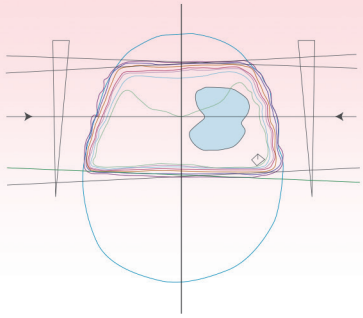
CHAPTER 8

Surgical Principles



Y. Nancy You and John H. Donohue

Surgery remains the central treatment for most cancers. Survival for the majority of patients with solid malignancies is still most dependent on the stage of the tumor and on the physician's ability to resect all of the known tumor. Surgeons help in the diagnosis, staging, curative and palliative therapy, and follow-up of patients with cancer. The surgical oncologist does not act in isolation; instead, interaction with colleagues from other specialties is routine. Because many of the common solid tumors are treated with a combination of therapies, the surgeon usually provides treatment in collaboration with medical and radiation oncologists. This interaction among specialists provides the best chance for patient cure and effective palliation.

Preoperatively, an accurate patient history is obtained and a physical examination plus routine laboratory tests and, when indicated, more specialized evaluations are performed to assess the tumor extent and the patient's ability to tolerate the proposed treatment. The goals of surgical intervention in patients with cancer include providing a histologic diagnosis, disease staging, and disease treatment, either with potential cure or symptom palliation. The role of surgical treatment in the relief of patient suffering is particularly beneficial for visceral obstruction, hemorrhage, perforation, and pain caused by tumor involvement. High-quality radiologic imaging studies such as ultrasonography, computed tomography (CT), and magnetic resonance imaging (MRI) plus three-dimensional reconstructions are instrumental in planning the appropriate operative procedure. A preoperative biopsy of a lesion that appears to be malignant is not necessary for diagnosis but is indicated for a patient receiving preoperative (neoadjuvant) or nonoperative therapy.

The role of the surgical oncologist in the multidisciplinary management of the cancer patient will be highlighted in this chapter. The surgeon's role in multimodality therapies for malignant diseases will be illustrated by the management of cancers of the breast, pancreas, rectum, and retroperitoneum.

HISTOLOGIC DIAGNOSIS

A pathologic diagnosis should be secured before the definitive surgical procedure in some patients. The goal of the diagnostic biopsy is to obtain sufficient tissue for complete analysis with minimal risk for complication. Either cytologic or histologic samples are adequate for most cancers, but a histologic diagnosis is usually preferable. A false-negative cytologic result occurs in 10% to 20% of cancer patients, and false-positive cytologic diagnoses can rarely occur. Biopsies that sample a tumor may underestimate the aggressiveness of a lesion (e.g., atypia or carcinoma in situ instead of invasive cancer) because of sampling error. A diagnostic tissue specimen may be obtained by aspiration cytology, core-needle biopsy, incisional biopsy, or excisional biopsy. A separate biopsy procedure is unnecessary unless it affects preoperative treatment planning. Endoscopically or laparoscopically directed biopsies both allow more accurate staging of intraabdominal malignancies than noninvasive procedures plus provide tissue for diagnosis.

Fine-needle aspiration cytology (FNAC) is widely used to evaluate solitary thyroid nodules. Using a 21-gauge needle and syringe, an aspirate of cellular material or fluid is obtained, differentiating between solid and cystic masses. If a cyst does not completely disappear with aspiration, FNAC examination of any residual solid component is necessary. The success of FNAC depends on the experience of the clinician performing the aspiration and on the interpretation of a skilled cytologist. FNAC of the thyroid enables the pathologist to differentiate most benign from malignant tumors. Papillary, medullary, and anaplastic carcinomas have typical cytologic appearances. Cytology cannot differentiate benign from malignant follicular and Hürthle cell neoplasms. A definitive diagnosis for these thyroid neoplasms depends on histologic examination of the entire excised tumor. The introduction of routine FNAC has dramatically reduced the number of diagnostic surgical operations for benign thyroid masses.

Percutaneous radiograph-directed FNAC has gained great popularity over the past 25 years.[1] Ultrasonography or CT scanning is routinely used to obtain hepatic, renal, pancreatic, and retroperitoneal biopsies. Percutaneous biopsy techniques are particularly useful to confirm the presence of metastases in a patient with a history of malignancy. Adrenal FNAC should be avoided if a pheochromocytoma has not been excluded. If potentially curable metastases (e.g., limited hepatic metastases from colorectal cancer) are present, this diagnostic test is unwarranted and potentially dangerous because of rare tumor seeding. If unresectable cancer is present at exploratory laparotomy, a confirmatory biopsy should be obtained.

The choice of ultrasonographic or CT guidance depends on several factors. In general, ultrasonography is used for superficial lesions. Ultrasonography possesses other advantages, including real-time imaging, which allows constant monitoring of the needle position, and lower costs compared with CT scanning. Ultrasonographic examination is limited by overlying bone and gas. CT guidance is more beneficial for deeper tumors, particularly in the retroperitoneum. Advantages of CT-guided biopsy include better spatial resolution and lack of interference from air or bone. Intravenous contrast provides an estimate of tumor vascularity.

Core-needle biopsy can be performed by hand if the mass is easily palpable and can be stabilized by the operator. Radiographically directed core biopsies, particularly of solid breast masses, are commonly performed preoperatively. Unlike an FNAC, a core biopsy provides sufficient tissue for histologic

analysis. Using local anesthesia, a small (3-mm) incision is made in the skin through which a coring biopsy needle is directed into the center of the lesion. Typically, a 1- × 10- to 20-mm tissue sample is obtained. Core-needle biopsy may also be performed with stereotactic imaging or ultrasonography for nonpalpable breast lesions.

Core-needle biopsies of intraabdominal and thoracic tumors offer the advantages of a histologic diagnosis and greater accuracy than the FNAC. Larger-bore needles can cause complications, most commonly hemorrhage. Some tumors, including many adjacent to major blood vessels, are not safely accessible percutaneously. Core-needle biopsy should not be used for potentially resectable malignancies because of a higher risk of needle track seeding than with FNAC. Intraoperative diagnostic core biopsies are preferable to incisional biopsies when a diagnosis is needed for an unresectable tumor. The decision to resect or not, as in a pancreaticoduodenectomy for painless jaundice, should be based on the clinical and operative findings; a histologic diagnosis is not mandatory before resection.

Incisional biopsy excises more of a tumor mass than needle biopsy. A full-thickness biopsy using a scalpel or punch biopsy tool of a larger skin tumor is a commonly performed incisional biopsy. A full-thickness sampling of the thickest portion of the lesion should be removed to allow accurate tumor staging. Sometimes an incisional biopsy of a sarcoma is performed to provide the diagnosis before proceeding with definitive treatment (e.g., amputation, preoperative chemotherapy, or radiation), but core-needle biopsies are another option. An incisional biopsy of an extremity tumor is preferably obtained through a longitudinal rather than a transverse incision because the longitudinal incision can be more readily incorporated with a wide local excision.[2] Intraoperative incisional biopsies during thoracotomy and laparotomy are rarely indicated; tumor spillage is more likely than with FNAC or core-needle biopsies.

