ORIGINAL RESEARCH PAPER
Volume - 13 | Issue - 11 | November - 2024 | PRINT ISSN No. 2277 - 8179 | DOI : 10.36106/ijsr
INTERNATIONAL JOURNAL OF SCIENTIFIC RESEARCH

ROLE OF MULTIDETECTOR CT IN EVALUATION OF BENIGN LIVER LESIONS

Radiology

Dr Priyal Khanna Junior Resident, Department of Radiology, SAIMS & PG Institute, Indore

Dr Ajay Kumar Gupta* Associate Professor, Department of Radiology, SAIMS & PG Institute, Indore. *Corresponding Author

Dr Manish Bhagat Professor & HOD, Department of Radiology, SAIMS & PG Institute, Indore.

Dr Rounak Bagga Associate Consultant, Department of Radiology, Fortis Hospital, New Delhi.

Dr Sanchi Gulati Junior Resident, Department of Radiology, SAIMS & PG Institute, Indore.

ABSTRACT

Background: Multidetector computed tomography (MDCT) has revolutionized liver imaging in recent decades due to its speed, cost-effectiveness, and ability to provide detailed anatomical visualization. Its use in differentiating benign and malignant hepatic lesions has become increasingly vital for guiding clinical management. **Objective:** This study aims to evaluate the diagnostic utility of MDCT, particularly triple-phase CT, in detecting and characterizing benign liver lesions and determining its effectiveness in differentiating these lesions from malignant ones. **Methods:** A cross-sectional study was conducted on 24 patients, with clinically suspected benign hepatic lesions or nonspecific findings on prior imaging. CT scans were performed using a Siemens 128-slice scanner, and the images were analyzed by experienced radiologists. Statistical analysis was conducted using Excel and SPSS, with associations evaluated through the Chi-square test. **Results:** The study population had a mean age of 45.8 years, with males accounting for 62.5% of cases. The most commonly diagnosed lesions were hemangioma (47.8%), followed by liver abscess (37.6%). Significant associations were found between lesion calcification, necrosis, and histopathological findings ($p<0.05$). The study found a statistically significant association between CT and histopathological diagnoses, with MDCT demonstrating high diagnostic accuracy (80%), sensitivity (75%), specificity (83.3%), and strong predictive values for benign hepatic lesions. **Conclusion:** MDCT, particularly triple-phase CT, proves to be an effective diagnostic tool for identifying and characterizing benign hepatic lesions. Its high sensitivity and specificity make it invaluable in differentiating benign from malignant lesions, aiding in early detection and appropriate management. This study highlights the potential of MDCT in improving liver disease outcomes through early diagnosis and intervention.

KEYWORDS

Multiphasic Computed Tomography (CT), Benign Liver Lesions, Diagnostic Accuracy, Histopathological Examination.

INTRODUCTION

The liver, due to its essential detoxification functions and rich blood supply via the hepatic artery and portal vein, is vulnerable to various diseases and pathological changes. Over the last two decades, liver imaging practices have significantly evolved. The visibility of liver lesions on CT scans depends on the attenuation contrast between the lesion and normal liver tissue. While only a small fraction of lesions containing calcifications, cystic components, fat, or hemorrhage can be identified on a non-enhanced CT, multiphasic CT is a valuable tool in determining the number, location, and characteristics of liver lesions, as well as monitoring their size over time. The liver receives 80% of its blood from the portal vein and 20% from the hepatic artery, leading to distinct enhancement patterns for different liver lesions during various phases of contrast enhancement [1].

The advent of Multidetector Computed Tomography (MDCT) represents a major advancement in CT technology allowing scanning to be four to eight times faster than spiral CT [2]. Using the triphasic spiral CT technique, images of the entire liver can be captured in the arterial, portal, and equilibrium phases [3,4]. CT has become an ideal imaging modality due to its accessibility and short scan time [5,6]. The combination of arterial and portal venous phase imaging has enhanced lesion detection [7-10]. The portal phase is the most sensitive for lesion detection, while the arterial and equilibrium phases provide additional information on lesion vascularity [5-9]

Accurate diagnosis involves the use of multiple radiological imaging modalities, combined with histopathological characteristics and clinical evaluation [11].

