PRE-OPERATIVE EVALUATION AND TUMOUR-NODE-METASTASIS STAGING OF GASTRIC CARCINOMA USING 16 SLICE MULTIDETECTOR-ROW COMPUTED TOMOGRAPHY

Zeenat Adil[1], Sidra Saeed[1⊠]

1: Department of Radiology, Kuwait Teaching Hospital, Peshawar, Pakistan.

Contact #: +92-301-8159298

Email⊠: drsidrahsaeed233@yahoo.com

ABSTRACT

OBJECTIVE: To evaluate pre-operative tumour-node-metastasis staging (TNM) staging, metastases status and detection of role of multidetector-row computed tomography (MDCT) in gastric carcinoma patients in Pakistan.

METHODS: This cross-sectional study, spanned over 14 months (January 2018-February 2019), was conducted at Radiology Department of Kuwait Teaching Hospital. Sample size was 173. Patients, selected through non-probability consecutive sampling technique, irrespective of gender, aged over 18 years and having clinically and histopathologically diagnosed with gastric carcinoma were included in the study. MDCT of patients was done. SPSS Version-24 was utilized for data analysis. Chi-square test was applied with p-value ≤0.05 was considered significant.

RESULTS: Out of total 173 patients with gastric carcinoma, 121 (69.9%) were males and 52 (30.1%) were females. Mean age of patients was 48.5 ± 1.2 years. Majority of patients were in T4a stage (n=64; 37%) followed T4b, T3, T0, T1 & T2 (24.9%, 17.3%, 11% and 9.8%) respectively. N0 stage with no nodal metastases was 40.5% followed by N1 stage (1-2 lymph nodes), N2 stage (3-6 lymph nodes), N3a stage (7-15 lymph nodes) and N3b stage (more than 15 lymph nodes) with 25.4%, 19.7%, 5.8% and 8.7% respectively. M1 stage with distant metastases was in 76 (43.9%) patients. Age and gender had insignificant association with TNM system (p>0.05).

CONCLUSION: Multi detector row computed tomography was effective in pre-operative evaluation and TNM staging of gastric carcinoma. Lymph node detection on MDCT can further be utilized for fine needle biopsies if required.

KEY WORDS: Gastric carcinoma (Non-MesH); Multidetector Computed Tomography (MeSH); Tumor staging (Non-MesH); Neoplasm Staging (MeSH).

INTRODUCTION

Gastric carcinoma is the 2nd most common cause of death and remained 4th common malignancy, worldwide.[1] Gastric carcinoma appears symptomatic with advancement in stage. Five years survival rate is found to be 90% in Japan (due to early diagnosis), however, other European countries had 10-30% survival rate.[2] Incidence of gastric carcinoma varied with geographic variation. Moreover, 50% of new diagnosed cases occur in developing world.[3] Gastric carcinoma is very common among young males with an advanced stage (stage III and IV) in Pakistan. Overall, mortality with gastric carcinoma is Pakistan is 13.3%.[4] In last few decades, gastric carcinoma incidence has decreased due to improved food and hygiene standards, eradication of helicobacter pylori and effective high intake of fresh vegetables and fruits.[5] Socioeconomic status had significant association with risk reduction of gastric carcinoma[6], however, healthy dietary habits and maintenance of proper weight is associated with gastric carcinoma prevention.[7]

Multi detector computed tomography (MDCT) for gastric carcinoma has significant role in disease staging and is reported as method of choice regarding pre-operative disease staging or TNM staging as classified by American Joint Committee on Cancer's (8th edition) guidelines. MDCT technique is capable of local invasion identification and distant metastases recognition. MDCT staging is crucial for early detection, minimally invasive treatments including endoscopic resection (early tumor detection) and prevention of unnecessary surgical intervention for in-operable neoplastic disease process. Correct technique of MDCT has significant impact on better results obtention.[8]

Literature does support that MDCT showed good accuracy for preoperative staging of gastric carcinoma with respect to TNM calcification in relation to depth invasion and metastatic involvement with specificity of MDCT for early gastric cancer diagnosis being >95% and for determination of adjacent organ invasion was >84%.[9] This scan modality is in use in Pakistan however there is a scarcity of published data over its effective utilization. Hence, it is very important to evaluate role of MDCT in gastric cancer staging with respect to TNM classification in Pakistan. It will effectively contribute to the knowledge of radiologists specifically. Present study aims to assess and evaluate the gastric carcinoma TNM staging along with metastases status and lymph nodes involvement in such patients using MDCT.

