Accuracy of Pre-Operative Radiological Staging of Gastric Carcinoma and Its Correlation with Post-Operative Findings - A Study in A Tertiary Care Hospital of Eastern India

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Abstract
Background: *Carcinoma of the stomach has been described as one of the captains of man of death. Modern imaging techniques, especially Computed Tomography remains the most widely used imaging modality for pre-operative staging. CT not only can demonstrate gastric wall and perigastric tissue but also can demonstrate the direct extension of tumor into contiguous organs and presence of distant metastasis. Here we have assessed accuracy of pre-operative radiological staging of gastric carcinoma and its correlation with post-operative findings - a study in a tertiary care hospital of eastern india.*
Methods: *Between MAY 2018 and APRIL 2019, we studied retrospectively 35 patents admited to Medical College & Hospital, Kolkata who underwent both preoperative CT of the upper abdomen and assessment. Each patient had a preoperative histological diagnosis of gastric carcinoma, based upon an upper gastrointestinal endoscopic biopsy. Findings were noted in predesigned and pretested case record sheet.*
Results: *Peak prevalence was in between 50-60 years age group, majority being Hindu male people. Pre operative CT correlated with post operative pathologic findings turned out to have sensitivity of 91.6%, specificity of 75%, accuracy of 89.3%, all of which were significant. CT also had sensitivity of 73.1%, Specificity of 50% and accuracy of 71.4% in detecting lymph node metastasis.*
Conclusion: *Spiral CT is a useful modality for preoperative staging of gastric carcinoma with a high accuracy for evaluating serosal invasion and hepatic metastases and should be considered as modality of choice.*
Keywords: *Carcinoma Stomach; Spiral Computed Tomography; Pre operative staging;*

I. Introduction

Carcinoma of the stomach has been described as one of the captains of man of death. A top killer among the cancers of GIT it pauses a serious surgical challenge. Stomach cancer is the third most common cancer in Eastern India. At present surgery is the only therapeutic option offering a chance of cure. Despite increased referral for consideration of surgical treatment,15-30%of patients have unresectable disease and undergo no procedure other than open biopsy. The global incidence of gastric cancer varies 10 fold. The highest incidence (>30cases per 100,000 population is in Japan, Russia, China. South America, eastern Europe. Ingeneral men are affected more than women and incidence increases with age. Gastric cancer is a multifactorial disease. There are several risk factors for gastric cancer; most important among them is h. pylori infection. Chronic atrophic gastritis due to dietary factors, pernicious anemia and prior gastric surgery increases the risk of gastric cancer.

The proximal gastric cancer seems to affect principally higher socio- economic groups and does not seem to be associated with H.pylori infection. Modern imaging techniques including contrast enhanced Computed Tomography (CECT), Magnetic Resonance Imaging (MRI), Positron Emission Tomography (PET) and PET-CT are powerful tools in detection , diagnosing and staging of malignancy Traditionally staging has been performed at the time of surgery, although a sensitive and reliable staging tool which could identify patients with unresectable disease would be of great benefit in saving patients from unnecessary laparotomy. Computed Tomography remains the most widely used imaging modality for pre-operative staging. CT not only can demonstrate gastric wall and perigastric tissue but also can demonstrate the direct extension of tumor into contiguous organs and presence of distant metastasis.

II. Materials And Method:

Between MAY 2018 and APRIL 2019, we studied retrospectively 35 patents admited to Medical College & Hospital, Kolkata who underwent both preoperative CT of the upper abdomen and assessment. Each patient had a preoperative histological diagnosis of gastric carcinoma, based upon an upper gastrointestinal endoscopic biopsy. Seven patients were excluded because operative data, pathologic data or CT images were not available. Ultimately, the present study comprised the remaining 28 patients (20 men; 8 women) between 30 and 79 years of age (mean 52].

Exclusion Criterion
1. Patients suspected to be suffering from carcinoma stomach who on further investigation were found to be suffering from benign disease.
2. Diagnosed cases of gastric carcinoma under palliative treatment
3. Patients whose pathologic data or Ct images were not available

SPIRAL CT SCANNING PROTOCOL
The CT examinations were performed using Phillips Brilliance 16P 16 slice CT Scanner.
CT examination was done extending from the dome of diaphragm upto the pelvis.
Patient Position : Supine, with arms above the head.

Patients were kept NPO for at least 6 hours before the examination. Water (800 to 1,000 ml) was given as the oral contrast material to distend the stomach and better visualize the gastric wall.

Contrast material used was UROVIDEO 75% (Diatrizoate Meglumine and Diatrizoate Sodium Injection) administered through intravenous route. 2ml/ kg body weight, approximate in an average.

Following data were recorded: Primary tumor characteristic including the site of primary lesion, gastric wall thickness and the extent of the tumors. Metastasis to lymph nodes and adjacent organs were also noted. Findings were noted in predesigned and pretested case record sheet.
Approval from institutional ethics committee was obtained.

RESULT AND ANALYSIS

The study comprised of 28 endoscopic biopsy proven patients of gastric carcinoma who attended the Department of Radiology , Cancer Centre Welfare Home & Research Institute, Kolkata for staging and further assessment of their disease.

