Original Research Article

ROLE OF MULTI-DETECTOR COMPUTED TOMOGRAPHY IN DIAGNOSIS AND STAGING OF CARCINOMA STOMACH WITH HISTOPATHOLOGICAL CORRELATION

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ABSTRACT

Background
This study was conducted to identify, assess, and compare the CT staging of gastric cancer with the histological staging.

Methods
This was a hospital-based descriptive and analytical study conducted among 50 patients who presented with signs and symptoms of gastric cancer to the Department of Radiology, Krishna Rajendra Hospital, Mysore Medical College and Research Institute over a period of 18 months from June 2021 to November 2022 after obtaining clearance from the institutional ethics committee and written informed consent from the study participants.

Results
In our investigation, the T2/T3 stage (46%), the T4b stage (32%), and the T4a stage (16%) were the most frequently observed stages on MDCT (Multi-Detector Computed Tomography). According to TNM staging, lymph node staging was carried out; the

maximum N2 stage was observed in 17 patients (34%) and the maximum N3 stage in 15 patients (30%). Of the 50 patients in our study, 6 individuals (12%) had signs of distant metastasis (M1), with the liver and peritoneum accounting for 50% of these cases. A maximum of 23 individuals (46%) were classified as group II patients.

Conclusion

The main purpose of a CT scan is to rule out a distant or incurable metastatic illness. While MDCT is very sensitive in identifying nodes and distant metastases, it is not able to accurately distinguish between T2 and T3 neoplasms because it cannot reliably define the separate wall layers. Despite its drawbacks, CT is now the most commonly used modality for preoperative staging as well as for the first staging of newly diagnosed patients. Thus, the care of these patients will benefit from the investigation and detection of numerous CT abnormalities to aid in the diagnosis and preoperative staging of stomach carcinoma.

Keywords: Gastric Carcinoma, Gastric Outlet Obstruction, Multidetector Computerized Tomography

INTRODUCTION

In the world, gastric cancer ranks second in terms of cancer-related deaths and is the fourth most frequently diagnosed disease worldwide. In India, there are 7-8 cases per 100,000 people annually, and in Chennai, it is the most frequent cancer among men. For advanced stomach cancer, the prognosis is still not good. The process of gastric carcinogenesis is complex and multifaceted. It is frequently linked to environmental variables such as nutrition, lifestyle, and Helicobacter pylori infection. A Helicobacter pylori infection increases the risk of duodenal and stomach ulcers, which in turn increases the risk of gastric cancer.[1] Modern medical advancements have made it possible to diagnose this cancer with accuracy.

In the past, it was challenging to diagnose stomach cancer; however, current developments in endoscopy and radiography have greatly aided in the early diagnosis of stomach cancer. Conventional endoscopy and the upper gastrointestinal series (barium meal) are the modalities used to evaluate stomach cancer. However, this method is unable to pinpoint the nearby structure that is involved. When MDCT is combined with MPR (Multi-Planar Reformation) and ultrasound, it shows the lesion site and its spread inside and outside the lumen in terms of anatomy and physiology. The other modalities that are also utilised include PET (Positron Emission Tomography), virtual endoscopy, and MRI (Magnetic Resonance Imaging).

These tests are limited in their ability to evaluate the location and progression of the disease, and their efficacy varies. Dedicated multi-detector CT offers substantially more exact resolution of the abdominal structures than traditional endoscopy or upper gastrointestinal barium studies. It has been found that stomach neoplasms can be successfully staged using contrast-enhanced CT imaging. Thin-section collimation of the stomach during multi-detector CT produces high-quality MPR images, which significantly enhance the visualisation of the stomach's fine anatomic details, the gastric wall, the involvement of surrounding structures, the status of lymph nodes, and metastatic lesions. The histologic classification of gastric cancer during the last fifty years shows notable heterogeneity at the architectural and cytologic levels. The most significant benefit in terms of therapy and diagnosis is an endoscopic biopsy of the lesion. Intestinal type and diffuse type adenocarcinoma are the two

main histologic subtypes, with the indeterminate type being an uncommon variety. Today, most follow Lauren's criteria. Nonetheless, tubular, papillary, mucinous, and poorly cohesive are the four main histologic features of gastric tumours recognised by the WHO. The current study aims to assess and stage gastric cancer using MRCT and establish a correlation with histological staging.