Excisional biopsy of a breast mass illustrates the key principles of a diagnostic surgical biopsy. This procedure can be used for small, palpable lesions amenable to easy complete excision. A diagnostic excisional breast biopsy is now rarely performed. Almost all breast cancers are diagnosed with FNAC or core biopsy preoperatively. If possible, the skin incision should be circumareolar or situated within the elliptical incision that would be used for a mastectomy (Figure 8-1). If the breast mass is believed to be malignant, it should be excised with a 1-cm margin of normal tissue, centering the suspicious lesion in the specimen (Figure 8-2, *A*). The biopsy specimen should be oriented to permit the pathologist to specify which of the resection margins, if any, are histologically involved by tumor. Specimen orientation can be denoted with two sutures (Figure 8-2, *B*) or by painting the specimen with multiple-colored stains. If frozen-section evaluation of the resection margins is available, reexcisions can be performed immediately when necessary. When frozen-section evaluation is unavailable, separate, individually labeled margins may be sent in addition to the primary tumor specimen. Selective reexcision can be performed at a later date if the main specimen has been appropriately oriented with sutures, clips, multicolored inks, or separate margins. Surgical clips left at the base of the biopsy cavity facilitate accurate

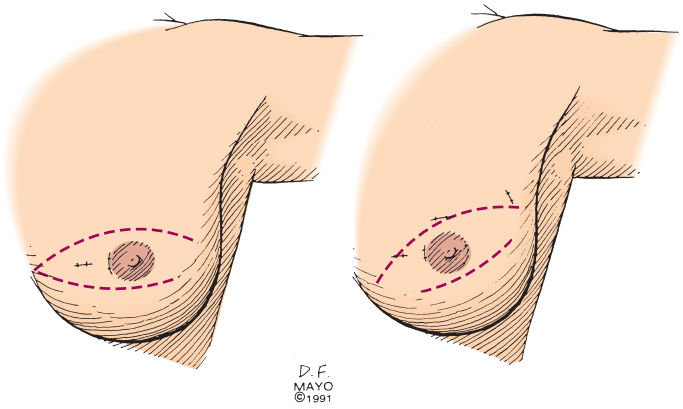


Figure 8-1 Excisional breast biopsy performed within the confines of a mastectomy incision.
Courtesy the Mayo Foundation.

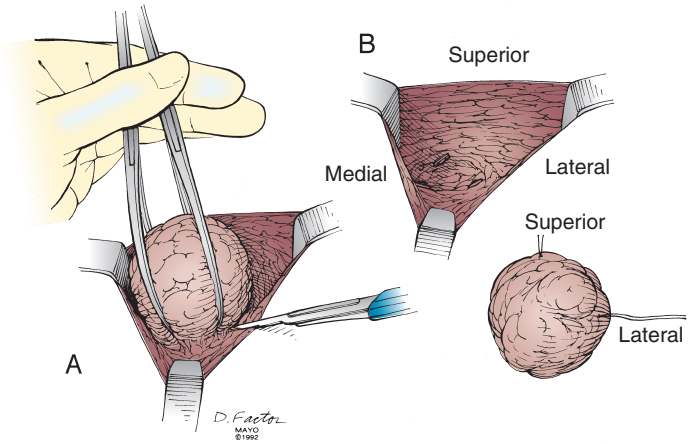


Figure 8-2 **A,** Excisional breast biopsy. **B,** Specimen orientation.
Courtesy the Mayo Foundation.

partial breast or boost-field radiation therapy after breast-conservation surgery. Small titanium clips provide accurate localization for the radiation oncologist with minimal interference on future images, including MRI.

STAGING

The stage of a malignant tumor usually determines the goal of intervention. Symptoms or physical signs frequently alert the clinician to metastatic disease, but diagnostic studies are usually required to confirm distant disease spread. Accurate preoperative staging results in the best treatment because the extent of tumor spread remains the single-most important determinant of patient prognosis.

Clinical and pathologic stages of disease for most cancers have been standardized in the American Joint Committee for Cancer (AJCC) TNM system.[3] In this nomenclature, T refers to the primary tumor, N indicates the status of regional lymph nodes, and M denotes the presence or absence of metastatic disease. For most cancers, the size (e.g., in lung, liver, or breast cancers) or the degree of invasion (e.g., in melanoma or stomach or colorectal cancers) of the primary tumor correlates with the probability of metastases.

Clinical tumor staging is normally determined using combined data from physical examination, a variety of radiologic tests (including plain radiographs, ultrasonography, CT, and MRI), and endoscopic examination. Positron emission tomography (PET)-CT imaging provides more sensitive staging compared with other imaging studies in a number of disease sites. PET-CT can be especially helpful in the diagnosis of unsuspected metastatic disease (e.g., esophageal cancer; melanoma) and in evaluating patients with possible recurrent cancer (e.g., locally recurrent rectal cancer). In symptomatic patients, skeletal metastases can also be diagnosed with a radioisotope bone scan or correlative plain radiographs.

Role of Laparoscopy

The introduction of laparoscopy in general surgical practice has led to more precise staging of many intraabdominal malignancies, particularly gastric,[4] pancreatic,[5] and hepatobiliary cancers.[6,7] Thoracoscopy allows inspection and biopsy of the pleural cavity to assess for intrathoracic tumor spread. When used for diagnosis, laparoscopy allows visualization of peritoneal surfaces; histologic evaluation of peritoneal, omental, or hepatic tumor masses; biopsy of lymph nodes; and collection of ascites or peritoneal washings for cytologic examination. Laparoscopic ultrasonography further improves the staging of pancreatic and hepatobiliary malignancies.[8-10] If the laparoscopic findings confirm metastatic malignancy, the attendant morbidity from tumor resection by traditional or minimally invasive techniques can be avoided. Laparoscopic techniques can be used for cancer therapy to palliate patients with advanced malignancy and curatively resect others.[11]

Staging of Pancreatic Malignancy

Laparoscopy is frequently used to stage pancreatic and periampullary carcinomas because hepatic or peritoneal metastases undetectable by radiographic means occur in up to 30% of patients with tumors believed to be resectable preoperatively.[5,12,13] Recent data[14] show an extended, complete laparoscopic inspection of the abdominal cavity should be undertaken using a 10-mm port at the umbilicus (Figure 8-3). Additional cannulae allow for retraction of the liver to allow observation of all surfaces, plus the lesser sac, omentum, and loops of intestine. Laparoscopic inspection should also include a Kocher maneuver to visualize the paraduodenal retroperitoneum. Inspection of the upper abdomen, looking for small hepatic metastases or drop metastases on the parietal and visceral peritoneum or the greater omentum, is readily accomplished. Any suspicious lesions should be sampled using a biopsy forceps or core-needle biopsy tool. The remainder of the abdomen can be examined, including the peritoneal surfaces, for seeding and dependent areas for ascites. Evidence of direct spread of a pancreatic carcinoma into the transverse mesocolon and small bowel mesentery should be assessed.

With the patient in the reverse Trendelenburg position, limited visualization of the anterior surface of the pancreas may be obtained with a supragastric approach after division of the lesser omentum (Figure 8-4, *A*) or an infragastric approach, entering the lesser sac through the gastrocolic omentum (Figure 8-4, *B*). Biopsy of peritoneal implants within the lesser sac should be obtained. Laparoscopic ultrasonography provides a more accurate assessment of visceral vascular involvement and deep hepatic metastases,[10] although

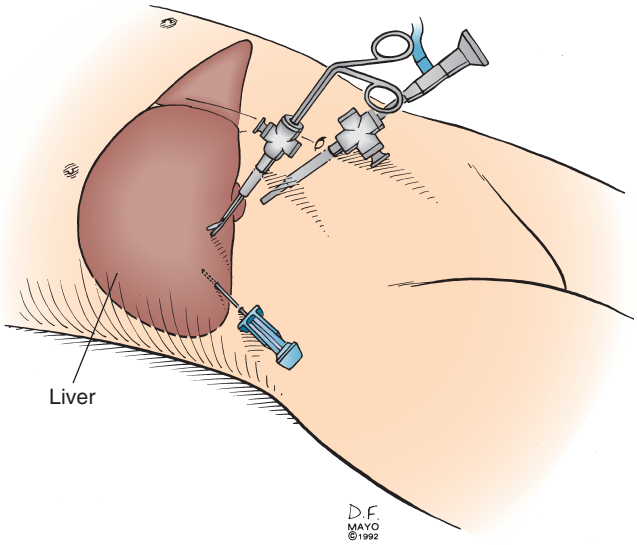


Figure 8-3 Laparoscopic examination of the upper abdominal cavity.
Courtesy the Mayo Foundation.