As per the anecdotal studies, triple phase CT has emerged as an excellent diagnostic tool for characterization & better evaluation of hepatic masses. Benign lesions should be differentiated confidently & accurately from malignant and also the different benign lesion should be differentiated from each other as well for better management of patients & proper triage by this it can be determined in such patient that which patient demand surgery & which needs follow up.

In India, comprehensive studies on the role of multiphasic MDCT scans in characterizing different benign liver lesions are limited. Therefore, this study was conducted to assess the utility of MDCT in the detection and characterization of benign liver lesions, aiming to guide further management strategies.

MATERIAL AND METHODS

Following approval from the institutional ethical committee, this cross-sectional study was conducted on 24 patients as they were found to have benign lesions of all age groups and both sexes, referred to the Department of Radiodiagnosis at SAIMS & PG Institute, Indore, with clinical suspicion of benign hepatic lesions, or previous images depicted benign hepatic lesions with nonspecific appearance detected clinically or sonographically during the period of study duration i.e., 1st September to 29th February 2024. Patients meeting the inclusion and exclusion criteria were enrolled after obtaining informed consent.

Inclusion Criteria

- All age group irrespective of sex with clinical suspicion of benign hepatic lesions, or previous images depicted benign hepatic lesions with nonspecific appearance detected clinically or sonographically within study duration.

Exclusion Criteria

- Patients with clinical suspicion of malignant hepatic lesions;
- Patients who are not willing to give consent;
- Patients on life support systems;
- Patients with history of trauma; and
- Patients in which CT scan is contraindicated.

Methodology

CT scans were conducted using a Siemens 128-slice CECT scanner (Somatom Definition AS), and images were reformatted into coronal and sagittal views. Experienced radiologists evaluated both axial and reformatted images, recording relevant for statistical analysis.

Statistical Analysis

The data was coded and entered into Microsoft Excel 2010, and analyzed using both Excel and SPSS 20.0 for Windows. The study results were organized into tables and subjected to statistical analysis. Descriptive statistics were employed to identify characteristics and features of the collected data, with mean and percentage utilized for representation. A Chi-square test was applied to assess associations between variables, considering a p-value of less than 0.05 as statistically significant. Additionally, sensitivity, specificity, positive

predictive value, and negative predictive value were calculated to further evaluate the data.

RESULTS

Among 24 patients with benign lesions the highest proportion in the 51-60 age group (27.5%), followed by those ≤40 years (22.5%), and equal representation of 17.5% in both the 41-50 and 61-70 age groups, while 17.0% were aged ≥71 years. The mean age was 45.8 ± 10.2 years. In terms of sex distribution, males represented a larger proportion at 62.5%, compared to females at approximately 37.5% with a M:F ratio of 1.6:1.

Table 1. General Characteristics of the Study Population

Parameter	Frequency	Percent
Age Group		
<=40 Years	5	20.5
41-50 Years	4	16.7
51-60 Years	7	29.2
61-70 Years	4	16.7
>=71 Years	4	16.7
Sex		
F	9	37.5
M	15	62.5

Out of 24 patients with benign hepatic lesions, MDCT identified that the majority of subjects were diagnosed with hemangioma (47.8%), followed by liver abscess (37.6%), and 2 (8.3%) patients each of calcified granuloma and hydatid cyst.

Based on histopathological findings, 37.5% patients were diagnosed with hemangioma, followed by liver abscess (29.2%), hydatid cyst (16.6%), adenoma (12.5%), and calcified granuloma (4.2%).