AIMS AND OBJECTIVES

- To detect and evaluate CT staging of gastric carcinoma and compare it with histopathological staging.

MATERIALS & METHODS

This was a hospital-based descriptive and analytical study conducted among 50 patients who presented with signs and symptoms of gastric cancer to the Department of Radiology, Krishna Rajendra Hospital, Mysore Medical College and Research Institute, over a period of 18 months from June 2021 to November 2022 after obtaining clearance from the institutional ethics committee and written informed consent from the study participants.

Inclusion Criteria

- Patients with clinical suspicion of gastric mass.
- Patients already been diagnosed with gastric carcinoma.
- Adult patients, including both males and females.

Exclusion Criteria

- Gastroesophageal junction tumors (5cm above and below the GE junction).
- Pregnant women.
- Patients allergic to contrast.
- Patients not giving consent.
- Unstable patient.

Statistical Methods

To achieve the objectives, the study's data were entered into Microsoft Excel sheets, where statistics like proportions, percentages, sensitivity, and specificity were computed. Tables were used to display the data. For the 44 instances that underwent surgery, the sensitivity and specificity of the MDCT and the results of the histopathological examination were ascertained. The computation of the positive and negative predictive values was done in addition to the sensitivity and specificity.

Sample Size Estimation

A minimum of 32 patients were

included in the study, with a 5% level of significance, a power of 80, and an absolute error of 10. (Sample size is calculated using the formula **N=z2pq/d2** where p is prevalence, q is (1-p), Z is 3.84 and d is precision). p = 8.6%; q = (1-8.6); d = 10%. The sample size (n) comes out to be 32. However, due to the availability of more cases, the sample size was increased to 50.

RESULTS

Age Group	Frequency	Percentage (%)
<35	4	8%
36-45	7	14%
46-55	15	30%
56-65	16	32%
66-75	8	16%
Total	50	100%
Age Distribution		
Sex	**No. of Patients**	**Percentage (%)**
Male	32	64%
Female	18	36%
Total	50	100%
Sex Distribution		
Table 1: Demographic Distribution		

There were 24 patients above the age of 55 and 26 patients under the age of 55 in the current study. The incidence of stomach cancer peaked in the fifth and sixth decades of life.

The age group that was most frequently afflicted was 56–65 years old (32%) followed by 46–55 years old (30%) and 66–75 years old (16%), indicating that stomach carcinomas are more common in older people.

In this series, a 28-year-old female patient was the youngest, and a 75-year-old male patient was the oldest.

There were 50 patients in the study group, of which 32 were male and the remaining 18 were female. This indicates a 1.77:1 male-to-female ratio.

CT-T Staging for CA Stomach	Sensitivity	Specificity	PPV	NPV	Accuracy	P-Value
T1	100	95.9	33.3	100	96	0.06
T2/T3	85.7	69.4	52.2	92.6	74	0.01
T4a	66.7	90.9	50	95.2	88	0.004
T4b	92.9	91.7	81.3	97.1	92	<0.001
Overall	86.3	86.9	54.2	96.2	87.5	
Table 2: CT 'T' Stage vs. Pathological 'T' Stage for CA Stomach Cases						

For the T1 stage, the MDCT's sensitivity, specificity, positive predictive value, negative predictive value, accuracy, and 33.3% were all 100%, 96%, 95%, 95%, and 33.3%, respectively.

For the T2/T3 stage, the MDCT's sensitivity, specificity, positive predictive value, negative predictive value, and accuracy were 85.7%, 69.4%, 52.2%, 92.6%, and 74%, respectively. For the T4a stage, the MDCT's sensitivity, specificity, positive predictive value, negative predictive value, accuracy, and 50%, 95.2%, and 88%, respectively, were measured.

In the case of the T4b stage, the MDCT's sensitivity, specificity, positive predictive value, negative predictive value, and accuracy were 91.7%, 81.3%, 97.1%, and 92%, respectively. For T-staging of cases, the overall specificity, positive predictive value, negative predictive value, and accuracy of MDCT were 86.3%, 86.9%, 54.2%, 96.2%, and 87.5% respectively.

