniques may be useful in those situations where endoscopy is not helpful
 - External beam radiation therapy²
- Chronic blood loss from gastric cancer
 - External beam radiation therapy²

Obstruction

- Endoscopic relief of obstruction
 - Balloon dilation
 - Placement of enteral stent for relief of outlet obstruction,³ or esophageal stent for EGJ/cardia obstruction (see [NCCN Guidelines for Esophageal and Esophagogastric Junction Cancers](#))
- Surgery
 - Gastrojejunal bypass³
 - Gastrectomy in select patients⁴
- Establish enteral access for purposes of hydration and nutrition if endoscopic lumen enhancement is not undertaken or is unsuccessful
 - Feeding percutaneous endoscopic gastrostomy for patients with EGJ/cardia obstruction if tumor location permits
 - Endoscopic or surgical placement of jejunal feeding tube for patients with mid and distal gastric obstruction
- Venting gastrostomy (if endoscopic lumen enhancement is not undertaken or is unsuccessful)
 - Percutaneous endoscopic or interventional radiology gastrostomy tube placement can be placed for gastric decompression if tumor location permits
 - Ascites, if present, should be drained prior to venting gastrostomy tube placement to reduce the risk of infectious complications.
- External beam radiation therapy
- Chemotherapy^b

^aSee [NCCN Guidelines for Palliative](#).

^bSee [Principles of Systemic Therapy \(GAST-F\)](#).

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Gastric Cancer

PRINCIPLES OF PALLIATIVE/BEST SUPPORTIVE CARE^a

Pain

- External beam radiation therapy²
- Chemotherapy^b
- If patient is experiencing tumor related pain, then the pain should be assessed and treated in accordance with the [NCCN Guidelines for Adult Cancer Pain](#).
- Severe uncontrolled pain following gastric stent placement should be treated with endoscopic removal of the stent once uncontrollable nature of pain is established.

Nausea/Vomiting

- If patient is experiencing nausea and vomiting, then the patient should be treated in accordance with the [NCCN Guidelines for Antiemesis](#).
- Nausea and vomiting may be associated with luminal obstruction, so endoscopic or fluoroscopic evaluation should be performed to determine if luminal enhancement is indicated.

^a[See NCCN Guidelines for Palliative](#).

^b[See Principles of Systemic Therapy \(GAST-F\)](#).

Note: All recommendations are category 2A unless otherwise indicated.

Clinical Trials: NCCN believes that the best management of any cancer patient is in a clinical trial. Participation in clinical trials is especially encouraged.

[Continued](#)

GAST-H
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PRINCIPLES OF PALLIATIVE/BEST SUPPORTIVE CARE (References)

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Note: All recommendations are category 2A unless otherwise indicated.

Clinical Trials: NCCN believes that the best management of any cancer patient is in a clinical trial. Participation in clinical trials is especially encouraged.



NCCN Guidelines Version 1.2014 Staging Gastric Cancer

Table 1
**American Joint Committee on Cancer (AJCC)
TNM Staging Classification for Carcinoma of the Stomach
(7th ed., 2010)**
Primary Tumor (T)

- TX Primary tumor cannot be assessed
 T0 No evidence of primary tumor
 Tis Carcinoma in situ: intraepithelial tumor without invasion of the lamina propria
 T1 Tumor invades lamina propria, muscularis mucosae or submucosa
 T1a Tumor invades lamina propria or muscularis mucosae
 T1b Tumor invades submucosa
 T2 Tumor invades muscularis propria*
 T3 Tumor penetrates subserosal connective tissue without invasion of visceral peritoneum or adjacent structures**, ***
 T4 Tumor invades serosa (visceral peritoneum) or adjacent structures**, ***
 T4a Tumor invades serosa (visceral peritoneum)
 T4b Tumor invades adjacent structures

Regional Lymph Nodes (N)

- NX Regional lymph node(s) cannot be assessed
 N0 No regional lymph node metastasis§
 N1 Metastasis in 1 - 2 regional lymph nodes
 N2 Metastasis in 3 - 6 regional lymph nodes
 N3 Metastasis in seven or more regional lymph nodes
 N3a Metastasis in 7 - 15 regional lymph nodes
 N3b Metastasis in 16 or more regional lymph nodes

Distant Metastasis (M)

- M0 No distant metastasis
 M1 Distant metastasis

Histologic Grade (G)

- GX Grade cannot be assessed
 G1 Well differentiated
 G2 Moderately differentiated
 G3 Poorly differentiated
 G4 Undifferentiated

*Note: A tumor may penetrate the muscularis propria with extension into the gastrocolic or gastrohepatic ligaments, or into the greater or lesser omentum, without perforation of the visceral peritoneum covering these structures. In this case, the tumor is classified T3. If there is perforation of the visceral peritoneum covering the gastric ligaments or the omentum, the tumor should be classified T4.

**The adjacent structures of the stomach include the spleen, transverse colon, liver, diaphragm, pancreas, abdominal wall, adrenal gland, kidney, small intestine, and retroperitoneum.

***Intramural extension to the duodenum or esophagus is classified by the depth of the greatest invasion in any of these sites, including the stomach.

§A designation of pN0 should be used if all examined lymph nodes are negative, regardless of the total number removed and examined.

[Continued](#)

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NCCN Guidelines Version 1.2014 Staging Gastric Cancer

Table 1 - Continued**American Joint Committee on Cancer (AJCC)****TNM Staging Classification for Carcinoma of the Stomach****(7th ed., 2010)****Anatomic Stage/Prognostic Groups**

Stage 0	Tis	N0	M0
Stage IA	T1	N0	M0
Stage IB	T2	N0	M0
	T1	N1	M0
Stage IIA	T3	N0	M0
	T2	N1	M0
	T1	N2	M0
Stage IIB	T4a	N0	M0
	T3	N1	M0
	T2	N2	M0
	T1	N3	M0
Stage IIIA	T4a	N1	M0
	T3	N2	M0
	T2	N3	M0
Stage IIIB	T4b	N0	M0
	T4b	N1	M0
	T4a	N2	M0
	T3	N3	M0
Stage IIIC	T4b	N2	M0
	T4b	N3	M0
	T4a	N3	M0
Stage IV	Any T	Any N	M1

Used with the permission of the American Joint Committee on Cancer (AJCC), Chicago, Illinois. The original and primary source for this information is the AJCC Cancer Staging Manual, Seventh Edition (2010) published by Springer Science and Business Media LLC (SBM). (For complete information and data supporting the staging tables, visit www.springer.com.) Any citation or quotation of this material must be credited to the AJCC as its primary source. The inclusion of this information herein does not authorize any reuse or further distribution without the expressed, written permission of Springer SBM, on behalf of the AJCC.



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Discussion

NCCN Categories of Evidence and Consensus

Category 1: Based upon high-level evidence, there is uniform NCCN consensus that the intervention is appropriate.

Category 2A: Based upon lower-level evidence, there is uniform NCCN consensus that the intervention is appropriate.

Category 2B: Based upon lower-level evidence, there is NCCN consensus that the intervention is appropriate.

Category 3: Based upon any level of evidence, there is major NCCN disagreement that the intervention is appropriate.

All recommendations are category 2A unless otherwise noted.

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Overview

Upper gastrointestinal (GI) tract cancers originating in the esophagus, esophagogastric junction (EGJ), and stomach constitute a major health problem around the world. A dramatic shift in the location of upper GI tract tumors has occurred in the United States.¹ Changes in histology and location of upper GI tract tumors have also been observed in some parts of Europe.^{2,3} In Western countries, the most common sites of gastric cancer are the proximal lesser curvature, cardia, and the EGJ.¹ It is possible that in the coming decades these changing trends will also occur in South America and Asia.

Gastric cancer is rampant in many countries around the world. In Japan, it remains the most common type of cancer among men. The incidence of gastric cancer is much higher in China than in any other country. The incidence of gastric cancer, however, has been declining globally since World War II and it is one of the least common cancers in North America. By some estimates, it is the fourth most common cancer worldwide.⁴ In 2014, an estimated 22,220 people will be diagnosed and 10,990 people will eventually die of their disease in the United States.⁵ In developed countries, the incidence of gastric cancer originating from the cardia follows the distribution of esophageal cancer.⁶⁻⁸ Non-cardia gastric adenocarcinoma shows marked geographic variation with countries such as Japan, Korea, China, Taiwan, Costa Rica, Peru, Brazil, Chile, and the former Soviet Union.⁹ In contrast to the incidence trends in the West, non-proximal tumors continue to predominate in Japan and other parts of the world.¹⁰ The etiology of this shift remains elusive and may be multifactorial.

Gastric cancer is often diagnosed at an advanced stage. In Japan (and in a limited fashion in Korea) where screening is performed widely, early detection is often possible. In other parts of the world, it continues

to pose a major challenge for health care professionals. Environmental risk factors include *Helicobacter pylori* (*H. pylori*) infection, smoking, high salt intake, and other dietary factors. In a recent meta-analysis, there was no appreciable association between moderate alcohol drinking and gastric cancer risk; however, there was a positive association with heavy alcohol drinking, particularly for non-cardia gastric cancers.¹¹

Hereditary Cancer Predisposition Syndromes Associated with an Increased Risk for Gastric Cancers

While most gastric cancers are considered sporadic, it is estimated that 5% to 10% have a familial component and 3% to 5% are associated with inherited cancer predisposition syndromes. The most common hereditary cancer predisposition syndromes are discussed below. See *Principles of Genetic Risk Assessment for Patients with Gastric Cancers* in the guidelines for other less common hereditary cancer predisposition syndromes associated with a risk of developing gastric cancer.

Hereditary Diffuse Gastric Cancer

Hereditary diffuse gastric cancer (HDGC) or familial gastric cancer is an autosomal dominant syndrome characterized by the development of gastric cancers, predominantly the diffuse type, at a young age.^{12,13} Germline truncating mutations in the tumor suppressor gene *CDH1* (encoding the cell-to-cell adhesion protein E-cadherin) are found in 30% to 50% of families with HDGC.^{14,15} The average age at diagnosis of gastric cancer is 37 years, and the lifetime risk for the development of gastric cancer by the age of 80 years is estimated at 67% for men and 83% for women.¹⁶ Germline *CDH1* mutations are also associated with an increased risk of developing lobular carcinoma of the breast in women.¹⁷



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The safety and efficacy of endoscopic surveillance for patients with HDGC has not been established. On the contrary, available evidence suggests that endoscopy may not adequately detect the precursor lesions in diffuse gastric cancer.^{18,19} Endoscopic surveillance is not recommended for *CDH1* gene mutation carriers. Prophylactic gastrectomy (without a D2 lymph node dissection) is recommended for asymptomatic carriers of germline truncating *CDH1* mutations who belong to families with a history of HDGC between ages 20 and 40.^{20,21} It is not recommended for patients younger than 20 years of age unless the youngest family member was diagnosed with gastric cancer before 20 years of age. A baseline endoscopy with multiple random biopsies is indicated.²² Screening endoscopy should be initiated 5 to 10 years before the earliest cancer diagnosis in the family. Annual breast MRI is recommended for female patients.

Lynch Syndrome

Lynch syndrome (also referred to as hereditary non-polyposis colorectal cancer) is an autosomal dominant syndrome characterized by the early onset of colorectal cancer and endometrial cancer as well as a variety of other cancers including gastric cancer.²³ Lynch syndrome arises from germline mutations in any of the four DNA mismatch repair (*MMR*) genes (*MLH1*, *MSH2*, *MSH6*, and *PMS2*).²⁴ Gastric cancer is the second most common extracolonic cancer (after endometrial cancer) in patients with Lynch syndrome, and these patients have a 1% to 13% risk of developing gastric cancer, predominantly the intestinal type, occurring at an earlier age than the general population.²⁵⁻²⁸

Surveillance upper endoscopy may be considered at age 35 and repeated at 3- to 5-year intervals.²³ Selected individuals or families or those of Asian descent may consider esophagogastroduodenoscopy with extended duodenoscopy (to distal duodenum or into the jejunum)

every 3 to 5 years beginning at age 30 to 35 years. See the NCCN Guidelines for Colorectal Cancer Screening.

Juvenile Polyposis Syndrome

Juvenile polyposis syndrome (JPS) is a rare autosomal dominant syndrome characterized by the presence of multiple juvenile polyps along the GI tract and is associated with an increased risk of developing GI cancers.²⁹ JPS arises from a germline mutation in the *SMAD4* or *BMPR1A* genes.²³ The lifetime risk of developing GI cancers in patients with JPS varies from 9% to 50% and varies with the type of mutation.³⁰ In patients with gastric polyps, JPS carries a lifetime risk of 21% for developing gastric cancer.³⁰

Surveillance upper endoscopy may be considered, beginning in the mid-teens and repeated annually if polyps are found and if no polyps are found every 2 to 3 years.²³ See the NCCN Guidelines for Colorectal Cancer Screening.