Result of Age & Sex distribution

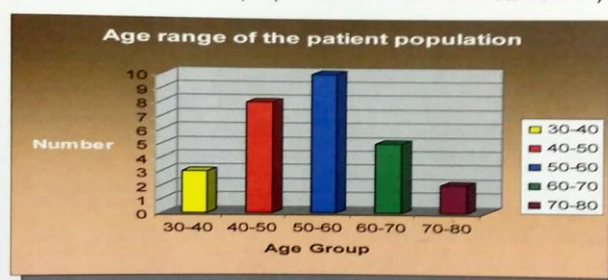Age range of the patient population was from 32 to 79 years.


Age range of the patient population

TABLE – I

AGE GROUP	NUMBERS	PERCENTAGE
30-40	3	10.71
40-50	8	28.57
50-60	10	35.71
60-70	5	17.85
70-80	2	7.14

The table shows that the disease was prevalent in 5th & 6th decades of the age of the patients population.

Result of Sex ratio of patient population

TABLE – II

| SEX OF THE PATIENTS	NUMBERS OF THE PATIENTS
Male	20
Female	8

Sex pattern of the patients
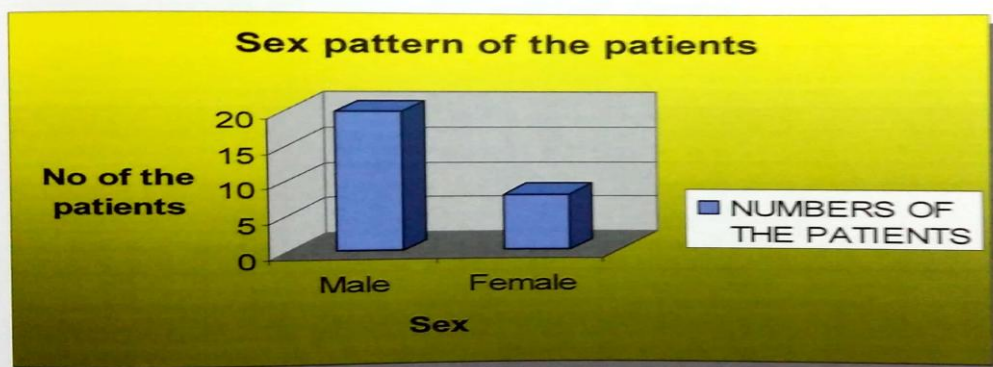
The result from the above table clearly shows that the disease is commoner in the male population. Male to female ratio is 2.5:1

Result of the various religion/ ethnic communities the patients belong to:

TABLE –III

Ethnic Community	No of the Patients
Hindu	18
Muslim	6
Christian	1
Buddhist	1

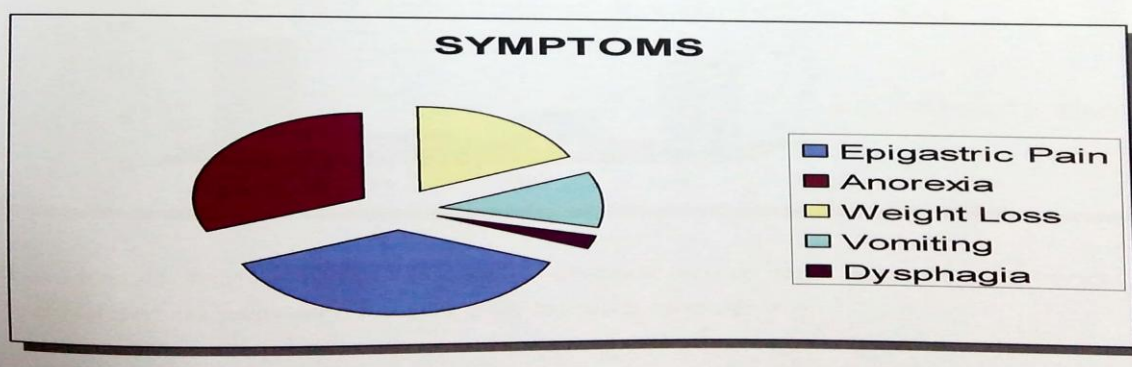### RELIGION PATTERN OF THE PATIENTS
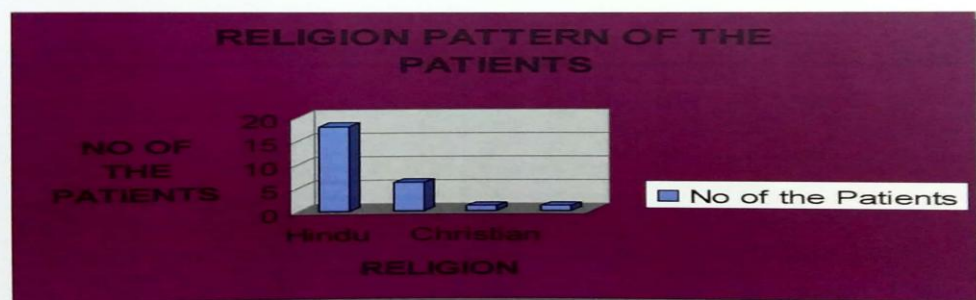
Result shows that the disease was more prevalent in the Hindu community than other communities.

