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Original Research Article

Comparative Analysis of Multiphasic Contrast-Enhanced CT and Contrast-Enhanced MRI in Evaluating Hepatic Mass Lesions

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Conflict of interest: Nil

Abstract:

Background: There are several different benign and malignant disorders that can cause hepatic mass lesions. Precise imaging is essential to diagnosis and treatment. Due to its higher soft tissue contrast and non-ionizing radiation nature, contrast-enhanced magnetic resonance imaging, or CEMRI, is becoming more and more popular over multiphasic contrast-enhanced computed tomography (CECT), which has been the standard method. The purpose of this study is to evaluate hepatic mass lesions and compare the diagnostic accuracy of multiphasic CECT and CEMRI.

Methods: A retrospective study included 80 patients with hepatic mass lesions. Forty patients underwent CECT and forty underwent CEMRI. Data on lesion size, number, and enhancement patterns were collected and analyzed using SPSS version 21.0.

Results: CEMRI demonstrated higher sensitivity (93%) and specificity (89%) compared to CECT (88% sensitivity and 82% specificity). The PPV and NPV for CEMRI were 90% and 91%, respectively, whereas for CECT, they were 85% and 86%. The differences in diagnostic accuracy between CECT and CEMRI were statistically significant ($p < 0.05$). Both modalities showed a predominance of heterogeneous enhancement patterns, with no significant difference in mean lesion size.

Conclusion: CEMRI is more accurate than CECT in evaluating hepatic mass lesions, offering higher sensitivity and specificity. This suggests that CEMRI should be preferred for the detailed assessment of hepatic lesions, potentially improving patient management and outcomes.

Recommendations: It is advised to do further prospective studies with bigger sample sizes to confirm these results and create evidence-based recommendations for the application of imaging modalities in the assessment of hepatic lesions.

Keywords: Hepatic mass lesions, Contrast-enhanced CT, Contrast-enhanced MRI, Diagnostic accuracy, Imaging modalities

Introduction

Hepatic mass lesions encompass a broad spectrum of benign and malignant conditions, including hepatocellular carcinoma (HCC), metastatic disease, and benign lesions like hepatic adenomas and hemangiomas. Accurate diagnosis and characterization of these lesions are crucial for determining appropriate clinical management, including the selection of therapeutic strategies and the assessment of prognosis. Advances in imaging technologies have significantly enhanced the diagnostic capabilities for hepatic lesions, with multiphasic contrast-enhanced computed tomography (CECT) and contrast-enhanced magnetic resonance imaging (CEMRI) being the most commonly used modalities.

CECT has long been considered a standard imaging technique for hepatic lesions due to its wide availability, rapid acquisition times, and high spatial resolution. It involves obtaining images at multiple phases of contrast enhancement (arterial, portal venous, and delayed phases), which helps in differentiating various types of lesions based on their enhancement patterns. However, CECT has certain limitations, including exposure to ionizing radiation and potential nephrotoxicity from iodinated contrast agents [1].

CEMRI, on the other hand, offers superior soft tissue contrast resolution without the use of ionizing radiation. Recent advancements in MRI technology, such as diffusion-weighted imaging (DWI) and hepatobiliary phase imaging with liver-specific contrast agents, have further improved the ability to characterize hepatic lesions. Studies have shown that CEMRI provides better lesion detection and characterization compared to CECT, particularly for small lesions and those with complex enhancement patterns [2].

Recent literature highlights the growing preference for CEMRI in hepatic imaging. A study demonstrated that CEMRI had higher sensitivity and specificity than CECT in detecting HCC, especially in patients with cirrhosis [3]. Another study reported that CEMRI was more effective in identifying and characterizing hepatic metastases from colorectal cancer compared to CECT [4]. These findings underscore the potential of CEMRI to improve diagnostic accuracy and guide clinical decision-making more effectively than CECT.

Despite these advantages, the choice between CECT and CEMRI can be influenced by various factors, including patient condition, availability of imaging modalities, and clinical context. Therefore, a comprehensive comparative analysis of these imaging techniques is essential to establish evidence-based guidelines for their use in the assessment of hepatic mass lesions.

This study aims to compare the diagnostic accuracy of multiphasic contrast-enhanced CT and contrast-enhanced MRI in evaluating hepatic mass lesions.

Methodology

Study Design: A comparative, retrospective study.

Study Setting: The study took place at the Radiology Department of Tertiary Care Hospital in India, over a period of 12 months from November 2022 to October 2023.

Participants: A total of 80 individuals were included in the study.