CT- N Staging	Sensitivity	Specificity	PPV	NPV	Accuracy	P-Value
N0	100	93.6	50	100	94	<0.001
N1	76.9	94.6	83.3	92.1	90	<0.001
N2	84.6	91.9	78.6	94.4	90	<0.001
N3	80	100	100	92.1	94	<0.001
Overall	85.4	95	77.9	94.7	92	<0.001

Table 3: CT 'N' Stage vs. Pathological 'N' Stage for CA Stomach Cases

According to the MDCT results, the N0 stage's sensitivity, specificity, positive predictive value, negative predictive value, accuracy, and 50%, 100%, and 94% were obtained.

The MDCT for the N1 stage had the following values: 76.9%, 94.6%, 83.3%, 92.1%, and 90% for sensitivity, specificity, positive predictive value, negative predictive value, and accuracy, respectively.

In the case of the N2 stage, the MDCT's sensitivity, specificity, positive predictive value, negative predictive value and accuracy were 91.9%, 78.6%, 94.4%, and 90%, respectively.

For the N3 stage, the MDCT's sensitivity, specificity, positive predictive value, negative predictive value, and accuracy were 80%, 100%, 100%, 92%, and 94% respectively.

The results of the MDCT for N-staging were as follows: overall specificity, positive predictive value, negative predictive value, and accuracy were 85.4%, 95%, 77.9%, 94.7%, and 92%, respectively.

DISCUSSION

After lung cancer, gastric cancer ranks as the second most frequent cancer globally and the second largest cause of cancer-related fatalities. The ageing of the global population has increased the absolute incidence, even though the incidence rate has been steadily declining over the past few decades. Eastern Asia has a notably high rate of stomach cancer incidence.[2]

Worldwide, more than a million instances of stomach cancer are diagnosed each year. In the world, stomach cancer ranks fifth in terms of frequency of diagnosis and seventh in terms of prevalence. The incidence of gastric cancer is higher in men. Males are diagnosed with stomach cancer at a rate 2.2 times higher than females in wealthy nations. The ratio in underdeveloped nations was 1.83.

Up until the mid-1990s, gastric cancer was the most common cause of cancer-related mortality worldwide. Gastric cancer is the third-most lethal cancer globally for men, claiming

783,000 lives annually. The stomach cancer rate is 8.3% of all cancer-related deaths. From birth to age 74, the cumulative chance of dying from stomach cancer is 0.57% for women and 1.36% for men.[3]

Men are more likely than women to die from stomach cancer. The same regions that have high incidence also have high mortality rates: eastern and central Asia and Latin America. Since there are few available treatments and historically low survival rates, particularly in developing countries, lowering incidence appears to be the route to lowering death.[4]

In the US, 31% of patients with stomach cancer survive for five years. Average survival rates show that the majority of diagnosed cases already had metastases. For pre-metastatic diagnoses, the 5-year survival rate is 67%. Depending on the stage of the surgical procedure, survival is very variable. For stage IA and stage IB tumours that are surgically treated, the 5-year survival rates are 94% and 88%, respectively. However, the 5-year survival rate for surgery-treated stage IIIC tumours was only 18%.[5]

The identification of the correlation between Helicobacter pylori infection (~55% risk; range 46–63%) and stomach cancer epidemiology is a noteworthy advancement. While 8–10% of stomach cancers have an inherited hereditary component, the majority are spontaneous. Gastric cancer risk factors also include a low vitamin A and C diet, a high intake of smoked foods, and tainted drinking water. There is a correlation between an elevated risk of esophageal distal segment, gastric proximal segment, and gastro-esophageal junction adenocarcinoma, high BMI (Body Mass Index), high-calorie diets, and gastro-esophageal reflux.[6]

In around 95% of cases, adenocarcinoma is the most common histological subtype of gastric cancer. Other less common subtypes include lymphomas, tumours of stromal origin, and neuroendocrine tumours.

The extent of tumour invasion and lymph node involvement affect the prognosis of patients. Patients with advanced tumours have a five-year survival rate of 7% to 27%, whereas those with early-stage tumours have a five-year survival rate of 85% to 100%.[7] Certain early-stage tumours (T1) may be removed laparoscopically or endoscopically (mucosectomy). However, in cases of advanced stomach cancer, some protocols recommend neoadjuvant chemotherapy and/or radiotherapy.[8]

As a result, determining the right course of treatment relies on precise preoperative staging, which can raise cure rates and enhance patients' quality of life.

One of the most often used staging methods is TNM (Tumor-Node Metastasis),[9,10] which is presently in its eighth edition.