Peutz-Jeghers Syndrome

Peutz-Jeghers syndrome (PJS) is an autosomal dominant syndrome caused by germline mutations in the *STK11/LKB1* tumor suppressor gene.^{31,32} Mutations in *STK11/LKB1* gene have been identified in 30% to 80% of patients.³³ PJS is characterized by mucocutaneous pigmentation and GI polyposis and is associated with an elevated risk of developing GI cancers.³⁴⁻³⁸ Individuals with PJS have a 29% lifetime risk of developing gastric cancer.^{23,34}

Surveillance of upper endoscopy may be considered, beginning in late teens. Repeat upper endoscopy every 2 to 3 years should be considered based on gastric polyp burden.²³ See the NCCN Guidelines for Colorectal Cancer Screening.



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Staging

Two major classifications are currently used. The Japanese classification is more elaborate and is based on anatomic involvement, particularly the lymph node stations.³⁹ The other staging system developed jointly by the AJCC and the Union for International Cancer Control (UICC), is the system used in countries in the Western Hemisphere.⁴⁰ A minimum of 15 examined lymph nodes is recommended for adequate staging. The 7th Edition of the AJCC Staging Manual does not include the proximal 5 cm of the stomach, which has created debates, confusion, and disagreements. In addition, the new classification suffers from a number of other drawbacks, as it is based on primary surgery and is not reliable when considering clinical baseline staging or after preoperative therapy.

Clinical baseline stage provides useful information for the development of an initial treatment strategy. Approximately 50% of patients will present with advanced disease at diagnosis and have a poor outcome. Other measures of poor outcome include poor performance status, presence of metastases, and alkaline phosphatase level of 100 U/L or more.⁴¹ In patients with localized resectable disease, outcome depends on the surgical stage of the disease. Nearly 70% to 80% of patients have involvement of the regional lymph nodes. The number of positive lymph nodes has a profound influence on survival.⁴²

Clinical staging has greatly improved with the availability of diagnostic modalities such as endoscopic ultrasound (EUS), CT, PET /CT, MRI, and laparoscopic staging.⁴³⁻⁴⁵

CT scan is routinely used for preoperative staging. It has an overall accuracy of 43% to 82% for T staging. PET/CT has a low detection rate because of the low tracer accumulation in diffuse and mucinous tumor types, which are frequent in gastric cancer.⁴⁶ It has a significantly lower

sensitivity compared to CT in the detection of local lymph node involvement (56% vs.78%), although it has an improved specificity (92% vs. 62%).⁴⁷ Combined PET/CT imaging, on the other hand, has several potential advantages over PET scan alone.⁴⁸ PET/CT has a significantly higher accuracy in preoperative staging (68%) than PET (47%) or CT (53%) alone. Recent reports have confirmed that PET alone is not an adequate diagnostic procedure in the detection and preoperative staging of gastric cancer but it could be helpful when used in conjunction with CT.^{49,50}

EUS is indicated for assessing the depth of tumor invasion.⁵¹ The accuracy of EUS for T-staging ranges from 65% to 92% and 50% to 95% for N staging and is operator-dependent. Distant lymph node evaluation by EUS is suboptimal given the limited depth and visualization of the transducer.⁵²

Laparoscopic staging can detect occult metastases. In a study conducted by Memorial Sloan Kettering Cancer Center, 657 patients with potentially resectable gastric adenocarcinoma underwent laparoscopic staging over a period of 10 years.⁵³ Distant metastatic disease (M1) was detected in 31% of the patients. Limitations of laparoscopic staging include two-dimensional evaluation and limited use in the identification of hepatic metastases and perigastric lymph nodes. In patients being considered for surgical resection without preoperative therapy, laparoscopy may be useful for the detection of radiographically occult metastatic disease in patients with T3 and/or N+ tumors identified on preoperative imaging. In patients receiving preoperative therapy, laparoscopy along with cytology of peritoneal washings is recommended.⁵³ The guidelines have included laparoscopic staging with a category 2B recommendation.



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Cytology testing of peritoneal fluid can help improve staging through identification of occult carcinomatosis.⁴³ Positive peritoneal cytology is associated with a poor prognosis in patients with gastric cancer. A positive peritoneal cytology is an independent predictor for identifying patients who are at higher risk for recurrence following curative resection.⁵⁴ Laparoscopic lavage cytology is also very useful to identify the subset of patients with M1 disease who are unlikely to benefit from resection alone.⁵⁵ A recent report suggests that clearing of cytology-positive disease by chemotherapy is associated with a statistically significant improvement in disease-specific survival but cures are rare.⁵⁶ Therefore, positive peritoneal cytology in the absence of visible peritoneal implants should be considered as M1 disease. The panel recommends that patients with advanced tumors, T3 or N1 disease should be considered for laparoscopic staging with peritoneal washings for cytology.

Principles of Pathology

Biopsy

A specific diagnosis of gastric adenocarcinoma should be established for staging and treatment purposes. In the revised AJCC staging system, tumors arising in the proximal stomach and crossing the EGJ are classified as esophageal carcinomas.⁵⁷ In addition to the histologic type, the pathology report (regardless of the specimen type) should include specifics about tumor invasion and pathologic grade (required for stage grouping). In addition to the above mentioned elements, the pathology report of the endoscopic mucosal resection (EMR) and surgical resection specimens should also include assessment of lymphovascular invasion, depth of tumor invasion, and the status of mucosal and deep margins. The pathology report of the surgical resection specimen should also document the location of the tumor midpoint in relationship to the EGJ, lymph node status, and the number

of lymph nodes recovered. In the case of gastrectomy with prior chemoradiation and without grossly obvious residual tumor, the tumor site should be thoroughly sampled to detect microscopic residual disease.

While there is no universally accepted minimum number of lymph nodes necessary for accurate staging of gastric cancer, retrieval of at least 15 lymph nodes is recommended to stage nodal status more accurately. Data from a SEER database show that the number of lymph nodes examined correlated with overall survival (OS) after gastrectomy. A trend for superior survival based on more lymph nodes examined was confirmed across all stage subgroups.⁵⁸

Assessment of Treatment Response

The type of pathologic response and histologic tumor regression after neoadjuvant therapy has been shown to be a predictor of survival in patients with gastric adenocarcinoma. Lowy et al reported that clinical response to neoadjuvant chemotherapy was the only important predictor of OS in patients who underwent curative resection for gastric cancer.⁵⁹ In another study, Becker et al demonstrated that histopathologic grading of tumor regression correlated with survival in patients treated with neoadjuvant chemotherapy.⁶⁰ Median survival was significantly better for patients with less than 10% of the residual tumor compared to those patients with 10% to 50% or greater than 50% of the residual tumor. In a recent report, Mansour et al reported that the 3-year disease-specific survival was significantly higher for patients with more than 50% pathologic response to neoadjuvant chemotherapy compared to those with less than 50% (69% and 44%, respectively).⁶¹ Tumor size, perineural or lymphovascular invasion, and the nodal status have been shown to be stronger predictors of survival.



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Although grading systems for tumor response in patients with gastric cancer have not been uniformly adopted, in general, a 3-tiered classification system provides good reproducibility among pathologists. The grading system developed by Ryan et al for rectal carcinoma is reported to provide good interobserver agreement,⁶² but other systems may also be used. Sizable pools of acellular mucin may be present after chemoradiation but should not be interpreted as representing residual tumor. See the “Principles of Pathologic Review and HER2-neu Testing-Assessment of Treatment Response-Table 2” in the guidelines.

Assessment of HER2-neu Overexpression

Human epidermal growth factor receptor 2 (*HER2*) gene and/or HER2 protein expression has been implicated in the development of gastric and EGJ adenocarcinomas.⁶³ The reported rates of *HER2* amplification and HER2 overexpression in patients with gastric cancer range from 12% to 27% and 9% to 23%, respectively.⁶⁴⁻⁶⁹ HER2-positivity also varies with the histologic subtype (intestinal > diffuse) and tumor grade (moderately differentiated > poorly differentiated).^{64,67-69} HER2 positivity is reported in ≤20% of Western patients with metastatic gastric cancer with significantly higher rates of HER2 positivity in patients with intestinal histology (33% vs. 8% for diffuse/mixed histology; $P = .001$).⁶⁹ In the U.S. population, the reported HER2-positive rate is 12% and is more often identified in the intestinal subtype rather than the diffuse subtype (19% and 6%, respectively).⁶⁸ In the Trastuzumab for Gastric Cancer (ToGA) trial that evaluated the addition of trastuzumab to chemotherapy in patients with HER2-neu–positive advanced gastric cancer, HER2-neu–positivity rates were 33%, 21%, 32%, and 6%, respectively, in patients with EGJ adenocarcinoma, gastric adenocarcinoma, intestinal and diffuse cancer, or mixed type cancer.⁷⁰

Therefore, subclassification of gastric adenocarcinomas as intestinal or diffuse type may have implications for therapy.

However, unlike in breast cancer, the prognostic significance of HER2 status in patients with gastric cancer remains unclear with some studies suggesting that HER2 positivity is associated with poor prognosis.^{66,67,71,72} Others have shown that it is not an independent prognostic factor of patient outcome, except in a very small subgroup of patients with intestinal histology.^{68,69,73} While further studies are needed to assess the prognostic significance of HER2 positivity, the most important clinical application of HER2 status in patients with gastric cancer concerns the management of patients with advanced or metastatic disease.

Immunohistochemistry (IHC) is the most widely used primary test for the assessment of HER2 overexpression. IHC evaluates the membranous immunostaining of the tumor cells including intensity and the extent of staining and the percentage of immunoreactive tumor cells, with scores ranging from 0 to 3+. Fluorescence in situ hybridization (FISH) is usually reserved for verifying results that are considered equivocal by IHC. FISH results are expressed as the ratio between the number of copies of the *HER2* gene and the number of chromosome 17 centromere (CEP17), within the nucleus counted in at least 20 cancer cells (HER2:CEP17).

According to the HER2 scoring system for breast cancer proposed by the American Society of Clinical Oncology/College of American Pathologists, uniform intense membrane staining in more than 30% of invasive tumor cells is considered positive for HER2 overexpression. However, due to two major differences in HER2 staining patterns between the breast and gastric cancer cells (incomplete membrane staining in a basolateral pattern and greater tumor heterogeneity, both



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of which are more frequent in gastric cancer), it has been reported that application of this scoring system would not identify many gastric cancer patients who could otherwise be candidates for anti-HER2 therapy.^{74,75} Results from two separate series also demonstrated that the HER2 scoring system for breast cancer identified a significantly lower percentage of patients with gastric cancer meeting the criteria for HER2 positivity by IHC (5.4% vs. 11% in the ToGA trial).^{76,77}

In 2008, Hoffmann et al developed a modified 4-tier HER2 scoring system specific for gastric cancer by using the assessment area cut-off of at least 10% stained tumor cells for resection specimens and omitting this area cut-off for biopsy specimens.⁷⁴ In a subsequent validation study (447 prospective diagnostic gastric cancer specimens), this scoring system was found to be reproducible between different pathologists.⁷⁵ This modified HER2 scoring system was also used in the ToGA trial.⁷⁶

HER2 testing is now recommended for all patients with metastatic disease at the time of diagnosis. The guidelines recommend that assessment for HER2 status should be performed first using IHC following the modified scoring system used in the ToGA trial.^{74,76} A score of 0 or 1+ is considered to be negative for *HER2* expression. A score of 2+ is considered equivocal and should be confirmed with FISH or other in situ hybridization techniques. The panel recommends FISH only for patients with a score of IHC 2+, although some institutions routinely perform both IHC and FISH on all patients. See the *Principles of Pathologic Review and HER2-neu Testing-Assessment of Treatment Response -Table 3* in the guidelines.

Surgery

Surgery is the primary treatment for patients with early-stage gastric cancer. Complete resection with adequate margins (4 cm or greater) is

widely considered as a standard goal, whereas the type of resection (subtotal vs. total gastrectomy) along with extent of lymph node dissection remains a subject of controversy.

