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Original Article

DIAGNOSTIC EFFICACY OF CT SCAN AND ULTRASONOGRAPHY IN IDENTIFYING HEPATIC METASTASES FROM GI CANCERS: A HISTOPATHOLOGICAL PERSPECTIVE

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Abstract:

Background: *Hepatic metastases are common in advanced gastrointestinal (GI) tract cancers and significantly influence staging, treatment decisions, and prognosis. Accurate detection is therefore critical, with ultrasonography (USG) and computed tomography (CT) being widely used diagnostic modalities. While USG is cost-effective and accessible, CT is often considered superior in lesion detection and characterization. The aim of this study was to evaluate and compare the diagnostic efficacy of USG and CT in detecting hepatic metastases from GI tract cancers, using histopathology as the reference standard.*

Methods: *This cross-sectional study was conducted in the Department of Radiology and Imaging, Bangabandhu Sheikh Mujib Medical University (BSMMU) from October, 2018 to September, 2019. Total 50 adult patients with suspected hepatic metastases from diagnosed case of GIT cancer and patients undergoing surgery were included in this study.*

Result: *The mean age was 57.9 years, with most patients aged 50–59 (34%) and predominantly male (66%). Histopathology confirmed hepatic metastases in 94% of cases. USG achieved a sensitivity of 89.36%, specificity of 66.67%, accuracy of 88%, PPV of 97.67%, and NPV of 28.57%. CT demonstrated superior sensitivity (95.74%), specificity (83.33%), accuracy (94.34%), PPV (97.83%), and NPV (71.43%). A significant association between CT and USG findings was observed (p = 0.001), though CT showed fewer false negatives.*

Conclusion: *CT outperformed USG in detecting hepatic metastases from GI cancers, particularly in specificity and NPV, making it more reliable for ruling out disease. USG remains a valuable initial screening tool, with its diagnostic yield potentially improved through contrast enhancement.*

Keywords:
Diagnostic Efficacy, CT Scan, Ultrasonography, Hepatic Metastases, GI Cancers, and Histopathological Perspective.

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Introduction

Gastro Intestinal (GI) cancers, like colorectal, gastric, and pancreatic cancers, are a major health burden worldwide and rank among the leading causes of mortality due to cancer globally. Singh[1] reported that colorectal cancers are almost 10% of the total new cancers globally; gastric and pancreatic cancers are also increasing in their malignant nature and dismal prognosis. The most striking feature of these cancers is their propensity to spread to the liver. The liver is the most common place for metastasis, particularly in colorectal cancer, where 50%–70% of patients develop hepatic metastases during the course of the disease[2]. The presence of liver metastases significantly impacts clinical practice, particularly stage, prognosis, and treatment selection. Early diagnosis of hepatic metastases not only enhances the likelihood of curative surgical resection but also the survival rate, whereas postponed or inaccurate diagnosis might leave the patients to be exposed to palliative treatment pathways[3,4].

The size, number, and pattern of hepatic metastases are important factors in the resectability and suitability for potentially curative therapy. Advancements in resection methods and surgery have expanded the resectability criteria but resection largely relies on

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accurate and timely imaging-based diagnosis[5]. Non-invasive imaging modalities such as contrast-enhanced computed tomography (CECT), ultrasonography (US), magnetic resonance imaging (MRI), and positron emission tomography (PET-CT) form the foundation of metastatic evaluation. CECT is most used due to its availability and high anatomical resolution, while ultrasound, including contrast-enhanced ultrasound and intraoperative ultrasound (IOUS), is real-time and with no radiation burden. Contrast-enhanced ultrasound, of particular note, excels in vascular-phase imaging, with improved diagnostic yield over grayscale B-mode ultrasonography[6].

CT, while most common for identifying liver metastases, may miss small (<1 cm) or isodense lesions in patients with hepatic steatosis or cirrhosis that compromise contrast uptake and lesion visibility[7,8]. Similarly, ultrasonography is dependent on the operator, with sensitivity of 36% to 69% that can vary by level of experience and equipment quality[9]. Although contrast-enhanced ultrasound holds potential for the improvement of ultrasonography's diagnostic capability, inconsistency remains for its comparative performance when compared with CT and MRI[10].

