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Diagnostic Accuracy of Multidetector Computed Tomography in Distinguishing Benign and Malignant Focal Liver Lesions at the National Referral Hospital, Bhutan: A Cross-sectional Study

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ABSTRACT

Introduction: Focal liver lesions (FLLs) are common findings in clinical practice, requiring accurate characterization to guide patient management. Multidetector computed tomography (MDCT) is widely available and routinely used in Bhutan. Therefore, this study aimed to determine diagnostic accuracy of multidetector computed tomography (MDCT) in detecting focal liver lesions compared with histopathological findings. **Methods:** This cross-sectional study was conducted at the Radiology Department of the Jigme Dorji Wangchuck National Referral Hospital from January 2024 to December 2025. All the patients who underwent MDCT were included in the study. Data were collected by reviewing medical documents and recorded using a standard pro forma, and data were analyzed using SPSS (version 26). **Results:** The majority were females (57.1%) with a mean age of 57.49 years. Histopathological examination revealed 79.4% malignant and 20.6% benign lesions. MDCT correctly characterized 49 malignant (72%) and 9 benign lesions (8%), yielding an overall diagnostic accuracy of 92.1%. The sensitivity and specificity of MDCT for differentiating malignant from benign lesions were 98.0% and 69.2%, respectively, with a PPV of 92.5% and NPV of 90.0%. Cohen's kappa coefficient showed substantial agreement between MDCT and histopathology ($\kappa = 0.74$). The association between MDCT diagnosis and histopathology was statistically significant ($\chi^2 = 34.923$, $p < 0.001$). **Conclusion**: MDCT demonstrates high diagnostic accuracy in characterizing focal liver lesions, with excellent sensitivity for detecting malignant lesions. These findings support the continued use of MDCT as the primary imaging modality in Bhutan, where access to advanced imaging modalities is limited.

Keywords: *Diagnostic accuracy; Histopathology; Liver lesions; Multidetector CT*

INTRODUCTION

Focal liver lesions (FLLs) encompass benign and malignant liver masses, including cysts, hemangiomas, primary liver cancer, and metastases[1]. While global prevalence of incidental benign FLLs is around 15% on imaging[2], liver cancer remains a significant health issue in Bhutan, with liver cancer ranking among the leading causes of cancer mortality (≈5.9 age-standardized deaths per 100,000) and liver disease contributing substantially to overall mortality[3]. Delayed diagnosis or misclassification due to suboptimal diagnostic tools can lead to progression of malignancy, poorer prognosis, unnecessary invasive procedures, and increased healthcare burden, underscoring the need for accurate imaging and timely histopathological confirmation[4].

Focal liver lesions (FLLs) present a frequent diagnostic challenge, as accurate differentiation between benign and malignant entities is essential for guiding clinical management[2]. Globally, imaging modalities such as ultrasound, computed tomography (CT), and magnetic resonance imaging (MRI) are integral to the initial evaluation of liver lesions[4], with histopathology serving as the definitive diagnostic standard[4].

Multidetector computed tomography (MDCT) is widely utilized because of its availability, rapid image acquisition, and multiphase imaging capability, that improve lesion detection and characterization[2]. Reported sensitivity and specificity of MDCT vary across protocols and lesion types, ranging from 75% to 95% for malignant lesions[3,5,6].

In Bhutan, MDCT is the most readily accessible advanced imaging modality for liver pathology. However, there is a lack of local evidence validating its diagnostic accuracy. This study was therefore undertaken to evaluate the accuracy of MDCT in characterizing focal liver lesions by comparing imaging findings with histopathology at the National Referral

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Previous studies have demonstrated the utility of MDCT in detecting and characterizing FLLs, though sensitivity and specificity have varied depending on imaging techniques and lesion subtypes[5]. Studies by VH Prashanth et al. (2025) and Sirisha et al. (2024) underscored the value of multiphase imaging in enhancing diagnostic accuracy. Nevertheless, inconsistencies across studies highlight the importance of region-specific investigations[6]. In the Bhutanese context, where alternative imaging modalities such as MRI are limited, MDCT remains the primary diagnostic tool. Therefore, this study aimed to provide locally relevant evidence on the MDCT diagnostic performance comparing to histopathology as a gold standard, which ultimately contributed to strengthening evidence-based diagnostic practices.

METHODS

Study Design

This cross-sectional study was conducted at the Department of Radiology, Jigme Dorji Wangchuck National Referral Hospital, Thimphu, Bhutan, from January 2024 to December 2025.