Symptoms

Table-IV

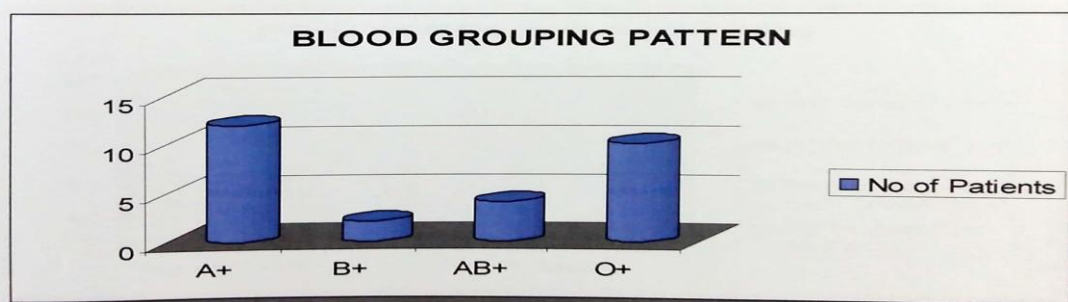| Clinical Symptoms	No of Patients	Percentage
Epigastric Pain	28	100
Anorexia	24	85.71
Weight Loss	14	50
Vomiting	8	28.57
Dysphagia	2	07.14

SYMPTOMS

- Epigastric Pain
- Anorexia
- Weight Loss
- Vomiting
- Dysphagia

Blood Group

Table –V

Blood Group	No of Patients
A+	12
B+	2
AB+	4
O+	10

BLOOD GROUPING PATTERN

No of Patients

The result from above table shows that the disease is more prevalent in patients with the blood group A+.

Predisposing factors:

TABLE- VI

| Predisposing factors	No of Patients	Percentage
Smokers only	12	42.85
Alcoholics only	8	28.57
Non smokers & non alcoholic	8	28.57
Prior gastric surgery	2	7.14

The result from the above table shows that the patients who had a past history of smoking, gastric surgery are more prone to gastric carcinoma.

Location of the Tumor

Table VII

Location of Tumor	No of Patients	Percentage
Pylorus	7	25
Antrum	14	50
Fundus	3	10.7
Body	2	7.1
Pylorus & Antrum	1	3.6
Diffuse	1	3.6
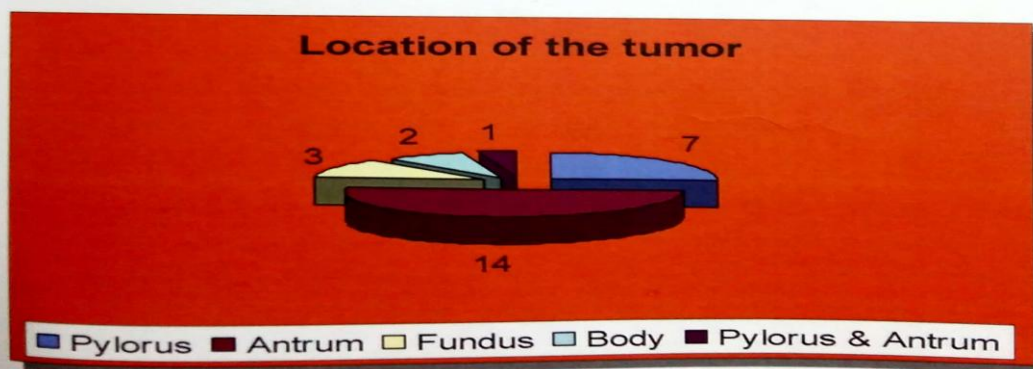
Comparison of T staging between spiral CT and pathology

Table VIII

Pathologic staging	Spiral CT staging			Total (n = 28)
	T1 /T2	T3	T4	
T2	2	0	0	2
T3	1	4	2	7
T4	0	2	17	19

- 21 pts were correctly staged.
- Two T2 and T3 tumors each were over-staged as T4.
- One T3 under-staged as T2 .
- Two T4 were under-staged as T3.
- Sensitivity and specificity for detection of T3 vs T4 tumors were 57.1 & 90.5 vs 89.5 & 77.8% respectively.
- Pre-operative scan suggested 11 pts had pancreatic invasion because of stranding and haziness of fat plane between the primary gastric tumor and pancreas.5 pts had pathologic pancreatic invasion.
- The sensitivity, specificity & accuracy of CT in evaluating for pancreatic invasion were 82%, 73.9% and 78.6% respectively.

Comparison of evidence of serosal with/without adjacent organs invasion between spiral CT and pathology

Table IX

Pathologic findings	Spiral CT findings		Total N=28
	+	-	
+	22	2	24
-	1	3	4
Total	23	5	28

- 22 pts had pathologic proven serosal or adjacent organ invasion.
- Spiral CT has achieved sensitivity, specificity and accuracy of 91.6, 75.0 and 89.3% for evaluating serosal involvement with/without adjacent organ invasion.

