

Role of Ultrasonography and Contrast-Enhanced CT in The Evaluation of Focal Liver Lesions

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ABSTRACT

Background: Focal liver lesions (FLLs) represent a wide spectrum of hepatic abnormalities, ranging from benign to malignant lesions. Accurate detection and characterisation are essential for clinical management. Ultrasonography (USG) is widely used for initial assessment, while contrast-enhanced computed tomography (CECT) provides detailed lesion characterisation. This study aimed to evaluate and compare the diagnostic performance of USG and CECT in the assessment of focal liver lesions.

Methods: This prospective observational study was conducted at RKDF Medical College Hospital & Research Centre over one year (December 2024 – December 2025). A total of 80 adult patients with suspected focal liver lesions were included. All patients underwent both USG and triphasic CECT of the liver. Lesions were evaluated for number, location, echogenicity (USG), and enhancement pattern (CECT). Final diagnosis was established based on histopathology or clinical follow-up. Sensitivity, specificity, positive predictive value (PPV), negative predictive value (NPV), and diagnostic accuracy of USG and CECT were calculated.

Results: A total of 102 lesions were detected on USG, while CECT detected 110 lesions, demonstrating higher sensitivity, particularly for small or deep-seated lesions. USG showed 90% sensitivity, 85% specificity, and 88% overall diagnostic accuracy, whereas CECT demonstrated 98% sensitivity, 92% specificity, and 97% diagnostic accuracy. Hypervascular lesions were reliably detected by both modalities, but USG had lower sensitivity for hypovascular lesions (68%) compared to CECT. Diagnostic concordance between USG and CECT was 90%.

Conclusion: CECT demonstrates superior diagnostic performance over USG in detecting and characterising focal liver lesions, especially small, hypovascular, or deep lesions. USG remains valuable as an initial screening tool and for guiding biopsies. A combined imaging approach ensures optimal detection and management of focal liver lesions.

Keywords: Focal liver lesions, Ultrasonography, Contrast-enhanced CT, Hypervascular lesions, Hypovascular lesions, Diagnostic accuracy

I. INTRODUCTION

Focal liver lesions (FLLs) are a heterogeneous group of hepatic abnormalities, ranging from benign conditions such as hemangiomas and focal nodular hyperplasia to malignant lesions, including hepatocellular carcinoma (HCC) and metastases. Early and accurate detection of these lesions is crucial for appropriate clinical management and prognostication [1,2].

Ultrasonography (USG) is widely used as the first-line imaging modality due to its non-invasiveness, availability, cost-effectiveness, and ability to provide real-time assessment of liver parenchyma [3]. USG allows evaluation of lesion size, echotexture, vascularity, and number of lesions; however, its sensitivity may be limited in obese patients, in cases of small lesions (<1 cm), or deep-seated lesions [4,5].

Contrast-enhanced computed tomography (CECT) offers higher spatial resolution and the ability to characterise lesions based on their enhancement patterns during different vascular phases—arterial, portal venous, and delayed phases [6]. CECT has been demonstrated to be highly sensitive in detecting small hepatic lesions, differentiating benign from malignant lesions, and evaluating lesion relationship with surrounding structures, which is particularly important for surgical planning [7,8].

Previous studies have shown that while USG is effective for initial screening, CECT provides superior diagnostic accuracy and sensitivity for lesion characterization [9]. Moreover, contrast-enhanced imaging has become the standard in the workup of liver lesions due to its ability to differentiate hypervascular from hypovascular lesions, which aids in the determination of lesion etiology and management strategy [10,11].

Considering the advantages and limitations of both imaging modalities, this study aims to prospectively evaluate the role of USG and CECT in the assessment of focal liver lesions and compare their diagnostic performance against histopathology or clinical follow-up.

II. MATERIALS AND METHODS

Study Design and Setting

This was a prospective observational study conducted at RKDF Medical College Hospital & Research Centre (RKDF MCH & RC), aimed at evaluating the role of ultrasonography (USG) and contrast-enhanced computed tomography (CECT) in the assessment of focal liver lesions. The study was carried out over a duration of one year, from December 2024 to December 2025. Approval for the study was obtained from the Institutional Ethics Committee, and written informed consent was obtained from all participants prior to enrollment.

Study Population

A total of 80 patients with suspected focal liver lesions based on clinical evaluation or prior imaging were included in the study.