Study setting

Jigme Dorji Wangchuck National Referral Hospital (JDWNRH) is a 380-bed teaching hospital situated in the capital city, Thimphu and serves as the apex referral center for the country.

This is the only hospital in the country with interventional radiologist who can perform MDCT and subsequently confirm it with histopathology study.

The Department of Radiology ensured quality control in accordance with established laboratory and imaging standards. Accordingly, both multidetector computed tomography (MDCT) and histopathological examinations were performed following standardized institutional protocols. All MDCT examinations were interpreted by well-trained and experienced radiologist, ensuring consistency and reliability of diagnostic findings.

Study population

All those patients who underwent MDCT at the Radiology Department, of the JDWNRH.

Inclusion Criteria

The study included patients aged 18 years and above who underwent MDCT for focal liver lesions and had available histopathological confirmation. Patients with incomplete imaging or histopathology reports and those with inconclusive histopathological diagnoses were excluded from the study.

Sample size and sampling method

There were 63 patients who underwent MDCT during the year 2024 to 2025, and all of them were included for the study, and a formal sample size calculation was not performed. A purposive sampling technique was utilized to include all consecutive patients who underwent both MDCT and histopathological evaluation during the study period.

Data Collection

Patients with focal liver lesions who underwent MDCT followed by histopathological examination were included in the study. Detailed patient information, MDCT findings, and histopathology reports were retrieved from medical records maintained in the Department of Radiology. The collected data were recorded using a structured pro forma developed for the study. The collected data were subsequently entered into the Statistical Package for the Social Sciences (SPSS) software after appropriate coding of study variables. To minimize data entry errors, double data entry was performed.

Statistical Analysis

Normally distributed continuous variables were expressed as the mean ± standard deviation, and categorical variables as frequencies and percentages. The sensitivity, specificity, positive predictive value, negative predictive value, and accuracy of MDCT and Histopathology diagnosis were compared using a 2x2 contingency table. The diagnostic performance of MDCT was compared with the Histopathological diagnosis using the chi-squared test. The consistency between MDCT and Histopathology was assessed using the kappa (κ) statistic, whereby a value of ≥ 0.75 indicates good agreement, and value of 0.40–0.75 indicates moderate agreement, and a value of <0.4 indicates poor agreement (Bandhari et al(7)). The statistical analysis was performed using SPSS version 26.0 software (IBM Corp., Armonk, NY, USA). A p-value of < 0.05 was considered statistically significant.

Ethical Considerations

Ethical approval for the study was obtained from the Institutional Review Board (IRB) of Khesar Gyalpo University of Medical Sciences of Bhutan with Protocol No: PN/2025/2 dated 25th July 2025. Administrative and site clearance was obtained from Ministry of Health and Jigme Dorji Wangchuck National Referral Hospital respectively. Patient confidentiality was strictly maintained throughout the study, and all data were anonymized using coded identifiers.

Results

In the year 2024 – 2025, there were 63 patients underwent MDCT at the Radiology Department, at the National Referral Hospital.

Demographic characteristic and symptoms of patients

The majority (57.1%) of the patients were female (n=36) and around 45% were age 61 years and above.

Around half of the patients (47.6%) presented within one month of having symptoms, and the most common symptom was upper abdominal pain (95.2%), followed by, weakness (82.5%), nausea/vomiting (76.2%), and abdominal distension (68.3%). Details are shown in Table 1.

Table 1: Demographic characteristic and symptoms of patients with focal liver lesions who underwent MDCT scan and Histopathological study at the Department of Radiology, at the National Referral Hospital, Bhutan, 2024-2025 (n=63)

Characteristics	Frequency (%)
Age (years)	
21-30	5 (7.9)
31-40	2 (3.2)
41-50	14 (22.2)
51-60	14 (22.2)
Above 61	28 (44.5)
Mean age ±SD years	57.5±14.6
Gender	
Male	27 (42.9)
Female	36 (57.1)
Duration of symptoms	30 (47.6)
<One month	30 (47.6)
One to two months	20 (31.7)
>two months	13 (20.7)
Symptoms	
Fever	23 (36.5)
Upper abdominal pain	60 (95.2)
Abdominal distension	43(68.3)
Itching	15(23.8)
Upper abdominal mass	12(19.0)
Nausea/ Vomiting	48(76.2)
Weakness	52(82.5)
History of weight loss	31(49.2)

SD: standard deviation

Multidetector computed tomography findings

The MDCT findings revealed that the liver size was normal in the majority of patients (66.7%), while most livers demonstrated isodense parenchyma appearances (81.0%). The majority had multiple lesion (65.1%), lobe/segment involved (63.5%), well defined margin of lesion (73.0%), irregular shape (60.3%), hypodensity (77.8%), absence of calcification (88.9%), mild enhancement character (88.9%), and heterogeneous enhancement patterns (96.8%) (Table 2).