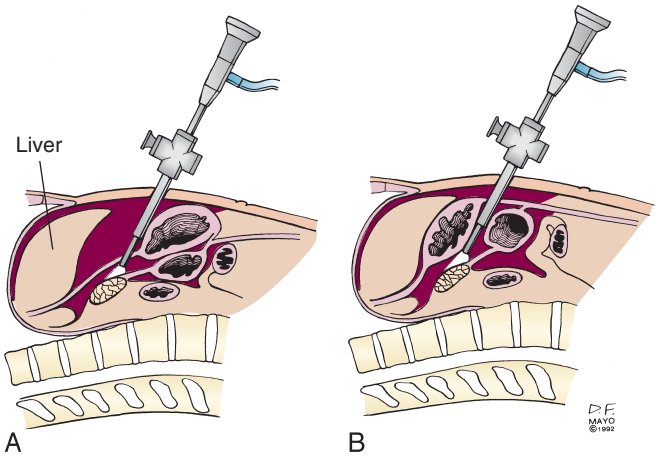


Figure 8-4 Laparoscopic examination of the pancreas: supragastric **(A)** and infragastric **(B)** approaches.
Courtesy the Mayo Foundation.

endoscopic ultrasonography (EUS) provides highly accurate staging in these sites.

GOALS OF SURGICAL INTERVENTION

The primary intent of surgical intervention is curative resection. The surgeon must be familiar with the cancer biology, including modes of spread (i.e., hematogenous, lymphatic, intracavitary, or direct extension). En bloc excision of the tumor is performed for the highest probability of cure (complete resection or R0 resection = no residual tumor). Complete extirpation of the primary tumor with a margin of normal tissue plus a regional lymph node dissection typifies this type of resection. For cancers such as colon carcinomas or retroperitoneal sarcomas, normal adjacent structures directly invaded or adherent to the malignancy should also be resected. Lysis of adhesions between a primary cancer and an adjacent structure can result in residual cancer and tumor spillage. When the local extent of a nonmetastatic malignancy prevents a gross total resection with negative margins, the surgeon should facilitate postoperative irradiation planning by leaving titanium clips at the site of residual microscopic disease (R1 resection = microscopic residual cancer).

Certain intraabdominal malignancies are appropriately treated by surgical debulking (R2 resection = gross residual disease) plus perioperative therapy. Examples include ovarian carcinomas and rare low-grade mucinous adenocarcinomas, known traditionally as pseudomyxoma peritonei, that are usually of appendiceal origin. The goal of operative therapy is to remove as much macroscopic intraabdominal disease as is feasible because patient outcome is improved.

For patients with known metastatic disease who have symptoms or are at risk for complications from locally advanced disease, surgical palliation (R1 or R2 resection) should be considered. Operative procedures should be reserved for well-defined problems amenable to surgical treatment in patients with reasonable performance status and life expectancy. Intestinal obstruction can be corrected by a resection, bypass, or proximal diversion (i.e., ostomy formation). When technically feasible, laparoscopic, laparoscopically assisted (i.e., mobilization using laparoscopic technique and a portion of the procedure performed through a limited celiotomy), and endoscopic stenting techniques are suitable and preferable to a formal laparotomy. Diffuse peritoneal implantation often prevents successful palliation and increases the risk of postoperative complications, including infection and intestinal fistula formation. The surgeon may prevent life-threatening hemorrhage or improve pain by resection of some cancers. Pain can also be alleviated by nerve transection or blockade, such as celiac plexus block for pancreatic carcinoma.

PERIOPERATIVE CARE OF THE ONCOLOGY PATIENT

The cancer patient may develop unique perioperative problems. The surgeon must strive to avoid such problems and must monitor the patient for their occurrence to minimize morbidity and minimize delays in adjuvant therapy. Patients with malignancy have a higher prevalence of postoperative complications because of their neoplastic disease, coincidental comorbidities in older patients, the major surgical procedures patients have undergone, and perioperative and adjuvant therapy-induced immunosuppression. Patients with gastrointestinal malignancies with or without obstruction frequently suffer from substantial weight loss, malnutrition, and resultant immunodeficiency. The hematologic, gastrointestinal, pulmonary, and cardiac toxicities associated with chemotherapy pose additional risks for the patient postoperatively. Before adjuvant therapy is started, sufficient time must be allowed to pass for wound healing and resolution of infectious complications to occur.

The extent and type of operative management must take into account the patient's preexisting and malignancy-induced comorbidities. Cancer cachexia resulting from anorexia is common and results in significant lean tissue loss and immunodeficiency. Because malnutrition significantly increases the risk for perioperative morbidity, the surgeon must carefully assess the degree of preoperative malnutrition. Although retrospective studies evaluating preoperative nutritional support show a reduction in postoperative complications for patients with severe malnutrition,[14] a meta-analysis did not support routine preoperative nutrition for oncologic patients.[15] Total parenteral nutrition should be reserved for patients unable to tolerate enteral nutrition, those unable to take sufficient calories by oral or enteric routes during therapy, and those felt to be unsuitable for operative or combined-modality therapy until their nutritional status improves. Enteral rather than parenteral nutrition should be used whenever possible. Postoperative nutritional support should always be considered, especially in patients with upper gastrointestinal malignancies such as esophageal, gastric, and pancreatic cancers. A feeding jejunostomy catheter placed intraoperatively facilitates delivery of postoperative nutrition.

The oncologic patient has a higher risk for postoperative infection. Immune compromise in patients with cancer occurs as a result of older age, surgical stress, malnutrition, and impaired host defense mechanisms. Neutropenia combined with defective cell-mediated immune responses render malnourished patients especially prone to postoperative complications and impair the patient's response to sepsis. Appropriate perioperative antibiotics and vigilant postoperative observation for infection are critical in reducing the morbidity of postoperative infections.

Older age, the presence of a malignancy, and undergoing operative procedures all increase the incidence of thromboembolic complications. A hypercoagulable state is especially common in patients with pancreatic, prostate, lung, breast, and gastric cancers. Increased factors I, V, VIII, IX, and XI;

decreased proteins C and S; and reduced antithrombin III levels have all been implicated in higher rates of thromboembolic events in patients with cancer. Perioperative subcutaneous heparin (both low-molecular-weight and unfractionated heparin are appropriate treatments), thromboembolic stockings, and sequential compression devices should be used for all patients undergoing oncologic surgery. Patients at high long-term risk for thromboembolic complications (e.g., prior history of deep venous thrombosis/pulmonary embolism [DVT/PE], inherited hypercoagulable trait, debilitated, or those with residual cancer) need to be considered for extended anticoagulation therapy.

Patients with malignancy are often anemic. Blood transfusions result in immunosuppression, including depression of specific cellular immunity, and nonspecific immune responses, including natural killer cell activity and macrophage phagocytosis. Some retrospective studies have shown higher cancer relapse rates in cancer patients receiving blood transfusions, but controlled trials have not demonstrated a poorer disease-specific survival (DSS) rate specifically related to perioperative transfusions.[16,17] Blood transfusion must be administered as appropriate in oncologic patients.

RADIATION THERAPY AND WOUND HEALING

Tissues exposed to radiation therapy develop acute inflammatory changes in proportion to the total dose. Higher-dose fractions may cause more significant changes. Acute radiation injury is manifested by vasodilation (erythema) and tissue edema. Following moderate-dose preoperative radiation (45 to 50 Gy in 1.8- to 2.0-Gy fractions), a 3- to 6-week preoperative recovery period is generally allowed for partial resolution of acute radiation changes.[18] Late radiation changes include atrophy and fibrosis, which result from decreased tissue vascularity.

Wound healing is impaired in irradiated tissue by several factors, including diminished blood supply, impaired collagen formation, and the increased risk of infection resulting in part from decreased leukocyte function. After high-dose irradiation, slow and nonhealing wounds are commonplace. In this situation, nonirradiated tissues, such as vascularized myocutaneous flaps, may need to be transferred into the radiation field to allow proper wound healing.[19] This is preferably done at the time of tumor resection rather than after a nonhealing postoperative wound develops. If partial resection of an irradiated hollow organ (e.g., bowel, bile duct, trachea) is necessary, one side of the anastomosis should be nonirradiated tissue whenever possible. This precaution provides a better blood supply for healing of the anastomosis. This policy will reduce the incidence of early postoperative leak and fistula formation and late anastomotic strictures.

