International Journal of Radiology and Diagnostic Imaging

E-ISSN: 2664-4444
P-ISSN: 2664-4436
www.radiologypaper.com
IJRDI 2025; 8(1): 83-88
Received: 09-01-2025
Accepted: 12-02-2025

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MDCT of gastroesophageal masses correlated with histopathological findings

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DOI: https://www.doi.org/10.33545/26644436.2025.v8.i1b.441

Abstract
Background: Multi-Detector Computed Tomography (MDCT) helps to define both upper and lower borders of tumors located in the Gastroesophageal (GE) transition zone.
Aim: estimation the role of Multi-Detector Computed Tomography in diagnosis and staging of gastroesophageal masses with histopathological findings.
Methods: 50 patients with gastroesophageal masses were admitted according.
Inclusion criteria: Any age, sex with gastroesophageal masses while.
Exclusion criteria: Patients with chronic cough, impaired renal function, contraindicated to contrast injection or pregnant female. All patients were assessed by demographic data collection, detailed history, complete clinical examination, tumor histopathological examination, routine laboratory and radiological investigations.
Results: Multi detector computed tomography could predict T_2 staging with 75% sensitivity, 97.83% specificity, 75% Positive Predictive Value (PPV), 97.83% Negative Predictive Value (NPP), and 96% accuracy. Multi-Detector Computed Tomography could predict T_3 staging with 81.25% sensitivity, 97.06% specificity, 92.86% Positive Predictive Value (PPV), 91.67% Negative Predictive Value (NPP) and 92% accuracy. Multi-Detector Computed Tomography could predict T_1 staging with 66.67% sensitivity, 93.18% specificity, 57.14% Positive Predictive Value (PPV), 95.35% Negative Predictive Value (NPP), and 90.00% accuracy. Multi-detector computed tomography could predict T_4 staging with 95.45% sensitivity, 100% specificity, 100% Positive Predictive Value (PPV), 96.55% Negative Predictive Value (NPP), and 98% accuracy.
Conclusion: Multi detector computed tomography has proper diagnosis, staging as well as follow-up of patients with cancer esophageal and stomach.

Keywords: MDCT, gastroesophageal junction, masses, histopathology

Introduction

About 90% of gastroesophageal tumors consist of carcinomas, with a 40-60% incidence of squamous cell type (SCC) and 30-50% for adenocarcinoma of the gastro-oesophageal junction (GEJ), with the latest representing 80% of tumors arising from Barrett's oesophagus [1]. Nearly 90% of adenocarcinoma develops in the lower oesophagus and may extend into the gastro-oesophageal junction and stomach; fewer cases develop in the middle third, and the smallest number in the proximal oesophagus [2]. Dysplasia is defined as neoplastic epithelium with cytologic, and architectural atypia confined to the epithelium. Features include surface maturation, glandular architecture, cytologic atypia and presence of inflammation/erosions [3]. Endoscopically, if detected early these tumors will present as mucosal irregularities. In later stages they appear as ulcerated/infiltrative or exophytic masses with obstruction. Histologically, these are gland-forming tumors with a tubular, tubulo-papillary or papillary growth pattern. A small subset of cases shows mucinous differentiation. A few cases with diffuse signet ring cell adenocarcinoma [4]. MDCT plays an important role in the staging of gastroesophageal cancer especially in T-staging. MDCT cannot differentiate between the different layers of the esophageal and stomach walls and therefore, can't distinguish between T_1 and T_2 tumors. T_3 stage is detected on MDCT as peri-esophageal fat infiltration. T_4 stage is identified with loss of fat planes between the tumor and adjacent mediastinal structure, it also helps to detect aortic and tracheobronchial invasion [5].

Patients and Methods

- **Patients:** This prospective observational study was conducted on 50 patients with gastroesophageal masses admitted to the Diagnostic Radiology Department, at Benha University Hospital and other hospitals after approval from the Institutional of the Ethical Committee of Faculty of Medicine, Benha University ?????????, The patients gave their informed written consent. Each patient was given a code number and an explanation of the study's objectives in the duration from November 2023 to May 2024.
- **Inclusion criteria were** patients at any age, sex, with gastroesophageal masses either clinically suspected cases and detected gastroesophageal cancer patients by endoscopy and histopathology).
- **Exclusion criteria were** patients with chronic cough, impaired renal function, contrast injection contraindicated or pregnant female.

