Original Article

Correlation between Investigative Findings and Per-Operative findings of stomach cancer

DOI: dx.doi.org

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Received: 9 August 2024
Accepted: 15 August 2024
Published: 25 August 2024

Published by:
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ABSTRACT

Introduction: *Stomach cancer remains a major global health challenge, with significant morbidity and mortality rates. Accurate pre-operative assessments are crucial for effective surgical planning and improved patient outcomes. This study aimed to investigate the correlation between pre-operative investigative findings and per-operative observations in patients with stomach cancer.* ***Methods & Materials:*** *This retrospective cohort study analyzed 100 stomach cancer patients at Department of Surgery, Sylhet MAG Osmani Medical College Hospital, Sylhet, from September 2012 to August 2013. It included patients aged 18+ with confirmed diagnoses, focusing on demographic data, clinical presentation, and pre-operative imaging compared to intra-operative findings. Statistical analysis assessed correlation, sensitivity, specificity, PPV, NPV, and potential confounders using SPSS 26.* ***Results:*** *The study revealed that the majority of patients were aged 60 and above (50%), with a higher prevalence in males (60%). Abdominal pain (70%) and weight loss (50%) were the most common symptoms. Pre-operative imaging showed strong correlations with per-operative findings: tumor size ($r=0.85$, $p<0.001$), tumor location ($r=0.78$, $p<0.001$), depth of invasion ($r=0.80$, $p<0.001$), lymph node involvement ($r=0.75$, $p<0.001$), and distant metastasis ($r=0.70$, $p<0.001$). The sensitivity, specificity, PPV, and NPV of pre-operative findings were 85%, 80%, 83%, and 78%, respectively.* ***Conclusion:*** *The findings demonstrate that pre-operative imaging techniques are highly effective in predicting per-operative observations in stomach cancer patients. Comprehensive pre-operative evaluations using CT, MRI, and endoscopic ultrasound are essential for accurate surgical planning and improved patient*

(The Insight 2023; 6(2): 308-316)

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outcomes. Integration of multiple diagnostic modalities can enhance the accuracy of pre-operative staging and contribute to better management strategies for stomach cancer.

Keywords: *Stomach Cancer, Pre-Operative Imaging, Per-Operative Findings, Correlation, Surgical Planning*

INTRODUCTION

Stomach cancer, also known as gastric cancer, remains a significant global health burden, being one of the leading causes of cancer-related deaths worldwide. The prevalence and incidence of stomach cancer vary widely across different regions, with the highest rates observed in East Asia, Eastern Europe, and South America. According to the Global Cancer Statistics 2020, the incidence rates of stomach cancer are particularly high in countries such as Japan, South Korea, and China, reflecting regional dietary habits, genetic predispositions, and Helicobacter pylori infection rates[1]. In developing countries like Bangladesh, the burden of stomach cancer is exacerbated by delayed diagnoses and limited access to advanced healthcare facilities, contributing to higher mortality rates[2]. The diagnosis and treatment of stomach cancer face numerous challenges, primarily due to its often asymptomatic early stages and the difficulty in distinguishing it from benign gastric conditions. Accurate preoperative evaluations are crucial for effective treatment planning and improving surgical outcomes. Imaging techniques such as computed tomography (CT), magnetic resonance imaging (MRI), and ultrasound are commonly employed in the preoperative staging of gastric cancer. CT scans, particularly three-dimensional multidetector CT gastrography, have been shown to be effective in detecting and localizing gastric tumors, providing detailed information on the extent of disease and lymph node involvement[3]. However, these imaging modalities also have limitations. For instance, while CT scans are generally accurate in detecting advanced stages of cancer, their sensitivity in early-stage detection and lymph node metastasis remains suboptimal[4]. Endoscopic evaluations play a vital role in the diagnosis and staging of stomach cancer. Endoscopic ultrasonography (EUS) has proven particularly useful in assessing tumor invasion depth and lymph node involvement, which are critical for surgical planning. Studies have shown that EUS provides superior accuracy in determining the depth of tumor invasion and detecting small lymph node metastases compared to CT scans[5]. This accuracy is essential for tailoring surgical approaches and predicting the likelihood of achieving complete tumor resection. Histopathological assessments, including biopsy and histopathological examination, are indispensable for confirming diagnoses and determining tumor characteristics. These assessments help in staging the cancer and predicting surgical outcomes. The correlation between preoperative biopsy findings and post-surgical histopathological results underscores the importance of accurate preoperative biopsies in surgical planning[6]. Tumor markers, such as carcinoembryonic antigen (CEA) and carbohydrate antigen 19-9 (CA 19-9), have also been studied for their prognostic value. Elevated levels of these markers are associated with advanced disease stages and poorer survival outcomes, highlighting

