DISSERTATION
ON

AN ANALYSIS OF CURATIVE GASTRECTOMY FOR ADENOCARCINOMA OF STOMACH

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CERTIFICATE

This is to certify that this dissertation entitled ***"AN ANALYSIS OF CURATIVE GASTRECTOMY FOR ADENOCARCINOMA OF STOMACH "*** is the bonafide record of work done by **Dr. E.M.J. KARTHIKEYAN**, submitted as partial fulfillment for the requirements of M.S. Degree Examinations, (Branch I) General Surgery, MARCH 2008.

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INTRODUCTION

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Adenocarcinoma of the stomach was the leading cause of cancer-related death worldwide through most of the twentieth century. It now ranks second only to lung cancer, and an estimated 875,000 new cases are diagnosed annually worldwide. (1)

The prognosis for this disease remains poor, except in a few countries. The explanations for these poor results are multifactorial. The lack of defined risk factors and specific symptoms and the relatively low incidence have contributed to the late stage at diagnosis seen in most Western countries. In Japan, where gastric cancer is endemic, more patients are diagnosed at an early stage, which is reflected by higher overall survival rates.

Although the incidence of gastric cancer has decreased dramatically over the past century, the decline has been limited to cancers below the esophagogastric junction. The number of newly diagnosed cases of proximal gastric and esophagogastric junction adenocarcinomas has increased markedly since the mid-1980s(3,4). These tumors are thought to be biologically more aggressive than distal tumors and more complex to treat. In Indian subcontinent there are contrary reports that incidence has not decreased dramatically and there is no site specific change of adenocarcinoma of stomach. Male above 40 years still continue to be commonly affected (5).Gastric cancer is one of the ‘captains of men of death’

The only proven, potentially curative treatment for gastric cancer is surgical resection of all gross and microscopic disease. Even after what is believed to be a "curative" gastrectomy, disease recurs in regional or distant sites, or both, in the majority of patients.

Efforts to improve these poor results have focused on developing effective pre- and postoperative systemic and regional adjuvant therapies.

Carcinoma Stomach is still leading killer in India as there is poor mass screening methods and usually late presentation. In potentially operable cases Surgery only offers probable cure and a good disease specific survival.

Incidence of carcinoma stomach as with total no of cancer patients in Thanjavur Medical College and Hospital

2005(July onwards) : 86 / 709 cases

2006 : 188 / 1641 cases

2007(upto August) : 124 / 1130 cases

TOTAL : 398 / 3480 cases

Carcinoma stomach accounts to 11.4% of total cancer patients.

It ranks third next to Breast and oral cavity malignancy.

CRUDE INCIDENCE RATE (CIR) OF COMMON CANCERS, FEMALE, 1984-98

(ranking of sites (in superscript) is based on absolute number of cases during 1984-98

SITE	1984-1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1984-1998
Cervix	33.6	30.6	27.3	26.6	24.2	26.2	24.7	23.3	22.6	24.8	24.4	27.7[1]
Breast	15.3	17.2	16.7	16.2	16.2	17.8	18.7	18.5	19.9	22.7	21.6	17.4[2]
Oral cavity*	5.9	5.8	7.0	6.4	5.8	4.6	4.8	5.2	4.8	5.2	5.3	5.7[3]
Stomach	4.6	4.7	5.0	4.4	4.9	5.5	4.7	5.4	5.7	4.7	6.6	5.0[4]
Oesophagus	4.4	5.0	4.5	4.7	4.3	3.7	4.5	5.0	5.6	4.4	5.4	4.6[5]

* UICC classification

CRUDE INCIDENCE RATE (CIR) OF COMMON CANCERS, MALE, 1984-98

(ranking of sites (in superscript) is based on absolute number of cases during 1984-98)

SITE	1984-1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1984-1998
Stomach	9.7	10.2	10.3	9.9	10.3	9.8	9.3	9.9	11.4	10.1	10.2	9.9[1]
Lung	5.9	6.9	9.4	8.4	8.6	9.3	7.9	7.8	8.3	8.8	8.8	7.5[2]
Oesophagus	5.3	6.2	6.8	7.4	6.4	6.2	6.5	6.5	5.6	7.1	7.0	6.1[3]
Oral cavity*	5.6	5.2	5.0	5.5	5.4	6.2	6.0	5.1	6.3	6.8	5.3	5.6[4]
Oropharynx*	4.4	4.5	4.2	5.5	4.9	4.9	5.1	6.2	4.7	4.3	6.3	4.8[5]

* UICC classification

AIMS OF STUDY

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To study various curative surgical modalities in the management of adenocarcinoma of stomach.

To analyse patients undergoing curative resection (R0).

To analyse age, sex, site, type, size, depth of invasion, nodes involved and examined in these patients.

To study the extent of gastric resection and lymphadenectomy in these patients.

To plot Nomogram for disease specific survival according to above factors.

To study the mortality and morbidity in these patients.

To compare and contrast with other studies.

REVIEW OF LITERATURE

REVIEW OF LITERATURE

Epidemiology and Etiology

The etiology of gastric cancer is likely multifactorial. A list of factors associated with increased risk of gastric adenocarcinoma is outlined in table. The etiologic basis for the rising incidence of proximal gastric and gastroesophageal junction cancers is being aggressively pursued. The increasing prevalence of obesity may be one contributing factor. Elevated body mass index and high caloric consumption have been associated with adenocarcinoma of the distal esophagus and gastric cardia. Gastroesophageal reflux disease may be another risk factor, although one also associated with obesity. A population-based, case-control study performed in Sweden found that for persons with recurrent symptoms of reflux, as compared to those without such symptoms, the odds ratio (OR) was 7.7 [95% confidence interval (CI), 5.3 to 11.4] for esophageal adenocarcinoma and 2.0 (95% CI, 1.4 to 2.9) for developing adenocarcinoma of the gastric cardia.Other studies have found tobacco use to be associated with tumors at these sites. Gammon et al. observed an OR of 2.4 (95% CI, 1.7 to 3.4) for the development of gastric cancer in cigarette smokers. Conversely, the use of aspirin and nonsteroidal and inflammatory drugs has been associated with a lower risk of esophageal and cardia cancers, implicating inflammation in the etiology of gastric cancer.

In 1965, Lauren[18] described two histologic types of gastric adenocarcinoma, intestinal and diffuse, which provided a model to understand better the etiology and epidemiology of the disease. The intestinal variant arises from precancerous lesions such as gastric atrophy or intestinal metaplasia within the stomach, occurs more commonly in men than in women, is

more frequent in older people, and represents the dominant histologic type in regions where stomach cancer is endemic, suggesting a predominantly environmental etiology. The diffuse form does not typically arise from recognizable precancerous lesions. It is more common in low-incidence regions, occurs slightly more frequently in women and in younger patients, and has a higher association with familial occurrence (blood type A), suggesting a genetic etiology.[19] Changes in the incidence of gastric cancer over time appear to reflect primarily a change in the incidence of the intestinal form.

Gastric adenocarcinomas of the body and antrum of the stomach have a strong association with H pylori infection. This is a common infection in many parts of the world and was associated with a doubled risk of such cancers in a metaanalysis of multiple studies. The precise mechanism by which H pylori infection increases gastric cancer incidence is unclear, but it appears to increase the incidence of chronic atrophic gastritis, which produces a low-acidity environment, and the incidence of metaplasia and dysplasia. However, because H pylori infection is present in more than 50% of the population in many parts of the world, it is clearly not a sufficient event for the development of gastric cancer. Reports suggest that gastric cancer develops in 5% of H pylori–positive persons over 10 years. Multiple factors have been suggested that may interact with H pylori in producing gastric cancer, including tobacco use, age at infection, gender, and diet (e.g., low intake of ascorbic acid, carotene, and vitamin E). The precise type of H pylori infection may also be a factor. A number of studies have suggested that cagA strains, which are associated with cytotoxin expression, produce more gastric inflammation and have a strong association with gastric cancer.

A number of other factors have been studied for their relationship with gastric cancer formation. Relatively little information is available to support a strong relationship between gastric cancer and alcohol use, although there may be a weak association between alcohol and tumors of the gastric cardia. A moderate association between tobacco use and gastric cancer formation appears to be present (overall risk, 1.5 to 2.5), with a long time interval after smoking cessation necessary before a decrease in risk is seen.

Evidence is fairly strong that eating fruits and vegetables (especially when raw) has a protective effect against gastric cancer, and there is a suggestion that eating foods high in antioxidants, including vitamins C and E, carotenoids, and flavonoids, may be beneficial. Green tea, which contains large amounts of phenols, could also be protective, but results have been inconsistent.

The data on nitrates found in preserved foods and gastric cancer are mixed. Nitrates can be converted to nitrites and then to N-nitroso compounds, which produce gastric cancer in laboratory animals. Some studies have shown a strong association between high intake of nitrates and gastric cancer, and other studies have shown no association.

Radiation exposure, especially at a young age, has been shown to produce a high risk of gastric cancer. Gastric ulcer disease is also associated with an increased risk of gastric cancer, whereas duodenal ulcer disease is associated with a modest risk reduction.

Anatomic Considerations

The stomach begins at the gastroesophageal junction and ends at the pylorus. Above it lie the diaphragm and left lobe of the liver; before it is the abdominal wall; and below it are the transverse colon, mesocolon, and greater omentum. Behind and to the sides are the spleen, pancreas, left adrenal gland, left kidney, and splenic flexure of the colon. Cancers arising from the proximal greater curvature may directly involve the splenic hilum and tail of the pancreas, whereas more distal tumors may invade the transverse colon. Proximal cancers may extend into the diaphragm, spleen, or left lateral segment of the liver.

The blood supply to the stomach is extensive and is based on vessels arising from the celiac axis. The right gastric artery, arising from the hepatic artery, and the left gastric artery, arising from the celiac axis directly, course along the lesser curvature. Along the greater curvature are the right gastroepiploic artery, which originates from the gastroduodenal artery at the inferior border of the proximal duodenum, and the left gastroepiploic artery, branching from the splenic artery laterally. The short gastric arteries (vasa brevia) arise directly from the splenic artery and make a relatively small contribution to the blood supply to the proximal portion of the stomach. The preservation of any of these vessels in the course of a subtotal gastrectomy for carcinoma is not necessary (and is not possible if the operation is performed correctly), and the most proximal few centimeters of remaining stomach are well supplied by collateral flow from the lower segmental esophageal arcade. The rich submucosal blood supply of the stomach is an important factor in its ability to heal rapidly and produce a low incidence of anastomotic disruption.

The venous supply of the stomach tends to parallel the arterial supply. The venous efflux ultimately passes the portal venous system and is reflected in the fact that the liver is a primary site for distant metastatic spread.

The lymphatic drainage of the stomach is extensive, and distinct anatomic groups of perigastric lymph nodes have been defined according to their relationship to the stomach and its blood supply. The six perigastric lymph node groups are the subpyloric and gastroepiploic nodes along the greater curvature and the suprapyloric and the lesser curvature lymph nodes along the lesser curvature and, proximally, the right and left pericardial nodes. The second echelon (extraperigastric) nodes include the common hepatic, left gastric, splenic hilum, and splenic artery lymphatics, which drain into the celiac and periaortic lymphatics. Proximally are the lower esophageal lymph nodes; extensive spread of gastric cancer along the intrathoracic lymph channels may be manifested clinically by a metastatic lymph node in the left supraclavicular fossa (Virchow's node) or left axilla (Irish's node). As the submucosal lymphatic supply of the stomach becomes extensively involved with tumor, other routes of lymphatic drainage may be recruited. Tumor spread to the lymphatics in the hepatoduodenal ligament can extend along the falciform ligament and result in subcutaneous periumbilical tumor deposits known as Sister Mary Joseph's nodes.

Wide spread metastatic disease may occur in any organ via lymphatics, haematogenous or transperitoneal spread especially to liver, lungs, ovary(Krukenberg tumor) and peritoneum.Sclerotic bone metastatis and carcinomatous meningitis may at times occur.

Pathology and Tumor Biology

Approximately 95% of all malignant gastric neoplasms are adenocarcinomas, and in general, the term gastric cancer refers to adenocarcinoma of the stomach. Other malignant tumors are very rare and include squamous cell carcinoma, adenoacanthoma, carcinoid tumors, and leiomyosarcoma. Although no normal lymphoid tissue is found in the gastric mucosa, the stomach is the most common site for lymphomas of the gastrointestinal tract. The increased awareness of association between mucosa-associated lymphoid tissue lymphomas and H pylori may explain, in part, the rise in incidence. The differentiation between adenocarcinoma and lymphoma can sometimes be difficult but is essential because staging, treatment, and prognosis are different for each disease.

Histopathology

Several staging schemas have been proposed based on the morphologic features of gastric tumors. The **Borrmann** classification divides gastric cancer into five types depending on macroscopic appearance. Type I represents polypoid or fungating cancers, type II encompasses ulcerating lesions surrounded by elevated borders, type III represents ulcerated lesions infiltrating the gastric wall, type IV are diffusely infiltrating tumors, and type V are unclassifiable cancers.(20)The gross morphologic appearance of gastric cancer and the degree of histologic differentiation are not independent prognostic variables.[21,22] **Ming**[22`]has proposed a histomorphologic staging system that divides gastric cancer into either a prognostically favorable expansive type or a poor-prognosis infiltrating type. Based on an analysis of 171 gastric cancers, the expansive-type tumors were uniformly polypoid

or superficial on gross appearance, whereas the infiltrative tumors were almost always diffuse. Grossly ulcerated lesions were equally divided between the expanding or infiltrative forms. **Broder's** classification of gastric cancer grades tumors histologically from 1 (well differentiated) to 4 (anaplastic). Bearzi and Ranaldi[23] have correlated the degree of histologic differentiation with the gross appearance of 41 primary gastric cancers seen on endoscopy. Ninety percent of protruding or superficial cancers were well differentiated (Broder's grade 1), whereas almost one-half of all ulcerated tumors were poorly differentiated or diffusely infiltrating (Broder's grades 3 and 4).

The most widely used classification of gastric cancer is by **Lauren**.[18] It divides gastric cancers into either intestinal or diffuse forms. This classification scheme, based on tumor histology, effectively characterizes two varieties of gastric adenocarcinomas that manifest distinctively different pathology, epidemiology, and etiologies. The intestinal variety represents a differentiated cancer with a tendency to form glands. In contrast, the diffuse form exhibits very little cell cohesion and has a predilection for extensive submucosal spread and early metastases. Although the diffuse-type cancers are generally associated with a worse outcome than the intestinal type, this finding is not independent of tumor, node, metastasis (TNM) stage.The **WHO** classification based on histology consists of Papillary,Tubular,Mucinous and signet cell types.

Patterns of Spread

Carcinomas of the stomach can spread by local extension to involve adjacent structures and can develop lymphatic metastases, peritoneal metastases, and distant metastases. These extensions can occur by the local invasive properties of the tumor, lymphatic spread, or

hematogenous dissemination. The initial growth of the tumor occurs by penetration into the gastric wall, extension through the wall, and involvement of an increasing percentage of the stomach. The two modes of local extension that can have a major therapeutic impact are tumor penetration through the gastric serosa, where the risk of tumor invasion of adjacent structures or peritoneal spread is increased, and involvement of lymphatics. Zinninger[24] has evaluated the spread in the gastric wall and has found a wide variation in its extent. Tumor spread is often through the intramural lymphatics or in the subserosal layers. Local extension can also occur into the esophagus or the duodenum. Duodenal extension is principally through the muscular layer by direct infiltration and through the subserosal lymphatics, but is not generally of great extent. Extension into the esophagus occurs primarily through the submucosal lymphatics.

Local extension does not occur solely by radial intramural spread but also by deep invasion through the wall to involve adjacent structures. Extension can occur through the gastric serosa to involve omentum, spleen, adrenal gland, diaphragm, liver, pancreas, or colon. Data from several large older series indicated that 60% to 90% of patients had primary tumors penetrating the serosa or invading adjacent organs and that at least 50% had lymphatic metastases.[25,26] Of the 1577 primary gastric cancer cases admitted to Memorial Sloan-Kettering Cancer Center between July 1, 1985, and June 30, 1998, 60% of the 1221 resected cases had evidence of serosal penetration, and 68% had positive nodes. Lymph node metastases were found in 18% of pT1 lesions after R0 resection in 941 patients. This rate increased significantly to 60% in pT2 lesions. The highest incidence of lymphatic metastasis was seen in tumors diffusely involving the entire stomach. Tumors located at the

gastroesophageal junction also had a high incidence relative to other sites. The pattern of nodal metastases also varies depending on the location of the primary site with the left gastric artery nodes being consistently at increased risk for nodal metastases, regardless of tumor location.

Gastric cancer recurs in multiple sites, locoregionally and systemically The literature reveals disagreements over failure patterns : these disagreements are likely related to the patient cohorts accepted for evaluation, the time at which failure was determined, and the method of determination of failure patterns. In two older autopsy series, the rate of locoregional failure [defined as tumor in perigastric tissues (e.g., in the retroperitoneal "gastric bed," perigastric lymph nodes, gastric remnant)] after potentially curative resection was 40% to 80%[27,28] Many patients had multiple sites of local failure. Shiu and coworkers[25] found a 23% local recurrence rate in 169 patients treated for carcinoma of the body of the stomach.

Gunderson and Sosin[29]reanalyzed the reoperation series performed by Wangensteen at the University of Minnesota, where patients had a second-look laparotomy after resection of the primary tumor. This type of analysis is valuable because it can demonstrate the early (and perhaps most treatable) modes of failure, rather than simply showing diffuse metastatic disease at autopsy. Sixty-nine percent of patients had evidence of a locoregional recurrence, and 42% had peritoneal seeding. Most of the local failures were located in the gastric bed (81%), although recurrences also occurred in the anastomosis or stump (39%) or in the regional lymph nodes (63%). A trial from the British Stomach Cancer Group

found the incidence of local failure in patients treated with surgery alone to be 37 of 69 (54%)[30] A series evaluating local failure patterns reported by Landry et al.[31] showed a total locoregional failure rate of 38%, with most of the local recurrences in the gastric bed, the anastomosis, or the gastric stump. The incidence of local failure increased when the primary disease extended through the gastric wall or when lymph nodes were involved at the initial surgery. Liver metastases occurred in 30% of patients and peritoneal seeding in 23%. Extraabdominal failure was relatively rare and occurred in 13% of patients.