Abdominal ultrasonography, computed tomography, and endoscopic ultrasound are commonly used for preoperative staging.[11] The most effective preoperative staging technique to ascertain the extent of tumour invasion (category T) was thought to be endoscopic radiography until recently.[12]

The most current worldwide consensus supported the need for preoperative TNM staging and identified multidetector-row computed tomography as the optimal staging technique.[13,14] This technique has proven to be as accurate, if not more so, than endoscopic ultrasonography for T-staging and to be clearly superior to other techniques for N- and M-staging. The ability to rapidly acquire submillimetric sections, perform isotropic multiplanar

reconstruction, and provide postprocessing options like virtual endoscopy and multidetector-row computed tomography-especially on apparatuses with 16 or more channels-improves method accuracy in local staging.[15] Computed tomography can also assess other organs and lymph nodes.[16]

According to some research, T staging accuracy in patients with gastric cancer is improved when MDCT is used in conjunction with MPR pictures. For this reason, the standard approach for staging gastric cancer uses MDCT with MPR pictures.

There was a little male predominance in this study of 50 stomach cancer patients, with 32 patients (%) being male and 18 patients (%) being female. The M:F ratio was 1.77:1. According to a study by Bray F et al., individuals with stomach cancer had a M:F ratio of 1.8:1. Male patients were shown to be more affected (25/40) (62.5%) in a research by Macdonald et al.[17] than female patients (15/40) (37.5%). As a result, the sex ratio in this study has a strong correlation with earlier research.

Most common age group of patients affected were between 56 - 65 years of age (%) followed by 46-55 years of age (%). Thus, the present study correlates well with the previous studies done.

In the earlier study by Allum et al,[18] the majority of patients had complaints when they were diagnosed, and the most prevalent clinical manifestations were dyspepsia, dysphagia, weight loss, and anaemia. This is in line with the findings, which showed that epigastric pain/dyspepsia (30 patients), gastric outlet obstruction, and vomiting after a meal accounted for 40 patients' most frequent clinical presentations.

Perez and Brady[19] discovered that the majority of study cases (>70%) had focal asymmetric mural thickness, which was in line with our findings in which all patients exhibited asymmetric wall thickening.

TNM Staging of Gastric Carcinoma

A maximum of 23 patients (46%) out of the 50 patients with stomach cancer were classified as group II patients. Group IVa was used to stage 13 individuals, or 26% of the total. A total of six patients (12%) were categorised under groups III and IVb. On MDCT, the fewest patients (2%), (n = 2) had group stage I.

In identifying the T1, T2/T3, T4a, and T4b stages, the overall sensitivity of MDCT was 100%, 85.7%, 66.7%, and 92.9%, respectively. In identifying T1, T2/T3, T4a, and T4b stages, the overall specificity of MDCT was 95.9%, 69.4%, 90.9, and 91.7%, respectively.

Out of 44 cases, 39 had "T" stages on MDCT that were the same as those on histology, and 5 had different "T" stages. This means that MDCT was 92% accurate for T-staging.

This is consistent with findings from Kumano et al.[20] who found that MDCT has sensitivities between 68.8 and 96.2% for the diagnosis of stomach malignancies. As per the research conducted by Karthikeyan B, Girija B, and Nagababu Pyadala[21] the MDCT demonstrated a sensitivity and specificity of 63% and 93% for T1 staging. Similarly, the specificity was 76% and the sensitivity was 60% for T2 or T3 staging. For T4A staging, the sensitivity and specificity of MDCT were 70% and 84%, respectively. Our analysis revealed a strong correlation with the MDCT's 82% and 98% sensitivity and specificity for T4B staging.

The diagnostic accuracy of MDCT for total T staging varies from 77% to 89%, per Kim et al.[22] and Chen CY et al.[23]

In this investigation, lymph nodes with short axis measures larger than one centimetre were thought to be predictive of adenopathies with metastases. Thirty percent (n = 15) of the fifty patients in our study were classified as being in the N3 stage, twenty-four percent (n = 12) as being in the N1 stage, and twelve percent (n = 6) as being in the N2 stage. With an overall MDCT accuracy of 92% in N staging, 36 of the 44 patients who underwent surgery had the same N stage, while 8 had a different N stage.

In order to determine the N0, N1, N2, and N3 stages, the overall sensitivity of MDCT was 100%, 76.9%, 84.6%, and 80%, respectively. In identifying N0, N1, N2, and N3 stages, the overall specificity of MDCT was 93.6%, 94.6%, 91.9%, and 100%, respectively.