Inclusion Criteria: Patients aged 18 years and above, with confirmed hepatic mass lesions on either multiphasic CECT or CEMRI, and who provided informed consent for participation were included.

Exclusion Criteria: The study excluded patients with renal insufficiency (eGFR <30 ml/min/1.73 m^2), pregnancy, history of liver surgery, contraindications to contrast media, and insufficient medical data.

Bias: To minimize selection bias, consecutive sampling was used. Additionally, the radiologists interpreting the imaging results were blinded to the clinical data of the patients.

Variables: The primary variables included the type of imaging modality (CECT or CEMRI), size and number of hepatic lesions, lesion enhancement patterns, and final diagnosis based on histopathology or follow-up imaging.

Data Collection: Retrospective data collection was conducted using the computerised medical records of the institution. Patient demographics, clinical history, imaging data, and histological findings were all included in the information.

Procedure: Patients' standard diagnostic workup for hepatic mass lesions included either multiphasic CECT or CEMRI. The imaging protocols were standardised and comprised various phases of T1-weighted, T2-weighted, and diffusion-weighted imaging for CEMRI, as well as arterial, portal venous, and delayed phases for CECT. Two seasoned radiologists who had noted lesion attributes such size, number, location, and enhancing patterns examined the imaging results.

Statistical Analysis: SPSS version 21.0 was used to analyse the data. The variables were presented as percentages, frequencies, and mean ± standard deviation. Using Chi-square tests, the sensitivity, specificity, positive predictive value (PPV), and negative predictive value (NPV) of CEMRI and CECT were determined and contrasted. Statistical significance was attained when the p-value was less than 0.05.

Ethical Considerations: The study protocol was approved by the Ethics Committee and written informed consent was received from all the participants.

Result

Eighty patients participated in the study; their average age was 55.6 ± 12.4 years. 35 (43.7%) and 45 (56.3%) of these were female. At 27.8 ± 3.6 kg/m^2, the mean body mass index (BMI) was found. The majority of the patients—65 percent—had a history of liver illness that was chronic.

Table 1: Patient Demographics and Clinical Characteristics

Characteristic	Value
Mean Age (years)	55.6 ± 12.4
Gender	
- Male	45 (56.3%)
- Female	35 (43.7%)

Mean BMI (kg/m²)	27.8 ± 3.6
Chronic Liver Disease	52 (65%)

The study evaluated 40 patients with multiphasic CECT and 40 patients with CEMRI. The characteristics of hepatic mass lesions are summarized in Table 2.

Table 2: Imaging Findings

Imaging Modality	CECT	CEMRI
Number of Lesions	102	98
Mean Size (cm)	4.3 ± 2.1	4.1 ± 1.9
Enhancement Pattern		
- Homogeneous	30%	25%
- Heterogeneous	70%	75%

The evaluation of the diagnostic accuracy of CECT and CEMRI in identifying lesions in the liver was done using either follow-up imaging or histological confirmation. Compared to CECT, which had a sensitivity of 88% and a specificity of 82%, CEMRI showed better sensitivity (93%) and specificity (89%). In comparison, the PPV and NPV for CECT were 86% and 90%, respectively, and 90% and 91%, respectively, for CEMRI.

The lesions were categorized based on their enhancement patterns. Homogeneous enhancement was observed in 30% of lesions on CECT and 25% on CEMRI. Heterogeneous enhancement was observed in 70% of lesions on CECT and 75% on CEMRI.

The differences in diagnostic accuracy between CECT and CEMRI were statistically significant ($p < 0.05$). Chi-square tests were used to compare the sensitivity and specificity of both modalities. The results indicated a significant difference in favor of CEMRI.

Table 3: Statistical Analysis

Parameter	CECT	CEMRI	p-value
Sensitivity	88%	93%	0.03
Specificity	82%	89%	0.04
PPV	85%	90%	0.02
NPV	86%	91%	0.01

Lesions found by CEMRI had an average size of 4.1 ± 1.9 cm, compared to 4.3 ± 2.1 cm by CECT. Whereas CEMRI identified 98 lesions, CECT found 102 in total. Between the two modalities, there was no discernible difference in the mean size of lesions ($p = 0.45$).

Discussion

The study included 80 patients with hepatic mass lesions, comparing the diagnostic performance of multiphasic CECT and CEMRI. The results demonstrated that CEMRI outperformed CECT in terms of sensitivity and specificity, with values of 93% and 89% respectively, compared to 88% and 82% for CECT. The PPV and NPV were also higher for CEMRI, indicating its greater accuracy in detecting hepatic mass lesions.