Some newer series suggest a higher incidence of peritoneal seeding as a failure pattern. Wisbeck et al.[100] evaluated autopsy and clinical records of 85 patients who died of gastric cancer. Sixteen patients had a resection with curative intent; 15 of these developed a locoregional recurrence, 8 developed peritoneal seeding, and 7 developed lung metastases. Of the entire cohort, 40 of 85 (47%) developed peritoneal seeding. Ajani et al.[32] treated 25 patients with preoperative chemotherapy. At the time of surgery, eight had peritoneal carcinomatosis, and it developed subsequently in an additional five patients. Because imaging studies were not done routinely postoperatively, they could not accurately determine the risk of locoregional failure. These data suggest that increased attention to methods of controlling local and regional disease as well as systemic disease is needed to improve long-term results.

Clinical Presentation and Pretreatment Evaluation

Signs and Symptoms

Because of the vague, nonspecific symptoms that characterize gastric cancer, most patients are diagnosed with advanced-stage disease. Patients may have a combination of signs and

symptoms such as weight loss, anorexia, fatigue, or epigastric discomfort, none of which unequivocally indicates gastric cancer.

Weight loss is a common symptom, and its clinical significance should not be underestimated. Dewys and colleagues found that, in 179 patients with advanced, nonmeasurable gastric cancer, more than 80% had a greater than 10% decrease in body weight before diagnosis. Furthermore, patients with weight loss had a significantly shorter survival than did those without weight loss.

In some patients, symptoms may suggest the presence of a lesion at a specific location. A history of dysphagia may indicate the presence of a tumor in the cardia with extension through the gastroesophageal junction. Early satiety is an infrequent symptom of gastric cancer but is indicative of a diffusely infiltrative tumor that has resulted in loss of distensibility of the gastric wall. Persistent vomiting is consistent with an antral carcinoma obstructing the pylorus. Significant gastrointestinal bleeding is uncommon with gastric cancer; however, hematemesis does occur in approximately 10% to 15% of patients. Ascites, jaundice, or a palpable mass indicates extensive and incurable disease. Signs and symptoms at presentation are often related to spread of disease. Because the transverse colon is held in proximity to the stomach by the gastrocolic ligament, the transverse colon is a potential site of malignant fistulization and obstruction from a gastric primary tumor. Diffuse peritoneal spread of disease frequently produces other sites of intestinal obstruction. A large ovarian mass (Krukenberg's tumor) or a large peritoneal implant in the pelvis (Blumer's shelf), which can produce symptoms of rectal obstruction, may be felt on pelvic or rectal examination. Nodular metastases in the subcutaneous tissue around the

umbilicus or in peripheral lymph nodes represent areas in which a tissue diagnosis can be established with minimal morbidity.

Screening

Mass screening programs for gastric cancer have been most successful in high-risk areas, especially in Japan. A variety of screening tests have been studied in Japanese patients, with a sensitivity and specificity of approximately 90%. Screening typically includes the use of double-contrast barium radiographs or upper endoscopy.

The yield in screened populations has been substantial; in some Japanese studies, up to 60% of patients actively participating in routine mass screening programs have the disease and up to 60% of newly diagnosed patients have early gastric cancer (EGC). The latter is clinically important because EGC has a very high cure rate with surgical treatment. However, the fact that gastric cancer remains the number one cause of death in Japan indicates the limitations of a mass screening program when the entire population at risk is not effectively screened. Studies have verified that a low serum pepsinogen I/II ratio can be used to better select patients at increased risk for atrophic gastritis and gastric cancer.

Pretreatment Staging

Tumor Markers

The carcinoembryonic antigen (CEA) level is elevated in approximately one-third of patients with primary gastric cancer. The sensitivity of CEA as a marker of gastric cancer is low, but when the CEA level is elevated, it generally correlates with stage. Combining

CEA with other markers, such as the sialylated Lewis antigens CA19-9 or CA50, can increase sensitivity, compared with CEA alone.

A large study of patients with gastric cancer evaluated the prognostic significance of serum levels of CEA (n = 237), α-fetoprotein (n = 164), human chorionic gonadotropin-β (β-HCG; n = 165), CA19-9 (n = 64), and CA125 (n = 104), as well as tissue staining for C-erb B-2 (n = 160) and β-HCG (n = 160). In a multivariate analysis, only a serum β-HCG level of 4 IU/L or greater (hazard ratio, 1.7; 95% CI, 2.8 to 1.1) and a CA125 level of 350 U/mL or greater (hazard ratio, 2.2; 95% CI, 4.2 to 1.2) had prognostic significance. Elevated serum β-HCG and CA125 levels in gastric cancer before chemotherapy may reflect not just tumor burden but also aggressive biology; however, the utility of these markers in staging must be compared to that of other known preoperative markers of stage, such as on T- and N-stage endoscopic ultrasonography (EUS).

Endoscopy

Endoscopy is generally considered to be the best method to diagnose gastric cancer. Endoscopy directly visualizes the gastric mucosa and allows biopsy of tissue for a histologic diagnosis.

EUS is presently available in some centers, and, although mainly used to further stage previously diagnosed tumors, it may be helpful in identifying early diffuse-type gastric carcinoma lesions that might otherwise be overlooked. EUS has the added capability to evaluate the deeper layers of the gastric wall to help define the T stage of the tumor and

provide information on the morphologic status of surrounding lymph nodes. EUS has an accuracy of up to 90% for T staging of gastric tumors and 75% for N staging; these rates are higher than those for preoperative computed tomography (CT) scans.

Computed Tomography

Once gastric cancer is suspected, CT of the abdomen and pelvis is an important part of the staging evaluation. Patients with Siewert type I or II tumors should also undergo a chest CT.

CT is useful for noninvasive assessment of perigastric lymphadenopathy, peritoneal disease, and intraabdominal visceral (primary liver) metastatic disease and for estimation of the degree of tumor penetration through the gastric wall. With modern multiphase, multidetector spiral CT imaging, there is increased accuracy in the assessment of extragastric disease and mural penetration (particularly for T2 and greater tumors). The accuracy of CT assessment of tumor location and T stage can be enhanced over that of conventional helical CT by use of water as an oral contrast agent—so called helical hydro-CT.

Positron Emission Tomography

Whole body 2-[^{18}F]fluoro-2-deoxyglucose (FDG)–positron emission tomography (PET) is being applied increasingly in the evaluation of gastrointestinal malignancies. A relative paucity of data is available on the role of PET in the staging of gastric cancer. A few pilot studies of PET imaging for gastric cancer (all stages) and the use of PET in the detection of recurrent disease have been reported. The absence of meaningful data on PET for staging

gastric cancer contrasts with esophageal cancer, for which PET has an increasingly well-defined role in pretreatment staging.

Important differences in tumor biology may limit the role for PET in gastric cancer. For example, the glucose transporter-1, an important transporter of FDG into tumor cells, is rarely present in common subtypes of gastric carcinoma, including signet-ring cell carcinoma and mucinous adenocarcinoma (2.0% and 6.3%, respectively). This may contribute to false-negative FDG-PET imaging. Interestingly, the presence of glucose transporter-1 and FDG-avid gastric cancers is associated with decreased overall survival.

Laparoscopy

Staging laparoscopy has become an accepted part of the pretreatment staging evaluation of patients who are believed to have localized gastric cancer after initial helical CT assessment. The rationale for laparoscopic staging is based on the fact that sensitivity of CT for detection of extragastric disease declines with the size of metastases. Indeed, current CT techniques cannot consistently identify low-volume macroscopic metastases that are 5 mm or less in size. Laparoscopy allows for direct inspection of the peritoneal and visceral surfaces for detection of CT-occult small-volume metastases. Staging laparoscopy also allows for assessment of peritoneal cytology and intraperitoneal evaluation with adjunctive diagnostic techniques such as laparoscopic ultrasound (LUS). Patients who are found to have occult metastatic disease at laparoscopy are considered incurable, and the use of laparoscopy allows them to avoid laparotomy.

The rate of detection of CT-occult M1 disease by laparoscopy is dependent on the quality of CT scanning and interpretation. Studies from the 1990s (during which time there was inconsistent use of the more sensitive helical CT technique) demonstrated that CT-occult disease could be identified in 13% to 37% of patients. It is likely that the yield of laparoscopy may be somewhat lower than this with more widespread use of higher-quality helical CT preliminary staging. Nonetheless, even high-quality helical CT is insufficiently sensitive for detection of low-volume extragastric disease, and, thus, laparoscopy, CT, and EUS are complementary staging studies.

A number of unresolved issues remain regarding the timing and extent of laparoscopy that should be performed for optimal staging. Laparoscopy can be performed as a separate staging procedure before definitive treatment planning or immediately before planned laparotomy for gastrectomy. When performed as a separate procedure, laparoscopy has the disadvantage of the additional risks and expense of a second general anesthetic. However, separate procedure laparoscopy allows the additional staging information acquired at laparoscopy to be reviewed and discussed with the patient and multidisciplinary treatment group before definitive treatment planning. This is important in some settings because laparoscopic staging findings that may alter therapeutic options and prognosis (e.g., peritoneal cytology) are not always available on a real-time basis during laparoscopy. Consequently, the timing of laparoscopy varies in different centers depending on factors such as the availability of intraoperative cytology assessment and the use of preoperative treatment approaches.

The extent of laparoscopic evaluation is another unresolved staging issue. LUS and "extended laparoscopy" are techniques that may increase the diagnostic yield of laparoscopy. LUS involves examination of the stomach, perigastric region, and peritoneal cavity using a laparoscopic ultrasound probe, whereas extended laparoscopy involves a more detailed laparoscopic examination of the perigastric region that includes laparoscopic examination of the lesser sac and retrogastric space (i.e., more than simple inspection of the stomach and peritoneal cavity). Preliminary results reveal conflicting data on the added benefit of LUS and extended laparoscopy. Further studies are required to evaluate the cost-benefit relationship of these advanced laparoscopic techniques to better define whether LUS and extended laparoscopy have a routine or selective role in patients undergoing conventional laparoscopic staging.

Staging, Classification, and Prognosis

The uniform and accurate staging of gastric cancer is essential to predict prognosis and assess outcome meaningfully. For patients with surgically treated gastric adenocarcinoma, pathologic staging [American Joint Committee on Cancer/International Union Against Cancer (AJCC/UICC), or Japanese system] and classification of the completeness of resection (R) should be done. In addition, although not formal components of AJCC stage grouping, the histopathologic grade and type and, when available, the peritoneal lavage cytology status should be recorded. The latter is important because the presence of free peritoneal cancer cells has been shown by a number of investigators to carry a prognosis comparable to that of visceral metastatic disease.

American Joint Committee on Cancer/International Union Against Cancer Tumor, Node, Metastasis Staging

The AJCC/UICC TNM staging system for gastric cancer is outlined in table.[33]

In the AJCC/UICC staging system, tumor (T) stage is determined by depth of tumor invasion into the gastric wall and extension into adjacent structures.

Nodal stage (N) is based on the number of involved lymph nodes—a criterion that may predict outcome more accurately than the location of involved lymph nodes.[34,35]Tumors with 1 to 6 involved nodes are classified as pN1, 7 to 15 involved nodes as pN2, and more than 15 involved nodes as pN3. The use of numeric thresholds for nodal classification has become increasingly more accepted, although the extent of lymphadenectomy and rigor of pathologic assessment may affect results.[36]The threshold approach is based on observations that survival decreases as the number of metastatic lymph nodes increase[35,37]and that there are decreases in survival at four or more involved[38,39]and again at seven or more involved lymph nodes.[34,40]Given the reliance on numeric thresholds for nodal staging, it is extremely important that surgeons and pathologists work together to ensure that adequate numbers of lymph nodes are retrieved and examined. Indeed, reports document poor compliance with AJCC staging primarily because the numbers of lymph nodes removed or examined, or both, were insufficient (15 or less).[41,42]

Ratio-based lymph node classification is an alternative to the threshold-based system currently used for AJCC/UICC staging. This alternative approach may minimize the confounding effects of regional variations in the extent of lymphadenectomy and in pathologic evaluation of the lymphadenectomy specimen on lymph node staging and

thereby reduce the impact of stage migration. Several reports have evaluated ratio-based lymph node staging.[34,36,43,44] Bando et al.[43] evaluated the ratio of metastatic to uninvolved lymph nodes (RML) in a group of 650 patients who underwent R0 gastrectomy with D2 lymph node dissection. The anatomic location, number of positive lymph nodes (as used in the current AJCC/UICC system), and RML were analyzed for staging accuracy and relationship to patient survival. RML was found to be an independent prognostic factor for survival and reduced the frequency of stage migration from 15% (when numeric thresholds were used for staging) to 7%. These findings were confirmed in a separate analysis of 1019 patients treated by R0 gastrectomy at Kansai Medical University in Japan.[44] On the basis of these reports, ratio-based lymph node staging should be considered for future versions of gastric cancer staging systems.

Japanese Staging System

The most recent Japanese Classification for Gastric Carcinoma was published in 1998 as outlined in table 3.[45] The Japanese classification and staging system are more detailed than the AJCC/UICC staging system and place more emphasis on the distinction between clinical, surgical, pathologic, and "final" staging (prefixes "c," "s," "p," and "f," respectively). For example, a surgically treated and staged patient with locally advanced, nonmetastatic gastric cancer might be staged as pT3, pN2, sH0, sM0, f stage IIIB (where H0 denotes no hepatic metastases and the "f" prefix denotes final clinicopathologic stage). The Japanese classification system also includes a classification system for EGC.

Similar to the AJCC/UICC staging system, primary tumor (T) stage in the Japanese system is based on the depth of invasion and extension to adjacent structures. However, the assignment of lymph node (N) stage involves much more rigorous pathologic assessment than is required for AJCC/UICC staging. The Japanese system extensively classifies 18 lymph node regions into four N categories depending on their relationship to the primary tumor and anatomic location.[45] Most perigastric lymph nodes (nodal stations 1 to 6) are considered group 1. Lymph nodes situated along the proximal left gastric artery (station 7), common hepatic artery (8), celiac axis (9), splenic artery (11), and proper hepatic artery (12) are defined as group 2. Paraaortic lymph nodes (16) are defined as group 3. The presence or absence of pathologically positive lymph nodes in each lymph node group is reflected in the assigned N stage.

The Japanese staging system also includes elements not included in the AJCC/UICC system . These are macroscopic description of the tumor (EGC subtype or Borrmann type for more advanced tumors), extent of peritoneal metastases (classified as P0-1), extent of hepatic metastases (H0-1), and peritoneal cytology findings (CY0-1).[45]

A comparison of the Japanese and AJCC/UICC staging systems suggested that the AJCC/UICC system more accurately estimates prognosis.[36] Nonetheless, the comprehensive "c," "s," "p," and "f" prefix system used in the Japanese system provides a succinct and accurate summary of an individual patient's extent of disease.

Classification of Esophagogastric Junction Cancers

Siewert and Stein[46] have developed a classification system for adenocarcinoma of the esophagogastric junction. Now commonly referred to as the Siewert classification, this system recognizes three distinct clinical entities that arise within 5 cm of the junction of the tubular esophagus and the stomach as shown in figure.

Type 1—adenocarcinoma of the distal esophagus, which usually arises from an area with specialized intestinal metaplasia of the esophagus (i.e., Barrett's esophagus) and may infiltrate the esophagogastric junction from above

Type II—adenocarcinoma of the cardia, which arises from the epithelium of the cardia or from short segments with intestinal metaplasia at the esophagogastric junction

Type III—adenocarcinoma of the subcardial stomach, which may infiltrate the esophagogastric junction or distal esophagus from below

The assignment of tumors to one of these subtypes is based on morphology and the anatomic location of the epicenter of the tumor. Classification can be performed based on the results of contrast radiography, endoscopy, CT, and operative findings. The Siewert classification system has been endorsed by the International Society for Diseases of the Esophagus and the International Gastric Cancer Association.

The Siewert classification has important therapeutic implications.[47] The lymphatic drainage routes differ for type 1 versus type II and III lesions. As shown on lymphographic studies, the lymphatic pathways from the lower esophagus pass cephalad (into the mediastinum) and caudad (toward the celiac axis). In contrast, the lymphatic drainage from the cardia and subcardial regions is toward the celiac axis, splenic hilus, and paraaortic nodes. Thus, the

Siewert classification provides a practical means for choosing among surgical options. For type I tumors, esophagectomy is required, whereas type II and III tumors can be treated by transabdominal extended gastrectomy (resection of the stomach and distal intraabdominal esophagus).[47]

R Classification

The R classification system indicates the amount of residual disease left after tumor resection.[48] R0 indicates no gross or microscopic residual disease; R1 indicates microscopic residual disease, and R2 signifies gross residual disease. The R classification has implications for individual patient care and clinical research. Surgeons should wait for the final pathology results before completing their operative summaries so that patient records include the R classification for the gastrectomy. Results of clinical trials that include surgery should include information on R status.

Readers should be aware of the dual use of the "R" terminology in the gastric cancer literature. Before 1995, the Japanese staging and treatment descriptive vernacular included an "R level," which described the extent of lymphadenectomy according to the highest echelon of lymph nodes included in the lymphadenectomy. The latter is now classified by "D" (for dissection) level. Care should be exercised in current use of the R classification, restricting such use to describe the completeness of resection (R0-2).