Methods

All patients were subjected to the following

Demographic data collection included Age ranged from 22 to 70 years with a mean of 48.1±14.89 years, 4 (8%) patients were at the age from 20 t0 30 years, 6 (12%) patients were at the age from 31 to 40 years, 24 (48%) patients were at the age from 41 to 50, 10 (20%) patients were at the age from 51 to 60, and 6 (12%) patients were at the age from 61 to 70. There were 38 (76%) males and 12 (24%) females. Weight ranged from 61 to 89 kg with a mean of 74.4±8.89 kg. Height ranged from 1.59 to 1.71 m with a mean of 1.7±0.04 m. BMI ranged from 20.86 to 35.2 kg/m^2 with a mean of 27.1±3.69 kg/m^2.

Detailed history taking including 16 (32%) patients were hypertensive, 11 (22%) patients were diabetic, and 7 (14%) patients had hyperlipidemia

Complete clinical presentation included 21 (42%) patients had abdominal pain, 24 (48%) patients had progressive loss of weight, 15 (30%) patients had vomiting colic, 9 (18%) patients had epigastric pain, 7 (14%) patients had dyspepsia, 6 (12%) patients had hematemesis, 5 (10%) patients had fever, 8 (16%) patients had loss of weight, 9 (18%) patients had dysphagia, 2 (4%) patients had nausea, and 2 (4%) patients had black stool.

- **Complete routine clinical examination, routine laboratory investigations**
- **Histopathological examination of tumor**

Radiological investigations

Computed tomography (CT) of the chest and abdomen using the 128-Slice Computed Tomography scanner, the staging was done using the TNM staging system [6] proposed by the American Joint Committee.

Multidetector CT (MDCT)

It was performed using 64 and 256 MDCTs (Philips Brilliance CT-64, Brilliance iCT-256 (Philips Medical Systems (Cleveland, Ohio 44143 United States) then were transmitted to a workstation for multi-planar reconstruction (MPR), with thickness of 2.5 mm& 2.5-mm intervals.

MDCT findings were compared with the histopathologic results obtained from endoscopic biopsies and/or intraoperative surgery specimen.

Endoscopy was performed again, and a biopsy was taken from tumor [7].

Statistical analysis

Statistical analysis was done by SPSS v26 (IBM Inc., Armonk, NY, USA). Quantitative variables were presented as mean and standard deviation (SD). Qualitative variables were presented as frequency and percentage (%). Evaluation of diagnostic performance of MDCT was performed using diagnostic sensitivity, specificity, PPV and NPV.

Results

Pathological types and stages of the tumors of the studied patients were represented in Table 1

28 (56%) patients had adenocarcinoma, 22 (44%) patients had squamous cell carcinomas, tumors. Regarding pathological stages, 4 (8.67%) patients had T_1 stage, 6 (12.89%) patients had T_2 stage, 18 (36.56%) patients had T_3 stage, and 22 (44.89%) patients had T_4 stage.

Malignant tumor diameter and esophageal wall thickness in the studied patients was represented in Table 2

The diameter of the malignant tumor ranged from 2.1 to 14.9 cm with a mean of 7.4±3.57 cm.

31 (62%) patients had esophageal wall thickness > 15 mm, and 19 (82.61%) patients had esophageal wall thickness from 5 to 15 mm.

The clinical data of the gastric and esophageal mass in the studied patients were represented in Table 3

23 (46%) patients had polypoidal or fungating mass, 9 (18%) patients had ulcerating lesion, 6 (12%) patients had focal wall thickening and 12 (24%) patients had circumferential wall thickening. Regarding the anatomical location of the gastric mass detected by MDCT, 6 (20%) patients had the tumor at the fundus, 13 (46%) patients had the tumor at the pylorus, 3 (6%) patients had the tumor at the cardia, 6 (12%) patients had diffuse body tumor, and 4 (8%) patients had extra gastric mass invading stomach. Regarding the site of esophageal cancer, 4 (8%) patients had esophageal cancer at the upper 1/3rd, 8 (16%) patients had esophageal cancer at the middle 1/3rd, and 10 (20%) patients had esophageal cancer at the lower 1/3rd of the esophagus. Regarding esophageal wall thickness, 13 (26%) patients had esophageal wall thickness > 15 mm, and 9 (18%) patients had esophageal wall thickness from 5 to 15 mm.

