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Correlation between preoperative tomographic staging and definitive histopathologic results in gastric cancer at the Hospital Central Militar☆

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KEYWORDS
Gastric cancer;
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Abstract
Background: In relation to the number of new cases diagnosed, gastric cancer is the fourth most common cancer worldwide, and the second cause of cancer death. The development of multidetector tomography has improved the preoperative staging of gastric cancer.
Aim: To correlate preoperative tomographic studies with the definitive pathologic results according to the TNM staging system.
Methods: A retrospective, cross-sectional study within the time frame of January 2009 to December 2013 was conducted that included the case records of 67 patients. They all had upper endoscopy and preoperative multidetector tomography examinations, underwent surgical resection, and had the corresponding histopathology study. Statistical analysis was carried out with the SPSS version 15.0 software and the sensitivity and specificity calculations were made using the Excel 2011 program for Mac.
Results: The majority of the patients included in the case series had clinical stage III and IV disease. When compared with the histopathologic result, the overall accuracy of multidetector CT was 83% (T0 96%, T1 94%, T2 93%, T3 67%, and T4 67%) for tumor size (T) and was 70% (N0 72%, N1 73%, N2 70%, and N3 66%) for lymph node involvement (N). Overall sensitivity was 48% (T0 100%, T1 0%, T2 33%, T3 44%, and T4 65%) for T and was 41% (N0 58%, N1 56%, N2 15%, and N3 35%) for N. A strong association between the multidetector CT results and the pathology results was demonstrated through the Spearman's correlation, especially in T4 and N3.

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Conclusions: Multidetector computed tomography showed greater congruency in detecting stages T4, N0, and N3 in gastric cancer, when compared with the definitive histopathologic results.

PALABRAS CLAVE
Cáncer gástrico;
Estadificación;
TC multidetector;
Histopatológico

Correlación entre la estadificación tomográfica preoperatoria con los resultados histopatológicos definitivos en cáncer gástrico en el Hospital Central Militar

Resumen
Antecedentes: El cáncer gástrico es el cuarto tipo de cáncer más común de reciente diagnóstico y la segunda causa de muerte relacionada con cáncer en el mundo. El desarrollo de tomografía multidetector ha mejorado la estadificación preoperatoria del cáncer gástrico.
Objetivo: Correlacionar los informes tomográficos preoperatorios con los resultados definitivos de patología de acuerdo con el sistema TNM.
Métodos: Análisis transversal, retrospectivo. De enero del 2009 a diciembre del 2013, se incluyó a 67 pacientes, todos tenían endoscopia superior, tomografía preoperatoria, fueron sometidos a cirugía resectiva y contaban con resultado histopatológico. El análisis estadístico se realizó con el programa de computadora SPSS versión 15.0. El cálculo de sensibilidad y especificidad se realizó con el programa Excel 2011 para Mac.
Resultados: La mayoría de los pacientes de la serie se encontraban en estadio clínico III y IV. La precisión global de la tomografía computarizada (TC) multidetector comparado con el resultado histopatológico para el tamaño del tumor (T) fue del 83% (T0 96%, T1 94%, T2 93%, T3 67% y T4 67%) y para N del 70% (N0 72%, N1 73%, N2 70% y N3 66%), la sensibilidad global para T fue del 48% (T0 100%, T1 0%, T2 33%, T3 44% y T4 65%) y para N del 41% (N0 58%, N1 56%, N2 15% y N3 35%). Así mismo se demostró, mediante correlación de Spearman, una fuerte asociación entre los resultados de la TC multidetector y el resultado de patología, sobre todo en T4 y N3.
Conclusiones: La TC multidetector mostró mayor congruencia en detectar las etapas T4, N0 y N3 en cáncer gástrico, comparadas con los resultados histopatológicos definitivos.