Predicting Individual Patient Prognosis

Kattan et al.[49] have developed a nomogram for estimating 5-year disease-specific survival using established prognostic factors derived from a population of 1039 gastric cancer

patients treated by R0 surgical resection at a single institution. Clinicopathologic factors incorporated in the nomogram include patient age and gender, primary tumor site, Lauren classification, tumor size and depth, and the numbers of positive and negative lymph nodes. For patients with surgically treated gastric carcinoma, the nomogram estimates the probability of individual (i.e., personal) survival unencumbered by specific knowledge of prognostic factors, relative risk, or the risk group in which he/she may belong. This tool may be useful for individual patient counseling, follow-up scheduling, and clinical trial eligibility assessment.

Stage II and Stage III Disease

Surgery

Surgical resection is the cornerstone of treatment for patients with localized gastric cancer; indeed, surgical resection can be curative in most patients with EGC. However, for stage II and III disease, surgery is necessary but often not sufficient for cure. The general therapeutic goal is to achieve a micro- and macroscopically complete resection (R0). Specific surgical issues including the extent of gastrectomy, extent of lymph node dissection, and role of partial pancreatectomy and splenectomy.

Extent of Resection for Mid and Distal Gastric Cancers

The extent of gastrectomy required for satisfactory primary tumor treatment depends mostly on the gross and microscopic status of surgical margins. For most clinical situations, a 5-cm grossly negative margin around the tumor and microscopically negative surgical margins (R0) are the treatment goals. When gastrectomy is performed with curative intent,

frozen-section assessment of proximal and distal resection margins should be used intraoperatively to improve the likelihood that an R0 resection has been performed.

Three relatively small, prospective randomized controlled trials (RCTs) have compared total gastrectomy to partial (subtotal) gastrectomy for distal gastric cancer.[50-52] Overall morbidity, mortality, and oncologic outcome were comparable in each of these RCTs. As a result, when the general oncologic goal of an R0 resection can be achieved by a gastric-preserving approach, partial gastrectomy is preferred over total gastrectomy. This is particularly relevant for distal gastric cancers, for which a gastric-preserving R0 approach may minimize the risks of specific sequelae of total gastrectomy, such as early satiety, weight loss, and the need for vitamin B_{12} supplementation.

Extent of Resection for Proximal Gastric Cancer

Many choices are available for surgical management of adenocarcinomas arising at the esophagogastric junction or in the proximal stomach (Siewert types II and III). Many abdominal surgeons have advocated transabdominal approaches with resection of the lower esophagus and proximal stomach or total gastrectomy. Surgeons trained in thoracic surgery have frequently advocated a combined abdominal and thoracic procedure (often termed esophagogastrectomy), with an intrathoracic or cervical anastomosis between the proximal esophagus and the distal stomach, or a procedure termed transhiatal (or blunt) esophagectomy (THE), which involves resection of the esophagus and gastroesophageal junction, with mediastinal dissection performed in a blunt fashion through the esophageal hiatus of the diaphragm. When THE is performed for adenocarcinoma of the

esophagogastric junction, gastrointestinal continuity is restored by low cervical anastomosis of the stomach (usually advanced through the esophageal bed in the mediastinum) to the low cervical esophagus. Selection among the options has been dependent primarily on individual surgeon training and experience.

The optimal surgical procedure for patients with localized tumors of the esophagogastric junction and proximal stomach is a matter of considerable debate. A Dutch RCT compared transthoracic esophagogastrectomy (TTEG, with abdominal and thoracic incisions) to THE in 220 patients with adenocarcinoma of the esophagus and esophagogastric junction.[53] Although this trial was designed for patients with esophageal cancer, 40 (18%) of the patients had adenocarcinomas of the esophagogastric junction (Siewert type II), and the operations evaluated are among those considered for patients with Siewert type II or III cancers. Perioperative morbidity was higher after THE, but there was no significant difference in in-hospital mortality compared to TTEG. Although median overall, disease-free, and quality-adjusted survival did not differ significantly between the groups, there was a trend toward improved overall survival at 5 years with TTEG. These results are believed to be equivocal,[54] and there is currently no consensus on the optimal surgical approach for patients with Siewert type II tumors. Until longer follow-up of the Dutch trial is available or additional RCTs are performed, or both, the surgical approach to these patients will continue to be individualized—determined by a constellation of factors, including surgeon factors (training and experience), patient factors (age, comorbidity, and performance status), and tumor factors (pretreatment T and N stage).

Extent of Lymphadenectomy

The dialogue surrounding lymphadenectomy involves at least two important issues: (1) staging—removal and histopathologic analysis of an "adequate" number of lymph nodes, and (2) therapy—are some forms of lymphadenectomy therapeutic for patients with gastric cancer?[55–57]

Single-institution reports suggest that the number of pathologically positive lymph nodes is of prognostic significance[40,58] and that removal and pathologic analysis of at least 15 lymph nodes are required for adequate pathologic staging.[35] Indeed, the current AJCC staging system (6th edition) accounts for these issues and therefore requires analysis of 16 or more lymph nodes to assign a pathologic N stage.[59] The multidisciplinary clinical correlates of this are obvious: (1) Surgeons must perform an adequate lymphadenectomy, and (2) pathologists must retrieve and examine at least 16 lymph nodes to provide optimal pathologic staging.

The possible therapeutic benefit of extended lymph node dissection has been the focus of four RCTs,.These trials were performed because retrospective[63,64] and prospective nonrandomized[65] evidence suggested that extended lymph node dissection may be associated with improved long-term survival. The RCTs tested the hypothesis that removal of additional pathologically positive lymph nodes (not generally removed as part of a standard lymph node dissection) improves survival. The larger RCTs attempted to follow what are referred to as the Japanese rules for lymph node classification and dissection[66] that govern the extent of nodal dissection required based on anatomic location of the primary tumor. Using these Japanese definitions, the RCTs compared limited lymphadenectomy of

the perigastric lymph nodes (D1 dissection) to en bloc removal of second-echelon lymph nodes (D2 dissection). At least two of the trials[50,60] are underpowered for their primary end point—overall survival. The most recent trials from the Medical Research Council (MRC) of the United Kingdom[61] and the Dutch Gastric Cancer Group[62] have received the most attention and discussion.

The MRC trial registered 737 patients with gastric adenocarcinoma; 337 (46%) patients were ineligible by staging laparotomy because of advanced disease, and 400 (54%) were randomized at the time of laparotomy to undergo D1 or D2 lymph node dissections. Postoperative morbidity was significantly greater (46% vs. 28%; P <.001), and in-hospital mortality was significantly higher in the D2 group than in the D1 group (13% vs. 6%, P <.04; 95% CI for D2, 4% to 11%).[67] The excess morbidity and mortality seen in the D2 group was thought to be related to the routine use of distal (left) pancreatectomy and splenectomy. Partial pancreatectomy and splenectomy were performed to maximize clearance of lymph nodes at the splenic hilum—primarily for patients with proximal tumors; however, many surgeons now believe that adequate lymph node dissection can be performed with pancreas- and spleen-preserving techniques. Long-term follow-up analysis of patients in the MRC trial demonstrated comparable 5-year overall survival rates of 35% and 33% in the D1 and D2 dissection groups, respectively (difference, –2%; 95% CI, –12% to 8%). Survival based on death from gastric cancer as the event was also similar in the D1 and D2 groups (hazard ratio = 1.05; 95% CI, 0.79 to 1.39), as was recurrence-free survival (hazard ratio = 1.03; 95% CI, 0.82 to 1.29).[61] The authors concluded that classic Japanese-

style D2 lymphadenectomy (with partial pancreatectomy and splenectomy) offered no survival advantage over D1 lymphadenectomy.

The Dutch Gastric Cancer Group conducted a larger RCT with optimal surgical quality control comparing D1 to D2 lymph node dissection for patients with gastric adenocarcinoma; 996 patients were registered, and 711 (71%) were randomized to D1 dissection (n = 380) or D2 dissection (n = 331). To maximize surgical quality control, all operations were monitored.[68] Initially, this oversight was done by a Japanese surgeon who trained a group of Dutch surgeons; they, in turn, acted as supervisors during surgery at 80 participating centers. Notwithstanding the extraordinary efforts to ensure quality control of the two types of lymph node dissection, noncompliance (not removing all lymph node stations) and contamination (removing more than was indicated) occurred, blurring the distinction between the two operations and confounding the interpretation of the oncologic end points.[69] The postoperative morbidity was higher in the D2 group (43% vs. 25%, P <.001), and the mortality was also significantly higher in the D2 group (10% vs. 4%, P = .004). Patients treated with D2 dissection also required a longer hospitalization.[70] As in the MRC trial, partial pancreatectomy and splenectomy were performed *en passant* in the D2 group. Five-year survival rates were similar in the two groups: 45% for the D1 group and 47% for the D2 group (95% CI for the difference, –9.6% to 5.6%). The subset of patients who had R0 resections, excluding those who died postoperatively, had cumulative risks of relapse at 5 years of 43% with D1 dissection and 37% with D2 dissection (95% CI for the difference, –2.4% to 14.4%). The Dutch investigators concluded that there was no role for the routine use of D2 lymph node dissection in patients with gastric cancer.

Interpretation of the existing level 1 evidence is encumbered by a number of issues.[66,67] The primary concerns relate to whether (1) the increased operative mortality associated with protocol-mandated partial pancreatectomy and splenectomy for patients with proximal tumors undergoing D2 dissection prevented identification of a potential therapeutic impact of extended lymph node dissection, and (2) the phenomena of noncompliance and contamination led to homogenization of the operative procedures to such an extent that the fundamental hypothesis was not tested. Owing to these interpretation issues, the question of a possible therapeutic benefit of D2 dissection remains unsettled.

Many Japanese gastric surgeons have considered the caveats associated with the MRC and Dutch trials and believe that, notwithstanding inherent patient selection and stage migration biases,[56,69] the existing retrospective data provide sufficient proof of a clinical benefit of D2 dissection. On this basis, D2 dissection has been adopted as the standard of care for patients with localized, higher-risk gastric cancer in many centers in Japan and some specialized centers in the West.[61] In Japan, the Japan Clinical Oncology Group (JCOG) has investigated an even more aggressive surgical approach in an RCT evaluating paraaortic lymphadenectomy in the management of completely resected (R0) T2 to T4 gastric cancer. Between July 1995 and April 2001, 523 patients from 25 institutions were registered. Patients were randomized intraoperatively to undergo D2 lymphadenectomy alone or D2 lymphadenectomy plus paraaortic lymph node dissection (D3). The primary end point is overall survival; only preliminary morbidity and mortality results have been reported.[100] The patients treated with D3 dissection had longer operation times, greater blood loss, and

a higher frequency of blood transfusion than did the group that underwent D2 dissection. However, the groups had no significant differences in postoperative complications, and only two patients (0.8%, one in each group) died of postoperative complications. These findings demonstrate that the addition of paraaortic lymph node dissection to D2 dissection in Japanese patients does not significantly increase the rate of postoperative morbidity or mortality.

Partial Pancreatectomy and Splenectomy: Resect or Preserve?

Partial (left, distal) pancreatectomy and splenectomy have been performed as part of D2 lymph node dissection to remove the lymph nodes along the splenic artery (station 11) and at the splenic hilum (station 12)—primarily for patients with tumors located in the proximal and mid stomach. Indeed, partial pancreatectomy and splenectomy were required for patients with proximal tumors in the D2 arm of the Dutch and MRC RCTs but were required only for direct tumor extension in the D1 arm. Splenectomy is associated with an increased risk for surgical complications and postoperative death. In addition, a multivariate analysis suggested that splenectomy is associated with inferior long-term survival. The frequent performance of splenectomy (e.g., 30% of patients in the D2 arm vs. 3% in the D1 arms of the Dutch trial) with its associated adverse effects on short- and long-term mortality confounds the interpretation of the Dutch and MRC RCTs. Thus, the hypothesis that spleen- and pancreas-preserving D2 lymph node dissection improves survival remains unproven.

Increasingly, experienced gastric surgeons have acknowledged the adverse effects of splenectomy. The evolving consensus is that splenectomy should be performed only in cases with intraoperative evidence of direct tumor extension into the spleen or when the primary tumor is located in the proximal stomach along the greater curvature. Partial pancreatectomy should be performed only in cases of direct tumor extension to the pancreas.

Reports have described pancreas- and spleen-preserving forms of D2 dissection.[72–74] This organ-preserving modification of classic D2 dissection allows for dissection of some station 11 and 12 lymph nodes without the potential adverse effects of pancreatectomy or splenectomy, or both. In a small single-institution RCT reported from Chile, Csendes et al.[75] randomized 187 patients with localized proximal gastric adenocarcinoma to treatment by total gastrectomy with D2 lymph node dissection plus splenectomy or total gastrectomy with D2 lymphadenectomy alone. Operative mortality was similar in the two groups (splenectomy group, 3%; control group, 4%). However, septic complication rates were higher in the splenectomy arm than in the control arm (P <.04). No difference was seen in 5-year overall survival rates, although it is not clear that the trial was designed with survival as the primary end point.

The JCOG is conducting a multiinstitutional RCT (JCOG 0110-MF) comparing D2 dissection with and without splenectomy for patients with proximal gastric cancer.[76] The hypothesis to be tested is that the 5-year overall survival of patients treated by D2 dissection without splenectomy is 5% less than that of patients treated by D2 dissection

with splenectomy. With a planned accrual of 500 patients, this design will provide a 70% power to reject the null hypothesis when 5-year overall survival is 3% greater after splenic preservation compared with splenectomy.[76] The results of this trial will elucidate the short- and long-term effects of splenectomy for patients with proximal gastric cancers.

Individualized Assessments of Lymph Node Involvement

Attention has focused on methods of individual assessment of risk of lymphatic spread. These techniques offer the possibility of tailoring surgical therapy for an individual patient based on clinicopathologic risk assessment of the primary tumor or pre- or intraoperative identification of SLNs or primary draining lymph nodes, or both. In the future, it is hoped that molecular determinants of lymph node metastasis will supplant these approaches. At present, at least three approaches to individual nodal risk assessment have been evaluated: computer modeling, preoperative endoscopic injection, and SLN biopsy.

Preoperative Computer Modeling of Individual Patient Nodal Involvement

Maruyama and colleagues have developed a computer program to estimate the probability of spread to specific nodal regions for an individual patient using his or her pretreatment clinicopathologic data. As initially developed, the program incorporated data on tumor size, depth of infiltration, location, grade, type, and macroscopic appearance of primary tumors from 2000 patients with surgically resected gastric cancers treated at the National Cancer Center of Tokyo.[77] The data set used for matching individual patient data is continuously updated and now includes more than 8000 patients. The Maruyama computer model has been validated in non-Japanese patients in studies done in Germany[78] and Italy.[79] In the

United States, Hundahl et al.[80] retrospectively applied this computer model to evaluate the surgical treatment of patients entered into the Intergroup trial of adjuvant fluorouracil (FU)-based chemoradiation. The Maruyama program was used to estimate the likelihood of disease in undissected regional node stations, defining the sum of these estimates as the Maruyama index of unresected disease. Of the participating patients, 54% underwent D0 lymphadenectomy. The median index was 70 (range, 0 to 429). In contrast to D level, the Maruyama index proved to be an independent prognostic factor of survival, even with adjustment for the potentially linked variables of T stage and number of positive nodes.

Preoperative Endoscopic Peritumoral Injection

The hypothesis that peritumoral injection of compounds designed to optimize lymph node dissection improves lymph node clearance was addressed in a small RCT evaluating preoperative endoscopic vital staining with CH40 before D2 dissection. The frequency of positive lymph nodes in patients injected with CH40 before D2 dissection was greater than that observed in patients treated by D2 dissection alone. This approach optimized the yield of lymph node dissection, presumably by directing surgeons to include specific lymph nodes in the dissection that would have otherwise been left in situ or by directing pathologists to examine specific areas of the lymphadenectomy specimens, or both. Further prospective studies of this approach are required to confirm the feasibility of this technique and assess its impact on intraoperative decision making regarding the extent of lymphadenectomy.

Sentinel Lymph Node Biopsy

The goal of SLN biopsy is to identify the node or nodes believed to be the first peritumoral lymph nodes in the orderly spread of gastric adenocarcinoma from the primary site to the regional lymph nodes. Sampling of this lymph node may allow for prediction of the nodal status of the entire lymph node basin—possibly obviating node dissection and its attendant morbidity in patients found to have a negative SLN. Pilot studies have evaluated the feasibility, sensitivity, and specificity of SLN biopsy for patients with gastric cancer. These pilot studies demonstrated that SLN identification is feasible in approximately 95% of patients. However, most patients with gastric cancer have multiple "sentinel" nodes, with mean numbers of SLNs per patient ranging from 2.6 to 6.3. It is likely that the numbers of identified SLNs depend on a number of factors, including anatomic location of the primary tumor, pathologic stage, and the node identification technique used. Most pilot studies of SLN biopsy have involved subsequent D2 lymph node dissection, thereby allowing assessment of the false-negative rate of SLN biopsy. The aggregate experience to date suggests that, among patients with pathologically involved lymph nodes, SLN results in false-negative assessment of pathologic nodal status in 11% to 60% of patients. Thus, the preliminary data available suggest that SLN biopsy cannot reliably replace lymph node dissection as a means of accurately staging regional nodal basins. Until further data are available, SLN biopsy should remain an investigational approach.