Above all else, regardless of the imaging device involved, histopathologic verification remains the unmitigated gold standard for hepatic metastases diagnosis. Imaging findings, even though suggestive, are best validated by histology, obtained via biopsy, surgical specimen, or autopsy to establish true diagnostic precision[11]. Discrepancies between imaging and histopathology, such as false positives or false negatives, may lead to classification errors in disease extent and erroneous decisions regarding therapy. These misclassifications can result in unnecessary surgery or failure to include patients in curative-intent treatment[12,13].

Despite the important roles of CT and ultrasonography in current practice, considerable variability does exist in reported estimates of sensitivity and specificity for both modalities, particularly against histologic endpoints. For example, Kinkel et al.[9] reported that there was considerable variation in studies' diagnostic performance indices, which emphasized the effect of patient variables, imaging technology, and operator expertise.

With this background, this study aims to compare and evaluate the diagnostic accuracy of computed tomography (CT) and ultrasonography (US) against histopathology as the reference standard for detecting hepatic metastases of gastrointestinal malignancies.

Objectives

To evaluate and compare the diagnostic efficacy of USG and CT in detecting hepatic metastases from GI tract cancers, using histopathology as the reference standard.

Materials and Methods

This cross-sectional study was conducted in the Department of Radiology and Imaging, Bangladesh Medical University (BMU) from October, 2018 to September, 2019. A total of 50 adult patients with suspected hepatic metastases from diagnosed case of GIT cancer and patients undergoing surgery were included in this study. Inclusion criteria encompassed patients with confirmed GI tract malignancies referred for metastatic liver evaluation who had undergone both imaging modalities and for whom histopathological correlation was available via biopsy, surgical specimen, or intraoperative findings. Exclusion criteria included pregnant patients, those with prior hepatic surgery or metastasis-targeted therapy, renal insufficiency precluding contrast administration, or incomplete imaging or clinical datasets. All participants underwent both abdominal ultrasonography and contrast-enhanced CT as part of their metastatic workup. Ethical approval was obtained from the institutional review board, and informed written consent was secured from all subjects prior to inclusion. Ultrasonography was performed using a high-resolution real-time B-mode scanner equipped with 3.5–5 MHz convex transducers. The liver was evaluated in multiple planes to identify any focal hepatic lesions, with documentation of their number, size, echotexture, and segmental distribution. Contrast-enhanced CT scans were conducted using a multidetector CT scanner following a triphasic protocol—comprising non-contrast, arterial, and portal venous phases. Intravenous iodinated contrast medium was administered at a dose of 1.5 mL/kg. The entire liver was examined for the presence of hypodense or enhancing lesions, and findings were analyzed with respect to size, location, margins, and enhancement patterns. Histopathological diagnosis served as the reference standard. Sensitivity, specificity, positive predictive value (PPV), negative predictive value (NPV), and overall diagnostic accuracy were calculated for both ultrasonography and CT. Statistical analysis was performed using Statistical Package for Social Sciences version 22.0 and p-values < 0.05 were considered statistically significant.

Results:

Table I presents the baseline characteristics of the study population. The mean age of participants was 57.9 ±

