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ORIGINAL ARTICLE

Evaluation of hepatic mass on ultrasound keeping triphasic multi detector computed tomography as gold standard.

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ABSTRACT… Objective: To evaluate the diagnostic performance of ultrasound in identifying hepatic mass using triphasic multi-detector computed tomography (MDCT) as the gold standard. **Study Design:** Prospective Observational, Validation study. **Setting:** Department of Radiology, Combined Military Hospital, Gujranwala, Pakistan. **Period:** January 2024 to December 2024. **Methods:** The inclusion criteria were age between 18-80 years, and presenting with focal hepatic lesions greater than 2 cm in size (as per ultrasound). All patients subsequently underwent triphasic MDCT of the liver within a maximum of two weeks of the initial ultrasound. Sensitivity, specificity, positive predictive value (PPV), negative predictive value (NPV), and accuracy of ultrasound compared to triphasic MDCT, were calculated. Receiver operating characteristics curves were drawn to calculate area under the curve (AUC) with 95% confidence interval. All statistical analyses were performed using IBM-SPSS Statistics, version 26.0. **Results:** In a total of 64 patients, 41 (64.1%) were males and 23 (35.9%) females. The mean age was 47.27±17.02 years, ranging between 18-80 years. Ultrasonography identified hepatic mass in 25 (39.1%) cases. The MDCT revealed positive findings for hepatic mass in 25 (39.1%) cases. Sensitivity, specificity, PPV, NPV, and accuracy of ultrasonography findings with respect to MDCT in diagnosing hepatic mass were 88.0%, 92.3%, 88.0%, 92.3%, and 90.6%, respectively. ROC curve analysis of ultrasonography findings taking MDCT as gold standard in diagnosing hepatic mass showed AUC as 0.902 with 95% CI of 0.813-0.990, $p<0.001$. **Conclusion:** The ultrasonography demonstrates high sensitivity and positive predictive value in detecting hepatic lesions, and serves as a valuable first-line modality.

Key words: Computed Tomography, Hemangioma, Hepatocellular Carcinoma, Liver Abscess, Ultrasonography.

INTRODUCTION

Liver lesions, also known as hepatic space-occupying lesions (SOLs), are commonly encountered in clinical practice. Studies estimate that up to 30% of individuals over the age of 40 develop hepatic SOLs at some point in their lives.[1] These lesions may arise due to abnormal proliferation of hepatic cells and can vary widely in nature, from benign cysts and hemangiomas to malignant tumors such as hepatocellular carcinoma (HCC) or metastatic deposits.[2,3]

Most hepatic SOLs are benign and asymptomatic, discovered incidentally during imaging for unrelated conditions.[4] Some lesions may present with non-specific symptoms such as nausea, hepatosplenomegaly, or jaundice.[5] If left untreated, certain SOLs may progress to liver failure or liver cancer, underscoring the importance of accurate and timely diagnosis.[6] Liver masses can appear cystic, solid, or heterogeneous in character, and while many resolve spontaneously, others may require medical or surgical intervention.[7] The etiology of hepatic SOLs is diverse, including chronic liver disease, cirrhosis, viral hepatitis (HBV, HCV), excessive alcohol consumption, exposure to toxins, or even congenital factors.[8,9]

Among malignant hepatic lesions, HCC is the most common primary tumor, particularly in patients with chronic liver disease.[10] Given the wide spectrum of hepatic lesions, imaging plays a pivotal role in their detection and characterization. While gray-scale ultrasound is widely used as a first-line, non-invasive, and cost-effective modality for initial assessment,

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it may lack specificity in differentiating benign from malignant lesions.[11] Triphasic multi detector computed tomography (MDCT) offers superior diagnostic accuracy and is considered the gold standard for characterizing hepatic masses based on vascular enhancement patterns.[12] This study aims to evaluate the diagnostic performance of ultrasound in identifying hepatic masses, using triphasic MDCT as the gold standard.