Introduction

The incidence of gastric cancer varies greatly worldwide. It is still the fourth most common type of newly diagnosed cases of cancer and is the second cause of cancer-related death in the world.[1] Despite the advances in diagnostic tools and multimodal treatment, the 5-year survival rate for all patients at all disease stages is still below 30%.[2] The preoperative evaluation of patients with gastric adenocarcinoma involves making the diagnosis, evaluating local disease, searching for distant disease, and assessing the patient's general medical condition. Three-dimensional computed tomography (3D-CT), with combined water and air distension, can improve the preoperative staging precision of gastric cancer in relation to tumor size (T) and lymph node involvement (N), with 78% diagnostic accuracy for lymph nodes.[3]

Gastric cancer is a locoregional disease with a high tendency for lymph node metastasis. Therefore, lymph node stage continues to be one of the most critical independent predictors of survival for patients after gastrectomy.[4,5] Surgical resection is still the basis of curative treatment for gastric cancer. According to the Union for International Cancer Control (UICC), curative surgical treatment strives to eliminate all tumor disease, obtaining safe surgical margins with no microscopic disease residuals, known as R0 surgery, and it reports better long-term disease control. There is disagreement between western and Japanese case series as to the extension of lymph node dissection, and total or subtotal gastrectomy with D2 dissection is the criterion standard of surgical treatment for gastric cancer in East Asia. A meta-analysis that compared gastrectomy with D1 versus D2 dissection concluded that the former was associated with less anastomosis leakage, lower postoperative complication and reoperation rates, shorter hospital stay, and a lower mortality rate at 30 days. The 5-year survival rate was similar for the two procedures.[6]

Multidetector CT development has improved gastric cancer staging, but the results with these techniques are not satisfactory, especially in evaluating tumor depth and N. There are no studies from our hospital that compare the preoperative diagnostic accuracy of tomography with the definitive histopathologic result. The evaluation of this information is important because larger resections

are reported to have a larger number of complications, longer hospital stay, and greater use of human and material resources. Thus, the aim of our study was to correlate the reports from the department of ionizing radiation based on tomographic criteria of gastric cancer with the definitive pathology results in relation to T, N, and clinical stage (CS), according to the TNM staging system.

Materials and methods

A retrospective, descriptive, observational, cross-sectional study was conducted that consisted of a case record review. The medical records of patients diagnosed with adenocarcinoma-type gastric cancer through endoscopic biopsy were included. All the patients had a complete abdominal CT scan with a written report and underwent gastric resection surgery with a definitive pathology report within the time frame of January 2009 and December 2013. Patients that received neoadjuvant treatment or were diagnosed with another type of neoplasia were eliminated from the study. A database of tables was created using the Excel (Microsoft Office®) program. The categorical variables were expressed as absolute values and percentages. The ordinal or continuous variable distribution was tested for normality using the Kolmogorov-Smirnov test. Distribution was not normal for the majority of the variables ($p < 0.05$), and so the results were shown as medians (p25-p75). The correlations between the tomographic staging and the histopathologic results were calculated with the Spearman and Kendall methods. The association between tomographic and histopathologic staging for T was calculated through Spearman correlation tests. Statistical significance was set at a p (alpha error) < 0.05. The statistical analysis was carried out with the SPSS Version 15.0 program. Sensitivity and specificity calculations were made with the Excel 2011 program for Mac.

Results

A total of 138 case records were reviewed. Sixteen cases that corresponded to other tumors (8 lymphomas and 8 tumors of gastrointestinal stroma of the stomach), 42 patients that underwent palliative surgery for advanced CS (biopsy, diversion), 3 cases that received neoadjuvant treatment, and 10 incomplete cases were all excluded from the study. Sixty-seven patients were included, within the study time frame. Eleven of those patients had documented distant metastasis in the preoperative CT scan, but were included in the study because they underwent surgical resection. All had upper endoscopy with tumor location and infiltration grade information, preoperative multidetector CT scan (31 GastroCT and 36 non-contrast and contrast studies) with a written report. All the patients underwent surgical resection and had a definitive histopathologic result. T and N were classified according to the seventh edition of the staging manual of the American Joint Committee on Cancer.[7] The correlation between the tomographic and histopathologic reports for T and N were based on Table 1, in accordance

Table 1 Comparison criteria between the tomographic and pathologic findings at the different clinical stages of gastric cancer.