Sensitivity = (22/24) × 100 = 91.6%
Specificity = (3/4) × 100 = 75.0%
Accuracy = (25/28) × 100 = 89.3%

Comparison of N staging between spiral CT and pathology

Table X

Pathologic findings	Spiral CT findings			Total N=28
	N0	N1	N2	
N0	1	1	0	2
N1	4	2	2	8
N2	3	1	14	18

- In two of 28 pts, the pathologic findings showed no perigastric (N1) or paragastric (N2) LN involvement.
- Nodel involvement correctly assessed with CT in 17(60.7%) of 28 pts.
- Four N1 and three N2 nodes were under-staged as N0 by CT.

Comparison of pathologic lymph nodes between spiral CT and pathology

Table XI

Pathologic findings	Spiral CT findings		Total N=28
	+	-	
+	19	7	26
-	1	1	2
Total	20	8	28

- CT evaluation yielded a sensitivity for detecting lymph nodes (i.e. N1 and N2) of 73.1% while achieving a specificity of 50.0%.

Sensitivity = (19/26) x 100 = 73.1%

Specificity = (1/2) x 100 = 50.0%

Accuracy = (20/28) x 100 = 71.4%

Comparison of M staging between spiral CT and pathology

Table XII

Pathologic findings	Spiral CT Staging		Total N=28
	M0	M1	
M0	10	1	11
M1	11	6	17

- CT visualized liver metastasis in 6pts with surgical pathologic evidence for 5.
- 12 pts had surgical pathologic evidence of peritoneal involvement but there persons weren't evaluated by CT.
- All four pts with ascitis visualized by CT also had pathologic peritoneal metastasis.
- One of these pts (1/12) had bilateral metastasis to ovanis (Krukenberg tumors).
- 1 pt had pulmonary metastasis detected by CT.

Comparison of TNM staging between spiral CT and pathology

Table XIII

Pathologic findings	Spiral CT Staging				Total N=28
	I	II	III	IV	
II	1	0	1	0	2
III	0	2	1	0	3
IV	0	2	2	19	23

Two patients (7.2%) stage as II
There patients (10.7%) stage as III
23 patients (82.1%) stage as IV

- The agreement in cancer staging by CT and surgical pathology review was 20 of 28 pts (71.4%).
- Tumors were under-staged in seven (25.0%) pts.
- Tumors were over-staged in one (3.6%) pts.
- Three of seven under-staged patients had peritoneal seeding.
- Three were under-staged as N0 & one patient was T2 despite being labeled as T3.
- The one over-staged patient had reactive LN identified a pathologic LN.

III. Discussion

Carcinoma of the stomach has been described as one of the captains of man of death. A top killer among the cancers of GIT it pauses a serious surgical challenge. Stomach cancer is the third most common cancer in Eastern India. A higher incidence has been reported from certain states in northern India, where potential risk factors have been identified. Similar data is available only to a limited extent from eastern India. Adenocarcinoma of the stomach is the second most common cancer world wide and a major cause of mortality and morbidity. Although the incidence of the gastric cancer is decreasing world wide, it remains the fourth commonest cause of death from cancer in the west. Increased awareness among the public and medical profession and open access

endoscopy have facilitated the detection of some lesions in the early course, although some patients still present with advanced disease. At present surgery is the only therapeutic option offering a chance of cure. Despite increased referral for consideration of surgical treatment,15-30%of patients have unresectable disease and undergo no procedure other than open biopsy. The global incidence of gastric cancer varies 10 fold. The highest incidence (>30cases per 100,000 population is in Japan, Russia, China. South America, eastern Europe. In general men are affected more than women and incidence increases with age. Gastric cancer is a multifactorial disease. There are several risk factors for gastric cancer; most important among them is h. pylori infection. Chronic atrophic gastritis due to dietary factors, pernicious anemia and prior gastric surgery increases the risk of gastric cancer. Diet rich in salted, smoked or pickled food and diet with high nitrates, menetriers disease genetic factors such as first degree relative of patients with gastric cancer and those with blood group a, recurrent gastro esophageal reflux develop gastric cancer. before1950, most gastric Adenocarcinoma were located in the antrum. Since. the location has gradually shifted from antrum to the body and fundus because of the rapidly increasing incidence of carcinoma in the gastric cardia and lower esophagus. Today 30%of gastric lesions are found in the antrum,30%are in the body and 40%are in the fundus and cardia. The proximal gastric cancer seems to affect principally higher socio- economic groups and does not seem to be associated with H.pylori infection. In 2001, stomach cancer affected 850,000people, of which 522,000men and 328,000 women died of stomach cancer. According to data collected by world health organization, the most common forms of cancer worldwide (excluding non melanoma skin cancer) lung (12.3%),breast(10.4%) and colorectum (9.4%), while the top 3 causes of death from cancer are lung and liver (8.8%). with gastric carcinoma, advanced lesions will have already invaded the muscularis propria: they are associated with metastasis to regional lymph or to local or distant structures. Early gastric cancers are confined to mucosa or submucosa. Patients with these tumors have 5 year survival rate of 90%. Most results are from Japan as a result of mass screening in that country. The key to improving the outcome of gastric carcinoma is