METHODS

This cross-sectional study was conducted from January 2018-February 2019, at Radiology Department of Kuwait Teaching Hospital, Peshawar, Pakistan. Ethical approval was taken from the ethical review board of the hospital.

TABLE I: DEMOGRAPHIC SEGMENTATION OF STUDY PARTICIPANTS

Characteristics		Frequency (n=173)	Percentage
Gender	Male	121	69.9
	Female	52	30.1
Age (years)	1-10	2	1.2
	11-20	10	5.8
	21-30	18	10.4
	31-40	30	17.3
	41-50	43	24.9
	51-60	42	24.3
	61-70	20	11.6
	>70	1	0.6

The sample size of 173 was determined using 5% significance level, 95% confidence interval and prevalence of gastric carcinoma as 13%[4]. Non-probability consecutive sampling technique was incorporated for patient's selection. Participation in the study was subjected to written informed consent. Patients, irrespective of gender, aged over 18 years and having clinically and histopathologically diagnosed with gastric carcinoma were included in the study. However, all the patients reporting to hospital with other malignancies, immunocompromised patients, pregnant and lactating females, and patients with any mental disability were excluded.

Patient preparation started with a minimum of eight hours. Patients having no contraindications were administered 10 mg of scopolamine butylbromide 15 minutes prior to study. Optimal gastric distention was achieved using 750-100 ml of positive neutral agent (Water). As protocol for CT using neutral agent, supine position was used.

Volumetric acquisition of upper abdomen was determined before the administration of IV iodinated contrast injection. Volumetric acquisitions include; upper abdomen at arterial phase, total abdomen at portal phase and in the end upper abdomen again at equilibrium phase (150 seconds after arterial phase).

MDCT was performed using a 16 - detector row CT scanner (Light speed VCT, GE Healthcare), with scanning parameters beam collimation, 0.62540 mm; pitch, 0.984; kVp/effective mA, 120/300. Non-ionic venous contrast agent (1.5Ml//kg) was injected into cubital vein (using 18G/20G venous catheter) and automated infusion pump was used for flow of 3.5mL/s, for contrast enhanced CT with scanning starting after 40 seconds of injection of contrast. The imaging area was from xiphoid process to symphysis pubis.

Hepatic steatosis and pathological calcification was determined through non contrast enhanced phase. It is used as reference to enhancement pattern of gastric lymph nodes or metastatic lesions. American Joint Committee on Cancer's (8th edition) guidelines were used for gastric carcinoma staging (TNM Classification). Arterial and delayed phase was used for evaluation of T stage, portal phase was used for N stage and M stage. Data was analysed through SPSS Version-24. Mean and standard deviation was determined for quantitative variable, however, frequency and percentages were determined for qualitative data. Chi-square test was applied for measuring association. P value ≤0.05 was considered significant.

RESULTS

Out of total 173 patients with gastric carcinoma, 121 (69.9%) were males and 52 (30.1%) were females (Table I). Mean age of patients was 48.5±1.2 years.

Gastro-esophageal junction was involved in 103 (59.5%) patients compared to no involvement in 70 (40.5%) patients. Anatomical involvement of cardia, fundus, body, antrum and pylorus are shown in table II.

Among 173 patients, 75 (43.4%) showed involvement of gastric lesser curvature. Out of all, 69 (39.9%) had gastric greater curvature involvement. Gastroesophageal junction and esophageal involvement were demonstrated with varying lengths of oesophagus being involved. 144 patients (83.2%) did not show any esophageal involvement, esophageal involvement was up to 12 cm in 2 (1.2%), up to 13 cm in 1 (0.6%), up to 14 cm in 1 (0.6%), up to 19 cm in 2 (1.2%), up to 20 cm in 3 (1.7%), 23 cm in 2 (1.2%), 26 cm in 1 (0.6%), 29 cm in 1(0.6%), 30 cm in 5 (2.9%), 35 cm in 1 (0.6%), 40 cm in 3 (1.7%), 45 cm in 1(0.6%), 52 cm in 1 (0.6%), 54 cm in 1 (0.6%), 76 cm 1 (0.6%), 86 cm in 1 (0.6%), 120 cm in 1 (0.6%) and up to 150 cm in 1 (0.6%) case. Maximal thickness of disease oesophageal segment was up to 0 mm in 144 (83.2%), 9 mm in 1 (0.6%), 10 mm in 5 (2.9%), 11 mm in 3 (1.7%), 12 mm in 7 (4%), 14 mm in 5 (2.9%), 15 mm in 1 (0.6%), 16 mm in 3 (1.7%), 17 mm in 2 (1.2%), 21 mm in 1 (0.6%) and up to 34 mm in 1 (0.6%). Out of these cases where oesophageal involvement was positive mediastinal was found in 8 (4.6%) and absent in 165 (95.4%). Duodenal involvement was found in 23 (13.3%) while absent in 150 (86.7%). Gastro-hepatic ligament involvement was seen in 111 (64.2%) patients, gastrocolic ligament involvement was present in 46 (26.6%), gastrosplenic ligament involvement was seen in 25 (14.5%), omental nodularity was seen in 33 (19.1%), direct hepatic involvement was present in 21 (12.1%), direct