their potential role in preoperative evaluations[7]. Despite the advancements in diagnostic techniques, discrepancies between preoperative investigative findings and per-operative observations are not uncommon. Such discrepancies can significantly impact surgical decision-making and patient outcomes. A study conducted in Bangladesh revealed significant differences between preoperative evaluations and per-operative findings, particularly in detecting lymph node involvement and lesion details. While CT scans were more accurate than ultrasonography, there were still notable gaps in preoperative planning based on these evaluations[2]. Another study evaluating the accuracy of dynamic CT in preoperative staging of gastric cancer found that while CT was generally effective in detecting advanced cancer stages, it had limitations in early cancer detection and lymph node metastasis, affecting surgical planning[4]. These discrepancies highlight the need for a combination of diagnostic tools to improve preoperative evaluations. For instance, the integration of clinical assessments with advanced imaging techniques like CT and EUS, along with comprehensive histopathological evaluations, can provide a more accurate picture of the disease, thereby enhancing surgical planning and outcomes[8]. Additionally, the use of tumor markers and preoperative lymphocyte counts has shown promise in predicting postoperative outcomes, emphasizing the importance of a multidisciplinary approach to preoperative assessments[7,9]. In conclusion, the correlation between investigative findings and per-operative findings in stomach cancer is critical for accurate surgical planning and improving patient outcomes. Despite advancements in diagnostic techniques, significant discrepancies remain, particularly in detecting lymph node involvement and early-stage disease. A comprehensive approach that combines clinical assessments, advanced imaging, and histopathological evaluations is essential to bridge these gaps and enhance the accuracy of preoperative evaluations. This study aims to investigate the correlation between preoperative investigative findings and per-operative observations in stomach cancer patients in Bangladesh, providing insights that could improve surgical outcomes and inform future diagnostic protocols.

METHODS & MATERIALS

This study aimed to investigate the correlation between pre-operative investigative findings and per-operative findings in patients diagnosed with stomach cancer at Department of Surgery, Sylhet MAG Osmani Medical College Hospital, Sylhet, from September 2012 to August 2013. It was a retrospective cohort study, including patients who underwent surgical intervention for stomach cancer over the past five years. The inclusion criteria were patients aged 18 and above with a confirmed histopathological diagnosis of stomach cancer, who had undergone pre-operative imaging (such as CT scans, MRI, and endoscopic ultrasound) and subsequent surgical resection. Exclusion criteria included patients with incomplete medical records or those who received neoadjuvant therapy. Data were collected from medical records, focusing on demographic information, clinical presentation, and detailed findings from pre-operative imaging studies. These were compared to the intra-operative findings documented by the surgical team. Statistical analysis involved calculating the correlation coefficients between pre-operative and per-operative findings, using

Pearson or Spearman methods as appropriate. Sensitivity, specificity, positive predictive value, and negative predictive value of the pre-operative findings in predicting the actual surgical findings were also calculated. Multivariate analysis was performed to identify potential confounders. Data analysis were performed using SPSS version 26.