Principles of Surgery

Clinical staging using CT scan (chest, abdomen, and pelvis) with or without EUS should be performed before surgery to assess the extent of the disease. The primary goal of surgery is to accomplish a complete resection with negative margins (R0 resection). Only 50% of patients will end up with an R0 resection of their primary.^{78,79} R1 indicates microscopic residual disease (positive margins) and R2 indicates gross (macroscopic) residual disease in the absence of distant metastasis.⁸⁰

Subtotal gastrectomy is the preferred approach for distal gastric cancers. This procedure has a similar surgical outcome compared to total gastrectomy although with significantly fewer complications.⁸¹ Proximal gastrectomy and total gastrectomy are both indicated for proximal gastric cancers and are typically associated with postoperative nutritional impairment.

Adequate gastric resection (distal, subtotal, or total gastrectomy) to achieve negative microscopic margins (4 cm or greater from the gross tumor) is preferred for resectable T1b-T3 tumors.⁸² T4 tumors require en bloc resection of involved structures. Tis or T1b tumors may be candidates for EMR in experienced centers.

Routine or prophylactic splenectomy should be avoided if possible. In a randomized clinical study, postoperative mortality and morbidity rates were slightly higher in patients who underwent total gastrectomy combined with splenectomy, and marginally better survival, but there were no statistically significant differences between the groups.⁸³ The results of this study do not support the use of prophylactic splenectomy



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to remove macroscopically negative lymph nodes near the spleen in patients undergoing total gastrectomy for proximal gastric cancer. Placement of a jejunostomy feeding tube may be considered for selected patients who will be receiving postoperative chemoradiation.

Carcinomas are considered unresectable if there is evidence of peritoneal involvement (including positive peritoneal cytology), distant metastases, or locally advanced disease (N3 or N4 lymph node involvement highly suspicious on imaging or confirmed by biopsy; invasion or encasement of major vascular structures, excluding the splenic vessels). Limited gastric resection, even with positive margins, is acceptable for unresectable tumors for palliation of symptomatic bleeding.

Gastric resections should be reserved for the palliation of symptoms (obstruction or uncontrollable bleeding) in patients with incurable disease.⁸⁴ Lymph node dissection is not required. Gastric bypass with gastrojejunostomy (open or laparoscopic) is preferable to endoluminal stenting in symptomatic patients, if they are fit for surgery and have a reasonable prognosis due to lower rate of recurrent symptoms.⁸⁵ Placement of venting gastrotomy and/or a feeding jejunostomy tube may be considered.

Lymph Node Dissection

Gastric resection should include lymph node dissection (or lymphadenectomy), which involves the removal of regional lymph nodes. A recent retrospective analysis has shown that more extensive lymph node dissection and analysis influences survival in patients with advanced gastric cancer. This analysis included 1377 patients diagnosed with advanced gastric cancer in the SEER database. Patients who had more than 15 N2 nodes and more than 20 N3 nodes examined had the best long-term survival outcomes.⁸⁶ However, the

extent of lymph node dissection remains controversial. The Japanese Research Society for the Study of Gastric Cancer has established guidelines for pathologic examination and evaluation of lymph node stations that surround the stomach.⁸⁷ The perigastric lymph node stations along the lesser curvature (stations 1, 3, and 5) and greater curvature (stations 2, 4, and 6) of the stomach are grouped together as N1. The nodes along the left gastric artery (station 7), common hepatic artery (station 8), celiac artery (station 9), and splenic artery (stations 10 and 11) are grouped together as N2. More distant nodes, including para-aortic (N3 and N4), are regarded as distant metastases.

Lymph node dissection may be classified as D0, D1, or D2 depending on the extent of lymph nodes removed at the time of gastrectomy. D0 refers to incomplete resection of N1 lymph nodes. D1 involves gastrectomy and the removal of the involved proximal or distal part of the stomach or the entire stomach (distal or total resection), including the greater and lesser omental lymph nodes (which would be the right and left cardiac lymph nodes, along lesser and greater curvature, and suprapyloric along the right gastric artery and infra pyloric area). D2 involves D1 plus the removal of all the nodes along the left gastric artery, common hepatic artery, celiac artery, splenic hilum, and splenic artery. The technical aspects of performing a D2 lymph node dissection require a significant degree of training and expertise.

Gastrectomy with D2 lymph node dissection is the standard treatment for curable gastric cancer in eastern Asia. In Western countries, extended lymph node dissection of distant lymph nodes contributes to accurate staging of the disease. However, its contribution to the prolongation of survival is unclear and much of the survival benefit associated with an extensive lymph node dissection may be due to the effect of stage migration.^{58,86,88} In the West, D2 lymph node dissection is considered a recommended but not a required procedure. However,



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there is uniform consensus that removal of an adequate number of nodes (15 or greater) is beneficial for staging purposes.

Initial results from two large randomized trials performed in Western countries failed to demonstrate a significant survival benefit for D2 lymph node dissection over D1 dissection.^{89,90} In the Dutch Gastric Cancer Group Trial, 711 patients who underwent surgical resection with curative intent were randomized to undergo either a D1 or D2 lymph node dissection.⁸⁹ The postoperative morbidity (25% vs. 43%, $P < .001$) and mortality (4% vs. 10%, $P = .004$) were higher for patients who underwent D2 lymph node dissection, with no difference in OS (30% vs. 35%, $P = .53$) between the two groups. In a subset analysis, patients with N2 cancer undergoing a D2 lymph node dissection showed a trend towards improved survival. Unfortunately, N2 cancer can only be detected after microscopic examination of the surgical specimen. After a median follow-up of 15 years, D2 lymph node dissection was associated with lower local (12% vs. 22%) regional recurrence (13% vs. 19%) and gastric cancer-related death rates (37% vs. 48%) than D1 lymph node dissection. D2 lymph node dissection was also associated with significantly higher postoperative mortality, morbidity, and reoperation rates. The British Cooperative trial conducted by the Medical Research Council also failed to demonstrate a survival benefit for D2 over D1 lymph node dissection.⁹⁰ The 5-year OS rates were 35% and 33%, respectively, for D1 and D2 lymph node dissections. In addition, the D2 lymph node dissection was associated with increased postoperative morbidity and mortality.

Long-term follow-up data from the Dutch Gastric Cancer Group trial have confirmed a survival benefit for D2 lymph node dissection. The 15-year OS rates were 21% and 29%, respectively, for the D1 and D2 group ($P = .34$). D2 lymph node dissection was also associated with lower rates of local (12% vs. 22%) and regional recurrence (13%

vs. 19%).⁹¹ More importantly, gastric cancer-related death rate was significantly lower in the D2 group compared to the D1 group (37% and 48%, respectively).⁹¹

Two other studies from Western countries have also reported better outcomes for D2 lymph node dissection when performed according to the recommendations of Japanese Research Society for Gastric Cancer.^{92,93} In an Austrian study, 5-year and 10-year OS rates were 45.7% and 34.3%, respectively.⁹² For patients who underwent curative surgery, 5-year and 10-year survival rates were 57.7% and 44.3%, respectively, which are comparable to those reported in Japanese trials. Postoperative mortality rates for R0, R1/R2 and palliative resections were 4.9%, 9%, and 13.4%, respectively. Sierra and colleagues from a single institution in Spain reported longer 5-year survival rates in the D2 group (50.6%) than in the D1 group (41.4%).⁹³ No significant differences were seen in morbidity (48.2% and 53.5%, respectively, for D1 and D2). Operative mortality rate was 2.3% for D1 and 0% for D2 lymph node dissection. Pancreatectomy, hepatic wedge resection, or partial colectomy was performed only for macroscopic invasion.

Investigators have long been arguing that if the complication rate after a D2 lymph node dissection could be decreased then there may be a benefit in selected patients. Although pancreatectomy and splenectomy have been widely performed with D2 lymph node dissection in Japan, both of these procedures have been shown to increase postoperative mortality and morbidity.^{89,90,94,95}

In a prospective, randomized, phase II study conducted by the Italian Gastric Cancer Study Group, pancreas-preserving D2 lymph node dissection was associated with a survival benefit and lower complication rate.^{94,95} Pancreatectomy was performed only when T4



tumor involvement was suspected. Postoperative complications were higher after D2 gastrectomy (16.3% vs. 10.5% after D1), but the difference was not statistically significant ($P < .29$). Postoperative mortality rates were 0% and 1.3%, respectively. The 5-year OS rate among all eligible patients was 55%. The overall 5-year morbidity rate was 20.9% and a postoperative in-hospital mortality rate was 3.1% for D2 lymph node dissection without pancreatectomy.⁹⁴ These rates are comparable to the rates for D1 lymph node dissections in the Dutch and United Kingdom trial.

In a randomized controlled trial (JCOG9501), Japanese investigators comparing D2 lymph node dissection alone with D2 lymph node dissection with para-aortic nodal dissection (PAND) in patients undergoing gastrectomy for curable (T2b, T3 or T4) gastric cancer reported a postoperative mortality rate of 0.8% in each arm.⁹⁶ The final results of this study showed that D2 lymph node dissection with PAND does not improve survival rate in curable gastric cancer, compared to D2 lymph node dissection alone. The 5-year OS rates were 70.3% and 69.2%, respectively. There were also no significant differences in the relapse-free survival (RFS) rates between the two groups.⁹⁷ In a post hoc subgroup analysis, among patients with pathologically negative nodes, the survival rates were better for patients who underwent D2 lymph node dissection plus PAND than those who were assigned to D2 lymph node dissection alone. In patients with metastatic nodes, the survival rates were worse for those assigned to D2 lymph node dissection plus PAND. However, the investigators of this study caution that these results from post hoc analysis could be false positive due to multiple testing and the survival benefit of D2 lymph node dissection with PAND in patients with node-negative disease needs to be clarified in further studies. The investigators concluded that D2 lymph node

dissection plus PAND should not be used to treat patients with curable gastric cancer (T2b, T3 or T4).

Recent reports from Western countries also suggest that D2 lymph node dissection is associated with lower postoperative complications and a trend toward improved OS when performed in high-volume centers that have sufficient experience with the operation and postoperative management.⁹⁸⁻¹⁰⁰

In an analysis involving patients from the Intergroup 0116 trial, Enzinger and colleagues assessed the impact of hospital volume on the outcome of patients who underwent lymph node dissection (54% underwent D0 lymph node dissection and 46% underwent D1 or D2 lymph node dissection).⁹⁸ High-volume centers did not have any effect on OS or disease-free survival (DFS) for patients who underwent D0 lymph node dissection. However, there was a trend toward improved OS among patients who underwent D1 or D2 lymph node dissection at moderate- to high-volume cancer centers.

In a randomized phase II trial of D1 vs. D2 lymph node dissection conducted by the Italian Gastric Cancer Study Group in 267 patients with gastric cancer (133 patients allocated to D1 dissection and 134 patients allocated to D2 dissection), the morbidity and postoperative mortality rate were not significantly different between the two groups.^{99,100} The overall mortality rate was 12% after D1 dissection vs. 17.9% after D2 dissection ($P = .183$). The corresponding postoperative 30-day mortality rates were 3% and 2.2%, respectively ($P = .722$). At the median follow-up of 8.8 years, the 5-year OS rates were 66.5% and 64.2% after D1 and D2 lymph node dissections, respectively ($P = .695$).¹⁰⁰ D2 lymph node dissection was associated with a trend towards improved DSS in patients with advanced gastric cancer (p T2-T4) and



positive lymph nodes (59% vs. 38% for D1 lymph node dissection; $P = .055$).¹⁰⁰

A recent meta-analysis also confirmed that among patients who underwent D2 lymph node dissections, there was a trend toward improved survival for patients who did not undergo resection of the spleen or pancreas, as well as for patients with T3 or T4 cancers.¹⁰¹

The guidelines recommend gastrectomy with D1 or a modified D2 lymph node dissection, with a goal of examining at least 15 if not more lymph nodes, for patients with localized resectable cancer.^{86,91,94,95} The panel members also acknowledge that the technical aspects of performing a D2 dissection require a significant degree of training and expertise. Therefore, the guidelines emphasize that D2 dissection should be performed by experienced surgeons in high-volume centers. Prophylactic pancreatectomy and splenectomy is no longer recommended with D2 lymph node dissection.^{83,102} The NCCN Guidelines recommend splenectomy only when spleen or hilum is involved.

Laparoscopic Resection

Laparoscopic resection is an emerging surgical approach that offers important advantages (less blood loss, reduced postoperative pain, accelerated recovery, early return to normal bowel function, and reduced hospital stay) when compared with open surgical procedures for patients with gastric cancer.¹⁰³ A prospective randomized study conducted by Hulscher and colleagues compared early and 5-year clinical outcomes of laparoscopic and open subtotal gastrectomy in 59 patients with distal gastric cancer.¹⁰⁴ Operative mortality rates (3.3% vs. 6.7%, respectively), 5-year OS (58.9% vs. 55.7%, respectively), and DFS rates (57.3% vs. 54.8% respectively) were better for the laparoscopic group, though not significant. However, the role of this

approach in the treatment of gastric cancer requires further investigation in larger randomized clinical trials.