TABLE II: ANATOMICAL INVOLVEMENT IN GASTRIC CARCINOMA

Gastric cancer		Frequency (N=173)	Percentage
Cardia involvement	Absent	99	57.2
	Present	74	42.8
Fundus involvement	Absent	121	69.9
	Present	52	30.1
Body involvement	Absent	116	67.1
	Present	57	32.9
Antrum involvement	Absent	113	65.3
	Present	60	34.7
Pylorus involvement	Absent	99	57.2
	Present	74	42.8

TABLE III: METASTASES STATUS IN STUDY PARTICIPANTS

Metastases status		Frequency (N=173)	Percentage
Metastases	No	91	52.6
	Yes	82	47.4
Hepatic metastases	No	131	75.7
	Yes	42	24.3
Omental metastases	No	156	90.2
	Yes	17	9.8
Peritoneal metastases	No	163	94.2
	Yes	9	5.2
Pulmonary metastases	No	138	79.8
	Yes	35	20.2
Bony metastases	No	161	93.1
	Yes	12	6.9
Ovarian metastases	No	167	96.5
	Yes	6	3.5

pancreatic involvement was seen in 25 (14.5%), transverse colon was involved in 4 (2.3%), direct splenic involvement was reported in 5 (2.9%), diaphragmatic involvement was found in 9 (5.2%) and infiltration of other adjacent structure was seen in 5 (2.9%) patients. Number of lymph nodes (LN) involved were zero in 71 (41%), 1-2 in 43 (24.9%), 3-6 in 34 (19.7%), 7-15 in 10 (5.8%), more than 15 LN were involved in 15 (8.7%) patients.

Tiers of lymph nodes status showed that third, second and first tier of lymph nodes were present in 26 (15%), 45 (26%) and 94 (54.3%) cases respectively.

Table-III projects the data pertaining to the metastasis's status in study participants.

Majority (37%) of patients were in T4a stage followed by T4b (24.9%) and T3 (17.3%). About 40.5% of patients were in N0 stage. Metastatic staging showed majority (56.1%) were in Mo stage (Table IV).

Age had insignificant association with T stage (p=0.101), N stage (p=0.829) and M stage (p=0.90). Gender had insignificant association with T stage (p=0.412), N stage (p=0.447) and M stage (p=0.317)

DISCUSSION

In our study on pre-operative TNM staging of gastric carcinoma through MDCT in Pakistani patients revealed that majority (37%) of patients were in T4a stage followed T4b, T3, T0, T1 & T2. N0 stage with no nodal metastases was 40.5% followed by N1 stage

(25.4%). M1 stage with distant metastases was in 43.9% patients.

MDCT had significant role in gastric carcinoma preoperative staging with great influence on therapeutic approach. In our study we found MDCT an accurate tool for TNM staging. A similar study reported that accuracy of tomographic staging was higher in T staging as compared to N and M staging.[10] Another similar study reported that MDCT was associated with low differentiation of T2 and T3 stage (p=0.01).[11] However, in our study we found that indicators like peri-gastric stranding and complete gastric wall thickness involvement a reliable tool for differentiating between these two.

In present study, majority of patients were in N0 stage 40.5% following N1, N2, N3a and N3b in 25.4%, 19.7%, 5.8% and 8.7% respectively. Majority of patients were in Mo 97(56.1%) stage

and 76(43.9%) were in M1. Zhang et al reported lymph node metastasis with tumor size, grade, serosa invasion, longest diameter and showing biological behaviour of gastric cancer. They predict lymph node metastasis preoperatively with support vector machine (SVM) model using MDCT.[12] Teixeira et al reported that positive and negative ratio between preoperative prognosis and non-metastatic lymph nodes could be explained by MDCT.[13]