METHODS

This prospective observational, validation study was conducted at the department of Radiology, Combined Military Hospital, Gujranwala, Pakistan from January 2024 to December 2024. Approval from Institutional Ethics Committee was obtained (ERB NO. 25-2023, dated: 20-02-2023). Informed and written consents were taken from all study participants explaining them the aims and methods involved in this study. Considering the diagnostic accuracy of USG taking CT as gold standard as 95.7%[13], with 95% confidence level, and 5% margin of error, the sample size was calculated to be 64. Non-probability, consecutive sampling technique was applied. The inclusion criteria were any gender, aged between 18 to 80 years, and presenting with focal hepatic lesions greater than 2 cm in size, detected on baseline ultrasound examination. Patients with lesions smaller than 2 cm, those under 18 years of age, and individuals with contraindications to contrast-enhanced imaging were excluded from the study.

Each patient underwent a comprehensive gray-scale abdominal ultrasound using a high-frequency transducer, performed by an experienced radiologist with at least five years of hepatobiliary imaging experience. All patients subsequently underwent triphasic MDCT of the liver within a maximum of two weeks of the initial ultrasound. The CT protocol included arterial, portal venous, and delayed phases, and images were reviewed independently by a second radiologist blinded to the ultrasound findings. Lesions were classified according to the “Liver Imaging Reporting and Data System (LI-RADS)”. The MDCT findings were considered the diagnostic gold standard for hepatic mass. Data were collected on a specially made proforma. Descriptive statistics were used to summarize patient demographics and age. Sensitivity, specificity, positive predictive value (PPV), negative predictive value (NPV), and diagnostic accuracy of ultrasound compared to triphasic CT, were calculated. Receiver operating characteristics curves were drawn to calculate area under the curve (AUC) with 95% confidence interval. All statistical analyses were performed using IBM-SPSS Statistics, version 26.0.

RESULTS

In a total of 64 patients, 41 (64.1%) were males and 23 (35.9%) females. The mean age was 47.27±17.02 years, ranging between 18-80 years. There were 49 (76.6%) patients who were aged between 18-60 years. Ultrasonography identified hepatic mass in 25 (39.1%) cases. The MDCT revealed positive findings for hepatic mass in 25 (39.1%) cases. Sensitivity, specificity, PPV, NPV, and accuracy of ultrasonography findings with respect to MDCT in diagnosing hepatic mass were 88.0%, 92.3%, 88.0%, 92.3%, and 90.6%, respectively (Table-I).

Ultrasonography Findings	Multi Detector Computed Tomography		Total
	Positive	Negative	
Positive	22 (True positive)	3 (False positive)	25
Negative	3 (False negative)	36 (True negative)	39
Total	25	39	64

Table-I. Diagnostic utility of ultrasonography findings taking MDCT as gold standard in diagnosing hepatic mass (N=64)

Figure-1 is showing a 25-year old male with h/o RTA, liver laceration one years back, follow up usg shows multiple intra hepatic cystic lesions which later on confirmed on Triphasic MDCT ABD, showing fluid density non enhancing well defined SOLs liver, consistent with simple hepatic cysts.

ROC curve analysis of ultrasonography findings taking MDCT as gold standard in diagnosing hepatic mass showed AUC as 0.902 with 95% CI of 0.813-0.990, $p<0.001$ (Figure-2).

ROC curve analysis analyzing ultrasonography findings with respect to age distribution taking

MDCT as gold standard in diagnosing hepatic mass showing AUC difference -0.069 with 95% CI of -0.231 to 0.093, p=0.405 (Figure-3).