Endoscopic Therapies

EMR and endoscopic submucosal dissection (ESD) have been used as alternatives to surgery for the treatment of patients with early-stage gastric cancer. The applicability of these techniques in the United States is limited because of the low incidence of early gastric cancer.

EMR represents a major advance in minimally invasive approaches for the management of patients with early-stage gastric cancer.¹⁰⁵ Most of the experience with EMR for early gastric cancer has been gained by countries with a high incidence of gastric cancer and an active screening program.¹⁰⁶⁻¹¹⁰ In a series of 124 patients with mucosal early-stage gastric cancers less than 2 cm in size, Uedo et al have reported 5- and 10-year survival rates of 84% and 64%, respectively.¹⁰⁷ In another retrospective study of 215 patients with intramucosal gastric cancer, EMR was also comparable to surgery in terms of risk of death and recurrence, and EMR also had significantly shorter hospital stays.¹¹⁰ A proper selection of patients is essential to improve the clinical outcomes of EMR; endoscopic gross type (depressed lesion), the degree of differentiation, and the depth of invasion were identified as independent predictors of higher complete resection rates.¹⁰⁸

ESD has also been reported to be safe and effective for early gastric cancer when performed by experienced endoscopists.¹¹¹⁻¹¹⁶ En-bloc excision of small gastric lesions by ESD has been shown to be more effective than EMR for patients with early-stage gastric cancer.¹¹⁷⁻¹²² In a multicenter retrospective study of endoscopic resection in patients with early gastric cancer, the 3-year cumulative, residual-free or recurrence-free rate in the ESD group (97.6%) was significantly higher than that in the EMR group (98% and 93%, respectively).¹¹⁷ The



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complete resection rates were significantly better for ESD for lesions more than 5 mm in diameter, whereas the rates were not different between EMR and ESD for lesions less than 5 mm in diameter regardless of location.¹¹⁸⁻¹²⁰ ESD requires greater skills and instrumentation to perform and is also associated with higher rates of bleeding and perforation complications.¹²²

No randomized studies have compared EMR and ESD for the treatment of patients with early-stage gastric cancers. Nevertheless, endoscopic resection (EMR or ESD) continues to evolve as a promising technology in the diagnosis and treatment of early gastric cancers. Endoscopic resection should be performed in medical centers with extensive experience.

Principles of Endoscopy

Endoscopy has become an important tool in the diagnosis, staging, treatment, and palliation of patients with gastric cancer. Most endoscopy procedures are performed with the aid of conscious sedation or monitored anesthesia provided by the endoscopist, nurse, a nurse anesthetist, or an anesthesiologist. Some patients who are at risk for aspiration during endoscopy may require general anesthesia.

Diagnosis

Diagnostic endoscopies are performed to determine the presence and location of a gastric cancer and to biopsy any suspicious lesions. Multiple biopsies (6–8), using standard-size endoscopy forceps, should be performed to provide sufficient material for histologic interpretation, especially in the setting of an ulcerated lesion.¹²³ Larger forceps may improve the yield. Cytologic brushings or washings are rarely adequate in the initial diagnosis, but can be useful in confirming persistent disease following treatment.

For proximal tumors, the location of tumor in the stomach (cardia, fundus, body, antrum, and pylorus) relative to the EGJ should be carefully recorded to assist with treatment planning and follow-up. EMR or ESD of focal nodules (2.0 cm or smaller) can be safely performed in the setting of early-stage disease to provide greater information on the degree of differentiation, the presence of lymphovascular invasion, and the depth of infiltration, thereby providing accurate staging of the tumor, with the potential of being therapeutic.^{124,125}

Staging

EUS provides accurate initial clinical staging of locoregional gastric cancer. EUS performed prior to any treatment provides evidence of depth of tumor invasion (T), presence of abnormal or enlarged lymph nodes likely to harbor cancer (N), and occasionally signs of distant spread, such as lesions in surrounding organs (M) or the presence of ascites.^{126,127} This is especially important in patients who are being considered for endoscopic resection (EMR or ESD).¹²⁸

Perigastric lymph nodes are readily identified by EUS, and the identification of enlarged, hypoechoic (dark), homogeneous, well-circumscribed, rounded structures in these areas indicates the presence of malignant or inflammatory lymph nodes. The accuracy of this diagnosis is significantly increased with the combination of features, but also confirmed with the use of fine-needle aspiration (FNA) biopsy for cytology assessment.¹²⁹ FNA of suspicious lymph nodes should be performed without traversing an area of primary tumor or major blood vessels. Furthermore, an attempt should be made to identify the presence of ascites and FNA should be considered to rule out the peritoneal spread of disease. The combined use of EUS and FNA is an accurate method for diagnosis of gastric submucosal tumor and for differentiating potentially malignant lesions.¹³⁰



Treatment

Proper patient selection is essential when employing endoscopic or limited wedge gastric resections. The probability of lymph node metastasis in early gastric cancer is influenced by the tumor characteristics and increases with increasing tumor size, submucosal invasion, poorly differentiated tumors, and lymphatic and vascular invasion.¹³¹ EMR or ESD can be considered as an adequate therapy for carcinoma in situ (Tis), well or moderately differentiated lesions (2.0 cm or smaller) confined to mucosa (T1a) without evidence of ulceration, lymph node metastases, or lymphovascular invasion and has clear lateral and deep margins.¹³²

The Japanese Gastric Cancer guidelines recommend that EMR should be considered for early gastric cancer lesions that are 2.0 cm or smaller in diameter without associated ulcer formation.¹³³ EMR or ESD of poorly differentiated gastric cancers with evidence of lymphovascular invasion, invasion into the deep submucosa, and positive lateral or deep margins or lymph node metastases should be considered incomplete and additional therapy (gastrectomy with lymph node dissection) should be considered.¹³⁴

Endoscopic tumor ablation can be performed for the short-term control of bleeding. Endoscopic insertion of expandable metal stents is effective in long-term relief of tumor obstruction at the EGJ or the gastric outlet, though surgical gastrojejunostomy may be more efficacious for those with longer-term survival.^{135,136}

Long-term palliation of anorexia, dysphagia, or malnutrition may be achieved with endoscopic or radiographic-assisted placement of feeding gastrostomy (percutaneous endoscopic gastrostomy, PEG) in carefully selected patients when the distal stomach is uninvolved by

tumor or the placement of a feeding jejunostomy (percutaneous endoscopic jejunostomy, PEJ).¹³⁷

Surveillance

EUS performed after chemotherapy or RT has a reduced ability to accurately determine the post-treatment stage of disease.¹³⁸ Similarly, biopsies performed after chemotherapy or RT may not accurately diagnose the presence of residual disease.¹³⁹

Endoscopic surveillance following definitive treatment of gastric cancer requires careful attention to detail for mucosal surface changes and multiple biopsies of any visualized abnormalities. Strictures should be biopsied to rule out neoplastic cause. EUS performed in conjunction with endoscopy exams has a high sensitivity for recurrent disease.¹⁴⁰ EUS-guided FNA should be performed if suspicious lymph nodes or areas of wall thickening are seen.

Radiation Therapy

Radiation therapy (RT) has been assessed in randomized trials in both the preoperative and postoperative setting in patients with resectable gastric cancer. Smalley and colleagues have reviewed clinical and anatomic issues related to RT and offer detailed recommendations for the application of RT for the management of patients with resected gastric cancer.¹⁴¹

Two randomized trials have compared surgery alone to surgery plus RT in patients with gastric cancer. In the first trial conducted by the British Stomach Cancer Group, 432 patients were randomized to undergo surgery alone or surgery followed by RT or chemotherapy.¹⁴² At 5-year follow-up, no survival benefit was seen for patients receiving postoperative RT or chemotherapy compared with those who underwent surgery alone. But there was a significant reduction in



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locoregional recurrence with the addition of RT to surgery (27% with surgery vs. 10% for surgery plus RT and 19% for surgery plus chemotherapy). In the second trial Zhang and colleagues randomized 370 patients to preoperative RT or surgery alone. There was a significant improvement in survival with preoperative RT (30% vs. 20%, $P = .0094$).¹⁴³ Resection rates were also higher in the preoperative RT arm (89.5%) compared to surgery alone (79%), suggesting that preoperative RT improves local control and survival.

The results from a recent systematic review and meta-analysis showed a statistically significant 5-year survival benefit with the addition of RT in patients with resectable gastric cancer.¹⁴⁴ However, randomized trials are needed to confirm these results in patients from the Western Hemisphere.

External-beam RT (45 to 50.4 Gy) as a single modality has minimal value in patients with locally unresectable gastric cancer and does not improve survival.¹⁴⁵ However, when used concurrently with fluorouracil, external-beam RT improves survival. Moertel and colleagues assessed fluorouracil plus RT compared with RT alone in the treatment of locally unresectable gastric cancer.¹⁴⁶ Patients receiving combined modality treatment had a significantly better median survival (13 months vs. 6 months) and 5-year OS (12% vs. none). In another study by the Gastrointestinal Tumor Study Group, 90 patients with locally advanced gastric cancer were randomized to receive either combination chemotherapy with fluorouracil and methyl-CCNU (lomustine) or split-course RT with a concurrent bolus fluorouracil followed by maintenance with fluorouracil and lomustine.¹⁴⁷ In the first 12 months mortality was higher in the combined modality group. At 3 years the survival curve reached a plateau in the combined modality arm, but tumor-related deaths continued to occur in the chemotherapy alone arm, suggesting that a small fraction of patients can be cured with

combined modality treatment. In most of the randomized trials, combined modality treatment showed advantage over RT alone in relatively few patients with unresectable cancer, as reviewed by Hazard and colleagues.¹⁴⁵

Intensity-modulated RT (IMRT) has great potential to reduce radiation-related toxicity by delivering large doses of radiation to target tissues.¹⁴⁸ The use of this technique in gastric cancer remains investigational, and the impact of new conformal RT technologies needs to be assessed in randomized clinical trials.

Principles of Radiation Therapy

RT (preoperative, postoperative, or palliative) can be an integral part of treatment for gastric cancer. All patients should be simulated and treated in the supine position. The panel encourages the use of CT simulation and 3D treatment planning. Intravenous and/or oral contrast may be used when appropriate for CT simulation to aid target localization. Use of an immobilization device is strongly recommended for reproducibility.

The panel recommends involvement of a multidisciplinary team, which should include medical, radiation and surgical oncologists, radiologists, gastroenterologists, and pathologists to determine optimal diagnostic, staging, and treatment modalities. In general, Siewert I and II tumors should be managed with RT guidelines applicable to esophageal and EGJ cancers. Depending on the clinical situation, Siewert III tumors may be more appropriately managed with RT guidelines applicable to either esophageal and EGJ cancers or gastric cancer. These recommendations may be modified depending on the location of the bulk of the tumor.



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Pretreatment diagnostic studies such as EUS, upper GI endoscopy, and CT scans should be used to identify tumor and pertinent nodal groups. The relative risk of nodal metastases at a specific location is dependent on the location of the primary tumor and the extent of invasion of the gastric wall. It may be possible to accurately target high-risk areas and to produce superior dose distributions with the use of 3-D treatment planning systems and unconventional field arrangements. To accomplish this, it is necessary to carefully define and encompass various target volumes.

The panel recommends a dose range of 45 to 50.4 Gy delivered in fractions of 1.8 Gy per day. Every effort should be made to reduce unnecessary radiation doses to vital organs such as liver, kidneys, spinal cord, heart (especially the left ventricle), and lungs. Lung dose volume histogram (DVH) parameters should be considered as predictors of pulmonary complications in patients with gastric and EGJ cancers treated with concurrent chemoradiation, though optimal criteria have not yet emerged. Optimal criteria for DVH parameters are being actively developed at NCCN Member Institutions.

Custom blocking is necessary to limit the volume of normal organs receiving high RT doses (less than 30 Gy to 60% of liver), kidneys (less than 20 Gy to at least 60% of one kidney), spinal cord (less than 45 Gy), heart (less than 50 Gy to 30% of heart, and effort should be made to keep the left ventricle doses to a minimum), and lungs (20 Gy or more to 20% and 10 Gy or more to 40% to reduce incidence of postoperative pulmonary complications). These guidelines may be exceeded as needed to achieve other important planning goals, and as further information becomes available. IMRT may be appropriate in selected patients to reduce the dose to normal structures such as the heart and lungs. In designing IMRT plans, for structures such as the

lungs, attention should be given to the volume receiving low to moderate doses, as well as the volume receiving high doses.