In present study, hepatic metastases were seen in 42(24.3%), omental metastases were seen in 17(9.8%), peritoneal metastases were seen in 9(5.2%), pulmonary metastases in 35(20.2%), bony metastases in 12(6.9%) and ovarian metastases in 6(3.5%) patients which is in line with findings reported as 55% of patients with gastric carcinoma had 25% of hepatic metastases, 11% omental metastases and 5% bony metastases by another study.[14] Another similar study reported that pulmonary metastases were in 25% of gastric carcinoma patients.[15] Hepatic metastases was reported to be the most common one in our study (24.3%) which is similar to that reported previously by another study labelling hepatic metastases to be the most common metastases in gastric carcinoma while ovarian metastases were least common metastases in gastric carcinoma.[16]

In present study, age and gender had insignificant association with TNM staging of gastric carcinoma (p>0.05). Pan et al reported that patients in older age group were more prone to accurately diagnosed with TNM

TABLE IV: TUMOUR-NODE-METASTASIS STAGING OF GASTRIC CARCINOMA (N=173)

Tumour-Node-Metastasis Staging		Frequency	Percentage
Tumor (T) Staging	T0	19	11
	T1 and T2	17	9.8
	T3	30	17.3
	T4a	64	37
	T4b	43	24.9
Lymph Node (N) Staging	N0	70	40.5
	1-2 ln	44	25.4
	3-6 ln	34	19.7
	N3a 7-15 ln	10	5.8
	N3b more than 15	15	8.7
Metastatic (M) Staging	M0	97	56.1
	M1	76	43.9

classification using MDCT.[17] Another similar study reported that females were more likely to be classified with gastric carcinoma using MDCT with respect to TNM classification system.[18] However, Takeuchi et al reported no significant correlation between accuracy of MDCT and Gender (r=0.1, p=0.54), age (r=0.2, p=0.54).[19]

As per the findings of our study, the MDCT was effective for T Staging which is also supported by previously published literature.[2] MDCT along with contrast filling evaluates the gastric carcinoma and area of spread and tumor extent.[21] Our study finds the MDCT to be of high diagnostic value which is also supported by another studies.[22-24]

LIMITATION

Since this present study was single centre study, so it limits the generalizability of result. A multi-centre study is therefore recommended along with comparison of other modalities used for said purpose.

CONCLUSION

Multi detector row computed tomography plays an effective role in gastric carcinoma preoperative assessments and staging. Lymph node detection on MDCT can further be utilized for fine needle biopsies if required. TNM stage classification in gastric carcinoma is accurately done with MDCT. Further research is required on determining exact diagnostic accuracy of MDCT.

REFERENCES

1. Parkin DM, Bray F, Ferlay J. Global cancer statistics, 2002. CA Cancer J Clin 2005;55(2):74-108.

2. Edge SB, Compton CC. The American Joint Committee on Cancer: the 7th edition of the AJCC cancer staging manual and the future of TNM. Ann Surg Oncol 2010;17(3):1471-4.

3. Torre LA, Bray F, Siegel RL. Global cancer statistics, 2012. CA Cancer J Clin 2015;12(1):154-6.

4. Daniyal A, Ahmad S, Ahmad M, Asif MH, Akram M, Rehman US, et al. Risk factors and epidemiology of gastric cancer in Pakistan. Asian Pac J Cancer Prev 2015; 16(12):4821-24.

5. Dixon M, Cardoso R, Tinmouth J. What studies are appropriate and necessary for staging gastric adenocarcinoma? Results of an international RAND/UCLA expert panel. Gastric Cancer 2014;17(3): 377-82.

6. Kierszenbaum ML, von Atzingen AC, Tiferes DA, Alvim MV, Lopes GD, Matos D, et al. Colonografia por tomografia computadorizada na visão do médico encaminhador: qual o seu valor segundo a visão de especialistas? Radiol Bras 2014;47(3): 135-40.

7. Maciel AC, Maciel LC. Colonografia por tomografia computadorizada: um método de rastreamento conhecido porém pouco utilizado. Radiol Bras 2014;47(3):56.

8. Barros RHO, Penachim TJ, Martins DL. Tomografia computadorizada de múltiplos detectores no estadiamento pré-operatório do adenocarcinoma gástrico. Radiol Bras 2015;48(2): 74-80.

9. Santana PJ, Júnior, Aurione ACV, Dangoni R. Tumor neuroendócrino gástrico tipo III. Radiol Bras 2014;47(4):11-13.

10. Monjardim RF, Costa DMC, Romano RFT, Diagnóstico da esteatose hepática pela tomografia computadorizada de abdome com meio de contraste intravenoso. Radiol Bras 2013;46(3):134-38.

11. Salvadori PS, Costa DMC, Romano RFT. Quando a fase de equilíbrio pode ser suprimida nos exames de tomografia computadorizada de abdome? Radiol Bras 2013;46(2): 65-70.