SURGICAL TREATMENT OF BREAST CANCER

The treatment of patients with breast cancer should occur in a multidisciplinary setting. Ideally, patients are evaluated in a breast clinic with treatment specialists, including a surgeon, radiation oncologist, medical oncologist, nurse, and medical geneticist providing preoperative consultation. There should be a focus on patient education regarding the treatment options currently available for both operative and nonsurgical adjuvant therapies.

Most women with breast cancer can now choose breast conservation. Data from multiple mature, controlled trials have demonstrated no significant difference in disease control or survival between patients who elect breast-conservation therapy and those who choose mastectomy.[20-22] Mastectomy is a suitable option if the woman chooses this form of treatment. Mastectomy is preferable for the management of multicentric disease and most large primary tumors (neoadjuvant chemotherapy may allow breast conservation in patients with a sufficient response) and in patients unable to receive postoperative radiation therapy. The majority of patients undergoing mastectomy can have immediate breast reconstruction, if desired. Consultation with a plastic surgeon should be obtained preoperatively to allow the patient to assess the immediate reconstruction options. The timing of breast reconstruction depends partly on patient preference. In addition, if chest wall irradiation is indicated by the breast cancer stage, the immediate reconstruction results are often cosmetically affected.

Early Breast Cancer

Most women with early-stage breast cancer (i.e., stage 0, I, or II breast cancers) are suitable candidates for breast-conservation surgery. The goals of breast-conservation surgery are optimal locoregional control of the breast cancer and preservation of the natural appearance of the breast. All known breast cancers must be excised from the breast and axilla. (It is not necessary to pathologically stage the axilla for most ductal carcinomas in situ.) Radiation therapy must be administered following breast-conservation surgery to reduce the risk of local tumor recurrence, given the high incidence of residual microscopic disease, even with pathologically clear margins. Because radiation therapy is an integral component of breast conservation, patients who are unsuitable for radiotherapy should not undergo this form of surgery. Contraindications to breast-conservation surgery include a history of certain collagen vascular diseases (e.g., scleroderma, polymyositis), the presence of diffuse indeterminate or suspicious calcifications on mammography, a history of therapeutic irradiation to the breast, and positive margins of resection despite wide excision.

Breast-conserving surgery is performed through an incision as close to the primary tumor as possible, whether the lesion is a palpable mass or a mammographic abnormality that has been localized. It is best to remove the entire abnormality with a 1-cm margin of grossly normal tissue to improve the probability of microscopically clear margins. A curvilinear incision in Langer's lines optimizes the cosmetic result in most locations, whereas a radial incision may be preferable in the lower quadrants. Incisions should be positioned to allow them to be included in a standard mastectomy incision wherever possible. After specimen excision, markers (e.g., sutures, clips, dyes) should be placed on the tissue to provide orientation. If frozen-section pathologic analysis is available, evaluation of margins can be obtained intraoperatively. If margin evaluation is performed later, correct specimen orientation will result in less tissue reexcision when the original specimen has tumor involvement of one or more margins. Titanium clips are placed at the base of the biopsy cavity to help target postoperative irradiation. The breast wound is usually closed without approximation of the breast parenchyma. Oncoplastic closures with mobilization of flaps can provide better cosmesis, especially with larger tumor excisions.

Sentinel lymph node biopsy or axillary lymph node dissection is best performed through a separate incision. The axillary incision should be placed between the axillary folds and not cross the lateral border of the pectoralis major muscle (Figure 8-5). Axillary staging aids patient management in determining prognosis and systemic adjuvant treatment. Patients with positive axillary nodes are almost routinely advised to receive systemic treatment, usually combination

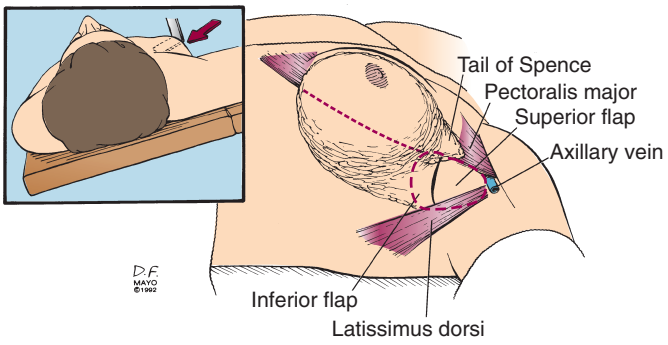


Figure 8-5 Incision of axillary dissection.
Courtesy the Mayo Foundation.

chemotherapy. Postoperative therapy commences after sufficient wound healing has occurred, usually within 4 weeks.

Sentinel Lymph Node Biopsy

Axillary lymph node dissection was once routinely performed in women with invasive carcinoma of the breast. The rationale for axillary lymphadenectomy has shifted from increasing the rate of cure and improved regional disease control to improved staging and appropriate selection of systemic therapy. With the widespread acceptance of the sentinel node biopsy procedure, formal axillary nodal dissection for early breast cancer is limited to patients with pathologic nodal metastasis. Regional metastases are the single-most important prognostic variable for patients who have breast cancer without distant metastases. Because nodal involvement cannot be accurately predicted except with microscopic tissue evaluation, axillary node examination is a necessity.

Minor complications, including seroma development, wound infection, and sensory nerve transection, occur after axillary lymphadenectomy. Although these problems are generally minor, severe and permanent disability from an axillary lymph node dissection may occur. Most commonly this results from upper extremity lymphedema and occasionally from sensory neuropathy. A sentinel lymph node biopsy with limited sampling of the nodes provides an accurate assessment of regional metastasis, with a low prevalence of significant complications. Sentinel lymph node biopsy allows selective completion lymphadenectomy in patients who have documented nodal metastasis.

A sentinel lymph node biopsy identifies and excises the first draining regional node(s). First popularized in the management of cutaneous malignant melanoma, in 1994 Giuliano et al[23] reported their adaptation of the sentinel node technique for patients with breast cancer. Using isosulfan blue to isolate the sentinel lymph node, they identified a sentinel node in 93% of patients with high accuracy for detecting axillary metastases. Given their success with sentinel node biopsy to identify nodal metastases, Giuliano et al[23,24] stopped performing axillary lymphadenectomy for patients with a negative sentinel node biopsy.

To successfully predict nodal metastasis requires an orderly spread of tumor cells in the lymphatics, not a random distribution. The initial draining node or sentinel lymph node is the site of first metastasis. After several confirmatory reports, sentinel lymph node biopsy became standard practice for patients with breast cancer who had no clinical evidence of axillary metastasis.[25-27] The sentinel lymph nodes can be localized with a dye (usually isosulfan blue or methylene blue), a radiolabeled colloid (usually sulfur colloid or human serum albumin), or with both dye and colloid. Through a small axillary incision (2 to 3 cm), the blue-stained lymphatics are frequently located at the lateral border of the pectoralis major muscle and followed to the blue-stained sentinel node. Alternately, a handheld gamma probe allows localization of the radioactive lymph nodes. All nodes stained with dye, those with high radioactivity counts, and those with both staining and high counts are excised and evaluated histologically. Any hard lymph node should also be removed and examined by the pathologist because a tumor-replaced node has no lymphatic flow. Tumor-involved nodes found on frozen-section evaluation allow immediate completion of the axillary dissection. The prognostic importance of minimal tumor involvement of a sentinel node, such as that detected only by immunohistochemical staining (i.e., N0[i+]) and micrometastases (i.e., a tumor deposits less than 2 mm in diameter; i.e., N1mi), remains controversial. Recommendations for complete axillary lymph node dissection and adjuvant treatment based on these limited metastases are still evolving.[28]

MULTIMODALITY THERAPY FOR PANCREATIC ADENOCARCINOMA

Ductal adenocarcinoma of the pancreas is a highly lethal disease with approximately the same number of new cases and deaths each year in the United States. The postoperative mortality rate after major pancreatic resection with curative intent has fallen significantly in major centers over the last three decades. With improved cross-sectional body imaging and endoscopic ultrasonography, preoperative disease staging has dramatically improved. This and new methods of nonsurgical palliation limit surgical intervention in patients with advanced disease that is not curable. Early diagnosis of pancreatic cancer is required to improve the probability of patient survival, but because the symptoms of pancreatic carcinoma are nonspecific and metastases occur early, the diagnosis commonly occurs when the cancer cannot be controlled with local treatments. Specific symptoms do not occur until there is invasion of adjacent structures. Most adenocarcinomas arise in the pancreatic head, with obstructive jaundice being a common presentation. Constant mid-back pain is an indicator of locally advanced cancer with tumor involvement of the splanchnic plexus and the central retroperitoneum. Duodenal obstruction resulting in nausea and vomiting can occur with local progression of the cancer.