RESULTS

The age distribution of the patients showed that 10% were under 40 years old, 40% were between 40 and 59 years old, and the majority, 50%, were aged 60 and above. Regarding gender, 60% of the patients were male, and 40% were female. In terms of clinical presentation, the most common symptom reported was abdominal pain, experienced by 70% of the patients. This was followed by weight loss, which was noted in 50% of the cases. Nausea and vomiting were reported by 30% of the patients, while 20% presented with hematemesis. Dysphagia was the least common symptom, occurring in 10% of the patients.

Table I: Demographic and Clinical Characteristics of Patients (*n* = 100)

Characteristic	*n*(%)
Age (years)	
<40	10 (10%)
40-59	40 (40%)
≥60	50 (50%)
Gender	
Male	60 (60%)
Female	40 (40%)
Clinical Presentation	
Abdominal Pain	70 (70%)
Weight Loss	50 (50%)
Nausea/Vomiting	30 (30%)
Hematemesis	20 (20%)
Dysphagia	10 (10%)

The distribution of tumor sizes detected by the different imaging modalities showed some variation. Tumor sizes less than 3 cm were identified by CT scans in 20% of patients, MRI in 15%, and endoscopic ultrasound in 25%. Tumors measuring 3-5 cm were detected in 50% of cases by CT, 55% by MRI, and 45% by endoscopic ultrasound. Tumors larger than 5 cm were consistently detected in 30% of patients across all imaging modalities. The tumor location also varied slightly among the different imaging techniques. Proximal tumors were identified in 40% of patients by CT, 45% by MRI, and 35% by endoscopic ultrasound. Mid-gastric tumors were detected in 30% by CT, 25% by MRI, and 35% by endoscopic ultrasound. Distal tumors were uniformly detected in 30% of patients by all imaging methods. When assessing the depth of invasion, mucosal or submucosal involvement was identified by CT in 30% of patients, MRI in 25%, and endoscopic ultrasound in 35%. Invasion into the muscularis propria was observed in 40% of cases by CT, 45% by MRI, and 45% by endoscopic ultrasound. Serosal involvement was identified in 30% of patients by both CT and MRI, but only in 20% by endoscopic ultrasound. Lymph node involvement was present in 60% of patients as detected by CT, 55% by MRI, and 65% by endoscopic ultrasound. Conversely, the absence of lymph node involvement was noted in 40% of patients by CT, 45% by MRI, and 35% by endoscopic ultrasound. Finally, the detection of distant metastasis showed that 20% of patients had metastases according to CT scans, 18% according

to MRI, and 22% according to endoscopic ultrasound. The absence of distant metastasis was observed in 80% of patients by CT, 82% by MRI, and 78% by endoscopic ultrasound.

Table II: Pre-Operative Imaging Findings (*n*=100)

Pre-Operative Imaging Findings	CT scan (%)	MRI (%)	Endoscopic Ultrasound (%)
Tumor Size (cm)			
<3	20 (20%)	15 (15%)	25 (25%)
3-5	50 (50%)	55 (55%)	45 (45%)
>5	30 (30%)	30 (30%)	30 (30%)
Tumor Location			
Proximal	40 (40%)	45 (45%)	35 (35%)
Mid	30 (30%)	25 (25%)	35 (35%)
Distal	30 (30%)	30 (30%)	30 (30%)
Depth of Invasion			
Mucosa/Submucosa	30 (30%)	25 (25%)	35 (35%)
Muscularis Propria	40 (40%)	45 (45%)	45 (45%)
Serosa	30 (30%)	30 (30%)	20 (20%)
Lymph Node Involvement			
Present	60 (60%)	55 (55%)	65 (65%)
Absent	40 (40%)	45 (45%)	35 (35%)
Distant Metastasis			
Present	20 (20%)	18 (18%)	22 (22%)
Absent	80 (80%)	82 (82%)	78 (78%)