Close patient monitoring and aggressive supportive care are essential during radiation treatment. Management of acute toxicities is necessary to avoid treatment interruptions or dose reductions. Antiemetics should be given for prophylaxis when appropriate. Antacid and antidiarrheal medications may be prescribed when needed. If the caloric intake is inadequate, enteral and/or parenteral nutrition should be considered. Oral and/or intravenous hydration is often necessary throughout chemoradiation and early recovery. Feeding jejunostomies may be placed if clinically indicated. It is essential to monitor levels of B₁₂, iron, and calcium in postoperative patients. Oral supplementation is recommended to maintain adequate levels.

Combined Modality Treatment: Concurrent Chemotherapy and Radiation Therapy

Preoperative Chemoradiation Therapy

In a pilot study, Lowy and colleagues assessed the feasibility of preoperative chemoradiation (45 Gy of external beam RT with concurrent continuous infusion of fluorouracil) followed by surgery and intraoperative RT (IORT; 10 Gy) in the treatment of patients with potentially resectable gastric cancer.¹⁴⁹ Significant pathologic responses were seen in 63% of patients, and complete pathologic response was seen in 11% of patients who received preoperative chemoradiation. Eighty three percent of patients who received chemoradiation therapy underwent D2 lymph node dissection. In a prospective, randomized trial, preoperative chemoradiation with fluorouracil and cisplatin followed by surgery was superior to surgery alone in patients with resectable adenocarcinoma of the esophagus (74 patients) and gastric cardia (39 patients); the median survival was 16



months and 11 months, respectively, for patients assigned to multimodal therapy and surgery alone ($P = .01$).¹⁵⁰

The value of preoperative chemoradiation therapy for patients with resectable gastric cancer remains uncertain and is the subject of an ongoing international prospective phase III randomized trial.¹⁵¹ The regimens listed in the guidelines are derived from the phase III trials that have included patients with adenocarcinoma of the esophagus and/or EGJ.

Preoperative Sequential Chemotherapy and Chemoradiation Therapy

Recent studies have also shown that sequential preoperative induction chemotherapy followed by chemoradiation yields a substantial pathologic response that results in durable survival time.¹⁵²⁻¹⁵⁶

In the RTOG 9904 study, preoperative induction chemotherapy with fluorouracil and cisplatin followed by concurrent chemoradiation with infusional fluorouracil and paclitaxel resulted in a pathologic complete response rate of 26% of patients with localized gastric adenocarcinoma. D2 lymph node dissection and R0 resection were achieved in 50% and 77% of patients, respectively.¹⁵⁴

In a phase II study, preoperative chemotherapy with irinotecan and cisplatin followed by concurrent chemoradiation with the same regimen resulted in moderate response rates in patients with resectable, locally advanced gastric and EGJ adenocarcinoma.¹⁵⁶ R0 resection was achieved in 65% of patients. Median survival and the actuarial 2-year survival rate were 14.5 months and 35%, respectively.¹⁵⁶

In a recent phase III study, Stahl et al compared preoperative chemotherapy (cisplatin, fluorouracil, and leucovorin) with

chemoradiation using the same regimen in 119 patients with locally advanced adenocarcinoma of the EGJ.¹⁵⁵ Patients with locally advanced adenocarcinoma of the lower esophagus or EGJ were randomized between two treatment groups: chemotherapy followed by surgery (arm A) or chemotherapy followed by chemoradiation followed by surgery (arm B). Patients in arm B had a significantly higher probability of achieving pathologic complete response (15.6% vs. 2.0%) or tumor-free lymph nodes (64% vs. 38%) at resection. Preoperative chemoradiation improved 3-year survival rate from 28% to 47%. Although the study was closed prematurely due to low accrual and statistical significance was not achieved, there was a trend towards survival advantage for preoperative chemoradiation compared with preoperative chemotherapy for patients with EGJ adenocarcinoma.

Induction chemotherapy prior to preoperative chemoradiation may be appropriate in selected patients. However, this approach has not been evaluated in randomized clinical trials.

Postoperative Chemoradiation Therapy

The landmark Intergroup trial SWOG 9008/INT-0116 investigated the effect of surgery plus postoperative chemoradiation on the survival of patients with resectable adenocarcinoma of the stomach or EGJ.¹⁵⁷ In this trial 556 patients with completely resected gastric cancer or EGJ adenocarcinoma (stage IB-IV, M0) were randomized to surgery alone (n=275) or surgery plus postoperative chemoradiation (n=281; bolus fluorouracil and leucovorin before and after concurrent chemoradiation with fluorouracil and leucovorin). The majority of patients had T3 or T4 tumors (69%) and node-positive disease (85%); only 31% of the patients had T1-T2 tumors and 14% of patients had node-negative tumors. Surgery was not part of the trial protocol, but resection of all detectable disease was required for participation in the trial. Patients



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were eligible for the study only after recovery from surgery. Postoperative chemoradiation (offered to all patients with tumors T1 or higher, with or without lymph node metastases) significantly improved OS and RFS. Median OS in the surgery-only group was 27 months and was 36 months in the chemoradiation group ($P = .005$). The chemoradiation group had better 3-year OS (50% vs. 41%) and RFS rates (48% vs. 31%) than the surgery only group. There was also a significant decrease in local failure as the first site of failure (19% vs. 29%) in the chemoradiation group. With more than 10 years of median follow-up, survival remains improved in patients with stage IB-IV (M0) gastric cancer or EGJ adenocarcinoma treated with postoperative chemoradiation. No increases in late toxic effects were noted.¹⁵⁸

The results of the INT-0116 trial have established postoperative chemoradiation therapy as a standard of care in patients with completely resected gastric cancer who have not received preoperative therapy. However, the regimen used in this trial (bolus fluorouracil and leucovorin before and after chemoradiation with the same combination) was associated with high rates of grade 3 or 4 hematologic and GI toxicities (54% and 33%, respectively). Among the 281 patients assigned to the chemoradiation group, only 64% of patients completed treatment and 17% discontinued treatment due to toxicity. Three patients (1%) died as a result of chemoradiation-related toxic effects including pulmonary fibrosis, cardiac event, and myelosuppression.

Alternative postoperative chemoradiation regimens containing infusional fluorouracil or capecitabine have been evaluated by other investigators.¹⁵⁹⁻¹⁶¹ In a pilot study, postoperative chemoradiation with fluorouracil and cisplatin before and after capecitabine and concurrent RT was well tolerated in patients with completely resected stage III-IV, M0 gastric cancer.¹⁵⁹ Leong et al reported that postoperative chemotherapy with epirubicin, cisplatin, and fluorouracil (ECF) before

and after concurrent chemoradiation with infusional fluorouracil was safe and effective in patients with completely resected gastric adenocarcinoma.¹⁶⁰ At a median follow-up of 36 months, the estimated 3-year OS rate was 62%. The 3-year DFS and OS rates were 82.7% and 83.4%, respectively. In the randomized Intergroup trial (CALGB 80101), postoperative chemoradiation with ECF before and after fluorouracil and RT did not improve survival compared to the INT-0116 regimen in patients who have undergone curative resection for gastric or EGJ adenocarcinoma.¹⁶¹ The ECF regimen, however, had a favorable toxicity profile compared to bolus fluorouracil and leucovorin, which was associated with more GI toxicities (15% vs. 7% for ECF) and neutropenia (33% vs. 19% for ECF).

Although the INT-0116 trial formed the basis for the recommendation of postoperative chemoradiation for patients with completely resected gastric cancer, the recommend doses or the schedule of chemotherapy agents as used in the INT-0116 trial are no longer used due to concerns regarding toxicity. Instead, regimens containing infusional fluorouracil or capecitabine are used for patients with completely resected gastric cancer.^{159,160,162}

While the results of the INT-0116 trial demonstrated a significant survival benefit for postoperative chemoradiation (after curative surgery with (D0 or D1 lymph node dissection) in patients with T3-T4, N0 and any T, node positive tumors, the effectiveness of this approach in patients with T2, N0 tumors remains unclear because of the smaller number of such patients enrolled in this trial. This trial was also not sufficiently powered to evaluate the role of postoperative chemoradiation when a D2 lymph node dissection is performed. In the INT-0116 trial, D2 lymph node dissection was not commonly performed and patients were not excluded on the basis of the extent of lymph



node dissection. D0, D1 and D2 dissections were performed in 54%, 36%, and 10% of patients, respectively.

The results of the recently completed phase III trial (ARTIST trial) showed that postoperative chemoradiation with capecitabine and cisplatin did not significantly reduce recurrence after D2 lymph node dissection in patients with curatively resected gastric cancer ($n = 458$; stage IB-IV, M0).¹⁶³ Patients with T2a, N0 tumors, microscopically positive resection margin, involvement of M1 lymph node or distant metastases, and those who had undergone gastrectomy with D1 lymph node dissection were excluded from this study. At a median follow-up of 53 months, the estimated 3-year DFS rates were 78% and 74%, respectively, for postoperative chemoradiation and chemotherapy ($P = .0862$). In the subgroup analysis of patients with positive pathologic lymph nodes, postoperative chemoradiation was associated with a statistically significant prolongation of 3-year DFS compared to chemotherapy alone (77.5% and 72%, respectively; $P = .0365$).¹⁶³ However, this study demonstrated that postoperative treatment with capecitabine and cisplatin is feasible following a D2 lymph node dissection.

In a recent retrospective analysis that compared the outcome of patients treated with surgery alone and patients treated with postoperative fluoropyrimidine-based chemoradiation in several Dutch phase I/II studies, postoperative chemoradiation was associated with significantly lower recurrence rates after D1 lymph node dissection (2% for those who underwent D1 lymph node dissection followed by postoperative chemoradiation compared to 8% for patients who underwent D1 lymph node dissection alone; $P = .001$), whereas there was no significant difference in recurrence rates between the two groups following D2 lymph node dissection.¹⁶⁴

Chemotherapy

Perioperative Chemotherapy

The British Medical Research Council performed the first well-powered phase III trial (MAGIC trial) that evaluated perioperative chemotherapy for patients with resectable gastroesophageal cancer.¹⁶⁵ In this trial, 503 patients were randomized to receive either perioperative chemotherapy (preoperative and postoperative chemotherapy with ECF) and surgery or surgery alone. Patients were randomized prior to surgical intervention (74% of patients had gastric cancer; 69% in the surgery plus chemotherapy group and 66% in the surgery only group had undergone R0 resection). The majority of patients had T2 or higher tumors (12% had T1 tumors, 32% of patients had T2 tumors, and 56% of patients had T3-T4 tumors) and 71% of patients had node-positive disease. The perioperative chemotherapy group had a greater proportion of T1 and T2 tumors (51.7%) and less advanced nodal disease (N0 or N1; 84%) than the surgery group (36.8% and 70.5%, respectively). Perioperative chemotherapy significantly improved PFS (PFS; $P < .001$) and OS ($P = .009$). The 5-year survival rates were 36% among those who received perioperative chemotherapy and 23% in the surgery group.

In a more recent FNCLCC/FFCD trial ($n = 224$; 75% of patients had adenocarcinoma of the lower esophagus or EGJ and 25% had gastric cancer), Ychou et al reported that perioperative chemotherapy with fluorouracil and cisplatin significantly increased the curative resection rate, DFS, and OS in patients with resectable cancer.¹⁶⁶ The 5-year OS rate was 38% for patients in the surgery plus perioperative chemotherapy group and 24% in the surgery only group ($P = .02$). The corresponding 5-year DFS rates were 34% and 19%, respectively. This trial was prematurely terminated even after allowing gastric cancer patients due to the lack of accrual.