Table 2. Distribution on Basis of CT Diagnosis

CT DIAGNOSIS	Frequency	Percent
Hemangioma	11	45.8%
Liver abscess	9	37.6%
Calcified granuloma	2	8.3%
Hydatid cyst	2	8.3%
Total	24	100%

Table 3. Distribution on Basis of Histopathological Diagnosis

Histopathological Diagnosis	Frequency	Percent
Hemangioma	9	37.5%
Liver abscess	7	29.2%
Hydatid cyst	4	16.6%
Adenoma	3	12.5%
Calcified granuloma	1	4.2%
Total	24	100%

The association between lesion characteristics and histopathological diagnosis revealed that calcification and necrosis had a statistically significant correlation (P<0.05). However, other factors such as age, sex, number of lesions, site/lobe, size, shape, and hemorrhage did not show a statistically significant association. (Table 4)

Table 4. Association Between Calcification, Necrosis, Hemorrhage and Histopathological Diagnosis

	HISTOPATHOLOGICAL DIAGNOSIS					Total	P value
	Ade-noma	Calcified Granuloma	Heman-gioma	Hydatid Cyst	Liver Abscess		
CALCIFICATION							
Absent	3	0	9	2	7	21 (87.5%)	0.000 * Sig
Present	0	1	0	2	0	3 (12.5%)	
NECROSIS							
Absent	1	1	9	3	0	14 (58.3%)	0.000 * Sig
Present	2	0	0	1	7	10 (41.7%)	
HEMORRHAGE							
Absent	2	1	9	4	5	21 (87.5%)	0.133 Non-Sig
Present	1	0	0	0	2	3 (12.5%)	

A statistically significant association was observed between CT Diagnosis and histopathological diagnosis. (P=0.000) (Table 5)

CT showed a high diagnostic accuracy of 80%, sensitivity of 75%, specificity of 83.30%, PPV of 75% and NPV of 83.30%, suggestive that CT serves as an efficient and efficacious diagnostic tool in differentiating different types of benign lesions of liver from malignant. (Table 6)

Table 5. Association Between CT Diagnosis and Histopathological Diagnosis

CT Diagnosis	HISTOPATHOLOGICAL DIAGNOSIS					Total
	Ade-noma	Calcified Granuloma	Heman-gioma	Hydatid Cyst	Liver Abscess	
Calcified Granuloma	0	1	0	1	0	2 (8.3%)
Hemangioma	1	1	9	3	0	14 (70%)
Hydatid Cyst	0	0	0	2	0	2 (5%)
Liver Abscess	1	0	2	0	0	11 (27.5%)
	3	1	9	4	7	24 (100%)
Chi-Square Tests	Value		df		P Value	Result
	107.633a		30		0.000	Sig

Table 6. Sensitivity and Specificity of CT Diagnosis Against Histopathological Diagnosis

CT Outcome		HISTOPATHOLOGICAL DIAGNOSIS		Total
		BENIGN	MALIGNANT	
BENIGN	Count (%)	20 (83.3%)	4 (25%)	24 (60%)
	Total	20 (83.3%)		
Pearson Chi-Square	Value	Df	P Value	Result
	13.611	1	0.000	Sig
Sensitivity	75.00%			
Specificity	83.30%			
PPV	75.00%			
NPV	83.33%			
Accuracy	80.00%			

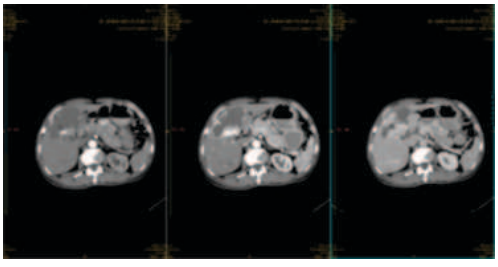

Figure 1: Imaging shows multiple hypoattenuating lesions with peripheral nodular enhancement in the arterial phase, progressive centripetal fill-in in the portal phase, and irregular fill-in in the venous phase, suggestive of hepatic hemangiomas. The largest lesion measures 6.3 x 6.6 x 8.2 cm (AP x TR x CC) and is predominantly located in segments IV and V of the liver.