Tumor size (T)	
T stage (Pathology)	T stage (Tomography)
pT1: tumor invasion of the lamina propria, muscularis mucosa or submucosa	T1: irregular focal thickening of the internal gastric wall, with or without contrast enhancement. A visible hypodense and hypovascular line is preserved along the external layer of the wall. There is intense focal contrast enhancement on the gastric wall with no nodular thickening
pT2: tumor invasion of the muscularis propria pT3: tumor invasion of the subserosa	T2-3: The entire gastric wall is thickened to a variable extent, but the external layer of the gastric wall is whole and the perigastric fat has a normal appearance
pT4a: tumor invasion of the serosa	T4a: The entire gastric wall is thickened with homogeneous enhancement. The surface of the external layer of the gastric wall is irregular and there are micronodules or dense stranding of the perigastric fat.
pT4b: tumor invasion of the adjacent structures	T4b: There is tumor extension into the adjacent organs, as well as thickening and enhancement of the gastric wall.
Lymph node involvement (N)	
Stage N (Pathology)	Stage N (Tomography)
N1: Infiltration into 1 - 2 regional lymph nodes	N1: Infiltration into 1 - 2 regional lymph nodes (perigastric and vascular compartment)
N2: Infiltration into 3 - 6 regional lymph nodes	N2: Infiltration into 3 - 6 regional lymph nodes
N3a: Infiltration into 7 - 15 regional lymph nodes	N3: Infiltration into 7 - 15 regional lymph nodes
N3b: Infiltration into 16 or more regional lymph nodes	

with the criteria stated by Hallinan and Venkatesh.[8] All the tomography studies were evaluated by 4 different abdominal radiologists with at least 3 years of experience, as indicated in the abovementioned criteria.

The study group was made up of 38 men (56.7%) and 29 women (43.3%) and their median age was 64 years, with a range of 28 to 89 years. A history of *Helicobacter pylori* was identified in 37 (55.2%) cases, alcoholism in 21 (31.3%), and blood type A in 15 (22.4%). The predominant symptoms were abdominal pain in 42 (62.7%) patients, weight loss in 39 (58.2%), and early satiety in 29 (43.3%). Forty patients (59.7%) were classified as Borrmann III in the upper endoscopy. Thirty-three patients (49.2%) underwent total gastrectomy, 28 (41.7%) underwent subtotal gastrectomy, and 6 patients (8.9%) had multiorgan resection. Thirty-one (46.4%) patients, which was the majority, were classified as CS III and 15 patients (22.3%) were classified as stage IV (Table 2).

The sensitivity, specificity, and diagnostic accuracy calculations for T, N, and CS were made with the 2011 Excel program for Mac and the results are presented in Tables 3 and 4.

In the histopathologic reports, 13 patients had metastasis, 6 of which were to the liver, one to the ovaries, one to the spleen, one to the pancreas, one with metastasis to the greater omentum, and 3 with metastasis to multiple organs (diaphragm, ovary, and colon). Of those patients, metastasis was previously detected through CT in 11 and not detected through CT in 2 cases.

The correlations between tomography staging and histopathologic results for T, N, and CS were calculated with the Spearman and Kendall methods, and Table 5 and Figures 1–3 show the corresponding statistically significant correlation coefficients ($p < 0.001$). The mean lapse of time between preoperative multidetector CT staging and surgical

Table 2 Demographic data of the patients with gastric adenocarcinoma diagnosis.

Sex	Men 38 (56.7%)	Women 29 (43.3%)
Age (years)	64 (28-89)	
BMI (kg/m^2)	24 (15.9-31.4)	
Blood type	O positive	46 (68.7%)
	A positive	15 (22.4%)
	Other	6 (9%)
Risk factor	Smoking	18 (26.9%)
	FH of gastric cancer	5 (7.5%)
	Blood type A	15 (22.4%)
	Alcoholism	21 (31.3%)
	H. pylori	37 (55.2%)
Borrmann	I	5 (7.4%)
	II	4 (5.9%)
	III	40 (59.7%)
	IV	4 (5.9%)
	V	11 (16.4%)
Symptoms	Abdominal pain	42 (62.7%)
	Weight loss	39 (58.2%)
	Early satiety	29 (43.3%)
	Vomiting	28 (41.8%)
Surgery	Total gastrectomy – EY	33 (49.2%)
	Subtotal gastrectomy – GY	28 (41.7%)
	Other (Multiorgan resection)	6 (8.9%)
Clinical stage	0	5 (7.4%)
	I	3 (4.4%)
	II	13 (19.4%)
	III	31 (46.4%)
	IV	15 (22.3%)

Table 3 Sensitivity, specificity, and diagnostic accuracy by CT levels compared with histopathologic result for T, N, and CS in gastric cancer.