Distant metastases of the gastroesophageal mass in the studied patients were represented in Table 4

Regarding the area of distant metastases, 1 (2.22%) patient had lung metastasis, 1 (2.22%) patient had bone metastasis, 5 (11.11%) patients had liver metastasis and 9 (18%) patients had diffuse body tumor, and 14 (29.22%) patients had proximal esophageal metastasis.

Diagnostic accuracy of MDCT for prediction of T_1, T_1, T_3, T_4 was represented in Table 5

- MDCT could predict T_1 staging with 66.67% sensitivity, 93.18% specificity, 57.14% PPV, 95.35% NPP and 90.00% accuracy.

- MDCT could predict T_2 staging with 75% sensitivity, 97.83% specificity, 75% PPV, 97.83% NPP and 96% accuracy.
- MDCT could predict T_3 staging with 81.25% sensitivity, 97.06% specificity, 92.86% PPV, 91.67% NPP and 92% accuracy.
- MDCT could predict T_4 staging with 95.45% sensitivity, 100% specificity, 100% PPV, 96.55% NPP and 98% accuracy.

Case presentations

- Case 1 was illustrated in Figure 1.
- Case 2 was illustrated in Figure 2.

Table 1: Pathological types and stages of the tumour's of the studied patients

		N=50
Pathological types	Adenocarcinoma	28 (56%)
	Squamous cell carcinomas	22 (44%)
Pathological stages	T_1	4 (8.67%)
	T_2	6 (12.89%)
	T_3	18 (36.56%)
	T_4	22 (44.89%)

Table 2: Malignant tumor diameter and esophageal wall thickness in the studied patients

		N=50
Malignant tumor diameter (Cm)	Mean±SD	7.4±3.57
	Range	2.1-14.9
Esophageal wall thickness	> 15 mm	13 (26%)
	5-15 mm	9 (18%)

Table 3: The clinical data of the gastric and esophageal mass in the studied patients

		N=50
Shape of gastroesophageal tumor	Polypoidal or fun gating mass	23 (46%)
	Ulcerating lesion	9 (18%)
	Focal wall thickening	6 (12%)
	Circumferential wall thickening	12 (24%)
Anatomical location of the Gastric mass detected by MDCT	Fundus	6 (12%)
	Pylorus	13 (26%)
	Cardia	3 (6%)
	Diffuse body	6 (12%)
Site of esophageal cancer	Upper 1/3rd	4 (8%)
	Middle 1/3rd	8 (16%)
	Lower 1/3rd	10 (20%)

Table 4: Distant metastases of the gastroesophageal mass in the studied patients

		N=50
Distant metastases	Lung	1 (2.22%)
	Bone	1 (2.22%)
	Liver	5 (11.11%)
	Proximal esophagus	14 (29.22%)

Table 5: Diagnostic accuracy of MDCT for prediction of T_1, T_2, T_3, T_4

MDCT	Sensitivity	Specificity	PPV	NPP	Accuracy
T_1	66.67%	93.18%	57.14%	95.35%	90%
T_2	75%	97.83%	75%	97.83%	96%
T_3	81.25%	97.06%	92.86%	91.67%	92%
T_4	95.45%	100%	100%	96.55%	98%

MDCT: Multidetector computed tomography, PPV: Positive predictive value, NPP: Negative predictive value.

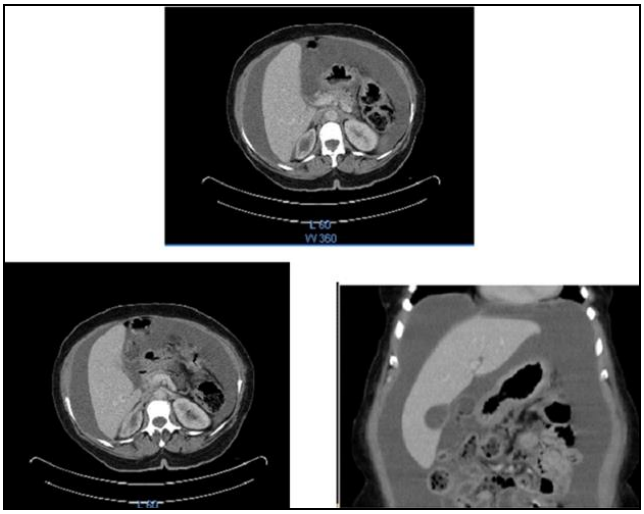

Fig 1: Female patient, 60 years old, nonsmoker, complaining of dyspepsia and abdominal distension, was unable to take oral contrast due to severe vomiting. MSCT diagnosis: Annular pyloric thickening. T_2 N0 M0. Pathologic Diagnosis: Undifferentiated adenocarcinoma