Preoperative staging of pancreatic carcinoma should determine if a curative operation is possible. High-quality, thin-cut, spiral CT scanning with oral and intravenous contrast media delineates the primary pancreatic mass, local vascular invasion, and liver metastasis in most patients. EUS and laparoscopy with or without ultrasonography provide more sensitive evaluation of limited metastatic disease.[8-14] With EUS, a high-frequency transducer within the gastric and duodenal lumen is positioned near the pancreas. This technique can detect small pancreatic masses (<1 cm), identify enlarged regional lymph nodes (and allow fine-needle aspiration biopsy of both), and better define the presence and extent of visceral vascular involvement. Laparoscopy for staging pancreatic carcinoma is the best means to detect peritoneal or liver metastases not detected with preoperative imaging.

Only 10% to 20% of patients with carcinoma of the pancreas can be completely resected (R0 resection). Palliation of symptoms to improve quality of life becomes the therapeutic goal for most patients with pancreatic cancer. Obstructive jaundice can be palliated surgically or nonoperatively. Several prospective, randomized studies showed nonoperative biliary

stenting to be as effective in the relief of jaundice as surgical biliary bypass.[29,30] Pain from posterior tumor invasion is effectively treated with a combination of oral analgesics and a celiac plexus block. Operative (laparoscopic or open) gastrojejunostomy or expanding metal endoluminal stents are both reasonable options for the management of duodenal obstruction caused by tumor invasion. Stenting is generally less durable than surgical bypass, requiring multiple procedures when patient survival is lengthy.

The operative results and long-term survival rates after pancreaticoduodenectomy have improved most significantly in medical centers with larger patient experiences. Operative management includes a full abdominal exploration, focusing on inspection of the liver, peritoneum, and omentum for distant metastases. The regional lymph nodes are also palpated to assess for tumor involvement. Periaortic, porta hepatis, small bowel mesentery, or celiac lymph node metastases indicate tumor spread beyond the limits of standard resection. Japanese surgeons have advocated radical lymphadenectomy to improve patient outcome,[31] but randomized trials of extended lymph node dissection have not resulted in improved patient survival rates.[32,33]

Local tumor factors that usually prevent curative resection include retroperitoneal extension to involve the inferior vena cava or aorta or direct involvement or encasement of the superior mesenteric artery or celiac axis. Several centers have shown that en bloc resection of the involved superior mesenteric or portal vein results in patient survival comparable to those of standard pancreaticoduodenectomy.[34,35] After excluding unresectable tumors, the surgeon can proceed with pancreaticoduodenectomy. The classic Whipple procedure, which resects the gastric antrum, or the pylorus-preserving modification provides similar results. Recently laparoscopic and robotic minimally invasive pancreaticoduodenectomy have become reasonable options at select centers with skilled surgeons.

Unfortunately, no more than 25% of patients who have a curative resection for ductal adenocarcinoma of the pancreas will survive for 5 years. Optimal long-term survival is seen with complete resection (R0), no lymph node metastases, small tumor size (<2 cm), and lack of perineural or duodenal invasion. Because survival after curative resection is modest, many nonsurgical therapies have been investigated.

Because approximately 50% of patients have locoregional recurrence after curative resection, adjuvant irradiation could have beneficial effects on patient survival rates.[36] The Gastrointestinal Tumor Study Group[37] first reported encouraging results from a prospective, randomized trial in 1985. The efficacy of adjuvant postoperative irradiation and chemotherapy for adenocarcinoma of the head of the pancreas was evaluated. Forty-three patients were randomized to receive adjuvant therapy with irradiation and 5-fluorouracil (5-FU) or no adjuvant therapy. The median survival time for the 21 patients who received adjuvant therapy was 20 months, and 3 (14%) survived more than 5 years. Among the 22 patients who did not receive adjuvant therapy, the median survival time was 11 months, and only 1 patient (4.5%) survived 5 years.[37] Similar results were noted in a collaborative study from Johns Hopkins Hospital and the Mayo Clinic[38] favoring adjuvant postoperative chemoradiation therapy over surgery alone. A European Study Group for Pancreatic Cancer (ESPAC-1)[39] trial showed benefit for adjuvant chemotherapy, with a deleterious impact of concurrent chemotherapy and irradiation. Major flaws in the ESPAC-1 trial are discussed in Chapter 48, Pancreatic Cancer, in this textbook.

Adjuvant chemotherapy and irradiation are still used in most major treatment centers in the United States for patients with resectable and locally advanced, unresectable pancreatic tumors. Despite improved local control of disease with adjuvant chemoradiation, most patients with pancreatic cancer will succumb to liver or other distant metastases. Pancreatic cancer appears to be a systemic disease at diagnosis in the majority of patients, and death commonly occurs despite clinical presentation with localized disease.

For locally advanced, unresectable pancreatic carcinomas, the use of external beam irradiation (EBRT) plus chemotherapy has been reported to result in a doubling of median survival compared with surgical bypass or biliary stenting. The 2-year survival range increases from 0% to 5% up to 10% to 20% with palliative chemoirradiation. Five-year survivors are rare, and nonprogression of the primary tumor is uncommon. The addition of intraoperative irradiation therapy (IORT) to EBRT with or without 5-FU improves local control, as shown by physicians at the Mayo Clinic and Massachusetts General Hospital.[40-42] This benefit did not translate into an improved patient survival because of liver and peritoneal metastatic progression.

If the full course of adjuvant chemoradiation is delivered preoperatively for patients with locally unresectable or borderline resectable pancreas cancer, this sequence allows restaging 2 to 3 months after treatment initiation.[42,43] The 2-year overall survival appears to be improved with this sequence of treatment followed by IORT. Improvement may result from altered patient selection, however, because the incidence of liver plus peritoneal failure is still excessive.[42,43] Until better systemic therapy is developed, the improved local control of locally unresectable pancreatic adenocarcinoma observed with IORT will not translate into improved survival for patients with locally advanced disease.

THERAPY FOR ADENOCARCINOMA OF THE RECTUM

Despite significant evolution in the multimodality therapy of rectal adenocarcinoma over the past decades, surgical resection continues to be the primary curative modality in these patients. The goal of surgery is to resect all known malignant tissue from the pelvis, thereby optimizing survival and minimizing local failure, while preserving normal bowel, bladder, and sexual function whenever possible. Several patient- and tumor-related factors influence not only the choice of the operation but also the coordination of surgical and nonsurgical treatment modalities. Preoperative clinical tumor staging should assess the level of the tumor from the anal verge, the extent of circumferential involvement, the depth of tumor invasion (T category), and the presence of locoregional adenopathy (N category), and of metastatic disease (M category).[3] Important patient-related factors may include body habitus, preoperative bowel and sphincter function, and the medical conditions that may contraindicate surgical resections due to high operative risk. Additional factors such as performance status, blindness, severe arthritis, or mental incapacity should also be considered before an operation that might result in an ostomy.

Accurate preoperative staging of rectal carcinoma is of central importance for selection of surgical strategy and for determining the need for preoperative therapy. Distant metastatic disease can be detected by CT scanning with 75% to 87% sensitivity. For patients without metastatic disease, preoperative pelvic irradiation with concomitant 5-FU–based chemotherapy remains the current standard of care in the United States for patients clinically staged to have T3-4 or node-positive disease.