Volume Relationships for Gastrectomy

Studies have established a clear relationship between institutional gastrectomy volume and perioperative mortality. The analysis of a national database by Birkmeyer et al.[81] of 31,854 patients who underwent gastrectomy between 1994 and 1999 demonstrated an inverse relationship between institutional gastrectomy volume and operative mortality. The OR for gastrectomy-related death was lowest among patients treated at the hospitals in the highest gastrectomy volume quintile (OR, 0.72; 95% CI, 0.63 to 0.83). A separate analysis evaluating surrogate end points for morbidity demonstrated that gastrectomy at high-volume centers was associated with the shortest duration of hospital stay and the lowest readmission rates.[82]

Similar findings were noted by Hannan et al.[83] in an analysis of the New York State Department of Health's administrative database. Their analysis of 3711 patients who underwent gastrectomy between 1994 and 1997 included adjustments for covariates such as age, demographic variables, organ metastasis, socioeconomic status, and comorbidities. Patients who had gastrectomy at hospitals in the highest-volume quartile had an absolute risk-adjusted mortality rate that was 7.1% lower (P <.0001) than those treated at hospitals in the lowest-volume quartile even though the overall mortality for gastrectomy was only 6.2%. These studies demonstrate that the risk-adjusted mortality for gastectomy is significantly lower when gastrectomy is performed by high-volume providers.

It is likely that the variations in gastrectomy-related mortality relate in part to surgeon training and experience with the procedure. Data on gastrectomy volume obtained from general surgeons undergoing recertification after a minimum of 7 years in practice demonstrate that the mean number of gastric resections performed by recertifying general

surgeons in the United States is only 1.4 per year. Thus, given the data supporting a relationship between hospital and provider volumes and the morbidity and mortality of gastric resection, there are reasons to consider regionalization of the surgical treatment of gastric cancers.

Outcome in Japan versus Western Countries

Stage-stratified survival rates for gastric adenocarcinoma are higher in Japan than in most Western countries. The reasons for this are complex, are incompletely understood.

Important differences in the epidemiology of gastric cancer may contribute to observed differences in outcome in Japan versus Western countries. First, the better-prognosis intestinal-type (Lauren classification[18]) tumors are seen more commonly in Japan, whereas the diffuse-type cancers that are associated with a poorer prognosis are more frequent in Western series. These regional differences in the frequencies of intestinal and diffuse cancers are believed to be related to the higher incidence of H pylori infection and atrophic gastritis in Japanese populations. Second, poorer-prognosis proximal gastric cancers are less frequent in Japanese than in Western populations.[84,85] Indeed, the increase in proximal gastric cancers observed in the West[10] has not been observed in Japanese populations.[86] These important differences in tumor location and Lauren subtype may contribute to observed differences in stage-specific outcome between Japan and Western countries.

Regional differences in the diagnostic criteria for EGC also may contribute to regional differences in observed outcome. In Japan, gastric carcinoma is diagnosed based on its structural and cytologic features without consideration of invasion of the lamina propria. In contrast, Western pathologists consider invasion of the lamina propria to be an essential

element of the diagnosis of carcinoma.[87,88] As a consequence, unequivocally neoplastic noninvasive lesions are classified as carcinoma in Japan but as dysplasia by Western pathologists.[87] To overcome these differences, the Padvova,[89] Vienna,[90] and revised Vienna[91] classifications have been proposed. However, until there is worldwide consensus and implementation of uniform diagnostic criteria for EGC, comparative assessments of the outcome of patients with EGC treated in Japan and Western countries should acknowledge the selection bias associated with different diagnostic criteria.

Stage migration is a well-documented factor contributing to the stage-specific differences in outcome between Japanese and Western patients.[56] Stage migration arises because there is widespread use of extensive D2 or D3 lymphadenectomy combined with rigorous pathologic assessment of the lymphadenectomy specimen in Japan. In contrast, these techniques are infrequently used in Western countries. More accurate stage assignment of Japanese patients leads to secondary stage migration—improvement in stage-specific survival without improvement in overall survival. The frequency and impact of stage migration were quantified by the Dutch Gastric Cancer Group in their RCT comparing D1 and D2 lymph node dissection.[62,92] Stage migration occurred in 30% of patients in the D2 group, and the stage-specific decreases in survival rates attributable to stage migration were 3% for AJCC/UICC stage I disease, 8% for stage II, 6% for stage III, and 12% for stage IIIB, with the more accurately staged D2 group having higher survival rates.[92]

In addition to regional differences in epidemiology, diagnostic criteria for early-stage cancers, and stage migration, other factors may contribute to the observed differences in stage-stratified survival. Such factors may include genetic, environmental, and biologic

differences between Japanese and Western patients and tumors. These factors have been less well studied but were addressed in a comprehensive review by Davis and Sano.[93]

MATERIALS AND METHODS

MATERIALS AND METHODS

This study was conducted in Thanjavur medical college and hospital from July 2005 to August 2007.Out of the 398 patients diagnosed as carcinoma of stomach in the study period only those undergoing curative resection was taken into study based on

1)Clinical examination.

2)Investigations performed

3)Surgery performed and

4)Detail study of histopathology of specimen.

All Patients were clinically evaluated and those with clinically evidence of metastasis were excluded

Clinical evidence of metastasis:

Supraclavicular (Virchow) Lymph node

Left axillary (Irish) Lymph node

Umbilical Metastasis (Sister Mary Joseph nodule)

Malignant ascites

Liver secondary (Nodules) and Jaundice

Pelvic deposits

Bone metastasis

All patients who where having metastasis with investigative modality like Ultrasonagram and Computed tomogram of abdomen were excluded from the study.

Ultrasound features of metastasis like liver secondaries, ascites and pelvic deposits were recorded.

High resolution Computed tomogram in not available in our centre, but details of perigastric lymphadenopathy, peritoneal disease and intraabdominal visceral (primary liver) metastatic disease and for estimation of adjacent organ infiltration was assessed to some extent with the available facility in all patients planned for surgery. Those with OGJ tumor underwent CT of Chest.

Those with suspected bone metastasis underwent skeletal survey and all patients underwent chest radiography.

Endoscopy was performed in nearly all patients except those with extensive metastasis and poor general condition.

All patients planned for surgery had endoscopy assessment of site, size of tumor and biopsy for conformation and degree of differentiation.Endoscopic ultrasonagram is not available in our centre.

Tumor markers and PET scan was not done in any patient in our study.

All patients were staged pre operatively with the above methods.

Out of 398 patients 164 had extensive disease and were excluded and referred for best supportive care or palliative chemotherapy. Out of 164 patients 38 underwent Palliative chemotherapy and 126 patients were given supportive care. The mortality was very high in the patients and the longest survival being 7 months.

Other 234 patients selected for various surgeries were analysed

Curative gastrectomy

Palliative gastrectomy

Palliative Bypass procedures

Feeding procedures

In those patients who were planned for curative surgery with intraoperative findings of inoperability and irresectability were excluded.

Diagnostic laparoscopy was used in selected cases before performing laparotomy.Although extended Laparoscopy was not performed in any patient. In patients with CT occult disease peritoneal lavage cytology and peritoneal biopsy was done. All 11 patients who underwent Laparoscopy were inoperable.

Inoperable findings like:

Ascites

Liver metastasis

Peritoneal deposits

Pelvic deposits

Irresectable findings like:

Involvement and infiltration into adjacent organs like liver,pancreas,transverse colon.

Fixity to surrounding structures

Vascular invasion

Those patients who present with macroscopic remnant tissue after resection were also excluded from the study. (R2) and considered as palliative resection.

Those patients with positive resected margins (R1) were also excluded, as considered palliative resection.

But patients with serosal involvement without involvement or infiltration into adjacent organs or structures were considered potentially curable and involved in the study.

Most of patients who fulfil the criteria fall into stage II and III.

Total no patients: 398

Total planned some form of surgery: 234

Total underwent curative surgery: 95

Inoperable after planning: 139

Palliative resection: 22

Irresectable: 117

Bypass procedure: 91

Feeding procedure: 15

Diagnostic laparoscopy and Closure: 11

So 95 patients were taken into study and various factors analysed

1) Age

2) Sex

3) Type of surgery performed

Extent of resection

Proximal and distal margin given

Resection of spleen and pancreas

Extent of lymph node dissection

Removal of pancreatic capsule

Involvement or infiltration into adjacent structures

4) Site of involvement

5) Type of tumor

Broader: Well, moderate or poor differentiation.

WHO: Papillary, Tubular, Mucinous or signet ring.

Lauren's: Intestinal, Diffuse or Mixed.

6) Size of tumor

7) Depth of invasion

8) Total Lymph nodes Positive

9) Total Lymph node negative

10) Resected margins.

Based on these factors the disease specific survival was plotted using nomogram designed by Kattan et al. The DSS was plotted and analysed in all these patients and compared with other studies. This tool was used for individual patient counselling, follow up scheduling and adjuvant therapy.

The average lymph node analysed in the study was compared with other studies.

The extent of resection and Lymphadenectomy and their relation with survival and mortality were also compared with other studies.

Surgical complication were also analysed and treated accordingly.

Mortality and morbidity were also studied

Most of the patients were followed up as per schedule with clinical examination, Endoscopy, ultrasonogram and CT.

Those who developed recurrence were confirmed and further adjuvant therapy given.

Patients in the study undergoing adjuvant therapy were also analysed.

OBSERVATION AND DISCUSSION

RESULTS AND DISCUSSION

In Thanjavur medical college carcinoma stomach accounts to 11.4% of total cancer patients.

Gastric cancer ranks third after breast and oral cavity malignancy.

Out of 398 patients diagnosed as carcinoma stomach only 95 patients i.e. 23.9% or one fourth underwent the possible curative resection (R0).

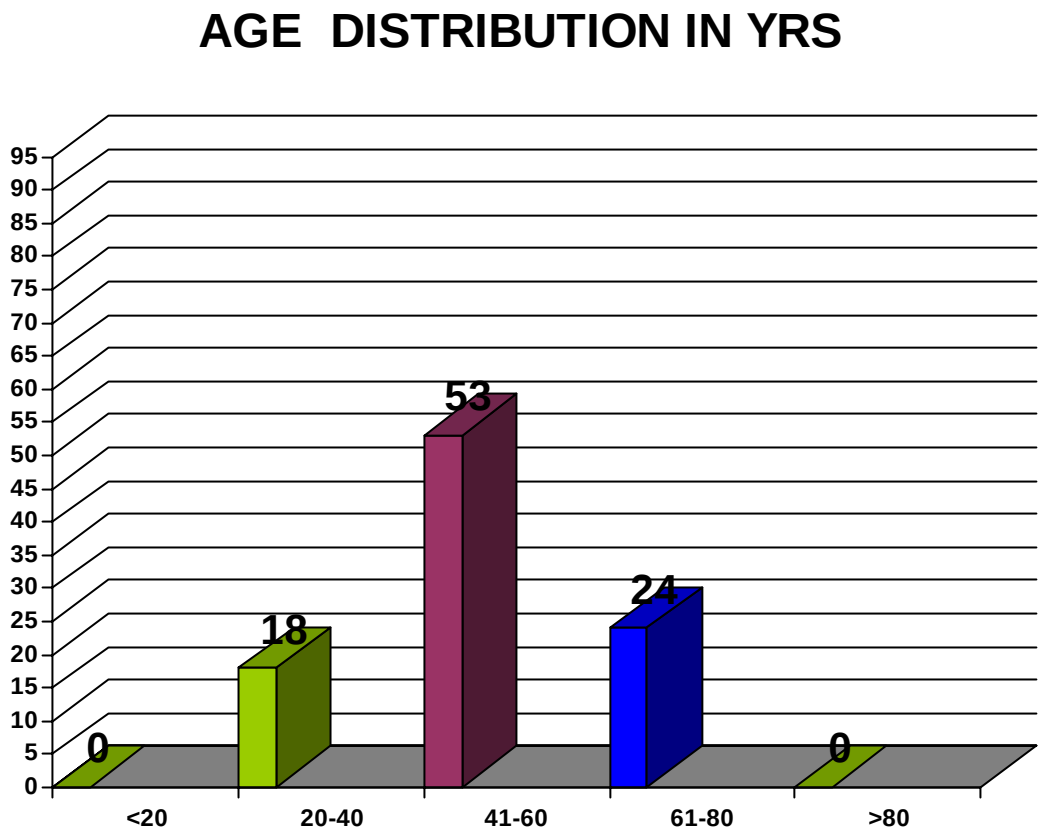
This explains our patient's unawareness and presenting in late stage and also the lack of screening programs in this area.

Out of 95 patients undergoing curative resection the following observations were made

Age wise distribution in years

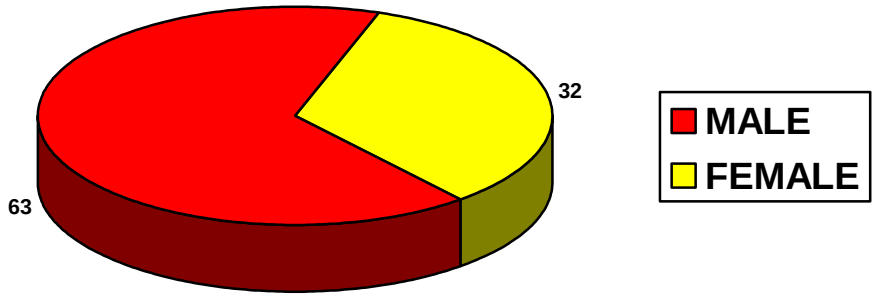
AGE	NUMBER	PERCENTAGE (%)
<20	0	0
20-40	18	19
41-60	53	55
61-80	24	26
>80	0	0
TOTAL	95	100

Most of the patients are above 40 years of age constituting about 55% which is comparable with other studies(5).The youngest was 29 yrs old female.



Sex wise distribution

sex	no	PERCENTAGE (%)
MALE	63	66
FEMALE	32	44
TOTAL	95	100

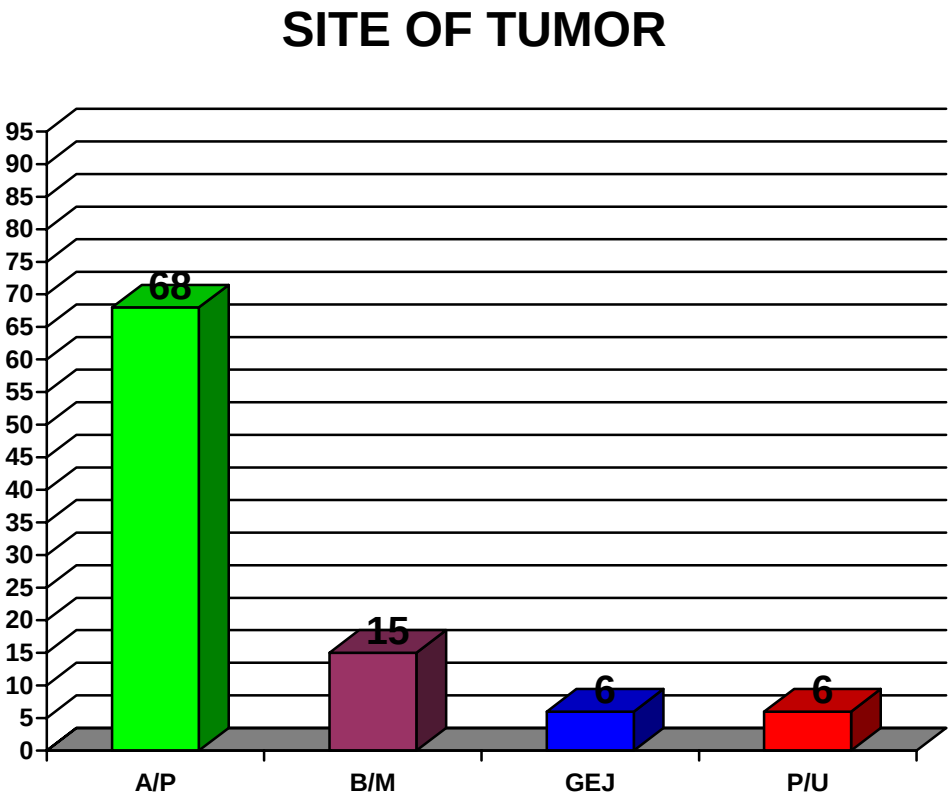


Above 2/3 of patients in this study were males showing a ratio of 2:1

In males gastric cancer ranks second to oral cavity malignancy. In females it ranks third to breast and oral cavity.

Site of Tumor

SITE	NO	PERCENTAGE (%)
ANTRUM & PYLORUS	68	72
BODY & MIDDLE	15	16
GASTRO EOSPHAGEAL JUNCTION	6	6
PROXIMAL & UPPER	6	6
TOTAL	95	100



A	ANTRUM
P	PYLORUS
B	BODY
M	MIDDLE
GEJ	GASTO EOSOPHAGEAL JUNCTION
P	PROXIMAL
U	UPPER

Growth antrum & pylorus is the most common site of carcinoma stomach in the study constituting about 72% comparable with other studies (4, 5).

In gastro-esophageal junction type which accounts to 6%. Out of 6 patients 5 belong to Siewert type III and one patient type II.All of these patients underwent CT of chest for staging. None of the patients belong to type I.

One patient presented with Post Gastrojejunostomy stromal growth which was confirmed by Endoscopy and biopsy.