17.8 years, with a range from 26 to 85 years. The most common age group was 50–59 years, comprising 34.0% of patients, followed by 60–69 years (26.0%). Males predominated, representing 66.0% of the cohort, while females accounted for 34.0%. The majority of patients (82.0%) reported a symptom duration of 2–6 months, with a mean duration of 5.19 ± 1.51 months. Only 14.0% had symptoms persisting beyond six months, and 4.0% did not specify duration. Table 2 summarizes the distribution of diagnoses based on ultrasonography (USG). Metastatic lesions were the most common finding, detected in 86.0% of cases. Benign hepatic lesions were less frequent, including haemangioma (6.0%), cysts (4.0%), focal nodular hyperplasia (2.0%), and focal fat-sparing areas (2.0%). Table 3 shows the distribution of diagnoses based on computed tomography (CT). CT detected metastatic lesions in 92.0% of cases, a higher proportion compared to USG. Haemangiomas (4.0%), cysts (2.0%), and abscesses (2.0%) accounted for the remaining diagnoses. Table 4 details the histopathological diagnoses, which served as the reference standard. Metastatic lesions were confirmed in 94.0% of patients, while haemangioma and cyst were confirmed in 4.0% and 2.0% of cases, respectively. Table 5 compares USG findings with histopathological results. USG correctly identified 42 true-positive cases and 2 true-negative cases. There was 1 false-positive and 5 false-negative results, yielding a total of 43 USG-positive and 7 USG-negative cases when compared to histology. Table 6 presents the comparison of CT findings with histopathology. CT correctly identified 45 true-positive cases and 2 true-negative cases. Similar to USG, there was 1 false-positive finding; however, CT had only 2 false negatives, resulting in 46 CT-positive and 4 CT-negative cases against histopathological confirmation. Table 7 compares USG with CT findings. Among 46 CT-diagnosed metastatic cases, 42 (97.7%) were also classified as metastatic by USG, whereas 4 (57.1%) of 7 USG "other" diagnoses corresponded to CT "other" diagnoses. Statistical analysis using the Chi-square test revealed a significant association between the two modalities (p = 0.001), indicating substantial but not complete agreement between CT and USG for diagnosing hepatic metastases. Figure 1 illustrates the comparative diagnostic performance of ultrasonography (USG) and computed tomography (CT) in evaluating hepatic metastases from gastrointestinal tract cancers, as assessed by sensitivity, specificity, accuracy, and predictive values. CT outperformed USG across most parameters, demonstrating a higher sensitivity (95.74% vs. 89.36%) and markedly better specificity (83.33% vs. 66.67%). Overall diagnostic accuracy was also superior for CT (94.34%) compared to USG (88%). Both modalities achieved similarly high positive predictive values, with CT at 97.83% and USG at 97.67%, indicating strong reliability in confirming metastatic disease when detected. However, a notable difference was observed in negative predictive value, where CT reached 71.43%, substantially exceeding USG's 28.57%, reflecting CT's greater ability to correctly exclude metastases in negative cases. These findings highlight CT's advantage as a more sensitive and specific modality with a significantly better capacity for ruling out disease compared to USG.

Table-I

Baseline characteristics of the study patients (N=50)

Characteristics	Number of Patients	Percentage
Age Group (years)		
26–29	3	6.00%
30–39	4	8.00%
40–49	7	14.00%
50–59	17	34.00%
60–69	13	26.00%
70–79	4	8.00%
80–85	2	4.00%
	Mean ± SD 57.9 ± 17.8	
Range	26–85 years	
Sex		
Male	33	66.00%
Female	17	34.00%
Duration (months)		
2–6	41	82.00%
>6	7	14.00%
Not specified	2	4.00%
Mean ± SD	5.19 ± 1.51	
Range	2–9 months	

Table -II

Distribution of the study patients by USG diagnosis (N=50)

Diagnosis	Number of Patients	Percentage
Metastatic Lesions	43	86.0%
Haemangioma	3	6.0%
Cyst	2	4.0%
Focal Nodular Hyperplasia (FNH)	1	2.0%
Focal Fat Sparing Area	1	2.0%

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Table-III

Distribution of the study patients by CT diagnosis (N=50)

Diagnosis	Number of Patients	Percentage
Metastatic	46	92.0%
Haemangioma	2	4.0%
Cyst	1	2.0%
Abscess	1	2.0%

Table-IV

Distribution of the study patients by Histopathological diagnosis (N=50)

Diagnosis	Number of Patients	Percentage
Metastatic	47	94.0%
Haemangioma	2	4.0%
Cyst	1	2.0%

Table-V

Comparison between USG finding with histopathological diagnosis of hepatic metastases from gastrointestinal tract cancer (N=50)