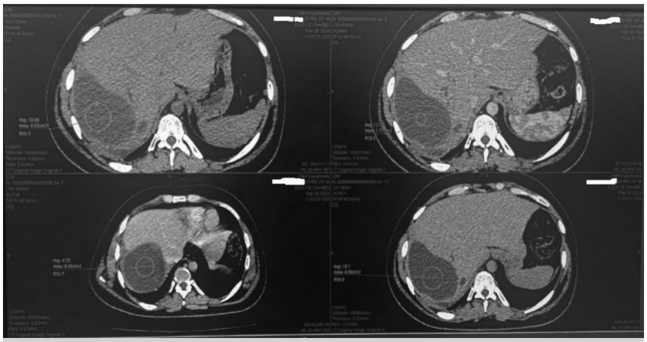

Figure-1. Fluid density non enhancing well defined space occupying lesions of liver

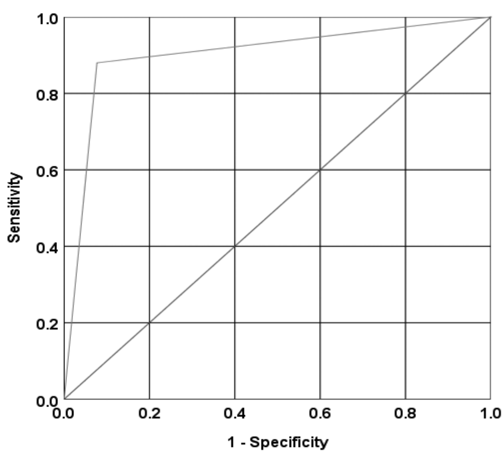

Figure-2. ROC curve analysis of ultrasonography findings taking MDCT as gold standard in diagnosing hepatic mass

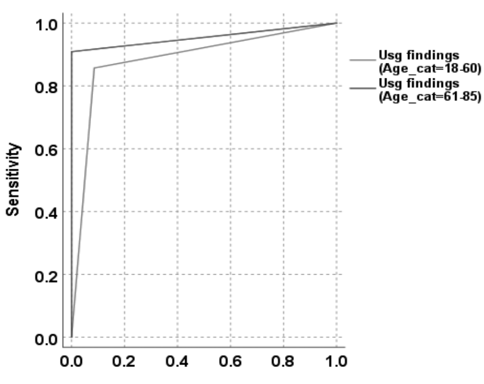

Figure-3. ROC curve analysis of ultrasonography findings with respect to age groups taking MDCT as gold standard in diagnosing hepatic mass

ROC curve analysis analyzing ultrasonography findings with respect to gender distribution taking MDCT as gold standard in diagnosing hepatic mass showing AUC difference 0.037 with 95% CI of -0.177 to 0.252, p=0.732 (Figure-4).

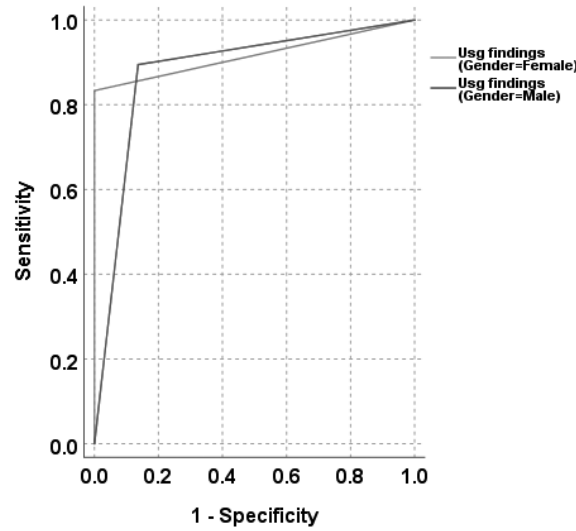

Figure-4. ROC curve analysis of ultrasonography findings with respect to gender distribution taking MDCT as gold standard in diagnosing hepatic mass

DISCUSSION

In this study, malignant lesions were identified in 39.1% cases on both USG and MDCT. Sensitivity, specificity, PPV, NPV, and accuracy of USG with respect to MDCT in diagnosing hepatic mass were 88.0%, 92.3%, 88.0%, 92.3%, and 90.6%, respectively. These findings underscore the utility of USG as a frontline diagnostic modality, particularly for initial screening and triage of liver lesions. The results align with those of Arif et al.[14], who reported a sensitivity of 88.57% and a diagnostic accuracy of 90.0% for USG in detecting hepatocellular carcinoma, affirming USG's utility in diagnosing malignant lesions. Kaushal et al.[15], documented a sensitivity of 90%, specificity of 82.5%, and overall accuracy of 87% for USG in identifying hepatic malignancies, compared to higher values for triphasic CT (sensitivity: 93.3%, specificity: 92.5%, accuracy: 93%). Some researchers have shown slightly lower sensitivity and overall diagnostic utility of USG than MDCT, especially in complex or atypical presentations.[16-19]