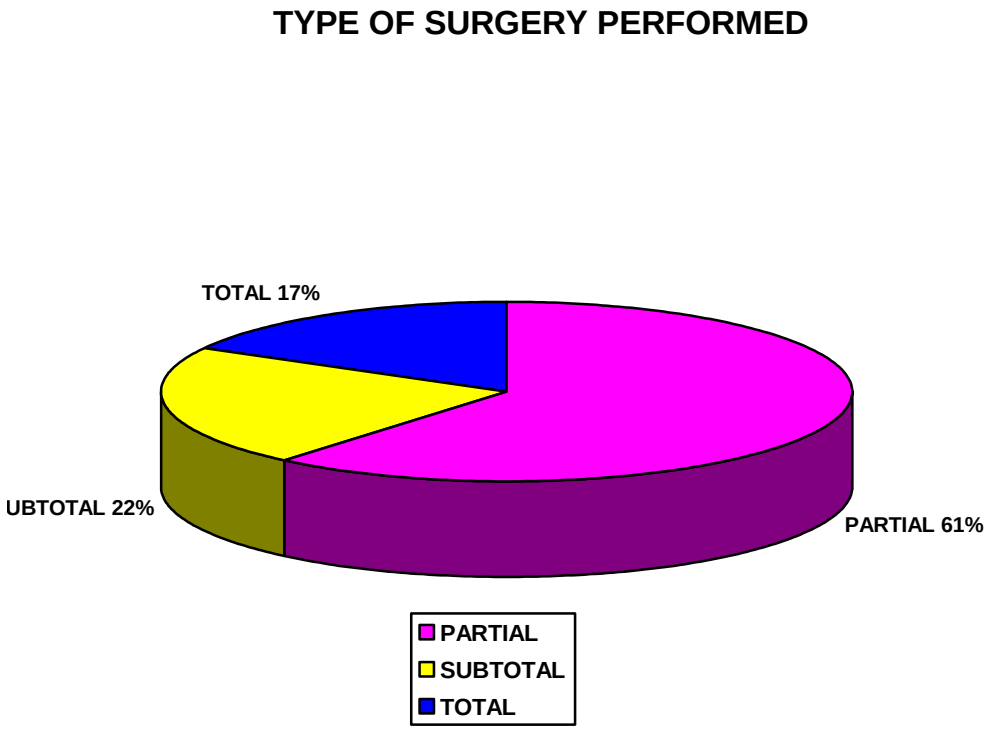
In OGJ tumor type all patients had dysphagia as primary symptom. Vomiting and early satiety was the primary symptom in the rest of patients.

50% of patients with antrum and pylorus growth had outlet obstruction either partial or total.

H pylori association with proximal or upper tumors was not done in our study.

Type of surgery – Gastrectomy performed

SURGERY	NO	PERCENTAGE (%)
PARTIAL	58	61
SUBTOTAL	21	22
TOTAL	16	17
TOTAL	95	100



Partial gastrectomy was the most common surgery performed about 61%, giving proximal clearance of 5 to 6 cms and distal 2 cms, mostly for antrum and pylorus growth.

In 16 patients undergoing total gastrectomy, 2 patients with proximal or upper growth also underwent spleenectomy.after resection all patients had Roux-en-Y oesophago jejunal anastomosis performed with either stapler or hand sewen method.

In GEJ type i.e. 6 patients, all underwent total gastrectomy with resection of intraabdominal part of oesophagus after hiatal dissection and stapler anastomosis, Via abdominal approach

Since none of patients had siewert type I and all patient's with Type II variety underwent abdominal approach comparision of abdominal with combined thoracic approach was not compared and studied.

3 patients with body or middle third growth underwent total gastrectomy.

One patient with stromal growth following Truncal vagotomy and gastro-jejunostomy also underwent total gastrectomy with Roux-en-Y anastomosis.

Subtotal gastrectomy was done for all other i.e. 11 patient's with body or middle growth.

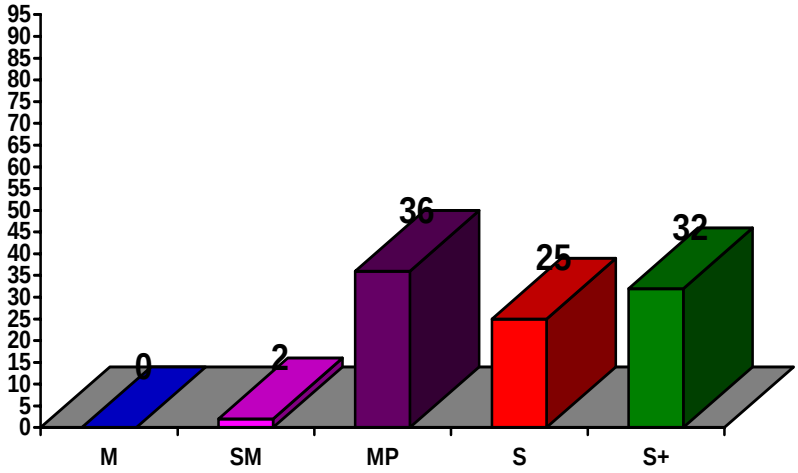
11 cases with antrum and pylorus growth also underwent subtotal gastrectomy.

Standard method of procedure of dissection and anastomosis was followed in all cases.

Depth of invasion

DEPTH	NO	PERCENTAGE (%)
MUCOSA	0	0
SUBMUCOSA	2	2
UPTO MUSCULARIS PROPRIA	36	38
UPTO SEROSA	25	26
SEROSA INVOLVED	32	34
TOTAL	95	100

DEPTH OF INVASION



M	MUCOSA
SM	SUBMUCOSA
MP	UPTO MUSCULARIS PROPRIA
S	SEROSA
S+	SEROSA INVOLVED

Although one of criteria for curative resection is serosa should not involved by the tumor, AJCC 2002 classify them into T3 and so they are potentially curable.
Out of 95 cases in our study the following Pathological Tumor (T) stage was observed.

Tumor Staging

T stage	No of cases
T1	2
T2a	36
T2b	25
T3	32
T4	0

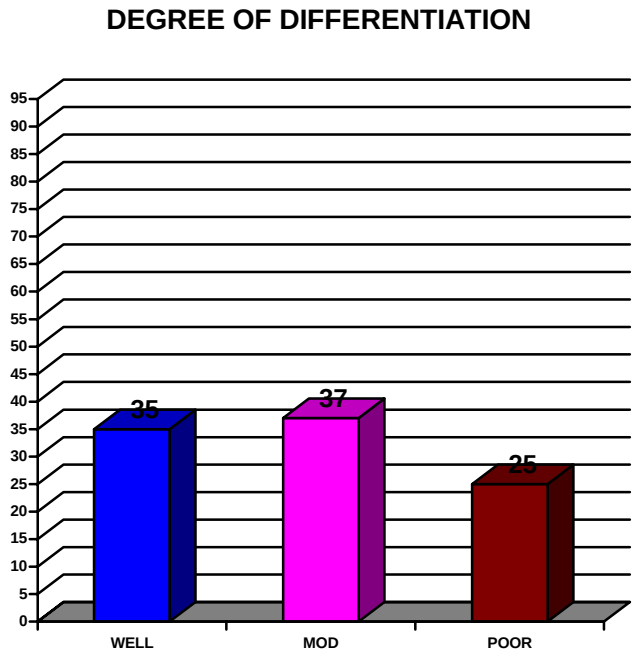
Only 2 cases fall into the early gastric cancer in the entire series of our study and in this one case had lymph node involved i.e. 50% in our series as compared to 18% in MSKCC series.
98% fall in the either T2 or T3.

34% of resected specimen had serosal involvement as compared to 60% in MSKCC series of 1221 cases.

In cases with serosal involvement 87.5% had Lymph node involvement as compared to 68% in MSKCC series.
16 out of 61 cases in T2 had lymph node involvement accounts to 26% as compare to 48 % in MSKCC series. (25, 26)

Degree of differentiation

DEGREE	NO	PERCENTAGE (%)
WELL	35	37
MODERATE	37	39
POOR	23	24
TOTAL	95	100



Lauren's classification which is the widely used one was not used in our study.

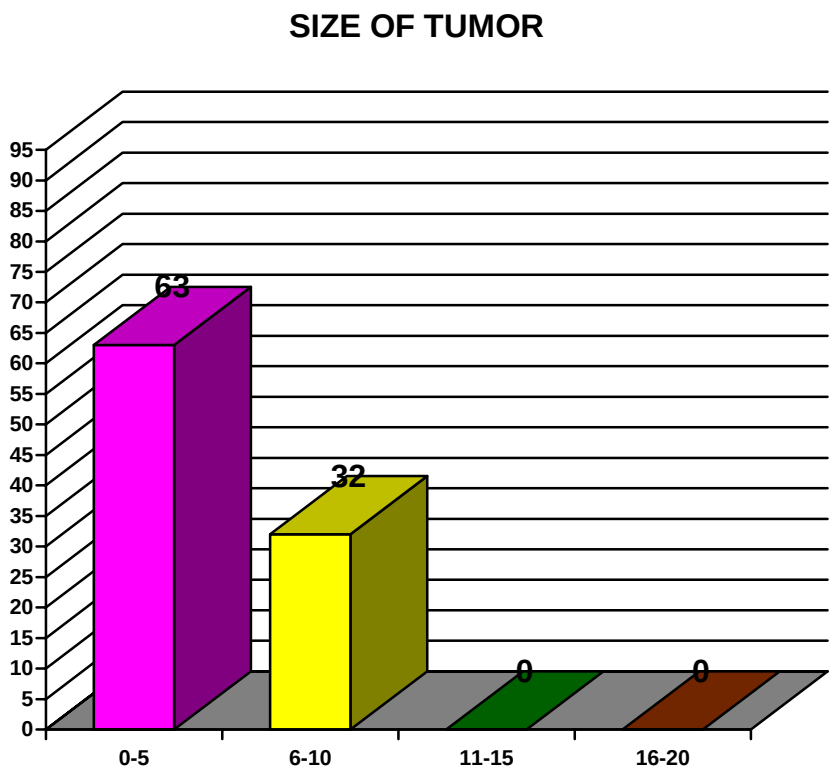
According to Broder's classification the degree of differentiation was analysed in our study

A slight modification of the original nomogram designed by Kattan et al where Lauren's classification was used was done using Broder's classification.

In our centre WHO and Broder's classification are followed by pathologist.

Size of tumour in centimetres

SIZE	NO	PERCENTAGE (%)
0-5	63	66
6-10	23	24
11-15	0	0
16-20	0	0
TOTAL	95	100



The largest one observed was 9.5 centimeters in size.

Morphology rather than size plays a major role in determining the differentiation of tumor and prognosis as suggested by Bearzi and Ronalddi et al. (23)

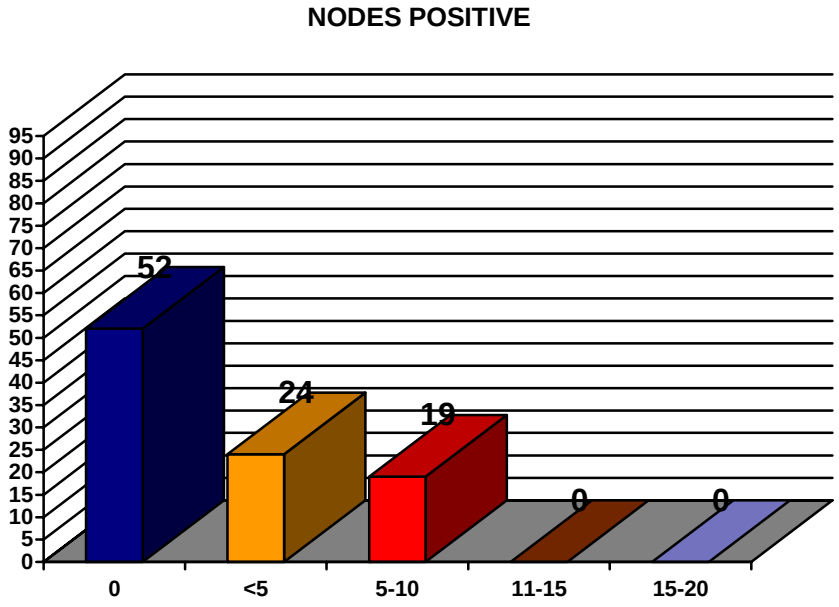
Nodal Staging

Nodal status	No of cases	Percentage
NO	52	55
N1	24	25
N2	19	20
N3	0	0

As per AJCC classification the minimum no of lymph nodes that must be dissected and examined for proper nodal staging is 15.In our study the average no of lymph node examined per specimen is 5.The maximum being 10 lymph nodes.

Number of nodes Positive

Nodes	no	PERCENTAGE (%)
NIL	52	55
<5	24	26
5-10	19	19
11-15	0	0
15-20	0	0
TOTAL	95	100



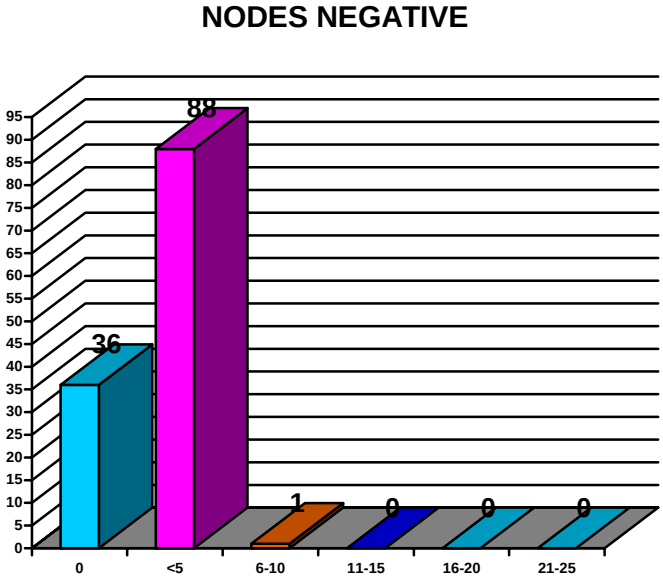
Out of 45% of patients having positive lymph node 19% had more than 5 positive Lymph nodes.

Patients with positive lymph node were given adjuvant chemotherapy consisting of 5-Fluorouracil alone or a combination with mitomycin or cisplatin, 3 cycles at one month interval.

All patients with more than 5 nodes positive were referred for adjuvant radiotherapy to gastric bed in addition to chemotherapy depending on general condition.

Number of nodes negative

NODES	NO	PERCENTAGE (%)
NIL	36	37
<5	88	92
6-10	1	1
11-15	0	0
16-20	0	0
21-25	0	0
TOTAL	95	100



When compared with other studies the average no of lymph nodes analysed in Japanese study is 62 per specimen where as it is 12 in MSKCC.In our centre it is on an average of 5 lymph nodes per specimen. So Nodal staging is poor as minimum of 15 Lymph nodes should be removed and analysed for proper staging as per AJCC staging and guidelines.

Study	**AVERAGE NO ANALYSED LN**
JAPANESE	62
MSKCC	12
PRESENT	5

German studies suggest that ratio of positive nodes to negative nodes may be an independent prognostic index. As cady et al has well explained, resecting more lymph nodes does not alter survival, so resecting more negative nodes certainly will not.

Comparative or randomised study of D1 verses D2 Lymphadenectomy was not done in our study as it has been well proved that D2 dissection does not alter overall survival in four separate RCT's (67, 68, 69, and 70)

In our institution only regional lymph node dissection depending on the site of tumor is done as routine

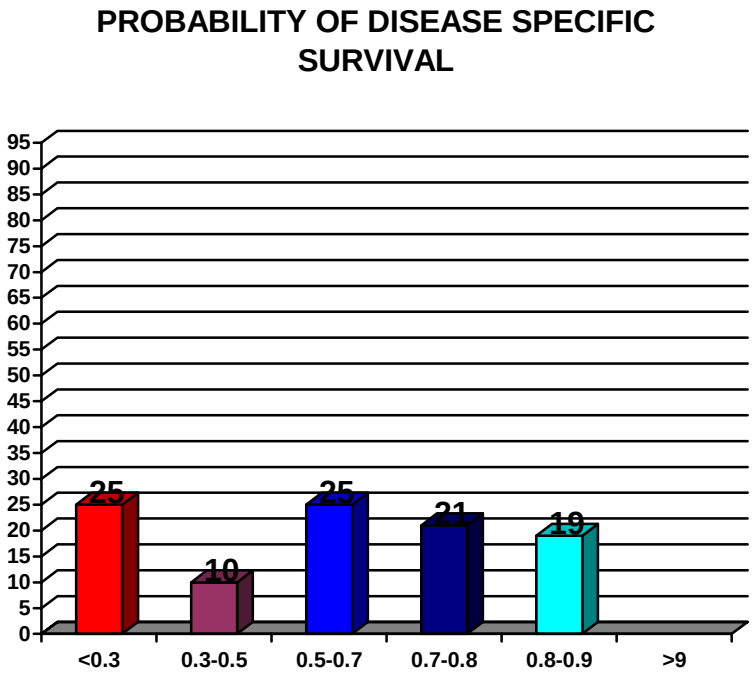
TNM STAGING

STAGE	**NO OF CASES**	**PERCENTAGE**
I	2	2
II	47	50
III	46	48
IV	0	0

98% of patients fall into Stage II and III in our study.

Probability of 5 yrs survival as per Nomogram

PRABABILITY	NO	PERCENTAGE (%)
<0.3	25	26
0.3-0.5	10	10
0.5-0.7	25	26
0.7-0.8	21	22
0.8-0.9	19	20
>0.9	0	0
TOTAL	95	100



Plotting the nomogram for all patients as per kattan et al the following observations were made. Nearly 64% of patients had survival probability greater than 0.5.

This was used to for patient counselling, adjuvant therapy and follow up scheduling.

Survival after Curative Resection for Gastric Cancer by TNM Stage

		Percentage (%)					
		T1		T2		T3	T4
Study	Number of Patients	M	SM	MP	US	S	S+
Noguchi et al (Japan)	3143	94	87	75	51	23	5
Maruyama et al (Japan)	3176	95	87	82	65	34	14
Boku et al (Japan)	238	—	—	90	—	42	29
Baba et al (Japan)	142	—	—	55	—	34	32
Hermanek (Germany)	977	84	75	73	40	24	25
Shiu et al (United States)	246	—	—	56		32	—
Bozzetti et al (Italy)	361	82	69	38		—	—
MSKCC (United States)	944	91		56		26	—
Our study	95	100		81		65	---

The survival depicted in the table shows till the present follow up which varies from 26 months to 2 months. Long term follow up of 5 years is necessary to completely analyse and compare with other studies.

Mortality and Morbidity

Six of our patients expired in the post operative period.