early diagnosis and although in Japan there is screening programme, most curable cases are picked up by liberal use of gastroscopy in patients with dyspepsia. Present guidelines suggest gastroscopy for any new dyspepsia, however mild in patients over 40 years of age. Most symptoms of gastric cancer reflect advanced disease such as indigestion, nausea or vomiting, dysphagia, postprandial fullness, loss of appetite, malena, hemetemesis and weight loss. The standard work up of gastric cancer patients includes routine laboratory test and radiological evaluation. The double contrast barium meal was the investigation most commonly carried out in the past. Flexible fibro- optic endoscopy is the most accurate method of diagnosing gastric cancer currently available with diagnostic accuracy of 87%. If biopsies were obtained, accuracy increased to 94%. Modern imaging

techniques including contrast enhanced Computed Tomography (CECT), Magnetic Resonance Imaging (MRI), Positron Emission Tomography (PET) and PET-CT are powerful tools in detection , diagnosing and staging of malignancy Traditionally staging has been performed at the time of

surgery, although a sensitive and reliable staging tool which could identify patients with unresectable disease would be of great benefit in saving patients from unnecessary laparotomy.

Computed Tomography remains the most widely used imaging modality for pre-operative staging, but its value remains controversial. CT not only can demonstrate gastric wall and perigastric tissue but also can demonstrate the direct extension of tumor into contiguous organs and presence of distant metastasis More recently, other staging investigations have been developed, notably endoluminal Ultrasound (EUs), which has shown to be superior to CT in the assessment both of depth of invasion through stomach wall (T stage) and of NI N2 lymph nodes (N stage) .Endoluminal Ultrasound does have limitations, as it is available only in specialist centre and requires expertise

to perform and interpret and is unable to assess fully the liverand is of limited value in the assessment of peritoneal disease. Accurate evaluation of the local and distant extent of gastric cancer is fundamental in the choice of an optimal therapeutic approach. Differentiation of intramural tumor extent and invasion beyond the gastric has considerable clinical importance because the prognosis of the disease is directly related to the depth of invasion of gastric wall and

lymph node involvement. The most fundamental aim of gastric surgery is to excise the primary lesion adequately. To achieve this goal, the position of the cancer and tumor margin have to be known. There is agreement in current literature about the surgical approach regarding the primary lesion. Nevertheless, the overall cure rate for gastric cancer remains around 10% in most countries. In marked contrast, the results from Japan are much better and overall cure rates of over 50% have been reported. Treatment options available for gastric Adenocarcinoma are divided into two broad groups: curative and palliative. Complete resection of tumor and adjacent lymph nodes is the only curative treatment for gastric cancer. Patients with locally advanced or metastatic disease may undergo palliative chemotherapy, radiotherapy or surgery (bypass gastrojejunostomy, feeding jejunostomy or palliative resection to relieve obstruction or bleeding).

IV. Conclusion

Spiral CT is a useful modality for preoperative staging of gastric carcinoma with a high accuracy for evaluating serosal invasion and hepatic metastases. From our study we conclude that gastric adenocarcinoma is a disease of old age prevalent in the males and more common in the population who smoke and consume alcohol. Recently, endoluminal ultrasound (EUS) has been developed and superior to CT in the assessment of the depth of tumor invasion through the gastric wall (T-stage) and of NI and N2 lymph nodes involvement (N-stage). However, EUS is only available in specialized centers and requires experienced persons to perform and interpret it. Evaluation of hepatic and

peritoneal metastases was also limited. However, CT scan is superior to any other single staging technique and can be used to assess the entire peritoneal cavity, retroperitoneum and other solid organs during a single exam. If any imaging technique is considered in the preoperatlive work-up, CT scan should be regarded as the modality of choice.

CONFLICTS OF INTEREST: There are no conflict of interest.