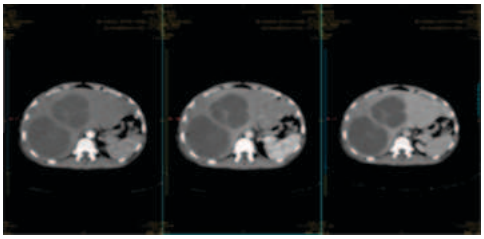

Figure 2 depicts an enlarged liver (~21.0 cm) with a normal outline. Two well-defined, peripheral-enhancing, thick-walled cystic hypodense lesions are visible in segments VII and VIII, accompanied by mild to moderate perilesional edema, suggestive of liver abscesses. The abscess in segment VIII measures approximately 418 cc, while the abscess in segment VII measures approximately 840 cc. The latter shows a focal capsular breach with extension into the pleural cavity, indicating a rupture of the abscess into both the abdomen and the pleural cavity.

DISCUSSION

A wide range of benign tumors can develop in the liver, the largest organ in the body. Traditionally, histopathological diagnosis has been considered the gold standard for identifying these lesions, though it comes with the limitation of being an invasive procedure. Advances in radiological imaging techniques, particularly triple-phase CT scanning, offer a less invasive alternative, often leading to a definitive or near-definitive diagnosis, thereby reducing the need for invasive methods.

Triple-phase CT scanning of the liver, which includes the Hepatic Arterial Phase (HAP), Porto Venous Phase (PVP), and Delayed Phase (DP), allows for the detailed analysis of liver lesions by distinguishing their vascular supply. This imaging technique enables the classification of liver lesions as benign based on their characteristic contrast uptake, vascular invasion, and capsular delineation and further differentiate and characterise the different types of benign hepatic lesions.

Therefore, this study was conducted to assess the utility of MDCT in the detection and characterization of benign liver lesions aimed to enhance diagnosis, staging, and aiming to guide further management strategies of liver pathologies. Additionally, the study seeks to correlate CT findings with clinical, histopathological, follow-up, or post-operative data where applicable and to calculate the sensitivity and specificity of triple-phase CT in detecting malignant liver lesions.

In the present study, the most common age group affected was between 51-60 years, comprising 29.2% of the patients, followed by 20.5% of patients aged ≤40 years. This finding aligns with studies by Ahirwar CP et al. [12], Tatikonda et al. [13], and Abbas KA et al. [14], which also identified the 51-60 year age group as predominant. The study showed a higher number of males [21 (62.5%)] compared to females [9 (37.5%)], with a male-to-female ratio of 1.6:1, consistent with research by Ahirwar CP et al. [12], Manchkanti V et al. [15], and others, where male predominance was observed.

In this study, hemangioma was the most common diagnoses based on CT findings, observed in 45.8% of patients, followed by liver abscess (37.6%), calcified granuloma and hydatid cyst (8.3% each). These results align with previous studies by Tatikonda et al. [13], Manchkanti V et al. [15], and Ahirwar CP et al. [12], which also identified hemangioma as the most common benign liver lesion.

Histopathological examination also showed hemangioma (37.5%) to be most common diagnosis amongst benign hepatic lesions followed by liver abscess (29.2%), hydatid cyst (16.6%) with smaller percentages for adenoma (12.5%) and calcified granuloma (4.2%). These findings are consistent with prior studies, such as Tatikonda et al. [13], which reported a similar distribution of liver lesions

In this study, the association between lesion characteristics and histopathological diagnosis revealed that calcification and necrosis had a statistically significant correlation ($P<0.05$). However, other factors such as age, sex, number of lesions, site/lobe, size, shape, and hemorrhage did not show a statistically significant association ($P>0.05$). Age and gender also showed no statistically significant correlation with histopathological diagnosis ($P>0.05$), though the majority of patients were over 50 years old (60%) and males. These findings are consistent with previous studies, such as Tatikonda VK et al.[13], who reported 60% of metastases in lung and stomach cancers occurring in patients aged 51-60, and Ahirwar CP et al.[12], who found liver metastases to be most common in the 41-60 age group.