Three died due to duodenal stump blow out and other three due to other medical complications.

Thirteen patients died in the follow up period of which 5 due to metastasis and others due to nutritional consequences and medical complications.

Nearly 25 % of patients expired in the follow up till the end of study period

All patients in the total gastrectomy category were given Vitamin B12 and Iron supplementation as routine.

Those who developed other nutritional as well as mechanical complication were managed accordingly.

Small stomach syndrome and afferent and efferent loop obstruction were the most common complication noted.

Till end of study period nearly 60% patients are being followed up and counselled.

All patients were advised monthly follow up with clinical examination.

Ultrasonogram two monthly.

Endoscopy was used in selected cases, suspicion of complication or recurrence.

Computed Tomogram was also used in selected cases.

Recurrence Patterns after Primary Surgery for Gastric Cancer

Author (Y)	Analysis	Local-Regional	Peritoneal	Distant
Landry et al.[29] (1990)	130 pts—clinical	38% (49/130)	—	—
Gunderson and Sosin[31] (1982)	105 pts—surgery	69% (74/105)	42% (44/105)	—
Wisbeck[100] (1986)	145 pts—autopsy	94% (15/16)	50% (8/16)	44% liver, 13% lung
Roviello et al.[95] (2003)	441 pts—first site of failure	22%—lymph node, 11%; gastric bed/adjacent organs, 8%; gastric stump, 3%	17%	17%
Allum et al.[96] (1989)	145 pts—clinical	27%	—	22%
Our study	95 pts-clinical & investigation	13%	6%	--

45% of our patients underwent adjuvant chemotherapy and 13% along with radiotherapy to gastric bed.

The recurrence pattern was studied and 12 patients developed loco regional recurrence and 5 cases developed metastasis, all of them expired.

Those who developed local recurrence, diagnosed and confirmed by investigations were referred for adjuvant Chemotherapy or if already completed chemotherapy, further

additional two course of chemotherapy was given with combination of 5 Fluorouracil and mitomycin.

CONCLUSION

CONCLUSION

Carcinoma Stomach is the third most common cancer in Thanjavur Medical College and Hospital.

Males above 40 years are most commonly affected.

Surgery is the only modality which offers cure.

Curative gastrectomy (RO) offers a reasonable DSS.

Mortality and morbidity of gastrectomy is high in our study.

Most patients present in late stage of disease in our study.

The extent of gastrectomy need not always be total and depends upon site of tumor.

Extent of lymphadenectomy is controversy and need not always go for D2 resection.

Extent of lymphadenectomy depends on site of tumor and should strive to attain MSKCC level or AJCC standard.

Nomogram is a good tool for predicting DSS and planning adjuvant therapy and counselling of patients which is accepted and followed in our centre.

Adjuvant therapy increases the overall survival.

Management of gastric cancer is a challenge and surgery offers a reasonable chance of survival in these patients.

MASTER CHART

MASTER CHART

S.No	I.P.No	Age	Sex	Surgery	Site	Type	Size	Depth	N+ve	N_ve	DSS
1	837031	42	M	Subtotal	A/P	Well	3	3	0	3	0.81
2	836155	60	M	Partial	A/P	Mod	2	3	0	5	0.82
3	840256	60	F	Partial	A/P	Mod	4	4	0	0	0.73
4	840201	50	M	Subtotal	A/P	Well	3	4	0	5	0.72
5	841117	50	F	Partial	A/P	Poor	4	5	1	3	0.48
6	845271	70	M	Total+S	B/M	Well	7	5	4	4	0.20
7	846791	42	M	Subtotal	A/P	Well	4	4	1	0	0.53
8	869033	40	F	Total	P/U	Well	6	5	1	3	0.48
9	869273	52	F	Subtotal	B/M	Poor	6	3	2	2	0.58
10	871549	60	F	Total	P/U	Well	7	5	5	0	0.28
11	873242	40	F	Subtotal	A/P	Poor	6	4	0	5	0.60
12	875260	52	M	Subtotal	B/M	Poor	6	4	2	3	0.34
13	875863	39	M	Partial	A/P	Poor	4	4	0	5	0.35
14	876484	40	F	Partial	A/P	Poor	4	3	0	5	0.74
15	875512	50	F	Partial	A/P	Mod	4	3	0	6	0.84
16	878463	46	F	Partial	A/P	Well	4	3	0	3	0.82
17	878487	48	F	Total+S	B/M	Mod	5	4	0	3	0.61
18	878355	50	M	Partial	A/P	Well	4	3	0	2	0.84
19	877787	42	F	Partial	A/P	Poor	4	4	0	5	0.68
20	879701	73	M	Partial	A/P	Well	5	5	3	3	0.34
21	877822	65	M	Partial	A/P	Mod	4	4	3	5	0.50
22	880589	45	M	Partial	A/P	Mod	4	3	0	0	0.75
23	881463	60	M	Partial	A/P	Poor	4	5	3	0	0.30
24	881477	29	M	Subtotal	A/P	Poor	3	5	3	0	0.25
25	881485	50	F	Subtotal	A/P	Mod	3	3	0	0	0.78
26	887291	60	M	Subtotal	B/M	Poor	5	5	10	0	0.10
27	887519	55	M	Partial	A/P	Well	6	4	1	0	0.60
28	886467	60	M	Subtotal	A/P	Well	6	3	0	5	0.83
29	889443	52	F	Subtotal	B/M	Mod	6	4	0	5	0.64
30	891797	45	F	Partial	A/P	Mod	4	3	3	3	0.33
31	891998	67	M	Subtotal	B/M	Well	4	4	2	1	0.34
32	900913	53	F	Partial	A/P	Poor	4	5	0	2	0.55
33	902180	54	M	Subtotal	A/P	Mod	3	5	0	5	0.55
34	901809	35	F	Partial	A/P	Mod	3	5	0	5	0.55
35	901283	60	M	Partial	A/P	Well	3	5	3	0	0.32
36	905086	70	F	Partial	A/P	Mod	6	3	0	3	0.78
37	905450	58	M	Partial	A/P	Well	3	5	0	5	0.64
38	906991	62	M	Partial	A/P	Mod	4	3	0	0	0.76
39	907217	30	F	Subtotal	B/M	Mod	6	5	3	0	0.18
40	908828	70	M	Partial	A/P	Well	4	3	0	5	0.78
41	908487	60	M	Partial	B/M	Mod	4	5	5	0	0.18
42	908691	30	M	Partial	A/P	Well	3	2	0	5	0.88
43	908622	53	M	Partial	B/M	Mod	4	3	5	0	0.20
44	911112	45	M	Subtotal	A/P	Mod	6	5	5	0	0.09
45	911503	42	M	Partial	A/P	Well	3	3	0	5	0.79
46	913644	40	M	Partial	A/P	Mod	6	5	5	0	0.21
47	916120	56	M	Subtotal	B/M	Poor	6	5	5	0	0.15
48	918631	45	M	Partial	A/P	Mod	4	5	5	0	0.22

49	920821	60	F	Partial	A/P	Mod	4	4	0	5	0.79
50	922224	40	F	Subtotal	B/M	Well	6	2	5	0	0.60
51	922616	58	F	Partial	A/P	Well	3	3	3	2	0.66
52	922651	65	M	Total	OGJ	Mod	6	3	0	3	0.64
53	924146	38	F	Partial	A/P	Well	3	4	2	3	0.52
54	924065	45	M	Partial	A/P	Well	4	3	0	3	0.80
55	925595	50	M	Partial	A/P	Mod	4	3	0	3	0.77
56	926172	52	M	Partial	A/P	Poor	4	4	2	2	0.34
57	927521	65	M	Partial	A/P	Mod	4	3	0	3	0.74
58	926960	40	M	Partial	A/P	Poor	4	3	0	5	0.72
59	929601	52	M	Partial	A/P	Poor	4	5	5	0	0.21
60	929364	68	M	Partial	A/P	Well	4	3	0	3	0.78
61	929157	45	F	Total	PGJ	Mod	3	4	0	0	0.65
62	929315	67	M	Total	P/U	Mod	8	5	5	0	0.06
63	929453	50	F	Total	OGJ	Mod	6	4	0	5	0.66
64	929200	68	M	Subtotal	B/M	Poor	8	3	5	0	0.24
65	928492	55	F	Partial	A/P	Mod	3	3	0	0	0.82
66	929454	45	F	Total	P/U	Poor	8	5	5	0	0.07
67	933751	51	M	Partial	A/P	Well	4	4	1	4	0.60
68	933284	60	M	Partial	A/P	Poor	4	4	1	4	0.58
69	933758	62	M	Partial	A/P	Mod	3	3	0	5	0.80
70	934018	35	M	Partial	A/P	Mod	4	3	0	5	0.75
71	936241	63	M	Total	OGJ	Well	8	4	0	10	0.65
72	934088	55	M	Partial	A/P	Mod	6	5	8	0	0.06
73	938341	60	F	Total	OGJ	Mod	8	5	5	5	0.25
74	938600	57	M	Partial	A/P	Well	4	3	0	3	0.84
75	935303	50	M	Partial	A/P	Well	4	3	0	2	0.82
76	934114	40	M	Total	OGJ	Poor	8	5	8	0	0.03
77	940915	40	F	Partial	A/P	Well	2	5	5	0	0.25
78	941860	50	F	Partial	A/P	Well	4	3	0	3	0.81
79	938776	63	M	Subtotal	A/P	Mod	6	5	3	3	0.26
80	943261	31	F	Partial	A/P	Mod	4	3	0	5	0.78
81	944628	45	M	Total	OGJ	Poor	3	3	0	5	0.72
82	946502	60	M	Partial	A/P	Mod	4	3	0	3	0.84
83	945052	47	M	Subtotal	B/M	Well	8	5	5	0	0.20
84	947136	43	M	Partial	A/P	Well	4	3	0	3	0.78
85	946648	51	M	Subtotal	A/P	Well	4	4	0	5	0.67
86	948069	40	F	Partial	A/P	Well	4	3	0	3	0.82
87	948402	40	M	Partial	A/P	Poor	4	5	10	0	0.04
88	948060	54	M	Subtotal	A/P	Mod	5	4	0	5	0.64
89	948018	55	M	Total	P/U	Well	8	3	0	3	0.73
90	950438	55	F	Partial	A/P	Well	4	3	0	3	0.84
91	949108	60	M	Partial	A/P	Well	4	4	0	5	0.72
92	952590	64	M	Partial	A/P	Poor	4	4	1	4	0.55
93	951440	52	M	Subtotal	B/M	Poor	6	5	4	1	0.23
94	954545	60	M	Partial	A/P	Mod	4	4	5	0	0.26
95	952248	62	M	Total	P/U	Mod	7	5	6	0	0.22

PROFORMA

CASE PROFORMA

NAME:

AGE:

SEX:

IP NUMBER:

UNIT:

DATE OF ADMISSION:
DATE OF SURGERY:
DATE OF DISCHARGE:

COMPLAINTS:

GENERAL EXAMINATION:

BP: **PR:** **GENERAL CONDITION:**

SYSTEMIC EXAMINATION:
ABDOMEN

- **MASS**
- **VGP**
- **FREE FLUID**
- **STATUS OF LIVER**
- **PR & PV**

INVESTIGATIONS:

ROUTINE BLOOD TESTS:
BLOOD GROUP:
X-RAY CHEST:
CONTRAST STUDIES:
UGI SCOPY & BIOPSY:
USG ABDOMEN:
CT ABDOMEM:
DIAGNOSTIC LAPROSCOPY:

ANAESTHETIC ASSESMENT:

SURGERY PERFORMED:

COMPLICATION:

PATHOLOGICAL SPECIMEN ANALYSIS:
1)PRIMARY SITE:
2)TYPE & DIFFERENTATION:
3)SIZE OF TUMOR:
4)DEPTH OF INVASION:
5)NO OF POSITIVE LYMPHNODES:
6)NO OF NEGATIVE LYMPHNODES:
7)PROXIMAL & DISTAL MARGINS:

NORMOGRAM FOR DISEASE SPECIFIC SURVIVAL:

ADJUVANT THERAPY:

FOLLOW UP:

BIBLIOGRAPHY

BIBLIOGRAPHY

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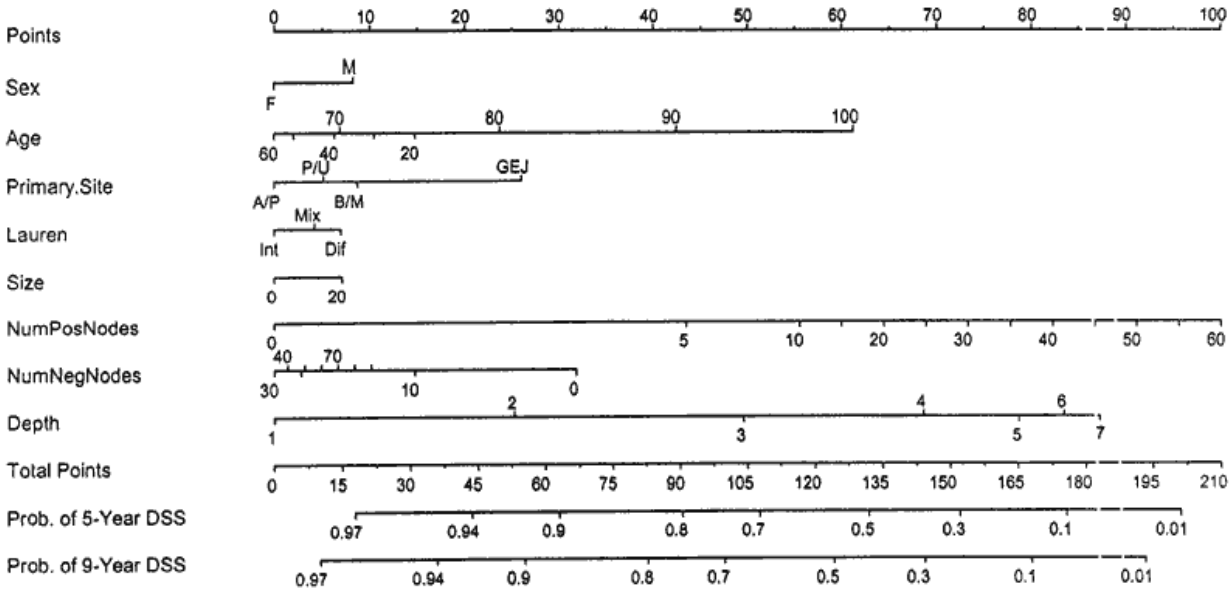
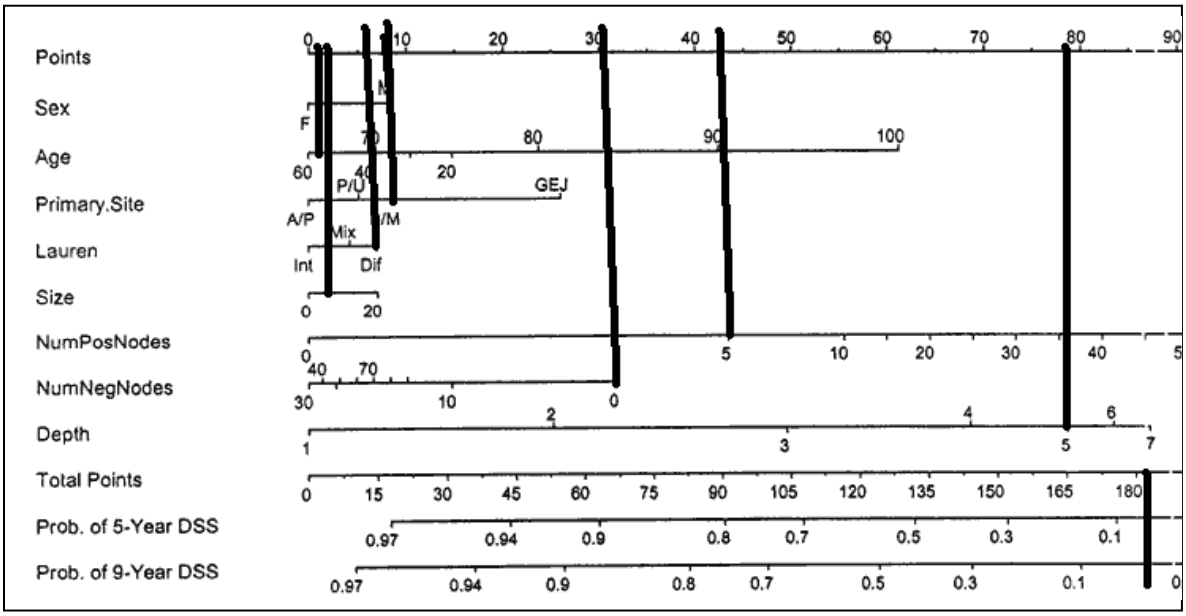
NOMOGRAM



Nomogram for disease-specific survival (DSS). Instructions for physician: Locate the patient's sex on the **Sex** axis. Draw a line straight upward to the **Points** axis to determine how many points toward gastric cancer–specific death the patient received for his or her sex. Sum the points achieved for each predictor, and locate this sum on the **Total Points** axis. Draw a line straight down to the disease-specific survival axes to find the patient's probability of surviving gastric cancer, assuming he or she does not die of another cause first. A/P, antrum or pyloric; B/M, body or middle one-third, Dif, diffuse; GEJ, gastroesophageal junction; int, intestinal; mix, mixed; NumPosNodes, number of positive nodes; NumNegNodes, number of negative nodes; Prob.; probability; P/U, proximal or upper one-third.