102 lesions with a mean size of 4.3 cm were found by CECT, compared to 98 lesions with a mean size of 4.1 cm by CEMRI. Comparable mean lesion size and number of detected lesions notwithstanding, the statistical analysis showed a substantial difference in diagnosis accuracy, with CEMRI showing superior performance. Both modalities revealed primarily heterogeneous enhancement patterns for the lesions, with a small increase in pattern detection on CEMRI.

The statistical analysis confirmed the superiority of CEMRI over CECT, with significant differences in sensitivity, specificity, PPV, and NPV ($p < 0.05$). This indicates that CEMRI is more reliable for accurate characterization and evaluation of hepatic mass lesions, potentially leading to better-informed clinical decisions and improved patient outcomes.

Overall, the study highlights the enhanced diagnostic capabilities of CEMRI compared to CECT for hepatic mass lesions, emphasizing the importance of selecting the appropriate imaging modality to achieve precise diagnosis and optimal patient management.

The evaluation of hepatic mass lesions using imaging techniques such as multiphasic CE-CT and CE-MRI is crucial for accurate diagnosis and treatment planning. Recent studies compared non-contrast MRI with multiphasic CT for diagnosing hepatocellular carcinoma (HCC). Non-contrast MRI demonstrated higher sensitivity (84.3% vs. 76.2%) and accuracy (75.5% vs. 57.1%) than multiphasic CT, while specificity remained comparable (86.4% vs. 80.9%). Non-contrast MRI

facilitated better clinical decision-making for chemotherapy and radiotherapy [5].

In order to diagnose hepatic masses, a study assessed the usefulness of multiphasic dynamic contrast-enhanced MRI (MDCE-MRI) parameters. The diagnostic value of parameters including mean enhancement time (MET), maximum slope of rise (MSI), and positive enhancement integral (PEI) was highlighted by their significant differences between malignant and benign lesions [6].

CE-MRI and CE-CT were evaluated in a meta-analysis to diagnose HCC in patients with cirrhosis. While specificities were similar (91% vs. 92%), MRI showed significantly higher sensitivity (82% vs. 66%) and a smaller negative probability ratio (0.20 vs. 0.37) than CT [7]. Additionally, a study evaluated MRI and CE-CT for the diagnosis of focal nodular hyperplasia (FNH). When comparing MRI to CT, hepatotropic contrast agents in particular shown improved diagnostic accuracy, specificity, and sensitivity, making MRI a better way to distinguish FNH from other hepatic lesions [8].

In a study, the viability of dual-source multiphasic CT employing low-voltage (70 kVp) protocols with lower radiation and contrast doses was assessed. According to the study, this technique preserved contrast enhancement and picture quality comparable to normal protocols, indicating that it could be a good choice for liver imaging [9]. Research has shown that the characterization of tiny, incidental hypoattenuating hepatic lesions can be much improved by iodine quantification utilising single-phase contrast-enhanced dual-energy CT (DECT) over conventional CT in terms of differentiating benign from malignant lesions [10].

Conclusion

The study demonstrated that CEMRI has higher sensitivity and specificity compared to CECT in the evaluation of hepatic mass lesions. The enhanced diagnostic accuracy of CEMRI suggests its superiority in detecting and characterizing hepatic lesions, potentially leading to improved patient management and outcomes. By providing comprehensive data and statistical analysis, this study highlights the importance of choosing the appropriate imaging modality for evaluating hepatic mass lesions, with CEMRI showing a significant advantage over CECT.

Limitations: The limitations of this study include a small sample population who were included in this study. Furthermore, the lack of comparison group also poses a limitation for this study's findings.

Recommendation: It is advised to do further prospective studies with bigger sample sizes to confirm these results and create evidence-based recommendations for the application of imaging modalities in the assessment of hepatic lesions.

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List of abbreviations:

BMI - Body Mass Index

CECT - Contrast-Enhanced Computed Tomography

CEMRI - Contrast-Enhanced Magnetic Resonance Imaging

DWI - Diffusion-Weighted Imaging

eGFR - Estimated Glomerular Filtration Rate

FNH - Focal Nodular Hyperplasia

HCC - Hepatocellular Carcinoma

MDCE-MRI - Multiphasic Dynamic Contrast-Enhanced MRI

MET - Mean Enhancement Time

MRI - Magnetic Resonance Imaging

MSI - Maximum Slope of Rise

NPV - Negative Predictive Value

PEI - Positive Enhancement Integral

PPV - Positive Predictive Value

SPSS - Statistical Package for the Social Sciences

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