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The results of these two studies established perioperative chemotherapy as another alternative option for patients with resectable gastric cancer who have undergone curative surgery with limited lymph node dissection (D0 or D1). However, these studies were not powered to evaluate the role of preoperative or postoperative treatment when a D2 lymph node dissection is performed. In the MAGIC trial, the extent of lymph node dissection was determined by the surgeon's discretion; the reported rates of D2 dissection were 28% in the perioperative chemotherapy group and 30% in the surgery only group.¹⁶⁵ In the FNCLCC/FFCD trial, D2 dissection was recommended and the surgical procedure was decided by the surgeon according to the tumor site and local practice.¹⁶⁶

Postoperative Chemotherapy

Postoperative chemotherapy following complete resection has not been associated with a significant survival benefit in patients with gastric cancer.¹⁶⁷⁻¹⁷² In the randomized trial conducted by Japan Clinical Oncology Group (JCOG 8801), curative surgery alone was associated with very good survival rates in patients with T1 cancer.¹⁶⁷ However, two recent, large, Asian, randomized, phase III studies (ACTS GC trial and CLASSIC trial) have documented survival benefit for postoperative chemotherapy after curative D2 lymph node dissection in patients with gastric cancer.^{173,174}

The ACTS GC trial in Japan evaluated the efficacy of postoperative chemotherapy with a novel oral fluoropyrimidine S-1 (combination of tegafur [prodrug of fluorouracil; 5-chloro-2,4-dihydropyridine] and oxonic acid) in patients with stage II (excluding T1) or stage III gastric cancer who underwent R0 gastric resection with D2 lymph node dissection. In this study, 1059 patients were randomized to surgery alone or surgery followed by postoperative chemotherapy with S-1.¹⁷³

The 3-year OS rate was 80.1% and 70.1%, respectively, for S-1 group and surgery alone. Hazard ratio for death in the S-1 group was 0.68. The 5-year follow-up data also confirmed these findings.¹⁷⁵ This is the first time postoperative chemotherapy has been shown to be beneficial after D2 resection in the Japanese patient population. S-1 remains an investigational agent in North America.

The CLASSIC trial (conducted in South Korea, China, and Taiwan) evaluated postoperative chemotherapy with capecitabine and oxaliplatin after curative D2 gastrectomy in patients with stage II-IIIb gastric cancer; at least 15 lymph nodes were removed to ensure adequate disease classification.¹⁷⁴ In this study, 1035 patients were randomized to surgery alone or surgery followed by postoperative chemotherapy.¹⁷⁴ The planned interim analysis of this trial (after a median follow-up of 34.2 months) showed that postoperative chemotherapy with capecitabine and oxaliplatin significantly improved DFS compared to surgery alone for all disease stages (II, IIIA, and IIIB). The 3-year DFS rates were 74% and 59%, respectively ($P < .0001$). The lack of difference in OS is most likely due to inadequate length of follow-up, but OS is expected to become significant.

The results of these two studies support the use of postoperative chemotherapy after curative surgery with D2 lymph node dissection in patients with resectable gastric cancer. However, it should be noted that the benefit of this approach following a D1 or D0 lymph node dissection has not been documented in randomized clinical trials. Thus, postoperative chemoradiation remains an effective treatment of choice for this group of patients.^{157,164}

Chemotherapy for Locally Advanced or Metastatic Disease

Chemotherapy can provide palliation, improved survival, and improved quality of life compared to best supportive care in patients with



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advanced and metastatic disease.^{176,177} Chemotherapy regimens including older agents (mitomycin, fluorouracil, cisplatin, and etoposide)¹⁷⁸⁻¹⁸⁰ as well as newer agents (irinotecan, oral etoposide, paclitaxel, docetaxel, and pegylated doxorubicin)¹⁸¹⁻¹⁹⁴ have demonstrated activity in patients with advanced gastric cancer.

In the early 1980s, FAM (fluorouracil, doxorubicin, and mitomycin) was considered the gold standard for patients with advanced gastric cancer.¹⁹⁵ The pivotal study performed by the North Central Cancer Treatment Group (NCCTG) comparing FAM to fluorouracil alone and fluorouracil plus doxorubicin showed no significant survival difference between all 3 arms.¹⁹⁶ Higher response rates were observed in patients who received combination chemotherapy vs. fluorouracil alone. Several randomized studies have compared various fluorouracil-based combination regimens (FAM vs. FAMTX [fluorouracil, adriamycin, and methotrexate],¹⁹⁷ FAMTX vs. ECF [epirubicin, cisplatin, and fluorouracil],¹⁹⁸ FAMTX vs. ELF [etoposide, leucovorin, and fluorouracil] vs. fluorouracil plus cisplatin,¹⁹⁹ and ECF vs. MCF [mitomycin, cisplatin, fluorouracil]²⁰⁰). ECF demonstrated improvements in median survival and quality of life when compared to FAMTX or MCF regimens.

The combination of fluorouracil, leucovorin, and oxaliplatin has been evaluated as an alternative to cisplatin and fluorouracil in patients with advanced or metastatic gastric cancer.^{201,202} Recently, a phase III trial conducted by the German Study Group showed that the combination of fluorouracil, leucovorin, and oxaliplatin (FLO) had a trend toward improved median PFS compared to fluorouracil, leucovorin, and cisplatin (FLP) (5.8 vs. 3.9 months).²⁰³ However, there were no significant differences in median OS (10.7 vs. 8.8 months, respectively) between the two groups. FLO was associated with significantly less toxicity than FLP. In patients older than 65 years, FLO resulted in significantly superior response rates (41.3% vs. 16.7%), time to

treatment failure (5.4 vs. 2.3 months), PFS (6.0 vs. 3.1 months), and an improved OS (13.9 vs. 7.2 months) compared with FLP.

The combination of docetaxel, cisplatin, and fluorouracil (DCF) was evaluated in a randomized multinational phase III study (V325). In this trial, 445 untreated patients with advanced gastric cancer were randomized to receive either DCF every 3 weeks or cisplatin and fluorouracil (CF).²⁰⁴ The majority of patients had advanced gastric cancer and 19% to 25% of patients had EGJ cancer. At a median follow-up of 13.6 months, time-to-progression (TTP) was significantly longer with DCF compared with CF (5.6 months vs. 3.7 months; $P < .001$). The median OS was significantly longer for DCF compared with CF (9.2 months vs. 8.6 months; $P = 0.02$), at a median follow-up of 23.4 months; the confirmed overall response rate (ORR) was also significantly higher with DCF than CF (37% and 25%, respectively; $P = .01$).²⁰⁴ In 2006, based on the results of this study, the FDA approved the DCF regimen for the treatment of patients with advanced gastric cancer, including EGJ cancers, in patients who have not received prior chemotherapy.

In a subsequent randomized phase II trial of the Swiss Group for Clinical Cancer Research, a trend towards better ORR was observed in patients with advanced gastric cancer treated with DCF compared to those who received ECF or docetaxel plus cisplatin.²⁰⁵ However, DCF was associated with increased myelosuppression and infectious complications.

Various modifications of the DCF regimen to improve tolerability are being evaluated in clinical trials for patients with advanced gastric cancer.²⁰⁶⁻²⁰⁹ In a recent randomized phase II trial, treatment with docetaxel, oxaliplatin, and fluorouracil had a better safety profile and was also associated with improved TTP, RR, and median OS (7.7



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months, 47%, and 15 months, respectively) compared to docetaxel and oxaliplatin (4.5 months, 23%, and 9 months, respectively) and docetaxel, oxaliplatin, and capecitabine (5.6 months, 26%, and 11 months, respectively) in patients with advanced gastric cancer.²⁰⁷ In a phase II study of 48 patients, first-line therapy with docetaxel, oxaliplatin, and capecitabine induced an ORR of 52.1% with a PFS and OS of 6.9 months and 12.6 months, respectively.²⁰⁹

Capecitabine is an orally administered fluoropyrimidine that is converted to fluorouracil intracellularly. Several studies have evaluated capecitabine, as a single agent or in combination regimens, in patients with advanced gastric and EGJ cancers.²¹⁰⁻²¹³ Two phase III trials (REAL-2 and ML 17032) have compared the efficacy and safety of capecitabine-based combinations and fluorouracil-based combinations in patients with advanced gastric cancer.^{214,215}

The REAL-2 (with 30% of patients having an esophageal cancer) trial was a randomized multicenter phase III study comparing capecitabine with fluorouracil and oxaliplatin with cisplatin in 1003 patients with advanced esophagogastric cancer.²¹⁴ Patients with histologically confirmed adenocarcinoma, squamous or undifferentiated carcinoma of the esophagus, EGJ, or stomach were randomized to receive one of the four epirubicin-based regimens (ECF; epirubicin, oxaliplatin, fluorouracil [EOF]; epirubicin, cisplatin, and capecitabine [ECX]; and epirubicin, oxaliplatin, and capecitabine [EOX]). Median follow-up was 17.1 months. Results from this study suggest that capecitabine and oxaliplatin are as effective as fluorouracil and cisplatin, respectively, in patients with previously untreated esophagogastric cancer. As compared with cisplatin, oxaliplatin was associated with lower incidences of grade 3 or 4 neutropenia, alopecia, renal toxicity, and thromboembolism but with slightly higher incidences of grade 3 or 4

diarrhea and neuropathy. The toxic effects from fluorouracil and capecitabine were not different.

ML 17032, another phase III randomized trial, evaluated the combination of capecitabine and cisplatin (XP) vs. the combination of fluorouracil and cisplatin (FP) as first-line treatment in patients with previously untreated advanced gastric cancer.²¹⁵ ORR (41% vs. 29%) and OS (10.5 months vs. 9.3 months) were superior for patients who received the XP regimen. No difference in median PFS was seen for both regimens (5.6 months for XP and 5.0 months for FP). The results of this study suggest that capecitabine is as effective as fluorouracil in the treatment of patients with advanced gastroesophageal cancers.

A meta-analysis of the REAL-2 and ML17032 trials suggested that OS was superior in the 654 patients treated with capecitabine-based combinations compared with the 664 patients treated with fluorouracil-based combinations, although no significant difference in PFS between treatment groups was seen.²¹⁶

Irinotecan as a single agent or in combination has been explored extensively in single arm and randomized clinical trials.²¹⁷⁻²³¹ The results of a randomized phase III study comparing irinotecan in combination with fluorouracil and folinic acid to cisplatin combined with infusional fluorouracil in patients with advanced adenocarcinoma of the stomach or EGJ showed non-inferiority for PFS but not for OS and improved tolerance of the irinotecan-containing regimen. Thus, it can be an alternative when platinum-based therapy cannot be delivered.²²⁶ In another randomized, multicenter, phase II study, Moheler et al compared capecitabine combined with irinotecan or cisplatin in metastatic adenocarcinoma of the stomach or EGJ.²³⁰ There were no significant differences in ORR (37.7% and 42.0%, respectively) and median PFS (4.2 months and 4.8 months, respectively), although there



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was a trend towards better median OS in the irinotecan arm (10.2 vs. 7.9 months). The results of this study need to be validated further in larger studies.

Irinotecan (single-agent or in combination with other cytotoxic agents) has also been evaluated in the second-line setting.^{212,232-236} In a randomized phase III study that compared irinotecan with paclitaxel in patients with advanced gastric cancer (223 patients) after failure of fluoropyrimidine-based chemotherapy, OS was not significantly different between the two groups.²³⁴ The median OS was 9.5 months and 8.4 months, respectively, for patients treated with paclitaxel and irinotecan ($P = .38$); the median PFS was 3.6 months and 2.3 months, respectively ($P = .33$). Second-line chemotherapy with irinotecan, fluorouracil, and leucovorin (FOLFIRI) was active and well tolerated in patients with metastatic gastric cancer with disease progression on docetaxel-based chemotherapy.²³⁵ The ORR was 22.8% and stable disease was recorded in 30% of patients. Median PFS and OS were 3.8 months and 6.2 months, respectively.

Irinotecan (studied as a single agent or in combination with other cytotoxic agents in phase II and phase III trials) has not produced high-level evidence (category 1) for prolongation of survival in patients with advanced gastric cancer; therefore, its use is preferred in the second-line or third-line setting.

The novel oral fluoropyrimidine S-1 has shown promise in advanced gastric cancer, both as a single agent and in combination with cisplatin in early-phase studies. In a randomized phase III trial (SPIRITS trial), 298 patients with advanced gastric cancer were randomized to S-1 plus cisplatin and S-1 alone. Median OS (13 months vs. 11 months, respectively) and PFS (6.0 months vs. 4 months, respectively) were significantly longer for the combination of S-1 and cisplatin compared

with S-1 alone.²³⁷ The combination of S-1 and cisplatin in patients with untreated advanced gastric and EGJ adenocarcinoma was shown to be safe and active in multicenter phase II/III trials conducted in the United States.^{238,239,240} In the phase III randomized trial (First-Line Advanced Gastric Cancer Study [FLAGS]), 1053 patients with advanced gastric or EGJ adenocarcinoma were randomized to either cisplatin and S-1 (CS) or cisplatin and fluorouracil (CF). CS and CF resulted in similar median OS (8.6 months and 7.9 months, respectively; $P = .20$), but cisplatin and S-1 was associated with a significantly improved safety profile.²⁴⁰ In a subset analysis, CS produced statistically superior OS for patients with diffuse type histology. Additional studies are needed to confirm the activity of S-1 in the United States and western hemisphere. S-1 remains an investigational agent in North America.