USG	Histopathology		Total
	Positive (n=47)	Negative (n=3)	
USG Positive	42 (True Positive)	1 (False Positive)	43
USG Negative	5 (False Negative)	2 (True Negative)	7

Table-VI

Comparison between CT finding with histopathological diagnosis of hepatic metastases from gastrointestinal tract cancer (N=50)

CT findings	Histopathology		Total
	Positive (n=47)	Negative (n=3)	
USG Positive	45 (True Positive)	1 (False Positive)	46
USG Negative	2 (False Negative)	2 (True Negative)	4

Table-VII

Comparison between USG with CT diagnosis of the study patients (N=50)

CT Diagnosis	USG		p-value
	Metastatic (n=43)	Other (n=7)	
Metastatic (n=46)	42 (97.7%)	4 (57.1%)	0.001^{s}
Other (n=4)	1 (2.3%)	3 (42.9%)	

s=significant

p value reached from Chi-square test

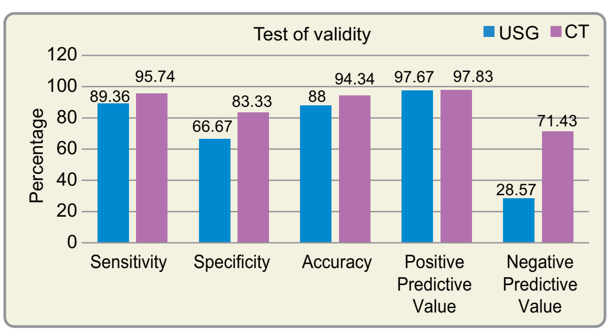

Figure 1: *Bar diagram showing Sensitivity, specificity, accuracy, positive and negative predictive values of USG and CT scan in the evaluation of hepatic metastases from gastrointestinal tract cancer.*

Discussion

The current study was conducted to evaluate the diagnostic efficacy of USG and CT in detecting hepatic metastases from GI tract cancers, using histopathology as the reference standard. In the present study, the demographic profile of patients with hepatic metastases from gastrointestinal (GI) cancers showed a mean age of 57.9 years, with the largest proportion belonging to the age group 50–59 years. This age distribution is consistent with previous reports highlighting that liver metastases from GI malignancies, particularly colorectal cancer, predominantly occur in the sixth and seventh decades of life[14]. The male predominance in our cohort (66%) mirrors findings in multiple series, where male patients exhibit higher prevalence, partly attributable to the epidemiological patterns of primary GI cancers[15]. The mean symptom duration of 5.19 months in our series is also within the range reported in clinical oncology cohorts, reflecting a relatively short interval between onset and diagnosis, which is critical for timely therapeutic decision-making[16].

Ultrasonography (USG) in our study detected metastatic lesions in 86% of cases, with benign hepatic lesions such as haemangioma, cyst, focal nodular hyperplasia (FNH), and focal fat-sparing comprising the remainder. This distribution is comparable to the findings of Freitas et al.[17], who noted that while metastases dominate the imaging landscape in oncologic patients, benign lesions remain important differentials.

By contrast, computed tomography (CT) in our series identified metastatic lesions in 92% of cases, a higher proportion than USG, and correctly identified 45 true positives with only 2 false negatives when compared with histopathology. This performance is in line with the results reported by Valls et al.[15], who observed that helical CT achieved an 85% detection rate for histologically confirmed metastases, with a high positive predictive value (~96%) and minimal false-positive rates. In our study, benign lesions on CT included haemangiomas, cysts, and abscesses, paralleling the spectrum of incidental findings noted in other imaging-based liver studies[17].

Histopathology confirmed metastases in 94% of patients, reinforcing its role as the gold standard for diagnostic accuracy. Our USG–histopathology comparison revealed 42 true positives, 2 true negatives, 1 false positive, and 5 false negatives, underscoring the limitations of baseline USG for comprehensive lesion detection. These limitations, particularly in detecting small or isoechoic lesions, have been well documented[16]. CT demonstrated superior diagnostic performance, with 45 true positives, 2 true negatives, 1 false positive, and only 2 false negatives. This finding aligns with previous comparative studies showing CT's higher sensitivity and accuracy for hepatic metastases detection, especially when multiphasic contrast protocols are used[14].