12. Costa DM, Salvadori PS, Monjardim RD, Bretas EA, Torres LR, Caldana RP, et al. Quando a fase sem contraste intravenoso é desnecessária nos exames de tomografia computadorizada do abdome? Análise retrospectiva de 244 casos. Radiol Bras 2013;46(3):197-202.

13. Teixeira AC, Torres UD, Westin CE, Oliveira EP, Gual F, Cardoso LV, et al. Tomografia computadorizada com multidetectores no diagnóstico pré-operatório das complicações intes-tinais causadas pela ingestão de corpos estranhos da dieta sem suspeita clínica: série de casos enfatizando o uso de técnicas de renderização volumétrica. Radiol Bras 2013;46(2):346-50.

14. Washington K. 7th edition of the AJCC cancer staging manual: stomach. Ann Surg Oncol 2010;17(4):3077-9.

15. Lee IJ, Lee JM, Kim SH, Heo SH, Han SM, Chen K, et al. Diagnostic performance of 64-channel multi-detector CT in the evaluation of gastric cancer: differentiation of mucosal cancer (T1a) from sub-mucosal involvement (T1b and T2). Radiology 2010;255 (4):805-14. https://doi.org/10.1148/radiol.10091313.

16. Shen Y, Kang HK, Jeong YY. Evaluation of early gastric cancer at multidetector CT with multiplanar reformation and virtual endoscopy. Radiographics 2011;31(4):189-99. https://doi.org/10.1148/rg.311105502.

17. Pan Z, Pang L, Ding B, Yan C, Zhang H, Du L, et al. Gastric cancer staging with dual energy spectral CT imaging. PLoS One 2013;8(1):123-5. https://doi.org/10.1371/journal.pone.0053651.

18. Coburn N, Seevaratnam R, Paszat L. Optimal management of gastric cancer: results from an international RAND/UCLA expert panel. Ann Surg 2014;259(2):102-8. https://doi.org/10.1097/SLA.0b013e318288dd2b.

19. Takeuchi H, Kitagawa Y. Sentinel lymph node biopsy in gastric cancer. J Clin Oncol 2013 Oct 10;31(29): 3704-10. https://doi.org/10.1200/JCO.2013.50.3789.

20. Furukawa K, Miyahara R, Itoh A, Ohmiya N, Hirooka Y, Mori K, et al. Diagnosis of the invasion depth of gastric cancer using MDCT with virtual gastroscopy: comparison with staging with endoscopic ultrasound. AJR Am J Roentgenol 2011 Oct;197 (4):867-75. https://doi.org/10.2214/AJR.10.5872.

21. Zytoon AA, El-Atfey SI, Hassanein SA. Diagnosis of gastric cancer by MDCT gastrography: diagnostic

characteristics and management potential. Egypt J Radiol Nucl Med 2020 Dec;51(1):1-7. https://doi.org/10.1186/s43055-020-0148-y.

22. Sharara SM, Nagi MA, Soliman SS. Multidetector computed tomography in the evaluation of gastric malignancy; A multicenteric study.

Egypt J Radiol Nucl Med 2018 Jun 1;49(2):304-9. https://doi.org/10.1016/j.ejrnm.2018.02.012.

23. Emam HM, Moussa EM, Abouelmaged M, Ibrahim MR. Role of multidetector CT in staging of gastric carcinoma. J Cancer Ther 2019 Jul 8;10(7):565-79. https://

doi.org/10.4236/jct.2019.107046.

24. Teama AH, El-Badry AM, Yousef ES. The role of multislice computed tomography in the diagnosis of gastric malignant tumors. Tanta Med J 2016 Jul 1;44(3):119. https://doi.org/10.4103/1110-1415.198480.

AUTHOR'S CONTRIBUTION

Following authors have made substantial contributions to the manuscript as under:

ZA & SS: Conception and study design, acquisition, analysis and interpretation of data, drafting the manuscript, critical review, approval of the final version to be published

Authors agreed to be accountable for all aspects of the work in ensuring that questions related to the accuracy or integrity of any part of the work are appropriately investigated and resolved.

CONFLICT OF INTEREST
Authors declared no conflict of interest
GRANT SUPPORT AND FINANCIAL DISCLOSURE
Authors have declared no specific grant for this research from any funding agency in the public, commercial or not-for-profit sectors

DATA SHARING STATEMENT
The data that support the findings of this study are available from the corresponding author upon reasonable request.

KMUJ web address: www.kmuj.kmu.edu.pk
Email address: kmuj@kmu.edu.pk