Local clinical staging for rectal cancer can be accomplished by either transrectal EUS or by high-resolution pelvic MRI. At present, T and N category are most commonly assessed by

transrectal EUS in the United States. EUS may be preferred to pelvic MRI for tumors of earlier T categories, given the ability for direct inspection of each layer of the rectal wall and perirectal structures. Fine-needle aspiration of suspicious perirectal nodes or extramural lesions can be performed. The reported stage-specific sensitivities and specificities of EUS are T1 (88% and 98%), T2 (81% and 96%), T3 (96% and 91%), and T4 (95% and 98%); corresponding sensitivity and specificity for nodal staging are 73% (95% CI, 71% to 76%) and 76% (95% CI, 74% to 78%), respectively.[44,45] EUS is operator dependent and is of limited value when severe luminal stenosis is present or when EUS is performed in the postirradiation setting because inflammatory changes of the soft tissues reduce the accuracy of EUS.[46] Although nodal staging by CT scanning carries a lower sensitivity (45% to 73%), visible perirectal adenopathy should be suspected as malignant.

High resolution MRI has recently emerged as a preferred method for clinical staging, especially in England and Europe, particularly when the assessment of the circumferential resection margin (CRM) or adjacent organ involvement might be critical. CRM refers to the degree of tumor infiltration of the mesorectal fascia.[47] Preoperative recognition of a threatened CRM where malignant infiltration is present within 1 to 2 mm of the mesorectal fascia allows surgical planning for a resection plane that will result in a negative CRM.[48] In the multicenter Magnetic Resonance Imaging and Rectal Cancer European Equivalence Study (MERCURY),[49] high-resolution MRI accurately predicted the involvement of the mesorectal margin to within 1 mm and extratumoral extension with a specificity of 92%. Using surgical resection specimens as the gold standard, 94% of the patients did have a negative CRM.[50,51] Long-term data after 62 months of follow-up showed high-resolution MRI preoperative assessment of CRM status is excellent for assessing local recurrence risk and disease-free survival.[52] For patients with locally advanced primary cancer or locally recurrent rectal tumor, pelvic MRI or CT are best for assessing tumor involvement or fixation to adjacent pelvic organs, helping the surgeon plan en bloc resection of involved organs for a microscopically negative margin.[48,51] The need for urologic, orthopedic, and plastic surgical assistance can be anticipated preoperatively with pelvic MRI or CT staging.

Surgical resection of curative intent removes the primary tumor, draining lymphatic tissue, and any involved pelvic structures in an en bloc fashion. Proximal, distal, and radial/circumferential resection margins are all key determinant of outcome after standard rectal resection.

The need for adequate distal resection margin is a key contributor to whether the patient is a candidate for sphincter preservation. Sphincter-preserving procedures include low anterior resection (LAR) and proctectomy with coloanal anastomosis, whereas an abdominoperineal resection (APR) results in a permanent colostomy. The choice of the procedure is mainly dictated by whether there is adequate distance remaining between the tumor and the anal verge. The exact location of the tumor is measured in reference to the anal verge or to the top of the anal sphincter complex (i.e., anorectal ring) by digital rectal examination and proctosigmoidoscopy. The adequacy of the distal margin is then assessed to determine the feasibility of sphincter preservation. The operative surgeon should ideally perform this evaluation before the patient receives preoperative adjuvant treatment. Previous studies have shown that tumor deposits in nodal tissue are rarely seen more than 2 to 4 cm distal to the tumor. Thus for tumors in the upper and mid rectum, the ideal adequate distal margin is 5 cm. For tumors located in the very distal rectum where the mesorectal tissue is very thin and has tapered significantly, a 2-cm distal margin is considered adequate because it resulted in no difference in overall survival or local failure rates when compared with a greater distal margin.[53,54] In all rectal operations, proximal ligation of the inferior mesenteric and superior hemorrhoidal vessels and full mobilization of the rectum either to a level well below the gross tumor or to the level of the levator ani muscles are performed. If sphincter preservation is possible, the rectum is transected, usually with a cutting linear stapler. An end-to-end colorectal anastomosis is then created using either a hand-sewn or stapling technique. When the line of rectal transaction is at the level of the anal sphincter, the rectal division may be accomplished transanally. A hand-sewn coloanal anastomosis using interrupted sutures placed transanally is then performed. Although intersphincteric dissection followed by hand-sewn anastomosis has been reported, its role remains highly limited.[55] When sphincter preservation is not possible, an APR is performed. Recently, a "cylindrical" approach to APR has been advocated, with an extended perineal dissection including the origin of the levator ani muscle from the lateral pelvic sidewall. This en bloc resection of the levator muscles results in a more cylindrical specimen and had been associated with less CRM positivity and intraoperative specimen perforation.[56]

When counseling patients for sphincter-preserving procedures, the risk of anastomotic leakage and long-term altered bowel function must be discussed. In an analysis of 5187 patients undergoing LAR in five randomized control trials, the symptomatic anastomotic leakage rate was 9.7%.[57] Leakage was associated with reduced overall survival. A diverting stoma lessened the symptoms of the leakage. Construction of a diverting stoma is prudent with a low rectal anastomosis or in patients who received neoadjuvant chemoradiation or will have adjuvant chemoradiation, or both.[58,59] Sphincter-preservation procedures are also accompanied by altered bowel function, most commonly stool frequency, urgency, and incontinence. Reconstructive techniques, including the colonic J pouch, transverse coloplasty, or side-to-end anastomosis, have been developed. A recent Cochrane review showed that functional outcomes were better with the colonic J pouch than with a straight rectal anastomosis in the short term (18 months). There was insufficient evidence for any long-term benefit.[60] These reconstructive options may not be feasible in patients with a bulky mesentery or narrow pelvis. Therefore, sphincter preservation must be considered in the context of (a) adequate oncologic margin, (b) risk of anastomotic leakage, and (c) altered bowel function.

For tumors confined within the mesorectum, total mesorectal excision (TME) is the optimal technique to minimize the risk of an involved CRM.[61] Popularized by Heald and associates,[62] TME involves sharp dissection of the avascular plane between the visceral covering of the mesorectum and the parietal fascia of the pelvis. The surgical planes between the integral visceral mesentery of the hindgut and the surrounding tissues provide a unique opportunity for defining a surgically achievable "tumor package," and, serendipitously, the field of spread of rectal cancer is commonly limited within this package, or mesorectum.[63,64] TME encompasses virtually every tumor satellite except those in patients in whom the tumor is widely disseminated. The excised specimen includes the entire posterior, distal, and lateral mesorectum to the plane of the inferior hypogastric nerve plexus, which is carefully preserved whenever possible. Anteriorly, the specimen includes the intact Denonvilliers fascia and the peritoneal reflection. The characteristic smooth, bilobed, encapsulated appearance posteriorly and distally reflects the contours of the pelvic floor and the midline anococcygeal raphe. In contrast to the local recurrence rates of 20% to 45% reported with traditional resections, rates between 4% and 7% and 5-year disease-free survival approaching 80% have been reported with TME alone.[63,64]