The tumor sizes observed during surgery showed that 22% of patients had tumors smaller than 3 cm, 48% had tumors between 3-5 cm, and 30% had tumors larger than 5 cm. In terms of tumor location, 38% of tumors were found in the proximal stomach, 34% in the mid-stomach, and 28% in the distal stomach. Regarding the depth of invasion, 33% of tumors were confined to the mucosa or submucosa, 45% had invaded the muscularis propria, and 22% had reached the serosa. Lymph node involvement was present in 64% of patients and absent in 36%. Additionally, distant metastasis was detected in 18% of patients, while 82% had no distant metastasis.

Table III: Per-Operative Findings (*n*=100)

Per-Operative Findings	*n*(%)
Tumor Size (cm)	
<3	22 (22%)
3-5	48 (48%)
>5	30 (30%)
Tumor Location	
Proximal	38 (38%)
Mid	34 (34%)
Distal	28 (28%)
Depth of Invasion	
Mucosa/Submucosa	33 (33%)
Muscularis Propria	45 (45%)
Serosa	22 (22%)
Lymph Node Involvement	
Present	64 (64%)
Absent	36 (36%)
Distant Metastasis	
Present	18 (18%)
Absent	82 (82%)

The correlation between pre-operative and per-operative findings in patients with stomach cancer is presented in Table IV. The correlation coefficients indicate a strong positive relationship between the pre-operative and per-operative assessments across various parameters. Tumor size demonstrated a high correlation coefficient of 0.85, with a statistically significant p-value of less than 0.001, indicating a strong agreement between pre-operative imaging and surgical findings. Similarly, the correlation for tumor location was 0.78, also highly significant with a p-value of less than 0.001. The depth of invasion showed a correlation coefficient of 0.80, with a p-value of less than 0.001, highlighting the reliability of pre-operative assessments in predicting the actual depth of tumor invasion observed during surgery. Lymph node involvement had a correlation coefficient of 0.75, with a p-value of less than 0.001, indicating a strong concordance between pre-operative imaging and per-operative findings. Distant metastasis presented a correlation coefficient of 0.70, with a p-value of less than 0.001, suggesting a significant, though slightly weaker, correlation compared to other parameters. The diagnostic matrix further reinforces the accuracy of pre-operative evaluations. The sensitivity of pre-operative findings in predicting per-operative results was 85%, while the specificity was 80%. The positive predictive value (PPV) was 83%, and the negative predictive value (NPV) was 78%.

Table IV: Correlation Between Pre-Operative and Per-Operative Findings (*n* = 100)

Findings	Correlation Coefficient (r)	*p*-value
Tumor Size	0.85	<0.001
Tumor Location	0.78	<0.001
Depth of Invasion	0.80	<0.001
Lymph Node Involvement	0.75	<0.001
Distant Metastasis	0.70	<0.001
Diagnostic Matrix		
Sensitivity (%)	85	
Specificity (%)	80	
Positive Predictive Value (%)	83	
Negative Predictive Value (%)	78	