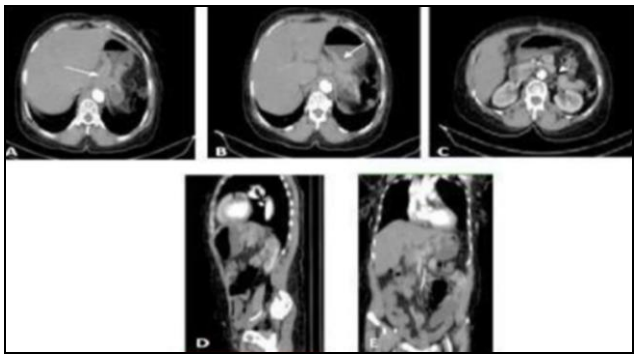

Fig 2: A 53-years-old female patient presented with vomiting, dysphagia and progressive weight loss for 4 months. MDCT Findings**:** Post contrast axial (a, b and c), sagittal (d) and coronal (e) CT scans of the abdomen and pelvis revealed circumferential mural thickening of the gastroesophageal junction reaching about 2 cm with focal wall thickening of the gastric fundus and lesser curvature of the stomach (long arow) measured about (1.5 cm) in its maximal dimensions with smudging of fat planes around it. Multiple enlarged perigastric, gastrohepatic, celiac and para-aortic LNs. (short arrow). No evidence of extragastric spread or distant metastasis could be noted suggesting gastric carcinoma stage III.

Discussion

Gastro-esopheageal cancer is classified as the fifth most common cancer worldwide and the third most common fatal illness. The only available curable treatment is surgical excision, depending on the stage of the disease at the presentation that determined by the extent of stomach wall invasion spread to lymph nodes and multi-organ metastasis. As early as possible we diagnose cancer stomach especially at early stages, the higher the rate of life. Nevertheless, most cases are diagnosed in late cases where surgery is not of the same benefit at early stages because of clinically indefinite symptoms [8].

The extent of wall and peritoneal invasion besides the presence or absence of distant metastasis is more helpful in determining the gastric cancer stages (TNM). Computed tomography is essentially used for staging gastric cancer. Advanced techniques such as gastric distension with water or gas have also aided in improving the accurate detection of gastric cancer [9].

Other diagnostic tools as endoscopic ultrasound and MRI can be used in assessing gastric cancer. However, endoscopic ultrasound is an invasive technique, cannot be performed on all patients, is not accurate for the detection of peritoneal disease, and not useful for detection of distant metastases and although magnetic resonance imaging (MRI) gives higher soft tissue contrast beside the capability of multi-planar imaging, is less used than multi-slice computed tomography because of their prolonged scan time as well as their expensive cost. Preoperative staging is generally performed with abdominal and endoscopic ultrasonography in combination with computed tomography [10].

Currently, endoscopic radiological imaging was recorded as the most useful diagnostic radiological method of preoperative staging to assess the extent of the tumor spread [11].

The most recent global consent verified the importance of preoperative TNM staging and specified multi-slice computed tomography as the best staging radiological technique, which has displayed identical or higher accuracy in comparison with endoscopic ultrasonography for T-staging and a clear benefit concerning alternative techniques for TNM staging [12].

In the present study, it was found that age ranged from 22 to 70 years with a mean of 48.1±14.89 years, 4 (8%) patients were at the age from 20 t0 30 years, 6 (12%) patients were at the age from 31 to 40 years, 24 (48%) patients were at the age from 41 to 50, 10 (20%) patients were at the age from 51 to 60, and 6 (12%) patients were at the age from 61 to 70. There were 38 (76%) males and 12 (24%) females. Weight ranged from 61 to 89 kg with a mean of 74.4±8.89 kg. Height ranged from 1.59 to 1.71 m with a mean of 1.7±0.04 m. BMI ranged from 20.86 to 35.2 kg/m2 with a mean of 27.1±3.69 kg/m2.

A multicenter retrospective study to highlight the diagnostic value of multidetector CT in assessment of gastro-esopheageal malignancy compared to surgical and pathological results where about 35 patients were included in the study. The results showed that, eight females and twenty-seven males with mean age 50 years (34–81) as conducted by [13].