	Pathology result							
CT	0	1	2	3	4	Accuracy	Sensitivity	Specificity
Tumor								
0	3	1	1	1	0	96%	100%	95%
1	0	0	0	0	0	94%	0%	100%
2	0	1	1	0	2	93%	33%	95%
3	0	2	0	4	15	67%	44%	71%
4	0	0	1	4	31	67%	65%	74%
Lymph nodes								
0	3	1	1	1	-	72%	58%	77%
1	0	0	0	0	-	73%	56%	76%
2	0	1	1	0	-	70%	15%	83%
3	0	2	0	4	-	66%	35%	85%
Clinical stage								
0	3	1	1	1	0	96%	80%	97%
1	0	0	0	0	0	93%	0%	97%
2	0	1	1	0	2	67%	77%	65%
3	0	2	0	4	15	76%	61%	89%
4	0	0	1	4	31	87%	53%	96%

Table 4 Overall sensitivity, specificity, and diagnostic accuracy of CT for T, N, and CS, compared with the histopathologic result in gastric cancer.

	Accuracy	Sensitivity	Specificity
Tumor			
Average	83%	48%	87%
(Minimum-maximum)	(67% – 96%)	(0% – 100%)	(71% – 100%)
Lymph nodes			
Average	70%	41%	80%
(Minimum-maximum)	(66% – 73%)	(15% – 58%)	(76% – 85%)
Clinical stage			
Average	84%	54%	89%
(Minimum-maximum)	(67% – 96%)	(0% – 80%)	(65% – 97%)

Table 5 Correlation between the preoperative tomographic staging and the definitive histopathologic report.

	Spearman method		Kendall method	
	Correlation coefficient	p	Correlation coefficient	p
Tumor size	0.506	<0.001	0.444	<0.001
Lymph nodes	0.500	<0.001	0.422	<0.001
Clinical stage	0.619	<0.001	0.536	<0.001

Source: direct.

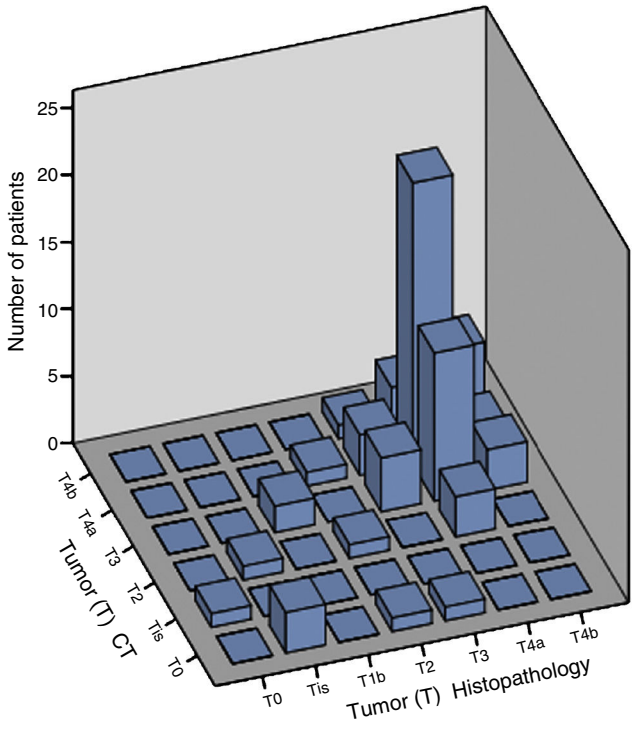

Figure 1 Bar graph representing the greater correlation between the preoperative tomographic staging and the definitive histopathologic results for T, in which the greater association is observed in the T4 stages. Source: direct.