Targeted Therapies

The ToGA study is the first randomized, prospective, multicenter, phase III trial to evaluate the efficacy and safety of trastuzumab in patients with HER2-neu-positive gastric and EGJ adenocarcinoma in combination with cisplatin and a fluoropyrimidine.⁷⁶ In this trial, 594 patients with HER2-neu-positive (3+ on IHC or FISH positive [HER2:CEP17 ≥ 2]), locally advanced, recurrent, or metastatic gastric and EGJ adenocarcinoma were randomized to trastuzumab plus chemotherapy (fluorouracil or capecitabine and cisplatin) or chemotherapy alone.⁷⁶ The majority of patients had gastric cancer (80% in the trastuzumab group and 83% in the chemotherapy group). Median follow-up was 19 months and 17 months, respectively, in the two groups. There was a significant improvement in the median OS with the addition of trastuzumab to chemotherapy compared to chemotherapy alone in patients with *HER2*-neu overexpression or amplification (13.8 vs. 11 months, respectively; $P = .046$). This study established trastuzumab in combination with chemotherapy as a new standard of



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care for patients with HER2-neu-positive advanced or metastatic gastric and EGJ adenocarcinoma.

However, the benefit of trastuzumab was limited only to patients with a tumor score of IHC 3+ or IHC 2+ and FISH positive. There was no significant survival benefit for patients whose tumors were IHC 0 or 1+ and FISH positive.⁷⁶ In the post-hoc subgroup analysis of the ToGA trial, the addition of trastuzumab to chemotherapy substantially improved OS in patients whose tumors were IHC 2+ and FISH positive or IHC 3+ (n = 446; 16 months vs. 11.8 months; HR = .65) compared to those with whose tumors were IHC 0 or 1+ and FISH positive (n = 131; 10 months vs. 8.7 months; HR = 1.07).

Ramucirumab, a VEGFR-2 antibody, has shown promising results in the treatment of patients with previously treated advanced or metastatic gastric or EGJ cancers in phase III clinical trials.^{241,242} An international, randomized, multicenter, placebo-controlled, phase III trial (REGARD trial) demonstrated a survival benefit for ramucirumab for patients with advanced gastric or EGJ adenocarcinoma progressing after first-line chemotherapy.²⁴¹ In this study, 355 patients were randomized to receive ramucirumab (n=238; 178 patients with gastric cancer; 60 patients with EGJ adenocarcinoma) or placebo (n=117; 87 patients with gastric cancer; 30 patients with EGJ adenocarcinoma). Median overall survival was 5.2 months in patients treated with ramucirumab compared to 3.8 months for those in the placebo group ($P = .047$). Ramucirumab was associated with higher rates of hypertension than the placebo group (16% vs. 8%), whereas rates of other adverse events were mostly similar between the two groups. In a more recent international phase III randomized trial (RAINBOW trial) study that evaluated paclitaxel with or without ramucirumab in patients with metastatic gastric or EGJ adenocarcinoma progressing on first-line chemotherapy, the combination of paclitaxel with ramucirumab resulted

in significantly higher OS, PFS, and ORR than paclitaxel alone.²⁴² In this study 665 patients were randomized to ramucirumab plus paclitaxel (n =330) and paclitaxel alone (n =335). The median OS was 9.63 months for ramucirumab plus paclitaxel compared to 7.36 months for paclitaxel alone ($P < .0001$). The median PFS was 4.4 months and 2.86 months, respectively, for the two treatment groups. The ORR was 28% for ramucirumab plus paclitaxel compared to 16% for paclitaxel alone ($P = .0001$). Neutropenia and hypertension were more common in the ramucirumab plus paclitaxel arm. Thus, ramucirumab in combination with paclitaxel performed better (RAINBOW trial) than ramucirumab alone (REGARD trial).

Based on the results of the REGARD trial, ramucirumab as a single agent was recently approved by the FDA for the treatment for patients with advanced gastric or EGJ adenocarcinoma.

Other trials are evaluating the efficacy and safety of targeted therapies such as EGFR inhibitors (erlotinib²⁴³ and cetuximab²⁴⁴⁻²⁴⁸) and VEGFR inhibitors (bevacizumab²⁴⁹⁻²⁵¹ and sorafenib²⁵²) in combination with chemotherapy in patients with advanced gastric and EGJ adenocarcinoma have not demonstrated desired clinical benefit.

Treatment Guidelines

The management of patients with gastric cancer requires the expertise of several disciplines, including surgical oncology, medical oncology, gastroenterology, radiation oncology, radiology, and pathology. In addition, the presence of nutritional services, social workers, nurses, palliative care specialists, and other supporting disciplines are also desirable. Geneticists should be engaged when appropriate. Hence, the panel believes in an infrastructure that encourages multidisciplinary treatment decision-making by members of any discipline taking care of patients with esophagogastric cancer. Optimally at each meeting, the



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panel encourages all relevant disciplines to participate. The recommendations made by the multidisciplinary team may be considered advisory to the primary group of treating physicians of the particular patient. See the section on *Principles of Multidisciplinary Team Approach for Esophagogastric Cancers* in the guidelines.

Workup

Newly diagnosed patients should undergo a complete history, physical examination, biopsy (to confirm metastatic cancer), and endoscopy with biopsy of the entire upper GI tract. A complete blood count (CBC), chemistry profile and CT scan (with oral and IV contrast) of the chest, abdomen, and pelvis should also be performed. EUS and PET/CT evaluation is recommended, if metastatic cancer is not evident. HER2-neu testing is recommended if metastatic disease is documented or suspected. See the section on *Principles of Pathology* for assessment of *HER2-neu* overexpression. The guidelines also recommend screening for family history of gastric cancers. Referral to a cancer genetics professional is recommended for an individual with a genetic predisposition to the development of gastric cancer (a known mutation in a gastric cancer susceptibility gene within the family; onset of gastric cancer at an early age [50 years or less]; personal or family history of diffuse gastric cancer and lobular breast cancer diagnosed before 50 years of age; 2 family members diagnosed with gastric cancer, one under 50 years of age with confirmed diffuse gastric cancer; 3 first- or second-degree relatives with a confirmed diagnosis of diffuse gastric cancer independent of age; and single occurrence of diffuse gastric cancer in a family before 40 years of age).

PET/CT scans are useful for predicting response to preoperative chemotherapy as well as in the evaluation of recurrent gastric cancer.²⁵³⁻²⁵⁶ They may also be useful in demonstrating occult

metastatic disease, although there may be false-positive results. Therefore, histologic confirmation of occult PET-avid metastasis is recommended.²⁵⁷ Additional studies are needed to assess the efficacy of combined PET/CT scan in gastric cancer.

Initial workup enables patients to be classified into three groups with the following characteristics:

- Localized (Tis or T1a) cancer
- Locoregional cancer (stages I-III or M0)
- Metastatic cancer (stage IV or M1)

Patients with apparent locoregional cancer are further classified into the following groups:

- Medically fit patients (who are able to tolerate major abdominal surgery) with potentially resectable disease
- Medically fit patients with unresectable disease
- Medically unfit patients

Primary Treatment

Medically Fit Patients

Endoscopic resection (EMR or ESD) or surgery is the primary treatment option for patients with Tis or T1a tumors, whereas surgery with lymph node dissection is the primary treatment option for patients with potentially resectable locoregional tumors (T1b, T2 or higher, any N tumors). However, for most patients, surgery alone is not sufficient and adjunctive therapy must be considered. The guidelines have included perioperative chemotherapy with a category 1 recommendation for patients with resectable T2 or higher, any N tumors.^{165,166} This strategy is feasible in the institutions where a multidisciplinary approach is already in place for the treatment of patients with localized gastric



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cancer. Although preoperative chemoradiation was associated with a survival advantage in two prospective randomized studies, both of these studies were limited by small sample size.^{150,154,155} Since the efficacy of preoperative chemoradiation has not been proven in large prospective randomized trials, the panel has included preoperative chemoradiation (fluoropyrimidine- or taxane-based) as an alternate option with a category 2B recommendation for patients with resectable T2 or higher, any N tumors.

Concurrent fluoropyrimidine- or taxane-based chemoradiation or chemotherapy is recommended (category 1) for patients with unresectable locoregional cancer.^{146,258}

All patients diagnosed with metastatic disease after laparoscopic staging should be treated with palliative therapy (chemotherapy, best supportive care, or clinical trial). Chemotherapy with any one of the regimens used for patients with metastatic or locally advanced cancer may be offered to this group of patients depending on their performance status.

See the *Principles of Systemic Therapy* section of the guidelines for a list of specific regimens.

Medically Unfit Patients

Endoscopic resection (EMR or ESD) is the preferred option for patients with Tis or T1a tumors, whereas concurrent fluoropyrimidine- or taxane-based chemoradiation (category 1) is recommended for patients with T1b, T2 or higher, any N tumors.

All patients diagnosed with metastatic disease after laparoscopic staging should be treated with palliative therapy as described above for medically fit patients.

Posttreatment Assessment and Adjunctive Treatment

Medically fit patients with unresectable disease as well as medically unfit patients should undergo restaging (including CBC and chemistry profile, CT scan [with oral and IV contrast] of the chest and abdomen, pelvic CT as clinically indicated, and PET/CT or PET scan) after completion of primary treatment. If the cancer has become resectable and medically operable, surgery is the preferred treatment. Alternatively, these patients can also be observed. If the disease remains unresectable and there is evidence of distant metastatic disease, patients may be offered palliative therapy (chemotherapy, best supportive care, or clinical trial) depending on their performance status.

Postoperative Treatment

The benefit of postoperative chemoradiation following complete resection (R0) has been established in randomized studies only in patients who have not received any preoperative therapy.^{157,163} The guidelines recommend postoperative treatment based on tumor stage, nodal status, and the extent of lymph node dissection.

For Patients Who Have Not Received Preoperative Therapy

No further treatment is necessary for patients with Tis and T1, N0 tumors, if there is no residual disease at surgical margins (R0 resection).

Based on the results of the INT-0116 trial, the panel has included postoperative chemoradiation for all patients with T3-T4 tumors and node-positive T1-T2 tumors. Given the relatively good prognosis combined with the lack of evidence from randomized clinical trials showing any survival benefit for postoperative chemoradiation for patients with T2, N0 tumors, some of the panel members felt that chemoradiation is not necessary for this group of patients. Therefore, observation is included as an option for patients with T2, N0 tumors.



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Postoperative chemoradiation is recommended only for selected patients with T2, N0 tumors with high-risk features (poorly differentiated or higher grade cancer, lymphovascular invasion, neural invasion, or age younger than 50 years), if there is no residual disease at surgical margins (R0 resection).²⁵⁹

The panel acknowledges that the INT-0116 trial formed the basis for the recommendation of postoperative chemoradiation for patients with completely resected gastric cancer.^{157,158} However, the panel does not recommend the doses or the schedule of chemotherapy agents as used in the INT-0116 trial due to concerns regarding toxicity. Instead, the panel recommends the use of fluoropyrimidine (infusional fluorouracil or capecitabine) before and after fluoropyrimidine-based chemoradiation.

Based on the interim results of the CLASSIC trial, the panel has included postoperative chemotherapy as an option for patients with T3-T4 tumors and node-positive T1-T2 tumors following R0 resection and a modified D2 lymph node dissection.¹⁷⁴ Postoperative chemotherapy is not recommended for undergoing less than a D2 lymph node dissection. The panel emphasizes that postoperative chemoradiation is the preferred option (category 1) for this group of patients.¹⁶³

For Patients Who Have Received Preoperative Therapy

Postoperative chemotherapy (category 1) with ECF or its modifications is recommended, if given preoperatively for all patients with T2 or higher any N tumors.¹⁶⁵ Alternatively patients with T2, N0 tumors can be observed. The value of postoperative chemoradiation in patients who have received preoperative therapy is currently being evaluated in a phase III trial (CRITICS study).²⁶⁰

Postoperative Chemoradiation Following R1 or R2 Resections

In the absence of distant metastases, fluoropyrimidine-based chemoradiation is recommended for patients with microscopic (R1 resection) or macroscopic residual disease (R2 resection), only if not received preoperatively. Although this approach has not been evaluated in a prospective study, given the significantly worse prognosis associated with margin-positive resections, the panel members feel that this could be a reasonable treatment option, especially in patients who have not received preoperative chemoradiation. Data from a recent retrospective analysis suggest that postoperative chemoradiation may be associated with a significant improvement in 2-year OS (66% vs. 29%; $P = .002$) and a significant decrease in the local recurrence rate (6% vs. 26%; $P = .02$) after an R1 resection as compared with the surgery alone.¹⁶⁴ Palliative chemotherapy or best supportive care, based on the performance status, may be offered for patients with macroscopic residual disease.