The study revealed a statistically significant association between CT diagnosis and histopathological diagnosis ($P=0.329$). The diagnostic performance of CT in diagnosing benign liver lesions was high, with an accuracy of 80%, sensitivity of 75%, specificity of 83.3%, positive predictive value (PPV) of 75%, and negative predictive value (NPV) of 83.3%. This indicates that CT is a reliable diagnostic tool for benign liver lesion characterization. These findings are consistent with previous studies. Ahirwar CP et al. [12] reported that triple-phase CT had excellent diagnostic capabilities for hepatic masses, with a sensitivity of 91.3%, specificity of 97.8%, PPV of 91.3%, and NPV of 97.8% ($P<0.001$). Similarly, Hafeez S et al. [16] found that triphasic MDCT had a sensitivity of 100%, specificity of 80%, PPV of 94.6%, NPV of 100%, and an overall diagnostic accuracy of 95.6%. Other studies, including those by Marin et al. [17], Kim et al. [18], and Ronzoni et al. [19], reported sensitivity values ranging from 94.4% to 96%. Tomar S et al. also demonstrated that triphasic CT scan had a sensitivity of 100%, specificity of 80%, PPV of 98.04%, NPV of 100%, and diagnostic accuracy of 98.18% in diagnosing benign liver lesions. Overall, these findings highlight the strong diagnostic efficacy of CT in evaluating liver pathology.

The study's limitations include a small sample size of 24 patients, which may affect the generalizability of the findings, and the lack of long-term follow-up to assess treatment outcomes based on MDCT diagnoses.

CONCLUSION

In recent decades, multidetector computed tomography (MDCT) has emerged as a primary diagnostic tool for hepatic lesions, favored for its accessibility, cost-effectiveness, speed, and precise visualization of anatomical structures and disease extent. Crucially, MDCT supports surgeons in planning procedures. The findings of this study show MDCT's high sensitivity in categorizing hepatic lesions into clinically significant groups, aiding in accurate diagnosis and comprehensive lesion evaluation.

Triple-phase CT, in particular, proves highly effective for diagnosing benign hepatic lesions, with an observed diagnostic accuracy of 80%, sensitivity of 75%, specificity of 83.3%, positive predictive value (PPV) of 75%, and negative predictive value (NPV) of 83.3%. This imaging modality is especially valuable for assessing lesion vascularity, enhancement patterns, and associated features such as vascular invasion, necrosis, and calcification. Its ability to capture various vascular phases is critical for diagnosing hepatic malignancies, guiding treatment plans, and aiding surgical strategies. This study emphasizes the potential for preventing liver disease through early detection and prompt management of hepatic lesions.