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FIGURE 1
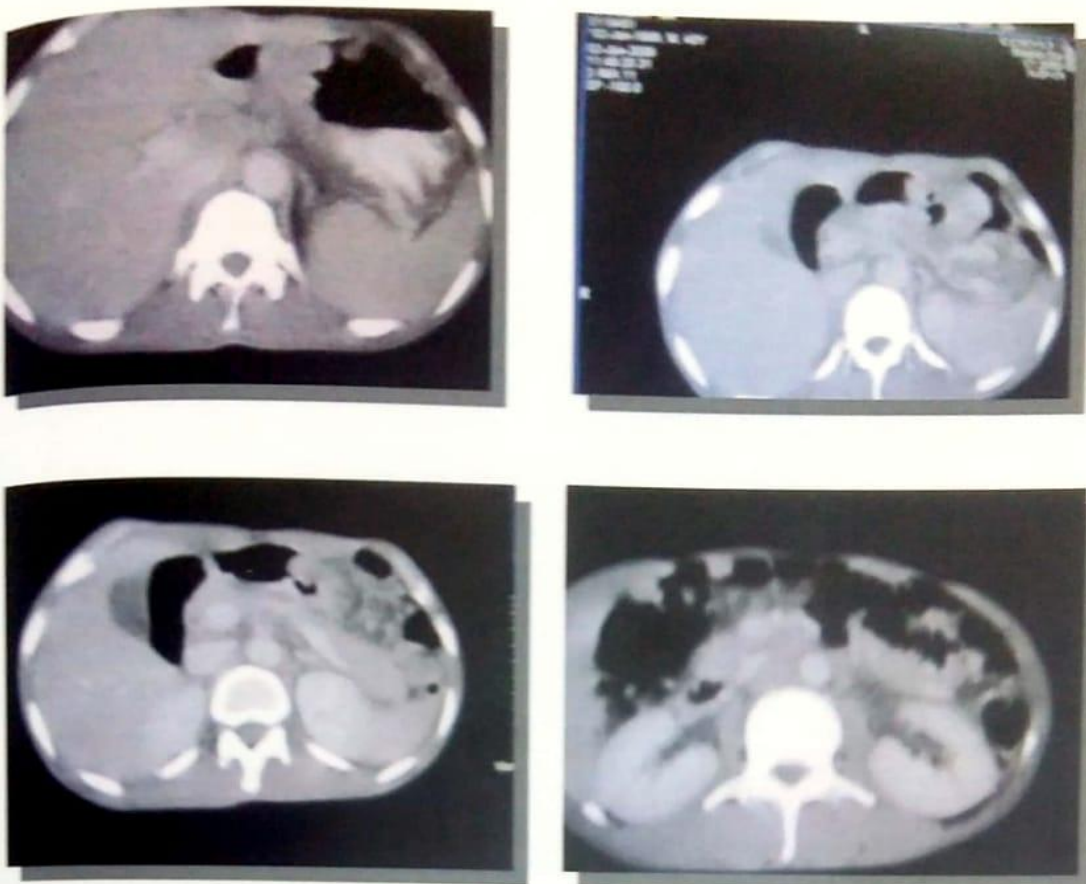
Axial CT scan in this patient shows growth at body and fundal region involving both greater and lesser curvature projecting intraluminally. The growth is extending upto pre-pyloric region with narrowing of lumen. Loss of fat plane is noted between gastro-hepatic, gastroduodenal, gastro-spleenic region. Multiple lymph nodes seen at aorto-caval, retrocaval and superior mesenteric region. Surgical findings reveal multiple peritoneal metastasis. (GRAND TABLE CASE NO - 4)

FIGURE 2

Axial CT scan shows large growth involving lesser and greater curvature of fundus and body of stomach. Mass is inseparable from adjacent structures. Multiple enlarged lymph nodes are noted along porta and celiac axis. hypodense area in liver. No ascitis. Surgical findings shows omental and small bowel seeding. (GRAND TABLE CASE NO - 13)
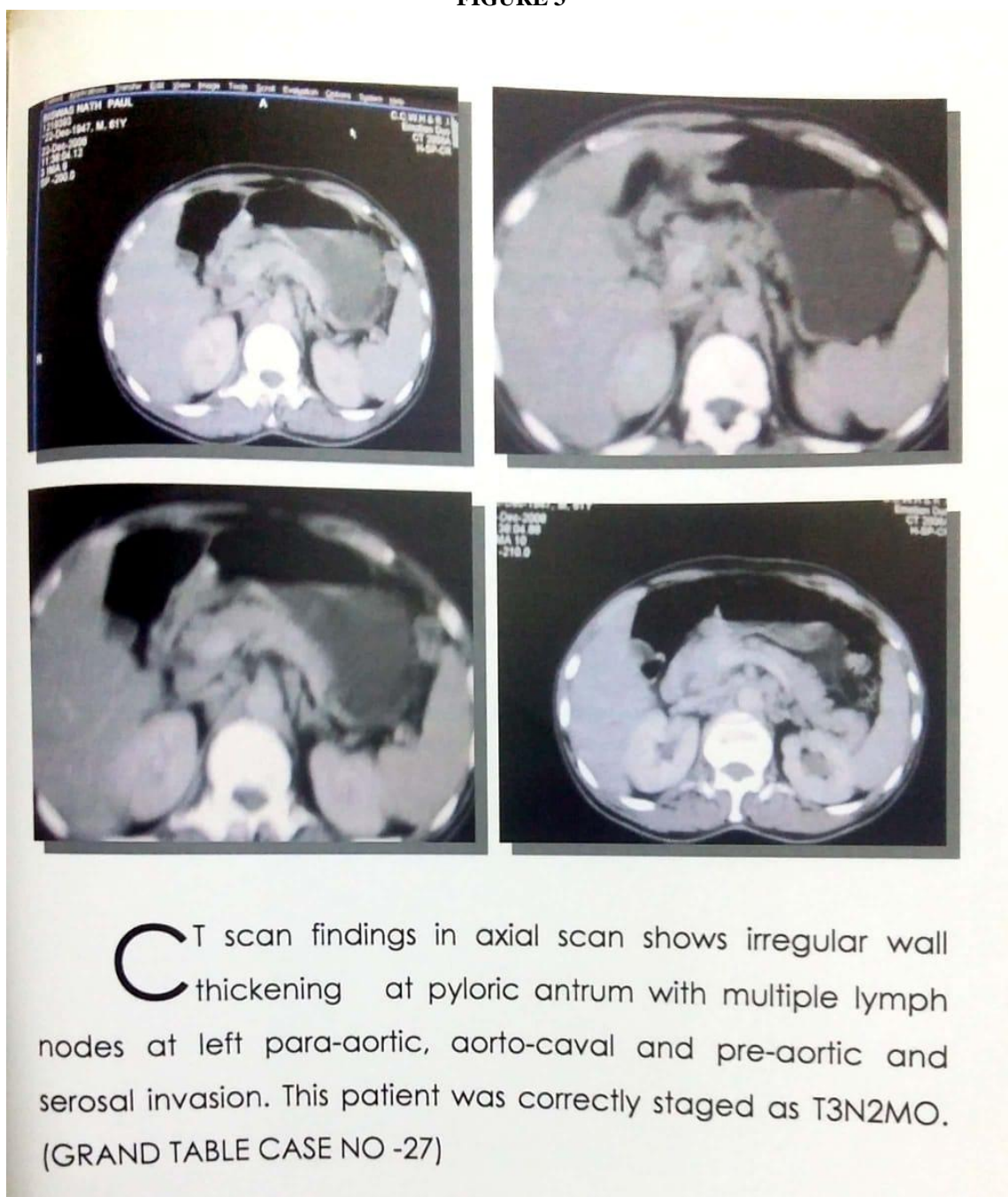
FIGURE 3