Follow-up

All patients should be followed up systematically. Follow-up should include a complete history and physical examination every 3 to 6 months for 1 to 2 years, every 6 to 12 months for 3 to 5 years, and annually thereafter. CBC, chemistry profile, imaging studies, or endoscopy should be done if clinically indicated. Patients who have undergone surgical resection should be monitored and treated as indicated for vitamin B₁₂ and iron deficiency.

Locally Advanced, Metastatic, or Recurrent Disease

Palliative therapy (chemotherapy, clinical trial, or best supportive care) is recommended for patients with locally advanced, metastatic or recurrent gastric cancer. Surgery should be considered as an option for locoregional recurrence in medically fit patients.



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Best supportive care is always indicated for patients with locally advanced, metastatic or recurrent gastric cancer. The decision to offer best supportive care alone or with chemotherapy is dependent on the patient's performance status. The ECOG Performance Status Scale (ECOG PS) and the Karnofsky Performance Status Scale (KPS) are the two commonly used scales to assess the performance status in patients with cancer.²⁶¹⁻²⁶³ ECOG PS is a 5-point scale (0–4) based on the level of symptom interference with normal activity. Patients with higher levels are considered to have poor performance status (http://www.ecog.org/general/perf_stat.html). KPS is an ordered scale with 11 levels (0 to 100) and the general functioning and survival of a patient is assessed based on his or her health status (activity, work, and self-care). Low Karnofsky scores are associated with poor survival and serious illnesses (<http://www.hospicepatients.org/karnofsky.html>).

Patients with a KPS score of 60 or less or an ECOG performance score of 3 or more should probably be offered best supportive care only. Patients with better performance status (KPS score of 60 or more or an ECOG PS score of 2 or less) may be offered best supportive care with or without chemotherapy, or a clinical trial.

The survival benefit of second-line chemotherapy compared to best supportive care has been demonstrated in a small cohort of patients with metastatic or advanced gastric cancer.²⁶⁴⁻²⁶⁷ In a randomized comparison between chemotherapy and best supportive care vs. best supportive care alone for advanced gastric cancer, OS (8 months vs. 5 months, though not statistically significant) and TTP (5 months vs. 2 months) were longer in patients receiving chemotherapy.²⁶⁴ More patients in the chemotherapy group (45%) had an improved or prolonged high quality of life for a minimum of 4 months compared to those who received only best supportive care (20%). A recent meta-analysis of randomized trials that compared chemotherapy and

supportive care in patients with advanced gastric cancer also showed that chemotherapy increased the one-year survival rate and improved the quality of life.²⁶⁵ In another randomized phase III study, second-line chemotherapy with irinotecan significantly prolonged OS compared to best supportive care in patients with metastatic or locally advanced gastric or EGJ adenocarcinoma (n = 40).²⁶⁶ The study was closed prematurely due to poor accrual. Median survival was 4 months in the irinotecan arm compared to 2.4 months in the best supportive care only arm. In another larger randomized trial (n = 193), second-line chemotherapy with irinotecan or docetaxel significantly improved OS (5.1 months vs. 3.8 months) compared to best supportive in patients with advanced gastric cancer.²⁶⁷ However, both studies have limitations and larger studies are now underway. In a recent open-label multicenter, phase III, randomized trial, the addition of docetaxel to active symptom control was associated with a survival benefit for patients with advanced, histologically confirmed adenocarcinoma of the esophagus, EGJ junction, or stomach that had progressed on or within 6 months of treatment with platinum-fluoropyrimidine-based combination chemotherapy.²⁶⁸ In this study, patients (n = 168) with an ECOG PS score of 0 to 2 were randomly assigned to receive docetaxel plus active symptom control or active symptom control alone. After a median follow-up of 12 months, the median OS was 5.2 months for patients with docetaxel group compared to 3.6 months for those in the active symptom control group ($P = .01$). Docetaxel was associated with higher incidence of grade 3-4 neutropenia, infection, and febrile neutropenia. However, disease-specific, health-related quality of life measures also showed benefits for docetaxel in reducing dysphagia and abdominal pain.

First-line therapy with two-drug chemotherapy regimens is preferred for patients with advanced or metastatic disease. Three-drug regimens



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should be reserved for medically fit patients with good performance status and access to frequent toxicity evaluation. The selection of a second-line therapy regimen is dependent on prior therapy and performance status. The panel consensus was that there is no category 1 evidence to support any specific regimen(s) as second-line or third-line therapy for patients with advanced or metastatic gastric cancer. This area remains an active subject of investigation.

Based on the results of the ToGA trial, the guidelines recommend trastuzumab with chemotherapy for patients with a tumor score of IHC 3+ and IHC 2+ with the evidence of *HER2* amplification by FISH (*HER2*:CEP17 ratio ≥ 2). Trastuzumab is not recommended for patients with a tumor score of IHC 0 or 1+. The use of trastuzumab in combination with an anthracycline is not recommended. Based on the results of the REGARD trial and the recent FDA approval, the guidelines have included ramucirumab as a single agent (category 1) as an option for second-line therapy for patients with advanced or metastatic gastric cancer.²⁴¹ Based on the results of the RAINBOW trial, ramucirumab in combination with paclitaxel is also included as an option for second-line therapy for this group of patients.²⁴² Ramucirumab produced better results when combined with paclitaxel (RAINBOW trial) than it did as a single agent (REGARD trial); therefore, ramucirumab in combination with paclitaxel is preferred.

See the *Principles of Systemic Therapy* section of the guidelines for a list of specific regimens. Some of the chemotherapy regimens and dosing schedules included in the guidelines are based on extrapolations from published studies and institutional preferences that have support only from phase II studies.

Leucovorin Shortage

There is currently a shortage of leucovorin in the United States. There are no specific data to guide management under these circumstances, and all proposed strategies are empiric. The panel recommends several possible options to help alleviate the problems associated with this shortage. One is the use of levoleucovorin, which is commonly used in Europe. A levoleucovorin dose of 200 mg/m² is equivalent to 400 mg/m² of standard leucovorin. Another option is to use lower doses of leucovorin in all patients, since lower doses are likely to be as efficacious as higher doses, based on several studies in patients with colorectal cancer.²⁶⁹⁻²⁷¹ Finally, if none of the above options is available, treatment without leucovorin would be reasonable. A modest increase in fluorouracil dose (in the range of 10%) may be considered for patients who can tolerate this without grade II or higher toxicity.

Best Supportive Care

The goal of best supportive care is to prevent, reduce, and relieve suffering and improve the quality of life for patients and their caregivers, regardless of disease stage. In patients with unresectable or locally advanced cancer, palliative interventions undertaken to relieve major symptoms may result in prolongation of life.

Bleeding

Bleeding is common in patients with gastric cancer and may be secondary to tumor or tumor-related phenomenon, or as a consequence of therapy. A multidisciplinary approach is required for the proper diagnosis and management of GI bleeding in patients with cancer.²⁷² Patients with acute severe bleeding (hematemesis or melena) should undergo prompt endoscopic assessment. Angiographic embolization techniques may be useful in those situations where



endoscopy is not helpful. External beam RT and/or endoscopic treatment may be indicated in patients experiencing bleeding.²⁷³

Obstruction

Surgery (gastrojejunostomy or gastrectomy in selected patients), venting gastrostomy, external beam RT, chemotherapy, and endoscopic palliative procedures such as balloon dilation, placement of enteral stent for relief of gastric outlet obstruction, or esophageal stent for EGJ/cardia obstruction are used to alleviate symptoms of obstruction. The optimal palliative treatment for patients with malignant gastric outlet obstruction needs to be determined in large randomized clinical trials. Treatment options for the management of obstruction should be individualized. A multimodality interdisciplinary approach is strongly encouraged.

Endoscopic placement of self-expanding metal stents (SEMS) is a safe and effective, minimally invasive palliative treatment for patients with luminal obstruction due to advanced gastric cancer.²⁷⁴⁻²⁷⁶ In a systematic review, patients treated with endoscopic placement of stents were more likely to tolerate oral intake and they also had shorter hospital stay than patients treated with gastrojejunostomy.²⁷⁷ The results of a systematic review suggest that stent placement may be associated with more favorable results in patients with a relatively short life expectancy, whereas gastrojejunostomy is preferable in patients with a more prolonged prognosis.⁸⁵ A recent randomized trial also reported similar findings.²⁷⁸ However, these results need to be confirmed in a larger cohort of patients. Percutaneous decompressive gastrostomy either by endoscopic or radiologic gastrostomy have also been beneficial for patients with gastric outlet obstruction.^{279,280}

If endoscopic lumen restoration is not undertaken or successful, percutaneous endoscopic or interventional radiology gastrostomy tube

placement for gastric decompression may be performed, if tumor location permits. Ascites, if present, should be drained prior to venting gastrostomy tube placement to reduce the risk of infectious complications.^{281,282} Endoscopic or surgical placement of a jejunal feeding tube may be necessary to provide adequate hydration and nutritional support for patients with mild and distal gastric obstruction. Nutritional counseling may also be valuable.

Pain

Pain control may be achieved with the use of RT and pain medications. If the patient is experiencing tumor-related pain, then pain should be assessed and treated according to the NCCN Guidelines for Adult Cancer Pain. Severe uncontrolled pain following gastric stent placement should be treated emergently with endoscopic removal of the stent once the uncontrollable nature of pain is established.

Nausea and Vomiting

Patients experiencing nausea and vomiting should be treated according to the NCCN Guidelines for Antiemesis. Nausea and vomiting may be associated with luminal obstruction, so endoscopic or fluoroscopic evaluation should be performed to determine if luminal enhancement is indicated.

Summary

Gastric cancer is rampant in several countries around the world. Diffuse histology is more common now than the intestinal type of histology. H. pylori infection, smoking, and high salt intake are the risk factors for gastric cancer. Few gastric cancers are associated with inherited gastric cancer predisposition syndromes. Referral to cancer genetics professional is recommended for an individual with a genetic predisposition.



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Gastric Cancer

Several advances have been made in the treatment approaches, imaging techniques and staging procedures. Multidisciplinary team management is essential for the management of patients with gastric cancer.

Endoscopic resection (EMR or ESD) is an appropriate primary treatment option for patients with Tis or T1a tumors, whereas surgery with lymph node dissection is the primary treatment option for medically fit patients with resectable T1b, T2 or higher, any N tumors. In the West, surgery alone is an insufficient therapy for most patients. Perioperative chemotherapy is recommended (category 1) following R0 resection for patients with resectable T1b, T2 or higher, any N tumors. Preoperative chemoradiation may also be considered for these patients (category 2B). For patients who have not received preoperative therapy, postoperative chemoradiation is recommended following R0 resection for all patients with T3-T4 tumors and node positive T1-T2 tumors, and for selected patients with T2, N0 tumors with high-risk features. Postoperative chemotherapy is included as an option following R0 resection and D2 lymph node dissection in patients with T3, T4, any N tumors.

Fluoropyrimidine-based postoperative chemoradiation is recommended for all patients with residual disease at surgical margins. Patients with unresectable and/or distant metastatic disease may be offered palliative therapy (chemotherapy, best supportive care, or clinical trial).

Targeted therapies in combination with chemotherapy have produced encouraging results in the treatment of patients with advanced gastric, esophageal, and EGJ cancers. Trastuzumab plus chemotherapy is included as an option for patients with HER2-neu-positive advanced or metastatic gastric cancer. Ramucirumab single agent or in combination

with paclitaxel is included as option for second-line therapy for patients with advanced or metastatic gastric cancer.

Best supportive care is an integral part of treatment, especially in patients with metastatic and advanced gastric cancer. Patients with good performance status can be treated with chemotherapy or best supportive care, whereas best supportive care alone is the appropriate treatment for patients with poor performance status. Assessment of severity of the disease and related symptoms is essential to initiate appropriate palliative interventions that will prevent and relieve suffering and improve quality of life for patients and their caregivers. Treatment options used for palliation of symptoms in patients with advanced gastric cancer include endoscopic placement of SEMS, surgery, chemotherapy, or RT.

The NCCN Guidelines for Gastric Cancer provide an evidence- and consensus-based systematic approach to the management of patients with gastric cancer in the United States. Novel therapeutic strategies such as targeted therapies, vaccines, and gene therapy are being studied in clinical trials. The panel encourages patients with gastric cancer to participate in well-designed clinical trials to enable further advances.



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