REFERENCES

1. Hussain SM, Semelka RC. Hepatic Imaging:Comparison of modalities Radiol Clin North Am43.(2005) sep ; 43(5)929 – 47 .
2. Berland LL, Smith JK. Multi-detector array CT: once again, technology creates new opportunities (editorial). Radiology. 1998;20(9):327-29.
3. Bonaldi VM, Bret PM, Reinhold C, Atri M. Helical computed tomogram of liver, value of an early hepatic arterial phase. Radiology. 1995;19(7):357-63.
4. Francis IR, Cohan RH, McNulty NJ, Platt JF, Korobkin M, Gebremariam A, et al. Multi-detector CT of the liver and hepatic neoplasms: Effect of multiphasic imaging on tumor conspicuity and vascular enhancement. AJR Am J Roentgenol. 2003;18(1):1217-24.
5. Ichikawa T, Saito K, Yoshioka N, Tanimoto A, Gokan T, Takehara Y, et al. Detection and characterization of focal liver lesions: A Japanese phase III, multicenter comparison between gadoxetic acid disodium enhanced magnetic resonance imaging and contrast enhanced computed tomography predominantly in patients with hepatocellular carcinoma and chronic liver disease. Invest Radiol. 2010;4(5):133-41.
6. Hammersting R, Huppertz A, Breuer J, Balzer T, Blakeborough A, Carter R, et al. Diagnostic efficacy of gadoxetic acid (Primovist)-enhanced MRI and spiral CT for a therapeutic strategy: Comparison with Intraoperative and histopathologic findings in focal liver lesions. Eur Radiol. 2008;1(8):457-67.
7. Soyer P, Sirol M, Fargeaudou Y, Duchat F, Hamzi L, Boudiaf M, et al. Differentiation between true focal liver lesions and pseudolesions in patients with fatty liver: evaluation of helical CT criteria. Eur Radiol. 2010;20(1):1726-37.
8. Van Leeuven MS, Noordzij J, Feldberg MA, Hennipman AH, Doorneewaard H. Focal Liver lesions; characterization with tri-phasic computed tomography.Radiology. 1996;20(1):327-36.
9. Szklaruk J, Silverman PM, Chamsangavej C. Imaging in the diagnosis, staging, treatment and surveillance of hepatocellular carcinoma. AJR Am J Roentgenol. 2003;18(1):441-54.
10. Iannaccone R, Piacentini F, Murakami T, Paradis V, Belghiti J, Hori M, et al. Hepatocellular carcinoma in patients with non-alcoholic fatty liver disease: Helical CT and MR imaging findings with clinical-pathologic comparison. Radiology.2007;24(3):422-30.
11. Tyagi V, Sahoo K, Shaha P, Tyagi N, Thite H, Aggarwal D, et al. Evaluation of liver masses with 16 slice multi-detector computed tomography with pathological correlation. JMSCR. 2018;06(01):32033- 45.
12. Ahirwar CP, Patil A, Soni N. Role of triple phase computed tomography findings for evaluation of hepatic lesions. Int J Res Med Sci 2016;4:3576-83
13. Venkat Kishan Tatikonda et al., Role of Triple Phase CT in the Evaluation of Liver Lesions. International Journal of Anatomy Radiology and Surgery. 2021 Apr, Vol-10(2): RO65-RO7
14. Abbas KA, Caroline AE, Edward R. Triple phase CT Hounsfield & pattern in differentiation of liver lesions. Journal of Dental & Medical Sciences. 2017;16(01):120-25.
15. Venkatesh Manchikanti, N V K Sundeep, Najim Z. Alshahrani, Suneetha Pentyala. Role of triple phase CT (128 slice) in focal hepatic lesions. International Journal of Contemporary Medicine Surgery and Radiology. 2021;6(2):B52-B56
16. Hafeez S, Alam MS, Sajjad Z, Khan ZA, Akhter W, Mubarak F. Triphasic computed tomography (CT) scan in focal tumoral liver lesions. Pak Med Assoc. 2011;61(6):571-75.
17. Marin D, Di Martino M, Guerrisi A, De Filippis G, Rossi M, Ginanni Corradini S, et al. Hepatocellular carcinoma in patients with cirrhosis: qualitative comparison of gadobenate dimeglumine-enhanced MR imaging and multiphasic 64-section CT. Radiology. 2009;251(1):85–95.
18. Ji K, Jm L, Jy C, Yk K, Sh K, Jy L, et al. The value of gadobenate dimeglumine-enhanced delayed phase MR imaging for characterization of hepatocellular nodules in the cirrhotic liver. Invest Radiol. 2008;43(3):202–10.
19. Ronzoni A, Artioli D, Scardina R, Battistig L, Minola E, Sironi S, et al. Role of MDCT in the Diagnosis of Hepatocellular Carcinoma in Patients with Cirrhosis Undergoing Orthotopic Liver Transplantation. Am J Roentgenol. 2007;189(4):792–8.