In the present study, it was found that about 21 (42%) patients had abdominal pain, 24 (48%) patients had progressive loss of weight, 15 (30%) patients had vomiting colic, 9 (18%) patients had epigastric pain, 7 (14%) patients had dyspepsia, 6 (12%) patients had hematemesis, 5 (10%) patients had fever, 8 (16%) patients had loss of weight, 9 (18%) patients had dysphagia, 2 (4%) patients had nausea, and 2 (4%) patients had black stool.

Most common presenting complaint was dysphagia (100%) followed by weight loss (52%), and chest/epigastric pain (18%). Only 10% of patients were presented with cough and vomiting, 8% with odynophagia, 4% with complaint of hoarseness of voice and 8% with other complaints like GI bleed, hiccups etc as found by [14].

In the present study, it was found that about 23 (46%) patients had adenocarcinoma, 22 (44%) patients had squamous cell carcinomas, and 5 (10%) patients had benign tumors. Regarding pathological stages, 3 (6.67%) patients had T_1 stage, 4 (8.89%) patients had T_2 stage, 16 (35.56%) patients had T_3 stage, and 22 (48.89%) patients had T_4 stage. The most common histological type was Squamous cell carcinoma (94%) followed by Adenocarcinoma (6%) as indicated by [14].

In the present study, it was found that the diameter of the malignant tumor ranged from 2.1 to 14.9 cm with a mean of 7.4±3.57 cm.

Assessment of gastric wall thickness is an integral part. Optimal distension of the stomach results in effacement of the normal folds. The normal gastric wall is thin usually measuring 5-7 mm when the stomach is well distended, wall thickness greater than 8-10 mm is abnormal, and however, the wall of the fundus and antrum may appear thicker than the remainder of the stomach, because of their orientation within the scanning plane. The wall thickness of the cardia may appear thicker since axial slices may intersect the curved gastric wall, measuring up to 12-15 mm [15].

In the present study, it was found that about 23 (46%) patients had polypoidal or fungating mass, 9 (18%) patients had ulcerating lesion, 6 (12%) patients had focal wall thickening and 12 (24%) patients had circumferential wall thickening.

All the studied 60 patient had malignant stomach lesions and were finally diagnosed as gastric carcinomas, the final diagnoses were based on the findings of gastroscopic biopsy in 57 (95%) patients, and postoperative histopathological examination in 3 (5%) patients. 21 (35%) patients had polypoidal or fungating mass, 4 (6.7%) patients had ulcerating lesion, 15 (27%) patients had focal wall thickening and 15 (25%) patients had circumferential wall thickening as highlighted by [12].

Local invasion of the structures adjacent to the growth included Tracheo-bronchial (10%), Aortic (8%), Gastric (8%), Pericardium (2%) and Pyriform sinuses/Valeculla (2%) invasion. The esophageal wall thickening, or mass was eccentrically located in 58% of the cases with at least minimal luminal narrowing seen in all the 50 Cases (100%). Dilatation of the esophagus proximal to obstructing growth was seen in 30 cases (60%). In 70% of the patients, periesophageal soft tissue or fat stranding was seen by [14].

In the present study, it was found that about 10 (20%) patients had the tumor at the fundus, 18 (36%) patients had the tumor at the pylorus, 4 (8%) patients had the tumor at the cardia, 9 (18%) patients had diffuse body tumor, and 4 (8%) patients had extra gastric mass invading stomach.

This not agree with [16, 17] who found that the cardia was the most affected site with gastric cancer in their study

In the present study, it was found that about 1 (2.22%) patient had lung metastasis, 1 (2.22%) patient had bone metastasis, 5 (11.11%) patients had liver metastasis and 9 (18%) patients had diffuse body tumor, and 26 (57.78%) patients had esophageal metastasis.

This is agreed with [9] who found that 35% of patients presented with evidence of distant metastases at the time of diagnosis and about half of them had metastatic disease to the liver, the most common metastatic organ

In the present study, it was found that about 31 (62%) patients had esophageal wall thickness > 15 mm, and 19 (82.61%) patients had esophageal wall thickness from 5 to 15 mm.

Most of the patients have esophageal wall thickness > 15 mm (78%), 22% of the patients have esophageal wall thickness between 5-15 mm as revealed by [14].

In the present study, it was found that about 4 (15.38%) patients had esophageal cancer at the upper 1/3rd, 9 (34.62%) patients had esophageal cancer at the middle 1/3rd, and 13 (50%) patients had esophageal cancer at the lower 1/3rd of the esophagus.