These results reinforce the value of USG in resource-limited settings or as a first-line modality where rapid diagnosis is needed.[20,21] Triphasic MDCT, due to its multiphase enhancement capability, remains superior in lesion characterization, vascular mapping, and detection of subtle enhancement patterns critical for differentiating hepatocellular carcinoma, metastases, and cholangiocarcinoma.[22,23] As shown by Granata et al.[24], multiphasic imaging enables correlation of morphologic and functional tumor characteristics, especially relevant in HCC evaluation and ablation therapy planning. Tatikonda et al.[19], and Musa et al.[16], further affirmed the high sensitivity and specificity of triphasic CT in distinguishing hypervascular and hypovascular lesions, supporting its use as a definitive diagnostic tool.

Akbar et al. revealed that triphasic CT diagnosed 62% of liver lesions as malignant, while differences may reflect variations in population demographics, lesion types, or clinical settings. Akbar et al.[25], also emphasized CT's effectiveness in detecting early HCC, secondary metastases, and cholangiocarcinoma, highlighting its indispensable role in cancer staging and treatment planning. In tertiary care centers, triphasic CT retains its role as the standard imaging modality for comprehensive liver lesion evaluation. It not only confirms USG findings but provides additional detail regarding lesion enhancement, vascular involvement, and staging, critical for surgical or oncological planning. Its capability in differentiating benign from malignant lesions and characterizing atypical enhancement patterns enhances diagnostic confidence.

While USG is widely accessible, non-invasive, and cost-effective, its limitations include operator dependency, reduced sensitivity for deeply situated or isoechoic lesions, and reduced visualization in obese patients or those with excessive bowel gas. The lack of specificity data in this study also limits complete evaluation of USG performance. The histopathological confirmation, considered the true gold standard, was not available, and the reliance on MDCT findings, though highly accurate, may have limited final lesion verification. The study's exclusion of lesions smaller than 2 cm precludes generalization of findings to smaller or early-stage liver pathologies, which often require higher-resolution imaging for accurate detection. Despite these limitations, the findings have significant clinical implications. In primary or secondary care settings, USG remains an excellent screening tool for hepatic lesions, especially when high-risk features such as cirrhosis, chronic hepatitis, or abnormal liver function tests are present. Given its high PPV and sensitivity for fatty liver and malignancy, USG may guide early referral for MDCT, MRI, or biopsy when necessary.

CONCLUSION
The ultrasonography demonstrates high sensitivity and positive predictive value in detecting hepatic lesions, and serves as a valuable first-line modality. These findings support a tiered diagnostic approach where USG is utilized for screening and triage, and triphasic MDCT is reserved for definitive diagnosis and treatment planning. Future studies with larger samples, inclusion of histopathology, and standardized reporting systems such as LI-RADS are warranted to further refine diagnostic algorithms and improve liver lesion evaluation.

CONFLICT OF INTEREST
The authors declare no conflict of interest.

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AUTHORSHIP AND CONTRIBUTION DECLARATION	
1	**Sikandar Abbas:** Data collection, drafting, responsible for data, approved for publication.
2	**Noorulain:** Literature review, data analysis, proof reading, approved for publication.
3	**Nadeem Ibrahim:** Concept, design, critical revisions, approved for publication.
4	**Amer Hayat Haider:** Literature review, data analysis, proof reading, approved for publication.
5	**Jahanzeb Javed:** Literature review, data synthesis, proof reading, approved for publication.
6	**Izza Shahid:** Literature review, data synthesis, proof reading, approved for publication.