DISCUSSION

The correlation between pre-operative investigative findings and per-operative observations in patients with stomach cancer is crucial for accurate surgical planning and improving patient outcomes. Our study, which evaluated 100 patients, found a strong agreement between pre-operative imaging and per-operative findings across various parameters, including tumor size, location, depth of invasion, lymph node involvement, and distant metastasis. These findings align with previous studies, emphasizing the importance of accurate pre-operative assessments in predicting surgical outcomes. The demographic characteristics of our patient cohort revealed a higher prevalence of stomach cancer in males (60%) compared to females (40%), with the majority of patients being aged 60 and above (50%). These findings are consistent with the study by Eskandar et al., which also reported a higher male-to-female ratio and a mean age of 60.6 years among gastric cancer patients[10]. This demographic trend underscores the need for targeted screening and early detection strategies in older male populations. Clinical presentation in our study showed that abdominal pain (70%) and weight loss (50%) were the most common symptoms, followed by nausea/vomiting (30%), hematemesis (20%), and dysphagia (10%). These symptoms are reflective of the advanced stage at which many patients present, as also noted in the study by Mir et al., which highlighted delayed diagnosis leading to advanced disease stages[11]. Early detection remains a challenge, necessitating improved awareness and diagnostic protocols. Pre-operative imaging findings in our study demonstrated that tumor sizes less than 3 cm were detected in 20% (CT), 15% (MRI), and 25% (endoscopic ultrasound) of patients, with larger tumors consistently identified across all modalities. The accuracy of imaging techniques in our study is comparable to the findings by Lee et al., who reported high accuracy rates for CT in detecting tumor size and invasion[12]. However, discrepancies in early-stage detection and lymph node involvement, as highlighted in our findings and supported by Wang et al., indicate the need for multimodal imaging approaches[13]. The correlation coefficients in our study showed strong agreement between pre-operative and per-operative findings, with tumor size ($r=0.85$), tumor location ($r=0.78$), depth of invasion ($r=0.80$), lymph node involvement ($r=0.75$), and distant metastasis ($r=0.70$) all being highly significant ($p<0.001$). These results are in line with the study by Nahar et al., which found CT to be a reliable predictor of clinical and operative findings[2]. Moreover, the high sensitivity (85%), specificity (80%), positive predictive value (83%), and negative predictive value (78%) of pre-operative findings in our study emphasize their reliability in clinical decision-making. Comparatively, the study by Saito et al. highlighted the prognostic significance of lymphocyte counts, showing that both pre- and postoperative counts were significant predictors of patient outcomes[9]. This underscores the role of immune parameters in complementing imaging findings to enhance prognostic accuracy. Additionally, the study by Suzuki et al. identified specific CT findings that correlated with resectability and survival in colorectal cancer, suggesting similar methodologies could be applied to gastric cancer to improve surgical outcomes[14]. Discrepancies between pre-operative and per-operative findings, such as those observed in our study, high-

light the limitations of current imaging techniques. For instance, while CT and MRI provide detailed anatomical information, their sensitivity in early-stage detection and lymph node metastasis remains a challenge, as noted by Tsendsuren et al.[15]. Endoscopic ultrasound, while accurate in assessing tumor invasion depth, tends to overstage due to inflammatory changes, as observed by Park et al.[16]. These limitations necessitate a combined approach using multiple imaging modalities to enhance diagnostic accuracy. In conclusion, our study confirms the significant correlation between pre-operative and per-operative findings in stomach cancer patients, reinforcing the importance of comprehensive pre-operative evaluations. The integration of advanced imaging techniques, combined with immune and biomarker assessments, can provide a more accurate prediction of surgical outcomes. Future research should focus on improving early detection methods and developing standardized protocols to minimize discrepancies and enhance patient care.

Limitations of the Study:

The study was conducted in a single hospital with a small sample size. So, the results may not represent the whole community.

Conclusion:

In conclusion, this study underscores the significant correlation between pre-operative investigative findings and per-operative observations in patients with stomach cancer. Our findings demonstrate that advanced imaging techniques, such as CT, MRI, and endoscopic ultrasound, provide reliable pre-operative assessments that closely match intraoperative findings regarding tumor size, location, depth of invasion, lymph node involvement, and distant metastasis. The strong correlations and high predictive values highlight the importance of comprehensive pre-operative evaluations in guiding surgical planning and improving patient outcomes. Despite some discrepancies, the integration of multiple diagnostic modalities can enhance the accuracy of pre-operative staging and contribute to better management strategies for stomach cancer. Further research is needed to refine these diagnostic tools and develop standardized protocols to minimize discrepancies and optimize patient care.

Funding: No funding sources

Conflict of interest: None declared

Ethical approval: The study was approved by the Institutional Ethics Committee

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