Several less-invasive surgical approaches for patients with rectal cancer have gained attention in recent years. Transanal local excision, either conventionally or via transanal endoscopic microsurgery, may be an option in select patients with well-differentiated T1 tumors located within 8 cm of the anal verge, less than 3 cm in diameter, occupying less than 30% of the luminal circumference, and without suspicious perirectal adenopathy.[65] Excised specimens should be full-thickness, nonpiecemeal specimens with an adequate margin of resection for pathologic examination. Patients treated in this fashion enjoy minimal morbidity but face increased risks for local failure and, perhaps, decreased overall survival.[66-68] Although laparoscopic-assisted operations for rectal cancer are technically feasible, long-term data demonstrating oncologic equivalence to open procedures are just emerging. Particular concerns of the laparoscopic approach include inadvertent spillage of luminal contents, handling of the tumor specimen, implantation of tumor cells in the pelvis, and the potential for port-site relapse. In the short term, patients have reduced analgesia requirements, ambulate more readily, and appear to have less paralytic ileus.[69] The United Kingdom Medical Research Council trial of conventional versus laparoscopic-assisted surgery in colorectal cancer (UK MRC CLASSIC trial) included a subgroup of 381 patients with rectal cancer who were randomized to open versus laparoscopic procedures.[70] After accounting for a 34% conversion rate, 189 and 87 patients were treated in each arm, respectively. No statistically significant difference was seen in the rates of positive proximal, distal, or circumferential margins; 3-year local recurrence; or overall survival. However, in the subgroup of patients who underwent laparoscopic versus open LAR, the CRM was positive in 12% versus 6% of the open LAR patients (p = 0.19).[70] Finally, robotic surgery for rectal cancer has emerged, and offers the advantages of three-dimensional vision and fine articulation for pelvic dissection.[71] In the United States, the ACOSOG Z6051 trial compared open to minimally invasive surgery for resection of locally advanced rectal cancer, and allowed several minimally invasive techniques in the experimental arm including hand-, laparoscopic-, and robotic-assisted techniques. The initial results of this trial are expected to become available in 2014. Currently available evidence appears to suggest that the number of resected lymph nodes and surgical margins were similar and laparoscopic and open TME had similar effects on five-year disease-free survival.[69]

Despite surgical resection of rectal cancer with curative intent, approximately 20% of the patients develop disease relapse, usually during the first 3 postoperative years. Local pelvic recurrences can be highly morbid, causing pain, bowel obstruction, hemorrhage, and malignant fistulization. The risk of relapse correlates with the T and N category of the tumor, as well as completeness of surgical excision[72] (Table 8-1). Local failure is also more common with a positive CRM.[47,73] Consequently, adjuvant therapy has evolved with the goals of preventing local tumor recurrence, eliminating distant metastases, and increasing both disease-free and overall survival.[74] Both preoperative and postoperative regimens of irradiation or chemoradiation have been developed. Although early trials mainly involved postoperative irradiation, the potential for tumor down-staging, less tissue hypoxia, and less exposure to small bowel in the radiation field has shifted the focus toward preoperative treatment. Two meta-analyzes showed that when compared with surgery alone, the addition of preoperative irradiation to surgery decreased the local failure rate (odds ratio [OR] 0.49; 95% CI 0.38 to 0.62; p<0.001)[75] and that the yearly local failure rate was 46% lower with preoperative irradiation (p<0.001) and 37% lower with postoperative irradiation (p=0.002).[76] In the era of TME surgery, the German Rectal Cancer Study Group trial demonstrated the added benefit of preoperative combination chemoradiation: the local recurrence rate was 6% with preoperative treatments versus 13% with postoperative treatments (p=0.006), although no difference was seen in overall survival.[77] Although a second trial of similar design, NSABP R-03, did not meet its accrual goal, a superior 5-year disease-free survival was observed in the preoperative versus postoperative arm (65% vs. 53%; p=0.011).[78] A 5-year local recurrence rate of 10.7% was reported for both treatment arms. Although preoperative combination chemoradiation has been widely adopted in the United States for nearly all T3-4 and patients with node-positive rectal cancer, its use is more selective in Europe. A recent trial from the Medical Research Council (MRC CR07) compared short-course preoperative irradiation with TME surgery and selective postoperative chemoradiation and demonstrated that preoperative treatment still led to a 6% lower 3-year local recurrence rate, although no difference was seen in overall survival.[79] Finally, based on pooled data from five phase III North American rectal adjuvant trials, selected patients with intermediate-risk rectal cancers (T1-2N1 and T3N0) might not need radiation therapy as a component of adjuvant treatment.[72] An ongoing trial ALLIANCE N1048 is investigating the feasibility of omitting pelvic radiation in select intermediate risk upper rectal cancers (treatment arms of preoperative chemotherapy versus preoperative chemoradiation).[80] Ongoing research continues to focus on finding the optimal treatment regimen that provides oncologic benefit but spares potential toxicities.

MANAGEMENT OF RETROPERITONEAL SOFT-TISSUE SARCOMA

Soft-tissue sarcomas constitute less than 1% of all malignant tumors in the United States. Approximately 15% of sarcomas arise in the retroperitoneum.[81] Retroperitoneal sarcomas provide a challenge for the surgical oncologist. Most patients with retroperitoneal sarcoma eventually die of their disease, despite never developing disease outside the abdomen. The locally invasive growth pattern, the lack of anatomic boundaries in the retroperitoneum, and the large size of most sarcomas at presentation make complete R0 resection difficult. The rate of complete gross tumor resection (R0 and R1), which was

TABLE 8-1 Rectal Cancer: Overall Survival and Risk of Relapse by TN Category

Risk for Relapse	TN Category	5-Year Local Recurrence (%)	5-Year Distant Metastasis (%)	5-Year Overall Survival (%)
Low	T1-2N0	≤5	10	90
Intermediate	T3N0, T1-2N1	7-9	15-20	65-73
Moderately high	T4N0, T3N1,T1-2N2	8-12	28-37	48-58
High	T4N1, T3-4N2	14-23	39-53	30-36

approximately 50% in major centers,[81] has increased to 67% to 75%.[82,83] The local recurrence rate at 5 years after complete surgical resection ranges from 40% to 50%.[82-85] Among patients who are disease free at 5 years, 40% will experience a relapse by 10 years after their operation.[86] Uncontrollable local recurrence is the most common cause of death from retroperitoneal sarcoma. Retrospective analysis of more than 1000 patients with retroperitoneal sarcoma found primary tumor size; tumor fixation to nerve, vessels, or bone; regional lymph node involvement (rare); presence of metastatic disease; and tumor grade predictive of survival.[87]

The most common presentation for retroperitoneal sarcoma is an abdominal mass or pain, or both. An abdominal CT scan establishes the extent of tumor, the relationship of the sarcoma to normal organs, the presence or absence of tumor necrosis, and the presence of liver metastases. CT scanning of the chest is performed to rule out pulmonary metastases. Diagnosis of a retroperitoneal sarcoma can be made by a needle or rarely incisional biopsy if preoperative treatment is planned. A limited biopsy to exclude metastatic testicular cancer or lymphoma is indicated before primary surgical resection when the diagnosis is in doubt.

The surgical treatment of retroperitoneal sarcomas consists of en bloc resection of the tumor plus adjacent organs invaded by or adherent to the sarcoma. Recent reports recommend removal of any adjacent organs regardless of apparent tumor involvement.[88,89] This is feasible for some sarcomas but not for others.[90] This policy has not been shown to give better results in a controlled study.[87] Most retroperitoneal sarcomas involve left- or right-sided retroperitoneal structures, with few arising in the midline. Because of their large dimensions, en bloc resection often requires ipsilateral nephrectomy and colectomy, partial small bowel resection, distal pancreatectomy, and splenectomy. Less frequently, a partial gastrectomy, pancreaticoduodenectomy, major hepatectomy, or vascular resection may be indicated. Any adherence of the sarcoma to an adjacent structure must be assumed to be malignant in nature. These structures should be excised en bloc whenever feasible. If extensive venous collaterals are present from vena caval occlusion, the inferior vena cava may be resected without reconstruction; a prosthetic graft reconstruction is indicated in other patients. An aortic resection and prosthetic reconstruction should be considered for a sarcoma encasing the aorta when the sarcoma can be completely excised. When a retroperitoneal sarcoma has an extensive volume of necrotic tissue, care must be used during mobilization to avoid tumor rupture.