Table 2: Multidetector computed tomography findings of the patients with focal liver lesions at the Department of Radiology, at the National Referral Hospital, Bhutan, 2024-2025 (n=63)

Multidetector computed tomography findings	Frequency (%)
Size of liver	
Normal	42 (66.7)
Small	4 (6.3)
Enlarged	17 (27.0)
Density of liver	
Isodense	51 (81.0)
Hypodense	8 (12.7)
Hyperdense	4 (6.3)
Number of lesions	
Single	22 (34.9)
Multiple	41 (65.1)
Lobe / segment involved	40 (63.5)
Margin of lesion	
Well defined	17 (27.0)
Ill defined	46 (73.0)
Shape of lesion	
Rounded	6 (9.5)
Oval	19 (30.2)
Irregular	38 (60.3)
Density of lesion	
Isodense	4 (6.3)
Hypodense	49 (77.8)
Hyperdense	3 (4.8)
Heterogenous	7 (11.1)
Calcification present	7 (11.1)
Enhancement characters	
No enhancement	4 (6.3)
Mild	56 (88.9)
Moderate	3 (4.8)
Marked	0 (0.0)
Enhancement pattern	
Homogenous	2 (3.2)
Heterogeneous	61 (96.8)

Diagnostic accuracy of MDCT findings

Comparison of MDCT findings with histopathological diagnosis showed that 49 lesions were true positives, 9 were true negatives, 4 false positives, and 1 false negative.

The overall diagnostic accuracy of MDCT was 92.1%, with a sensitivity of 98%, specificity of 69.2%, positive predictive value of 92.5%, and negative predictive value of 90%. Agreement between MDCT and histopathology was substantial, with a Kappa statistic of 0.74 indicating good concordance beyond chance (Table 3).

Table 3: Diagnostic accuracy of MDCT findings of patients with focal liver lesions compared with Histopathological findings at the Radiology Department of the National Referral Hospital, Bhutan, 2024-2025 (n=63)

MDCT Finding	Histopathology		Total (%)	Sensitivity (%)	Specificity (%)	PPV (%)	NPV (%)	Accuracy (%)	Kappa(κ)
	Malignant	Benign							
Malignant	49	4	53	98%	69.2%	92.5%	90%	92.1%	0.74
Benign	1	9	10	90	92.5	90	92.5	92.1	
Total	50	13	63	98	69.2	92.5	90	92.1	

MDCT: multidetector computed tomography; NPV: negative predictive value, PPV: positive predictive value

Association between MDCT and histopathology

Chi-square analysis revealed a statistically significant association between MDCT diagnosis and histopathological diagnosis (χ^2 = 34.923, df = 1, $p < 0.001$) confirming that MDCT results were strongly consistent with the gold standard histopathology (Table 4).

Table 4. Association between MDCT findings and Histopathology in patients with focal liver lesions presented to the Radiology Department of the National Referral Hospital, Bhutan, 2024-2025, (n=63)

MDCT diagnosis	Histopathological diagnosis		χ^2	df	p-value
	Malignant	Benign			
Malignant	49 (92.4%)	4 (7.6%)	34.923	1	< 0.001
Benign	1 (10.0%)	9 (90.0%)		1	
Total	50 (79.4%)	13 (20.6%)		1	

DISCUSSION

The present study evaluated the diagnostic performance of multidetector computed tomography (MDCT) in differentiating benign and malignant focal liver lesions using histopathology as the reference standard[5]. The findings demonstrate that MDCT is a highly sensitive (98%) and accurate imaging modality for the detection of malignant focal liver lesions, showing substantial agreement with histopathological diagnosis, consistent with reports from previous studies[5,8].