PLOTTED NOMOGRAM OF PATIENT



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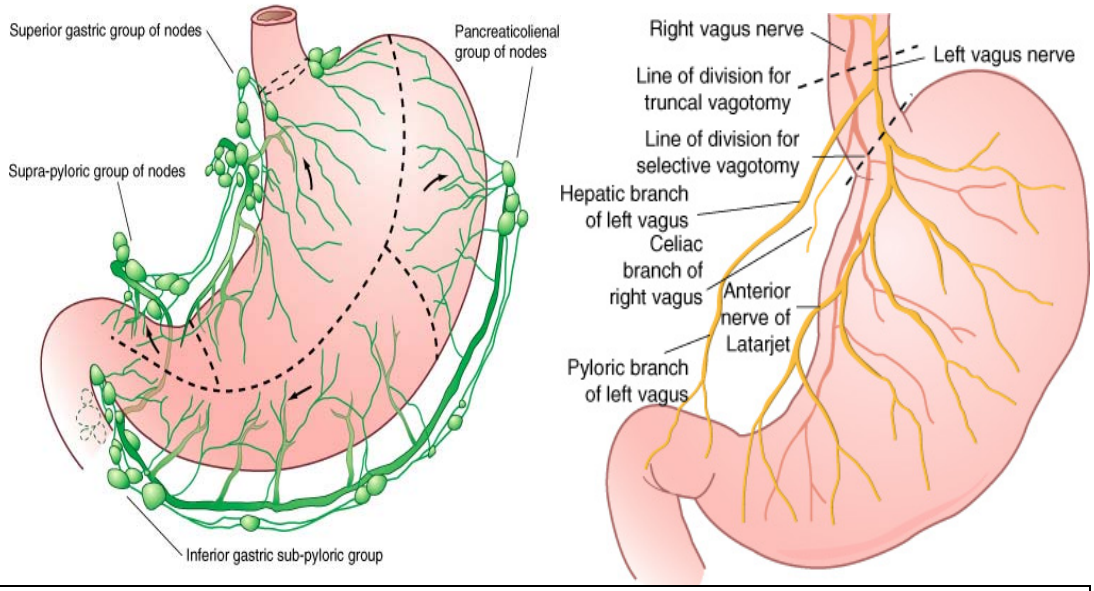
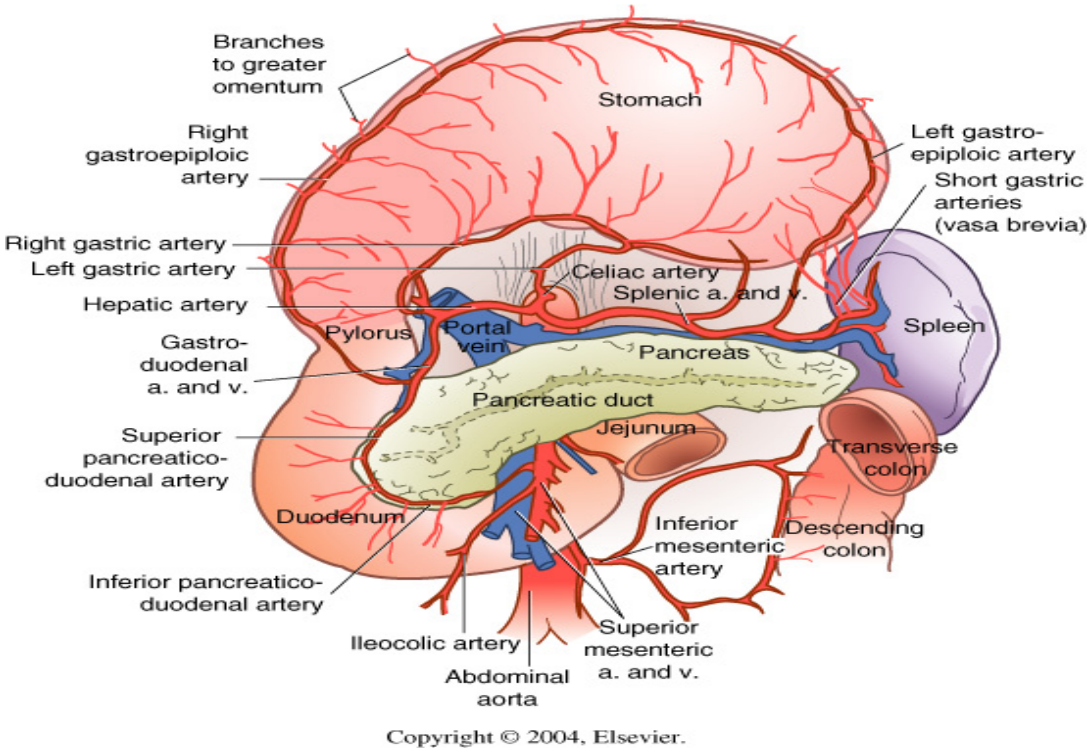
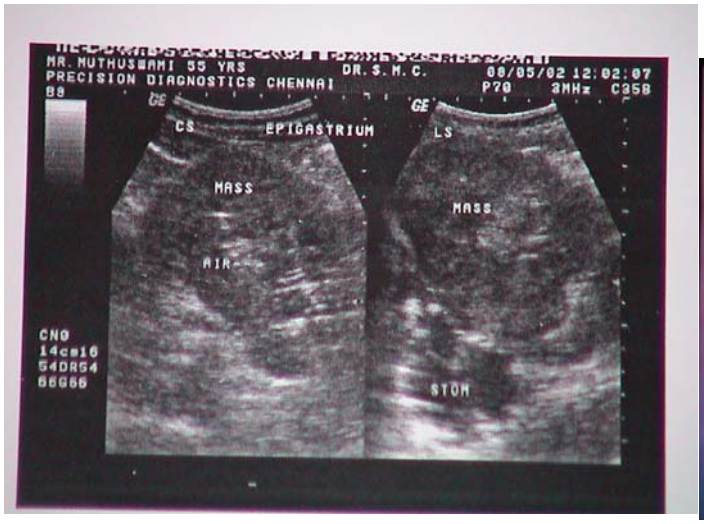


Nerve supply and lymphatic drainage of stomach

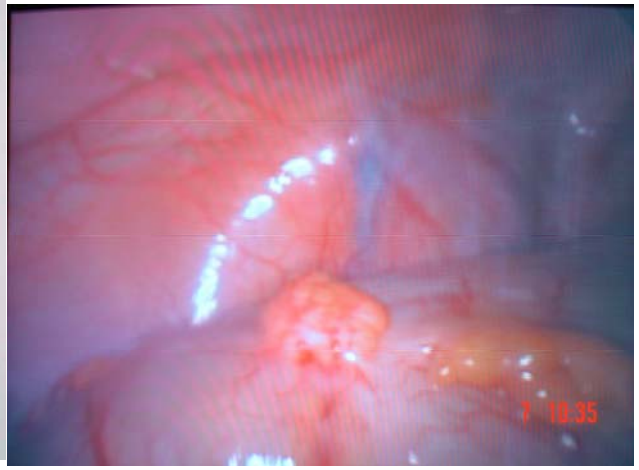


Blood supply of stomach

ULTRASOUND



LAPAROSCOPY



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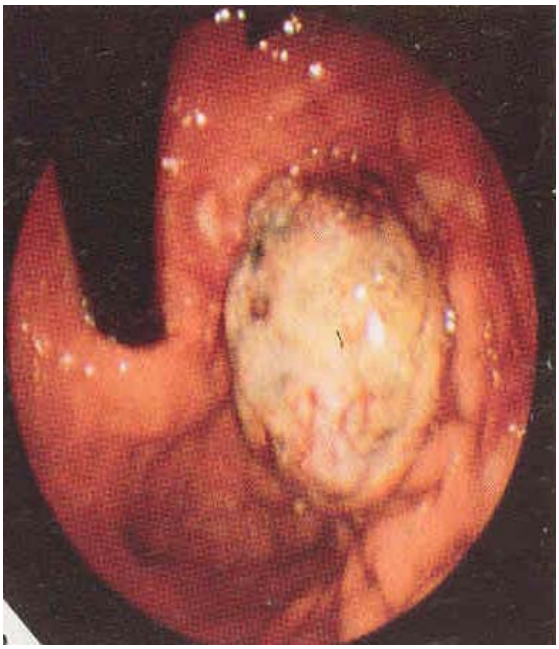
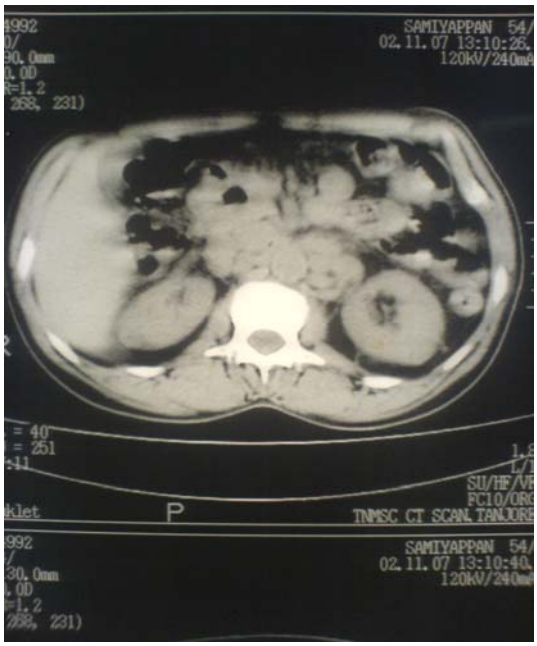


COMPUTED TOMOGRAM

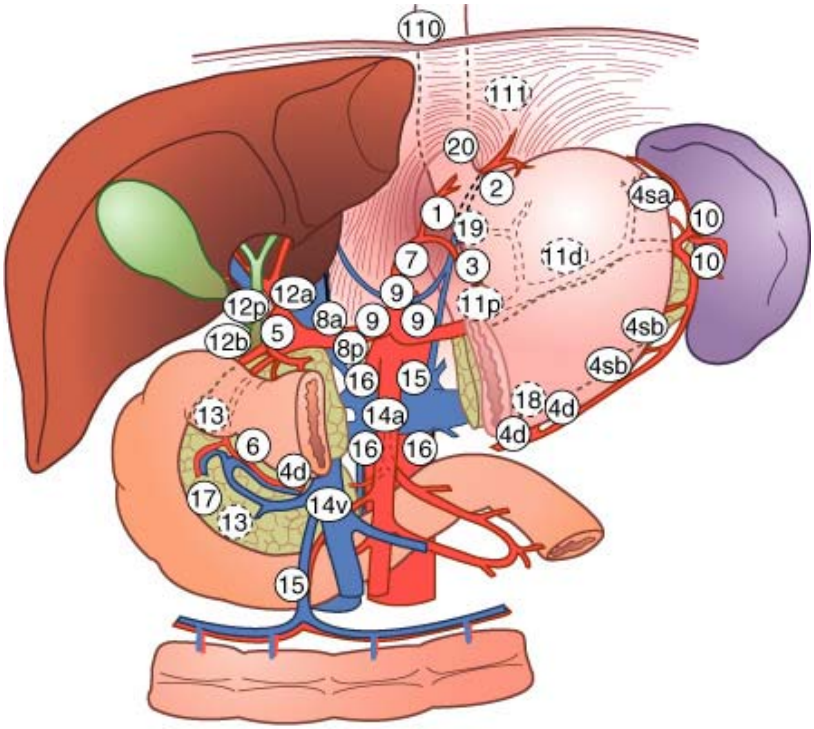


LAPAROSCOPE UNIT

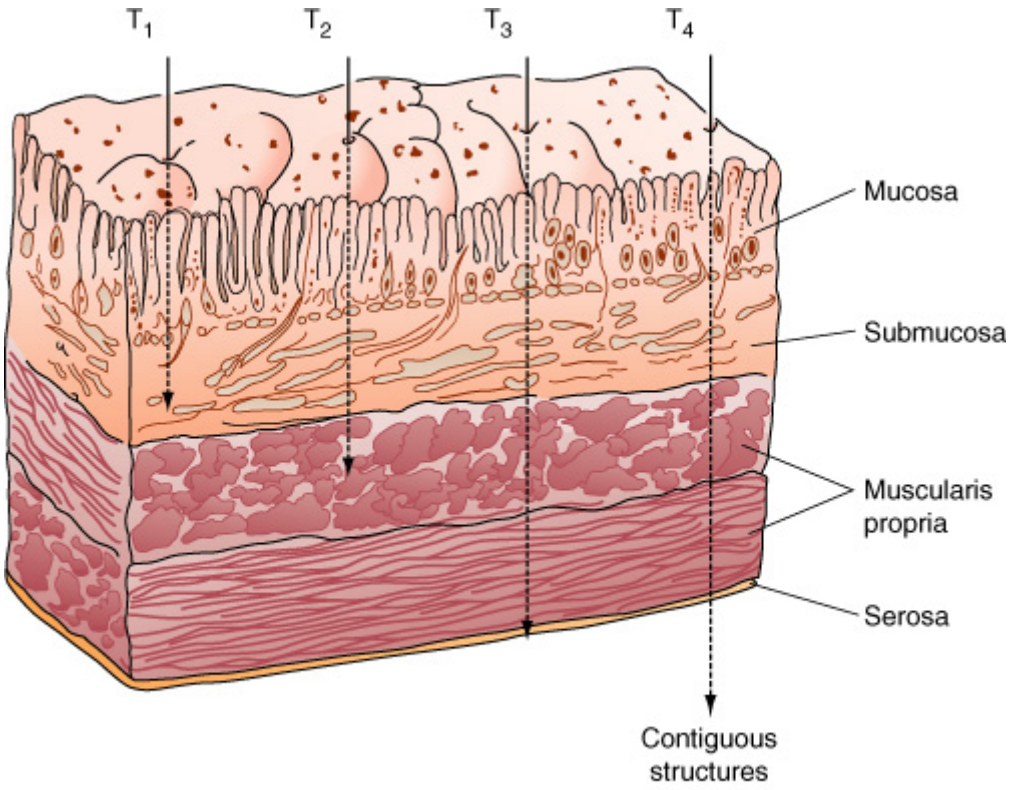
ENDOSCOPE UNIT

Pattern of Nodal Metastases from Gastric Cancer			
	Upper Third (%)	**Middle Third (%)**	**Lower Third (%)**
Paracardia	22	9	4
Lesser or greater curvature	25	36	37
Right gastric artery/ suprapyloric	2	3	12
Infrapyloric	3	15	49
Left gastric artery	19	22	23
Common hepatic artery	7	11	25
Celiac axis	13	8	13
Splenic artery/hilum	11	3	2
Hepatoduodenal ligament	1	2	8
Others	0–5	0–5	0–5

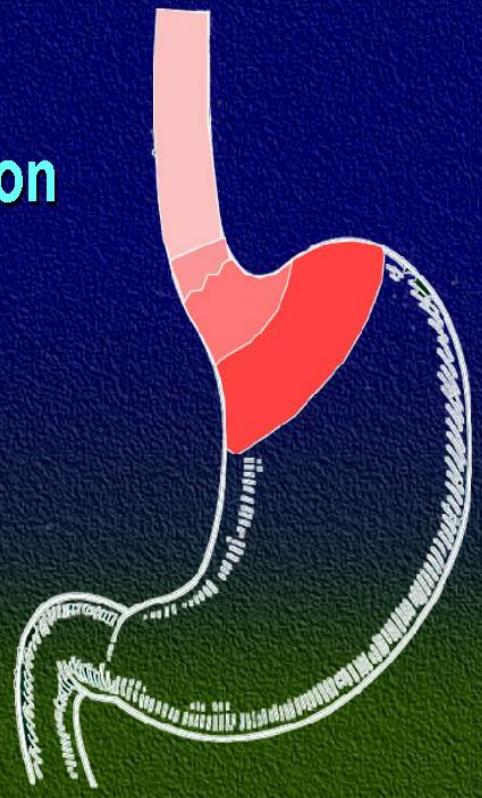
LYMPHNODE STATION

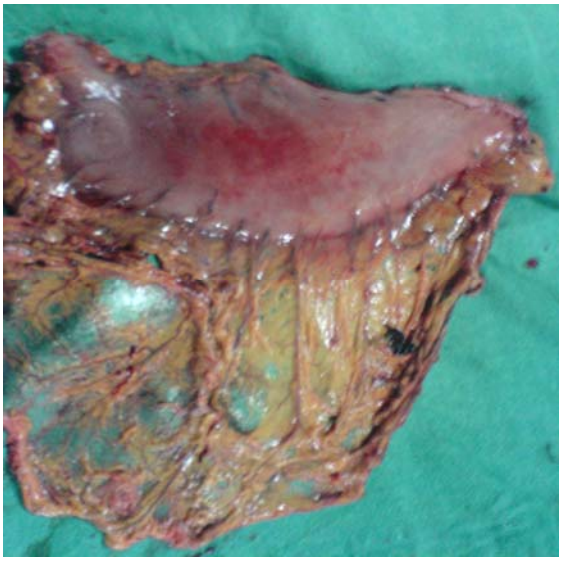


Definition of American Joint Committee on Cancer/International Union Against Cancer T stage based on depth of penetration of the gastric wall.