CT scan findings in axial scan shows irregular wall thickening at pyloric antrum with multiple lymph nodes at left para-aortic, aorto-caval and pre-aortic and serosal invasion. This patient was correctly staged as T3N2MO. (GRAND TABLE CASE NO -27)
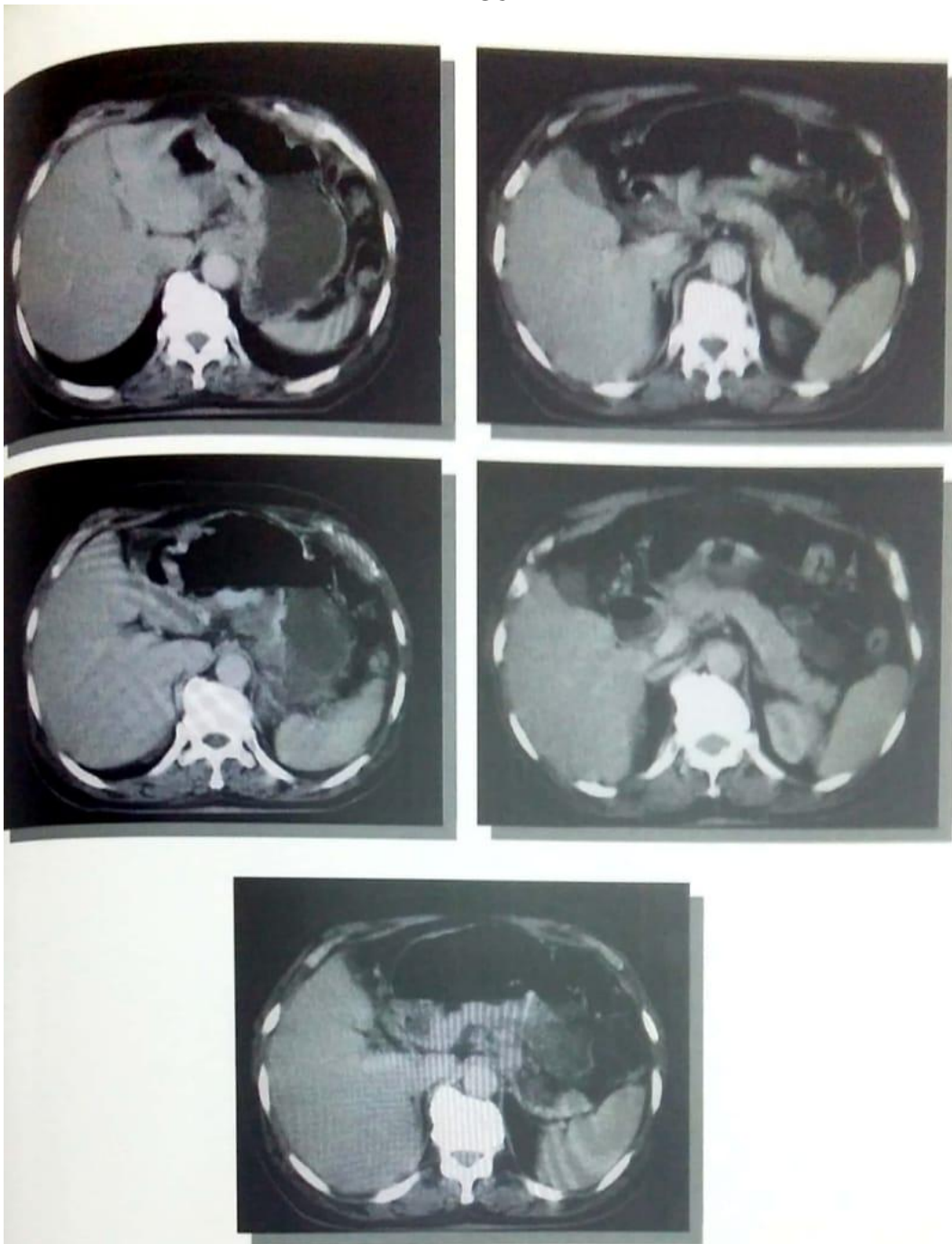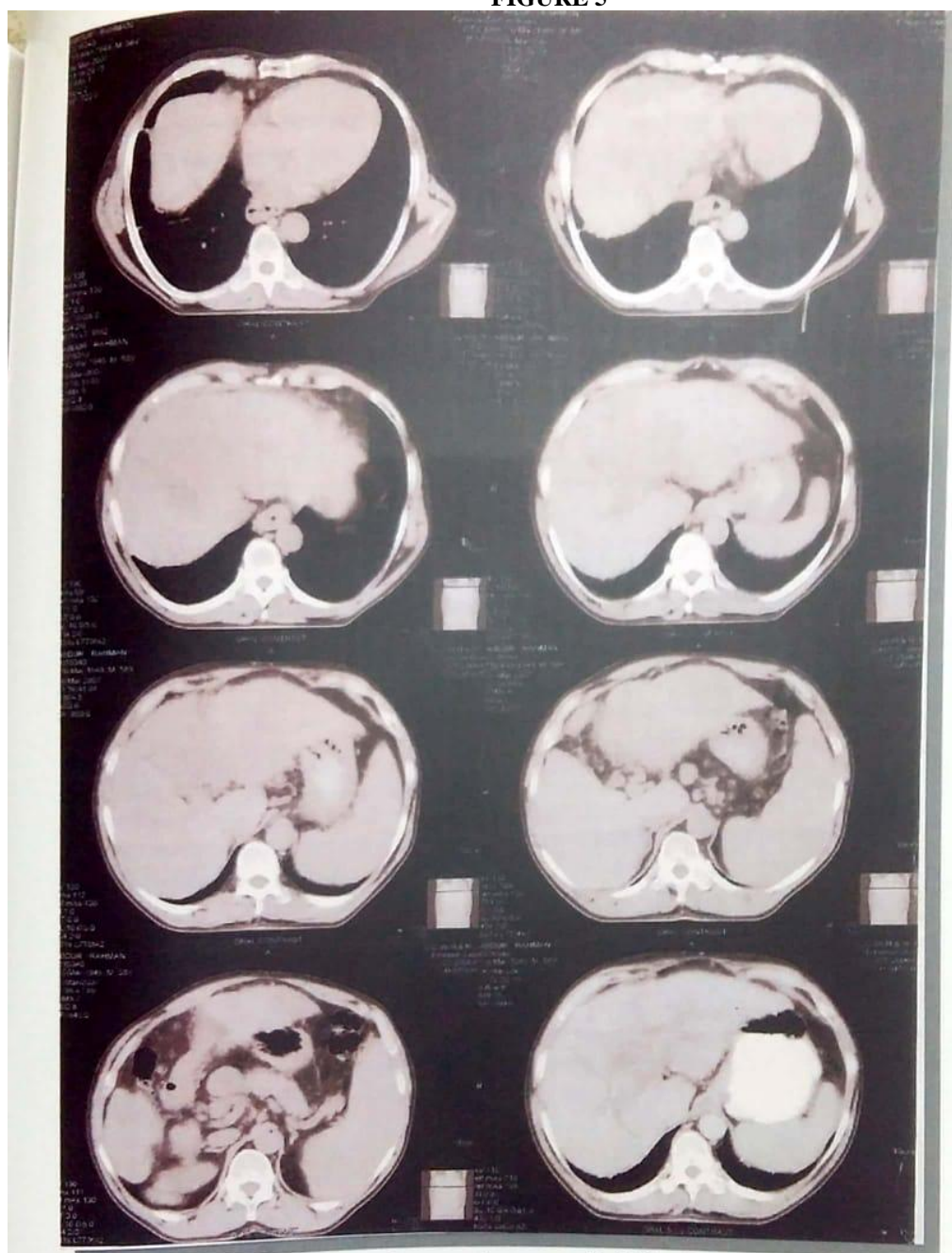
FIGURE 4

Axial CT scan in this patient shows irregular wall thickening at antrum of stomach . Surgical findings reveal multiple perigastric and paragastric lymph nodes (GRAND TABLE CASE NO -5)

FIGURE 5

AXIAL CT scan shows irregular wall thickening involving distal esophagus G E Junction and whole of body of stomach, multiple lymph nodes are noted in the perigastric region and along the gastro-hepatic and porta. Surgical findings revealed multiple peritoneal nodes. (GRAND TABLE CASE NO -16)