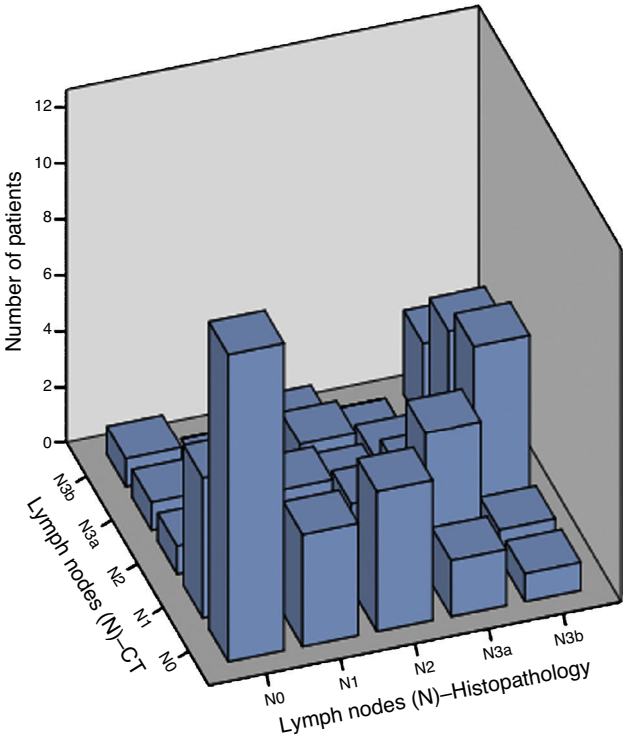

Figure 2 Bar graph representing the greater correlation between the preoperative tomographic staging and the histopathologic results for N, in which the greater association is observed in stages N0, N3a, and N3b. Source: direct.

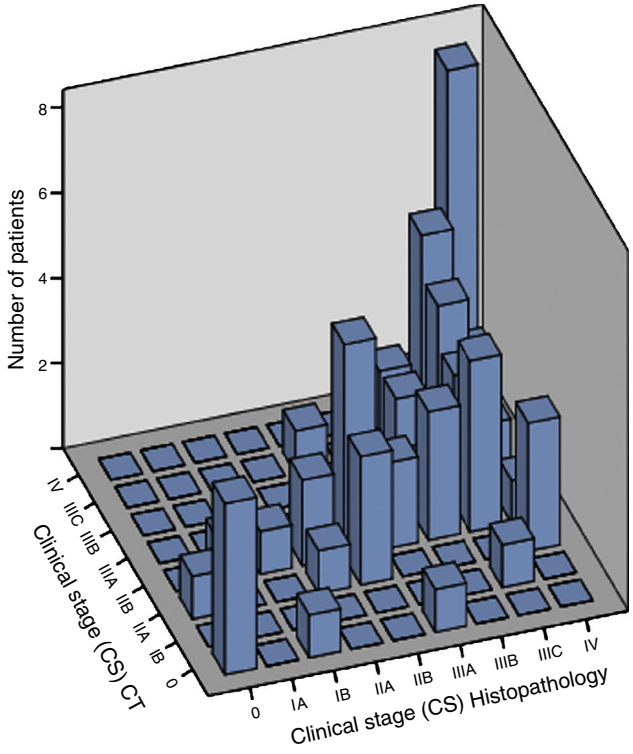

Figure 3 Bar graph representing the greater correlation between the preoperative tomographic staging and the histopathologic results for CS, in which the greater association is observed in CS 0, CS III, and CS IV. Source: direct.

procedure was 14 days, which reduced the risk for disease progression, limiting variation in our results.

Discussion

Today, gastric cancer is one of the neoplasias with the worst prognosis, given that the majority of patients are diagnosed at advanced stages of the disease. The treatment of choice continues to be surgical resection, either as a curative or palliative measure. CT is an indispensable tool for adequate preoperative staging and the development of multidetector CT has increased diagnostic accuracy for T and N.