Resection of a large retroperitoneal sarcoma en bloc is presented in Figures 8-6 and 8-7. This patient reported pain and had an abdominal mass. A preoperative CT scan image appears in Figure 8-6. The sarcoma filled the left upper quadrant, displacing the spleen and distal pancreas anteriorly. On abdominal exploration through a midline incision, the tumor was found to be limited to the left retroperitoneum. The stomach was not involved by tumor. After opening the lesser sac, the stomach was reflected cephalad. The splenic flexure of the colon was also uninvolved. It was retracted caudad, providing excellent exposure of the distal pancreas, spleen, left kidney, and anterior surface of the sarcoma (Figure 8-7, *A*). The neck of the pancreas was divided, allowing ligation of the splenic artery and vein (Figure 8-7, *B*). To minimize intraoperative bleeding, the vascular supply along the medial aspect of the sarcoma was ligated before the sarcoma was mobilized and en bloc resection was performed. The left renal artery and vein were then exposed and ligated (Figure 8-7, *C*). The resected retroperitoneal sarcoma with the distal pancreas, spleen, and left kidney are shown in Figure 8-7, *D*.

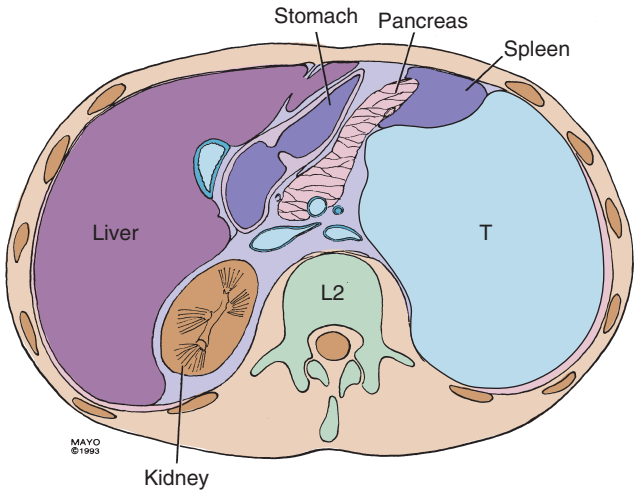


Figure 8-6 Appearance of left upper quadrant mass on CT scan. *T*, Tumor.
Courtesy the Mayo Foundation.

Because local tumor recurrence is the most common pattern of treatment failure, radiation therapy should theoretically improve results. Some retrospective series have suggested an improvement in the local control and survival of retroperitoneal sarcoma patients with adjuvant irradiation.[91,92] The large-field radiotherapy needed to treat the resection bed following retroperitoneal sarcoma excision can cause significant complications. IORT plus EBRT has been considered a better alternative to full-dose EBRT because of less toxicity to normal tissues. A prospective, randomized clinical trial performed at the National Cancer Institute compared IORT plus postoperative low-dose EBRT with postoperative high-dose EBRT alone. This study showed no statistically significant difference in survival rates between patient groups, but the pattern of disease failure differed between the two groups. Patients receiving IORT plus EBRT had significantly better local disease control within irradiation fields and a significantly lower prevalence of small bowel toxicity.[93] A trial sponsored by the American College of Surgeons Oncology Group to study whether adjuvant EBRT improved local control and survival rates compared with resection alone for patients with retroperitoneal sarcoma closed prematurely because of poor patient accrual. Currently, there is no proven survival benefit for the use of either adjuvant radiation therapy or chemotherapy for retroperitoneal sarcomas.

SUMMARY

Surgery is still the single-best treatment for most solid tumors in adults. The surgical oncologist must understand the biology of the particular malignancy. Accurate preoperative tumor staging is crucial in treatment decisions. The goal of surgical intervention may be potential cure or palliation. Adjuvant radiotherapy and chemotherapy should be used whenever evidence-based data show that they confer additional survival time or palliative benefit. The physiologic status of the patient must be established and maximized preoperatively to minimize surgical morbidity or mortality. The principles of surgical oncology, including complete en bloc tumor resection, should be followed whenever possible. Adequate postoperative healing must occur before adjuvant therapy starts. The survival of patients with most surgically treated cancers will likely improve as the result of improved nonsurgical treatments rather than more radical surgical procedures.

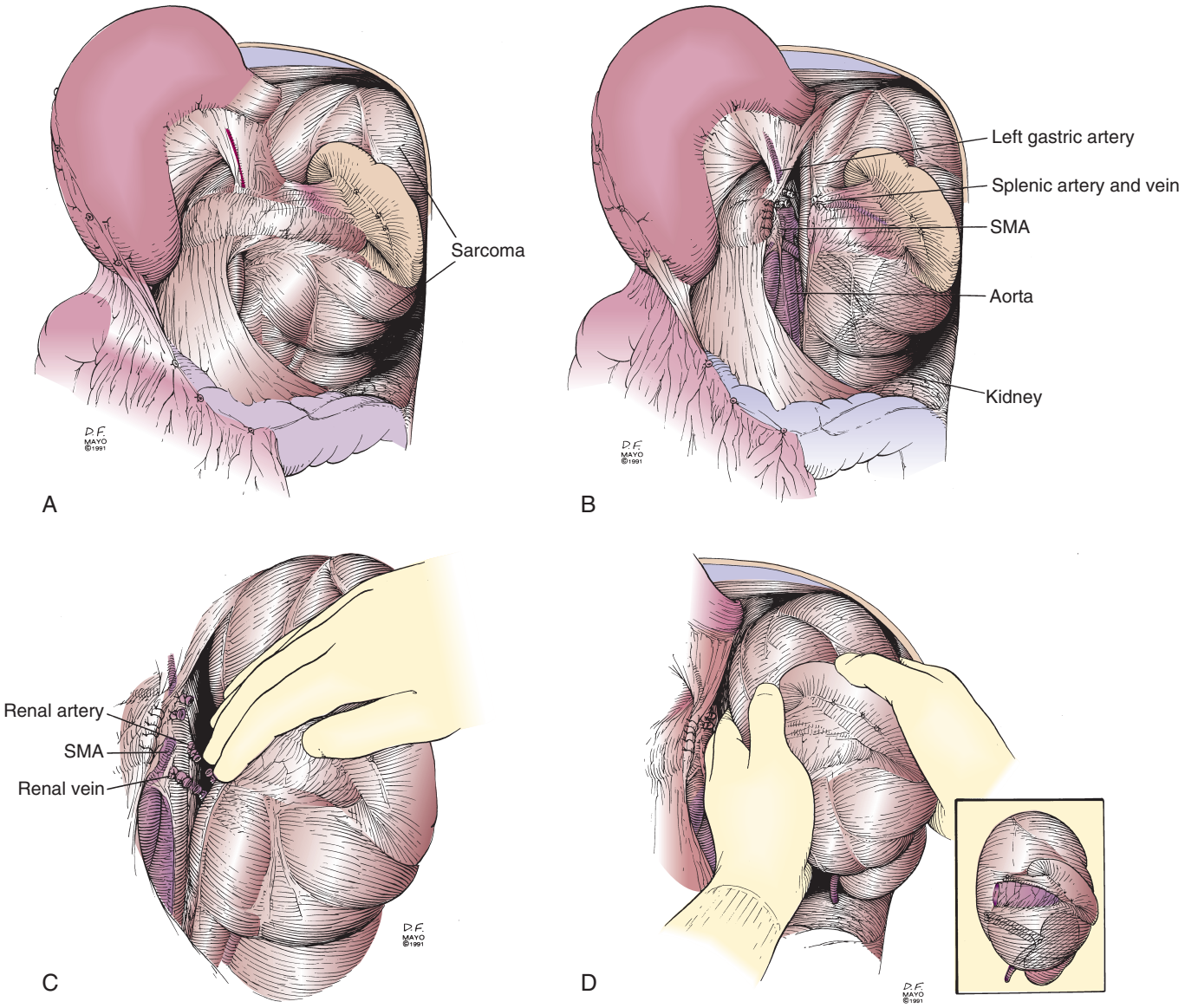


Figure 8-7 **A,** Mobilization of the transverse colon and stomach with exposure of retroperitoneal structures. **B,** Division of the neck of the pancreas and ligation of the splenic artery and vein. **C,** Ligation of the left renal artery and vein. **D,** En bloc resection. *Inset,* Specimen consisting of the sarcoma, spleen, distal pancreas, and left kidney. *SMA,* Superior mesenteric artery.
Courtesy the Mayo Foundation.

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