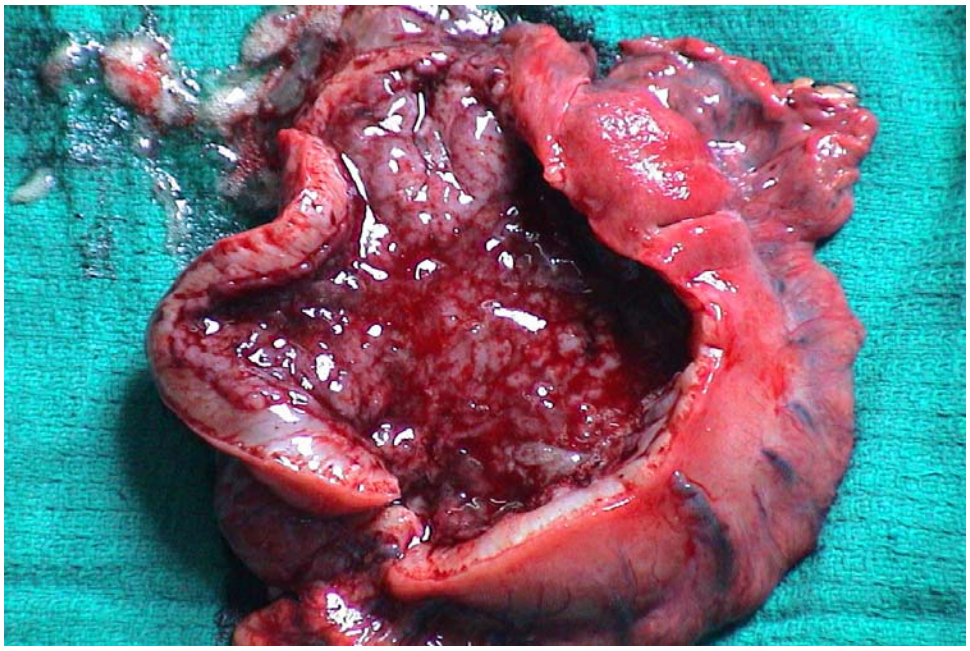
Siewert's Classification



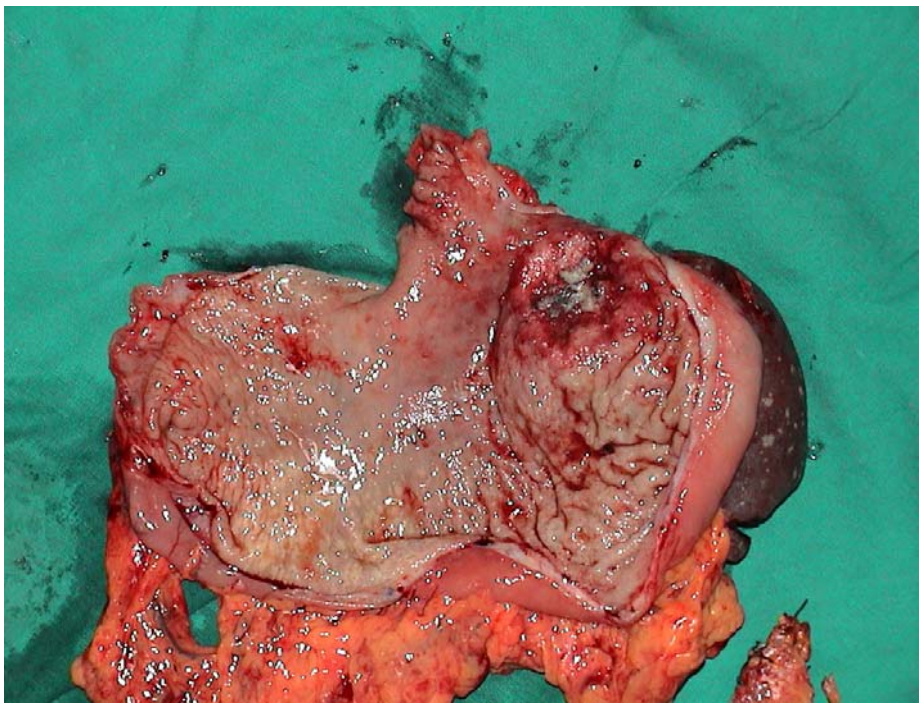


PATIENT UNDERWENT TOTAL GASTRECTOMY

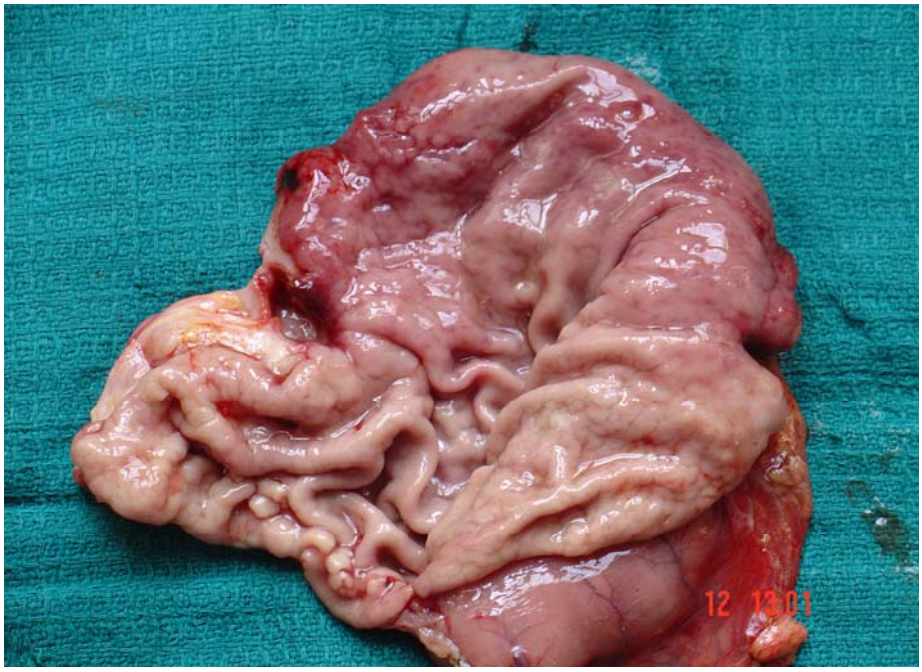
OGJ GROWTH



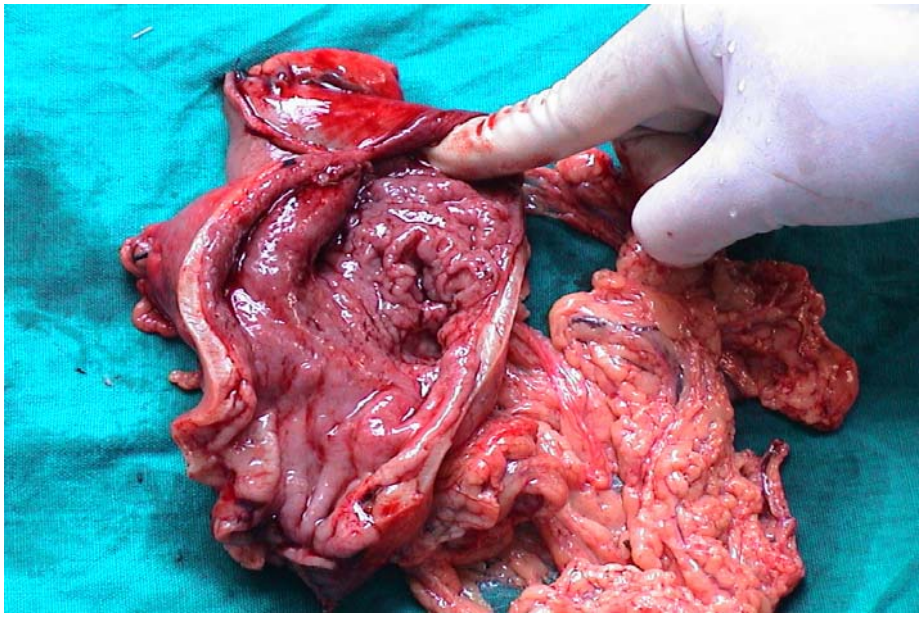
BODY GROWTH



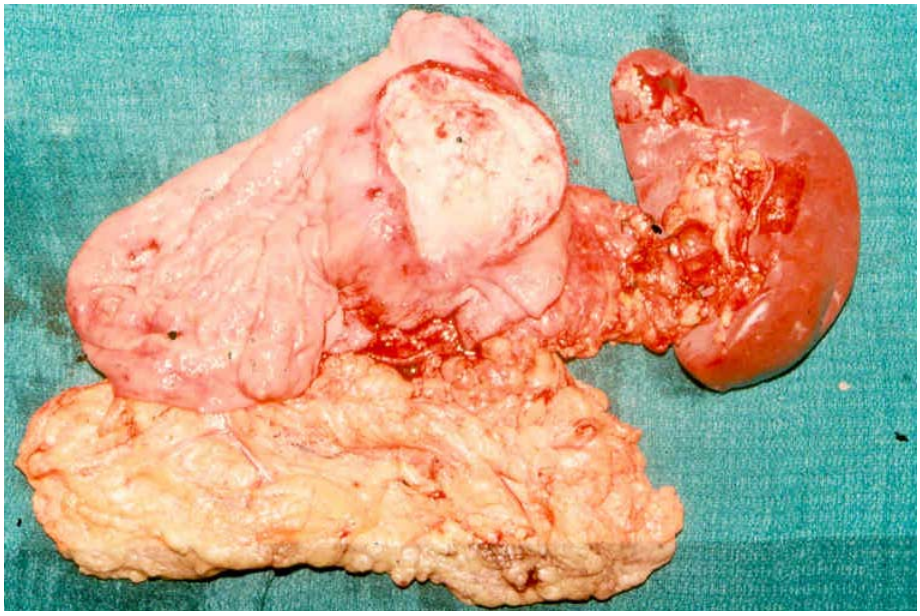
ANTRAL GROWTH



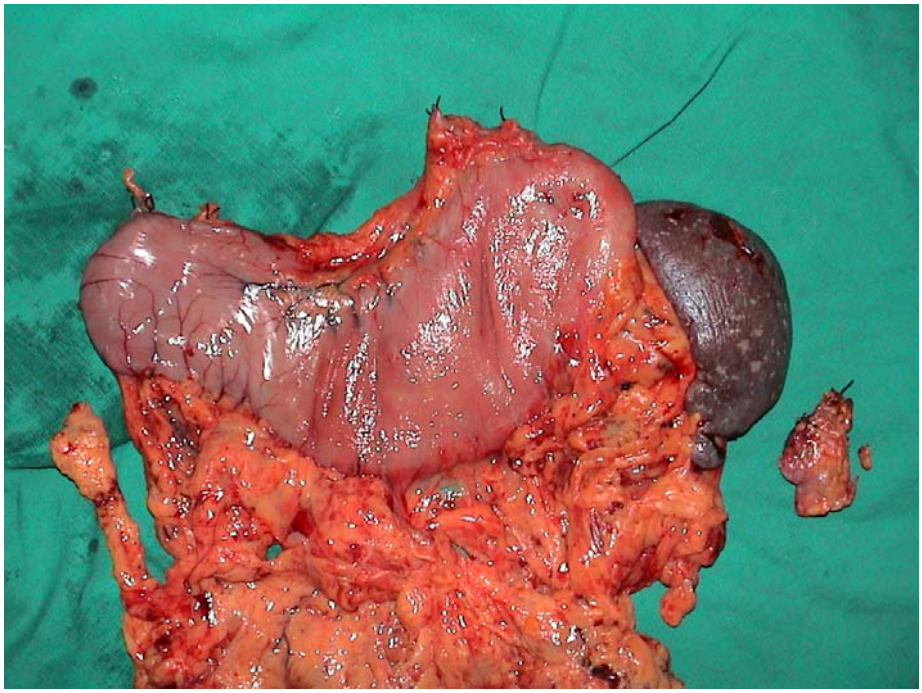
FUNDAL GROWTH



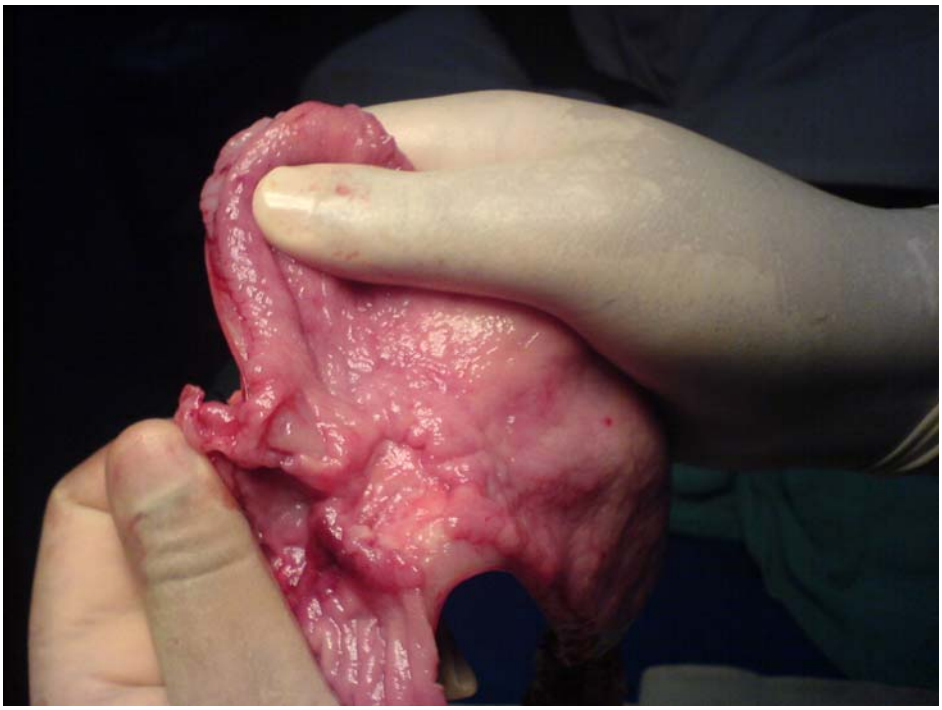
GASTRECTOMY WITH SPLENECTOMY + PANCREATECTOMY



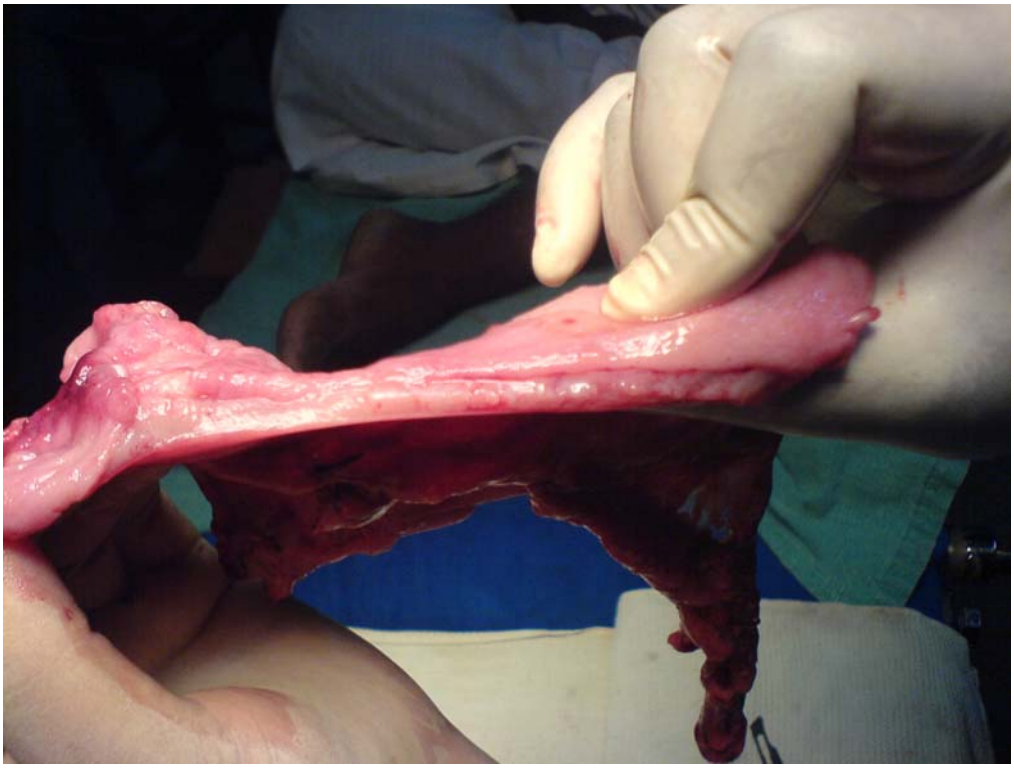
GASTRECTOMY WITH SPLENECTOMY



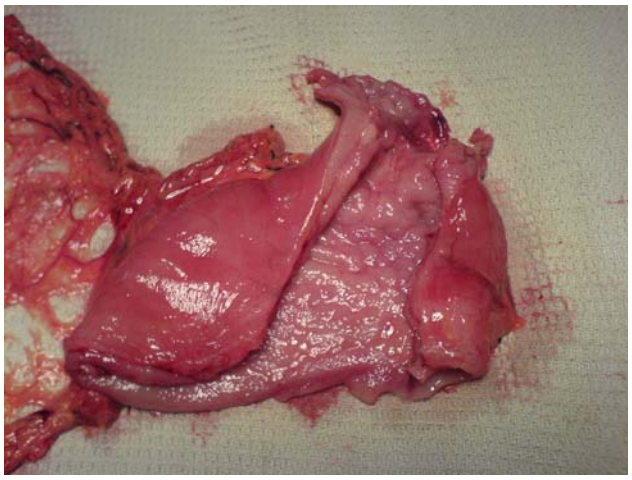
SIZE OF TUMOR

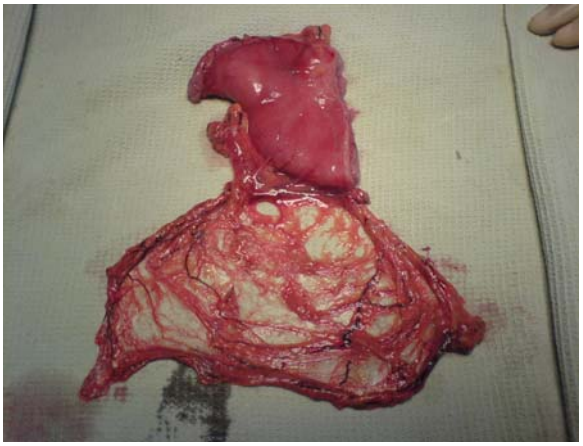


DEPTH OF TUMOR



PARTIAL GASTRECTOMY





GJ ANASTOMOSIS