When comparing CT and USG directly, we found that 97.7% of CT-diagnosed metastatic cases were also classified as metastatic by USG, with a statistically significant association between the modalities ($p = 0.001$). This high level of agreement, though not perfect, echoes the substantial concordance reported in other modality comparison studies[14]. Discrepancies in classification—where USG diagnosed benign lesions that were metastatic on CT—may be attributable to USG's operator dependence and lower sensitivity for deep or subdiaphragmatic lesions[17].

The integration of contrast-enhanced ultrasonography has been shown to markedly improve lesion detection and characterization, narrowing the performance gap between USG and CT. Piscaglia et al.[16] demonstrated that contrast-enhanced ultrasound approaches CT's sensitivity for detecting metastases, suggesting that the incorporation of contrast-enhanced ultrasound in preoperative workups could further reduce false-negative rates, as observed in our study.

Our findings demonstrate that CT was better than USG in most of the diagnostic parameters, with higher sensitivity (95.74% vs. 89.36%), specificity (83.33% vs. 66.67%), and overall accuracy (94.34% vs. 88%). Both modalities yielded comparable positive predictive values (PPV) of approximately 98% but CT had a much better negative predictive value (NPV) of 71.43% compared with 28.57% for USG. Such a difference underscores the greater reliability of CT for excluding hepatic metastasis in the event of negative imaging results. Pooled sensitivities of 74–83% for CT and 57–70% for US in detecting hepatic metastases from GI malignancies were noted by Kinkel et al.[9] (2002), with CT having consistently higher specificity and diagnostic accuracy. Our 94% histopathology-proven metastasis concurs with the literature in which the liver was the most frequent location for metastasis in GI cancer, more particularly colorectal cancer. In a head-to-head diagnostic accuracy study, Hanna et al.[18] noted that while US, CT, and MRI all had excellent PPVs for liver lesions, CT and MRI maintained excellent NPVs, reflecting the advantage of cross-sectional imaging in negative or indeterminate examinations. On direct comparison of CT and USG findings, our study demonstrated substantial agreement ($p = 0.001$), with USG detecting 97.7% of CT-diagnosed metastatic cases correctly. This concurs with the report of Tsili et al.[7] and Kinkel et al.[9], who both highlighted the superiority of CT in demonstrating lesion morphology and vascular enhancement patterns, particularly when contrast was used.

In summary, the diagnostic efficacy observed in our study aligns closely with published literature, underscoring CT's superiority over USG, the importance of histopathology as the reference standard, and the potential role of contrast-enhanced ultrasound in enhancing ultrasonographic detection. Future studies with larger cohorts and inclusion of advanced imaging modalities may further refine diagnostic algorithms for hepatic metastases from GI cancers.

Conclusion

This study concludes that computed tomography demonstrated superior diagnostic performance over ultrasonography in detecting hepatic metastases from gastrointestinal cancers, with higher sensitivity, specificity, accuracy, and negative predictive value. While both modalities achieved comparable positive predictive values, CT more reliably excluded disease in negative cases. Histopathology confirmed metastases in the majority, validating imaging results. These findings support CT as the preferred modality for comprehensive evaluation, while USG remains valuable as a first-line, accessible screening tool, especially in resource-limited settings. In suspected case of hepatic metastases from gastrointestinal tract cancer CT scan may be recommended as a routine procedure. However, further study can be undertaken with large number of patients

Limitations of the study

In our study, there was small sample size. Study population was selected from one center in Dhaka city, so may not represent wider population. The study was conducted at a short period of time. There was risk of hypersensitivity of contrast media. As bowel preparation was not given to patients, so interpretation was difficult in some cases.

Conflict of interest:

None to disclose.

Ethical approval: Approved by the IRB, Bangladesh Medical University, Shahbagh, Dhaka.

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