In a research by Karthikeyan B, Girija B, and Nagababu Pyadal, the MDCT's specificity was only 75% and its sensitivity was approximately 90% higher. However, the sensitivity of MDCT for N1, N2, and N3 staging was much lower-12%, 20%, and 37%, respectively. For the staging of N3, MDCT revealed the best specificity of 100%, which corresponded well with our findings.

Of the fifty patients that were part of our investigation, six (12%) had signs of distant metastases and were assigned an M1 stage; the other forty-four (88%) patients were assigned a M0 stage. In our study, 98% of the 50 patients had the M stage determined correctly. A great technique for identifying illnesses that have spread to the liver, adrenal glands, and lungs is a CT scan.

There is a significant degree of consistency between our results and the research of Horton and Fishman[24] who reported that the liver was the most often affected organ for distant metastasis. Liver metastases followed by peritoneal deposits developed in about half of the study cases.

In a research by Karthikeyan B, Girija B, and Nagababu Pyadala, the MDCT sensitivity and specificity for M1 staging were 70% and 100%, respectively, which was completely opposite from M0 staging.

Stabile Ianora et al.[25] state that computed tomography has a 97% and 100% diagnostic accuracy for determining the M parameter. Our study's accuracy of up to 98% correlated favourably with the earlier investigation.

Ascites at staging CT show a sensitivity and specificity of 40% and 97% for the presence of cancer cells on cytology and 51% and 97% for the presence of peritoneal metastases, according to a research by Yajima et al.[26]

Since contrast-enhanced CT is a quick and non-invasive way to assess local tumour extension, lymphadenopathy and metastatic disease-all of which are crucial for assessing resectability and planning radiation therapy-it continues to be the imaging investigation of choice for preoperative gastric cancer staging.

CONCLUSION

In India, stomach cancer ranks among the most prevalent gastrointestinal malignancies. Planning the best surgical course of action for stomach cancer requires accurate preoperative staging. As the preferred method for staging gastric carcinoma and for ruling out distant or incurable metastatic disease, CT plays a crucial role in the evaluation of patients with gastric

carcinoma by providing crucial information to determine which patients may be suitable for surgical resection.

Multiplanar pictures are frequently used because they improve diagnostic precision when assessing the extent of the tumour, the anatomical interactions with neighbouring organs, and the identification of distant and lymph node metastases. Having this knowledge is essential when deciding between drastic and palliative surgery.

MPR and VR are regarded as highly representative prognostic values that aid in the evaluation of tumour extension. Establishing it as the preferred imaging technique for the detection and staging of stomach malignancies

It offers important and useful details on the thickness of the stomach wall, the location of the growth, its eccentricity, the approximate length of the tumour, luminal narrowing, peri-gastric soft tissue or fat stranding, and the local invasion of the pancreas, liver, and gallbladder. Additionally, CT offered comprehensive details regarding the patients' substantial lymphadenopathy pattern, encompassing both non-regional and regional lymphadenopathy. CT also aided in identifying metastases to other organs, such as the liver, lungs, bone, adrenal glands, kidneys, spleen, brain, etc.

It is now established that MDCT technology has set a new standard for gastric cancer staging by introducing the T stage category in addition to the M stage. The research that has been done has been quite successful in identifying the T1–T4 phases and using that information in reports to support theories about the diagnosis of gastric cancer. Furthermore, it can still be challenging to differentiate between the muscular and serosal layers in some stomach regions using endoscopy, although MDCT can definitely help. As a result, MDCT plays a critical role in the diagnosis and prognosis of gastric cancer. It is very helpful to keep an eye on patients receiving surgical or pharmaceutical treatment so that, in the unlikely event that the cancer progresses, a treatment response can be elicited.

The majority of the time, endoscopic uncertainty comes from the inability to distinguish the muscular layer from the serosal layer in gastric cancer. Yet, the separation of the stomach's two layers can be more accurately assessed when MDCT technology is used. As a result, MDCT has been determined to be the most beneficial method for organising operational strategy, as shown below:

a) The human body's structure and its relationship to surrounding structures can be clearly displayed using spiral CT-3D reconstruction;
b) CT pictures are clear and have a high density resolution in human tissue;
c) The CT scan is crucial for the preoperative staging of stomach surgery.

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