Chen et al.[3] compared surgical and histopathologic results and reported an overall staging accuracy with multidetector CT for the T stage of 73.8% (T1 45.93%, T2 53.03%, T3 86.49%, and T4 85.79%) and an overall staging accuracy of the N stage of 75.22% (N0 76.17%, N1 68.81%, and N2 80.63%). In our study, values were higher for T and lower for N, with an overall accuracy for T of 83% (T0 96%, T1 94%, T2 93%, T3 67%, and T4 67%) and for N of 70% (N0 72%, N1 73%, N2 70%, and N3 66%). A relevant factor in the results was study interpretation. In our case series, it was carried out by an abdominal radiologist and in the Chen study each CT scan was interpreted by 2 radiologists that were unaware of the endoscopic findings.

In a study by Yan et al.,[9] they also compared surgical and histopathologic results, reporting an overall diagnostic accuracy through multidetector CT for T of 90.9% (560/616). Said accuracy increased for advanced stages (T4), with similar results to those of our case series.

In a 2014 Mexican study[10] on 27 patients that underwent surgery, the authors reported that CT sensitivity for T and N, compared with definitive histopathologic results, was 0% for T2, 53.8% for T3, and 40% for T4 and sensitivity for N was 61.5% for N0, 10% for N1, and 66.7% for N2. These results were lower than those of our study, in which sensitivity was 33% for T2, 44% for T3, and 65% for T4 and sensitivity for N was 58% for N0, 56% for N1, and 15% for N2. It should be mentioned that both studies were retrospective and 64-detector CT equipment was employed. In our study, there was no statistically significant difference between the study protocols (GastroCT vs contrast and non-contrast CT), which differs from that reported in the literature.[9] We believe this is due to advanced disease stage.

Sarela et al.[11] conducted a study on 657 patients diagnosed with potentially resectable gastric cancer that underwent staging laparoscopy. They found distant metastasis as an independent factor in 31% of the cases, with a greater metastasis prevalence in tumors of the gastroesophageal junction or that compromised the entire stomach, or when there were lymphadenopathies. The authors concluded that by using multidetector CT staging, laparoscopic staging can be avoided if the primary tumor is not in the gastroesophageal junction or involving the entire stomach, and if there are no abdominal lymphadenopathies.

Staging laparoscopy has been shown to be very useful in differentiating disease spread, compared with other modalities, but the difference is small. It is in those centers that have endoscopic ultrasound, making better decisions in cases of advanced gastric cancer possible, where 1,319 patients with gastric cancer have been seen over a 10-year period. In the oncologic surgery service of the *HCM*, laparoscopic gastrectomy and preoperative staging is carried out in some, but not all cases, which is why it was not analyzed in the present study. In addition, the incidence of gastric cancer in our hospital is 60 cases per year and on average 2 surgeons perform the work on those patients. Current tendencies have also shown that laparoscopic staging surgery in advanced gastric cancer with no peritoneal disease or ascites continues to be necessary, and basic treatment is always surgical.[12,13]

Positron emission tomography (PET) is not a first-line diagnostic procedure in gastric cancer, but it can play an important role in detecting distant metastasis to the liver, lungs, adrenal glands, ovaries, and bones. It can also be useful in the follow-up of patients undergoing chemotherapy, enabling the evaluation of early treatment response. There are studies that report significantly greater accuracy in preoperative staging by combining PET/CT (68%), compared with PET (47%) or CT (53%) alone.[14]

Conclusions

Multidetector CT is useful in gastric cancer staging. It has high diagnostic accuracy, especially in advanced-stage disease, thus reducing the need for staging surgery for the patient. Multidetector CT showed greater congruence in detecting stages T4, N0, and N3 in gastric cancer, compared with the definitive histopathologic results.

The mean time between multidetector CT and surgery was 14 days. Surgery should be carried out as soon as possible

after preoperative multidetector CT staging, because the correspondence between the CT report and the definitive histopathologic result can vary with the passing of time, due to the natural progression of the disease.

Ethical responsibilities

Protection of human and animal subjects. The authors declare that the procedures followed were in accordance with the regulations of the relevant clinical research ethics committee and with those of the Code of Ethics of the World Medical Association (Declaration of Helsinki).

Confidentiality of data. The authors declare that no patient data appear in this article.

Right to privacy and informed consent. The authors declare that no patient data appear in this article.

Conflict of interest

The authors declare that there is no conflict of interest.

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