The study population predominantly comprised older individuals, with nearly half of the patients aged above 61 years. This age distribution aligns with the known epidemiology of malignant liver lesions[5,1], which are more prevalent in the elderly due to cumulative exposure to risk factors such as chronic liver disease, cirrhosis, and metabolic disorders[2,8]. A female predominance was observed in the present study, similar to findings reported in a few other studies[9,10]. This observation may reflect referral patterns or regional demographic characteristics rather than a true gender predisposition, as suggested by previous studies[2].

Clinically, most patients presented within one month of symptom onset (47.6%), suggesting early healthcare-seeking behavior. Upper abdominal pain, abdominal distension, weakness, and nausea or vomiting were the most frequently reported symptoms in our study, findings that have also been reported by other authors[2,6,9]. Several previous studies have reported that focal liver lesions often present with non-specific symptoms, making imaging a crucial tool for early diagnosis and characterization[11,12]. Weight loss was present in nearly half of the patients, further supporting the high proportion of malignant lesions observed in this cohort.

In our study, MDCT imaging revealed that the majority of lesions were multiple, hypodense, ill-defined, irregular in shape, and showed heterogeneous enhancement patterns. These imaging characteristics were reported in many other studies[6,7,10] and were recognized features suggestive of malignant liver lesions, particularly metastatic disease and hepatocellular carcinoma. The predominance of heterogeneous enhancement and ill-defined margins in the present study reinforces the role of MDCT in providing morphological clues that aid in distinguishing malignant from benign lesions. When compared with histopathology, MDCT demonstrated excellent sensitivity (98.0%) which is comparable to Prashanth et al. (2025) who reported 98.0% and high overall diagnostic accuracy (92.1%) in detecting malignant focal liver lesions. This indicates that MDCT is highly reliable in identifying malignant lesions and has a very low false-negative rate, making it a valuable screening and diagnostic modality. The high positive predictive value (92.5%) further suggests that lesions categorized as malignant on MDCT

are very likely to be confirmed on histopathology.

However, the specificity of MDCT was comparatively lower (69.2%), than Sirisha et al. (2024), reflecting a modest false-positive rate. This finding may be attributed to overlapping imaging features between certain benign and malignant lesions, such as inflammatory lesions, atypical hemangiomas, or regenerative nodules, which can mimic malignancy on CT. This limitation highlights the continued importance of histopathological confirmation, particularly in cases where CT findings are equivocal[13].

The Cohen's kappa coefficient of 0.74 indicates substantial agreement between MDCT and histopathological diagnosis, supporting the reliability and consistency of MDCT interpretation in clinical practice. Additionally, the statistically significant association between MDCT diagnosis and histopathology ($p < 0.001$) underscores the diagnostic validity of MDCT in evaluating focal liver lesions, with similar findings reported in other studies[5,8,14].

Despite its strengths, the present study has certain limitations. The sample size was relatively small, and the study was conducted at a single center, and children <18 years were excluded from the study, which may limit the generalizability of the findings. Additionally, the study did not evaluate lesion-specific diagnostic accuracy or compare MDCT with other imaging modalities such as MRI or contrast-enhanced ultrasound, which may offer improved tissue characterization in selected cases.

This study demonstrates that MDCT has high diagnostic accuracy in characterizing focal liver lesions at Bhutan's National Referral Hospital. Sensitivity and specificity values align with international findings, reinforcing the utility of MDCT as a frontline imaging modality in resource-limited settings. Findings provide first-time local evidence supporting MDCT as a reliable diagnostic tool for liver lesions in Bhutan. Future prospective multicenter studies with larger cohorts are recommended.

CONCLUSION

Multidetector computed tomography (MDCT) is a reliable, non-invasive modality for the evaluation of focal liver lesions, demonstrating high sensitivity and substantial agreement with histopathological findings. While specificity is moderate, the strong correlation with histopathology confirms the diagnostic validity of MDCT. It serves as a valuable first-line imaging tool; however, histopathological confirmation remains essential for equivocal or atypical cases to ensure accurate diagnosis and optimal patient management.

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Following authors have made substantial contributions to the manuscript as under:

TG: Conceptualization, data collection, data analysis, manuscript writing and review

GD: Conceptualization, data collection, data analysis, manuscript writing and review

KW: Conceptualization, data collection, data analysis, manuscript writing and review

BP: Conceptualization, data collection, data analysis, manuscript writing and review

Authors agree to be accountable for all respects of the work in ensuring that questions related to the accuracy and integrity of any part of the work are appropriately investigated and resolved.

CONFLICT OF INTEREST

None

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