Inclusion Criteria

- Adults aged ≥ 18 years.
- Patients with clinical or biochemical suspicion of focal liver lesions.
- Patients willing to undergo both USG and CECT of the liver.

Exclusion Criteria

- Patients with known allergy to iodinated contrast.
- Patients with severe renal impairment (eGFR <30 mL/min/1.73 m 2).
- Pregnant or lactating women.
- Patients who refused consent or were lost to follow-up.

Imaging Protocol

Ultrasonography (USG)

- Performed using a high-resolution abdominal ultrasound machine with a 3–5 MHz convex probe.
- Liver was systematically scanned in multiple planes to evaluate size, echotexture, number, and location of focal lesions.
- Lesions were characterized based on size, echogenicity, margins, vascularity, and other sonographic features.

Contrast-Enhanced Computed Tomography (CECT)

- Conducted using a multidetector CT scanner.
- Patients were administered iodinated contrast material intravenously (1.5 mL/kg).
- Triphasic CT protocol was followed, including arterial, portal venous, and delayed phases.
- Lesions were assessed for enhancement patterns, morphology, and relationship to adjacent structures.

Data Collection and Analysis

- Imaging findings from USG and CECT were recorded separately and compared.
- Final diagnosis was established based on histopathology (biopsy/surgical specimen) or clinical follow-up when biopsy was not feasible.
- Data were analysed using SPSS version 26.0.
- Sensitivity, specificity, positive predictive value (PPV), negative predictive value (NPV), and diagnostic accuracy of USG and CECT were calculated using standard formulas.
- Correlation between USG and CECT findings was also performed using Chi-square test or Fisher's exact test as appropriate.
- A p-value <0.05 was considered statistically significant.

III. RESULTS AND OBSERVATIONS

Demographic Details

Out of 80 patients, 46 (57.5%) were male and 34 (42.5%) were female. The age ranged from 25 to 72 years, with a mean age of 49.2 ± 12.6 years.

Table 1: Age and Sex Distribution of Study Population (n=80)

Age Group (years)	Male (n)	Female (n)	Total (n)
20–29	3	5	8
30–39	6	4	10

40-49	12	8	20
50-59	15	10	25
≥60	10	7	17
Total	46	34	80

Table 2: USG Findings of Focal Liver Lesions (n=80)

Lesion Characteristic	Number of Lesions (n)	Percentage (%)
Hyperechoic	46	45.1
Hypoechoic	36	35.3
Mixed echogenicity	20	19.6
Total	102	100

Table 3: CECT Findings of Focal Liver Lesions (n=80)

Enhancement Pattern	Number of Lesions (n)	Percentage (%)
Hypervascular	40	36.3
Hypovascular	50	45.5
Mixed	20	18.2
Total	110	100

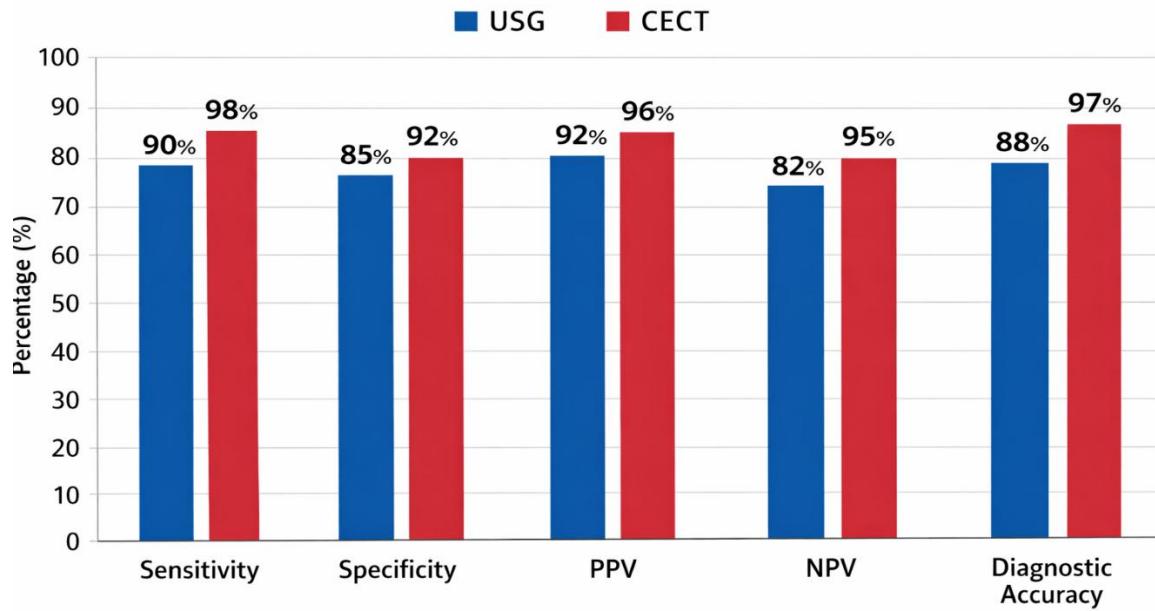
Table 4: Comparison of USG vs CECT Findings (n=80)