The lower 1/3rd of the esophagus including the GE junction was the most common site (46%) followed by middle 1/3rd of the esophagus (40%). The upper 1/3rd of the esophagus was involved only in 14% of the cases. Regional lymphadenopathy was seen in 60% of the cases whereas non-regional lymphadenopathy was seen in 18% of the cases. Lymph nodes more than 1cm in size in short axis diameter were only considered to be significant as stated by [14].

In the present study, it was found that MDCT could predict T_1 staging with 66.67% sensitivity, 93.18% specificity, 57.14% PPV, 95.35% NPP, and 90.00% accuracy. MDCT could predict T_2 staging with 75% sensitivity, 97.83% specificity, 75% PPV, 97.83% NPP, and 96% accuracy. MDCT could predict T_3 staging with 81.25% sensitivity, 97.06% specificity, 92.86% PPV, 91.67% NPP, and 92% accuracy. MDCT could predict T_4 staging with 95.45% sensitivity, 100% specificity, 100% PPV, 96.55% NPP, and 98% accuracy.

On MDCT, the extension of tumor load was categorized as follows: T0, no proof of alteration of the gastric wall with even perigastric fat around; T_1, infiltration of the gastric mucosa or submucosa [18]; T_2, invasion to muscularis propria [19]; T_3, invasion to subserosa [18] and T_4, invasion to serosa and adjacent organs or structures [11, 20].

The sensitivity of MDCT in recognition and evaluation of gastric neoplasms was documented parallel with the histopathological results as a gold standard. In the current study, there is a significant relationship between pathological and CT staging by using of thin-slice axial CT as we found that CT was specific and accurate in diagnosis of all stages of gastric cancer with specificity ranged between 93 and 97% and accuracy ranged between 9 and 92.5%. The present study showed that MDCT gives the highest sensitivity (90%) in stage IV, but the lowest on of stages I and II as found by [21].

Prognosis and therapy of gastric carcinoma depend on the stage of the disease at the time of the diagnosis and the first challenge for clinicians is to define the extent of the tumor. In addition, multi-detector row CT with combined water and air distension can improve the accuracy of preoperative staging of gastric cancer [22].

There has been controversy regarding the effectiveness of CT for T staging of gastric cancer, and an overall accuracy of 66–82% has been reported in the literature [23]. Found detection rates of primary tumors with axial images, MPRs, and combinations of MPR and virtual gastroscopy images were 91%, 96%, and 98%, respectively. Overall accuracy in assessment of tumor invasion of the gastric wall (T stage) was significantly better with MPR images (89%) than with axial images (73%), whereas that for lymph node (N) staging was 78% with MPR images and 71% with axial images.

Despite all these advantages, MPR and virtual endoscopy have some limitations. The main disadvantage is that they are time-consuming. Although greater computer processing power makes more rapid reconstructions possible, the entire procedure takes approximately 20–30 min per patient. With increased data volumes, the results may take longer to generate. A second limitation is the inability to obtain histologic results. If a lesion is detected at CT gastrographic, subsequent endoscopic biopsy is necessary to confirm the histopathologic findings [13].

Still, MDCT gastroscopy demonstrated several practical advantages over conventional gastroscopy, including better patient tolerance, absence of complications, and no requirements for sedation. CT gastroscopy also showed several technical advantages including the ability to visualize the entire stomach, accurate localization of lesions, the ability to visualize stomach distal to an obstructing lesion, and the ease of navigation through the stomach in both antegrade and retrograde manner [13].

CT correctly diagnosed spread in seven of these patients. There were seven 'true-positive', six 'true-negative', three 'false-positive' and five 'false-negative' CT examinations (Table 1). The overall accuracy of CT in predicting spread beyond the muscular layer of the gut, but excluding nodal disease, was 62% with sensitivity, specificity, positive predictive value (PPV) and negative predictive value (NPV) of 58%, 66%, 70% and 55%, respectively as reported by [24]. These authors have also reported accuracies in the region of 90% for the assessment of the depth of tumor invasion. However, endoscopic ultrasound is an invasive technique and is unable to assess more distant spread such as pancreatic invasion, peritoneal tumor, and the presence of liver metastases. The accurate staging of patients following neoadjuvant chemotherapy is clearly important [24].

Conflict of Interest
Not available

Financial Support
Not available

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How to Cite This Article
Sheikh HALSAL, Salih MH, Tawfik MA. MDCT of gastroesophageal masses correlated with histopathological findings. International Journal of Radiology and Diagnostic Imaging. 2025;8(1):83-88.