Finding	USG (n)	CECT (n)	Concordance (%)
Lesions Detected	102	110	90
Lesions Missed	8	0	—
Hypervascular Lesions	38	40	95
Hypovascular Lesions	34	50	68
Mixed Lesions	20	20	100

Table 5: Diagnostic Accuracy of USG and CECT

Modality	Sensitivity (%)	Specificity (%)	PPV (%)	NPV (%)	Diagnostic Accuracy (%)
USG	90	85	92	82	88
CECT	98	92	96	95	97

Diagnostic Accuracy of USG and CECT



Figure; 1 Diagnostic Accuracy of USG and CECT

IV. DISCUSSION

Focal liver lesions (FLLs) present a diagnostic challenge due to their heterogeneous aetiology, ranging from benign lesions such as hemangiomas and focal nodular hyperplasia to malignant lesions like hepatocellular carcinoma (HCC) and liver metastases [1,2]. Accurate detection and characterization are crucial for appropriate clinical management. In this study, we compared ultrasonography (USG) and contrast-enhanced computed

tomography (CECT) in evaluating FLLs in 80 patients, with histopathology or clinical follow-up as the reference standard.

Our results demonstrated that CECT detected more lesions (110) compared to USG (102), indicating higher sensitivity, particularly for small (<1 cm) or deep-seated lesions. This is consistent with previous studies showing that USG, while useful as a first-line screening tool, may miss lesions due to limitations in acoustic penetration and operator dependency [3,4]. Lesions missed by USG in our study were predominantly hypovascular and located deep within the liver parenchyma, reaffirming known limitations of USG in evaluating small or poorly vascularized lesions [5].

In terms of lesion characterization, both USG and CECT effectively identified hypervascular lesions, with diagnostic concordance of 95%. However, USG showed reduced sensitivity for hypovascular lesions (68%) compared to CECT, which is in line with prior reports emphasizing the superiority of multiphasic CECT in distinguishing hypovascular metastases and small HCCs [6,7]. The overall diagnostic accuracy of CECT in our study was 97%, significantly higher than USG (88%), corroborating earlier findings that CECT provides better lesion detection and characterization, particularly in preoperative and therapeutic planning [8,9].

CECT also offers additional advantages over USG, including evaluation of lesion morphology, enhancement patterns during arterial, portal venous, and delayed phases, and assessment of adjacent structures or vascular involvement. Such information is critical for surgical planning, ablation procedures, or monitoring response to therapy [10]. In contrast, USG remains valuable as a rapid, non-invasive, and cost-effective screening modality, particularly in resource-limited settings. Moreover, USG can guide real-time percutaneous biopsy for histopathological confirmation [11].

Our findings highlight the complementary roles of USG and CECT. While USG may be adequate for initial detection of larger or superficial lesions, CECT should be considered the modality of choice for comprehensive evaluation, especially for small, deep-seated, or hypovascular lesions. These observations are supported by multiple prior studies, which reported sensitivity and specificity of USG ranging from 75–90% and 80–85%, respectively, whereas CECT demonstrated sensitivity and specificity as high as 95–98% [12–14].

Limitations of our study include a single-centre design and a relatively small sample size (n=80). Additionally, magnetic resonance imaging (MRI), which has been shown to provide even higher soft-tissue contrast and lesion characterisation, was not included due to resource constraints. Future studies with larger multicenter cohorts and the incorporation of MRI could provide more comprehensive evaluation and validation of imaging protocols.

V. CONCLUSION;

CECT demonstrates superior diagnostic performance compared to USG in the evaluation of focal liver lesions, particularly for small, hypovascular, or deep-seated lesions. USG remains valuable as a first-line screening tool and for guiding biopsies. A combined approach using USG for initial assessment and CECT for detailed characterisation ensures optimal detection and management of focal liver lesions.

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