RESEARCH PAPER

Imaging Evaluation of Hepatic Lesions Using Multiphasic CT in Patients with Suspected Hepatocellular Carcinoma

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ABSTRACT

Background: Hepatocellular carcinoma (HCC) is the most common primary liver malignancy, often arising in patients with chronic liver disease. Early and accurate diagnosis is essential for optimal management. Multiphasic computed tomography (CT) plays a key role in noninvasive diagnosis based on characteristic vascular patterns.

Aim: To evaluate the role of multiphasic CT in the detection and characterization of hepatic lesions in patients with suspected hepatocellular carcinoma.

Materials and Methods:A prospective observational study was conducted in the Department of RadioDiagnosis at Maharishi Markandeshwar Institute of Medical Sciences and Research, Haryana, over a period of 6 months. A total of 50 patients with suspected hepatic lesions were included. All patients underwent multiphasic CT, including non-contrast, arterial, portal venous, and delayed phases. Imaging findings such as lesion size, enhancement pattern, capsular appearance, vascular invasion, and extrahepatic spread were analyzed. Statistical analysis was performed, and p-values <0.05 were considered significant.

Results: The majority of patients were in the 51–60 years age group (36%), with a male predominance (68%). Hepatitis B (28%) was the most common risk factor. Typical arterial enhancement with washout was observed in 64% of cases (p=0.001). Most lesions measured 2–5 cm (48%). Capsular enhancement (56%) and vascular invasion (32%) were common associated findings, showing significant correlation.

Conclusion: Multiphasic CT is a reliable and effective imaging modality for diagnosing and staging hepatocellular carcinoma, aiding in timely management decisions.

Keywords: Hepatocellular carcinoma, multiphasic CT, hepatic lesions, arterial enhancement, washout, liver imaging.

How to cite this article: Kapoor R, Goyal K, Mishra VD. Imaging Evaluation of Hepatic Lesions Using Multiphasic CT in Patients with Suspected Hepatocellular Carcinoma. Int J Drug Deliv Technol. 2026;16(20s): 860-865. DOI: 10.25258/ijddt.16.20s.85

INTRODUCTION

Hepatocellular carcinoma (HCC) is the most common primary malignancy of the liver and represents a major global health burden, particularly in regions with a high prevalence of chronic liver disease such as viral hepatitis and cirrhosis. Early and accurate diagnosis of HCC is critical, as prognosis and treatment options are closely linked to the stage at detection. Imaging plays a pivotal role not only in the detection and characterization of hepatic lesions but also in guiding management decisions, often obviating the need for invasive biopsy in typical cases. Among various imaging modalities, multiphasic computed tomography (CT) has emerged as a cornerstone in the evaluation of suspected HCC due to its widespread availability, rapid acquisition, and high diagnostic accuracy [1,2].

Multiphasic CT involves imaging the liver during different phases of contrast enhancement, typically including the non-contrast, arterial, portal venous, and delayed phases. This technique exploits the unique vascular characteristics of HCC, which typically demonstrates arterial phase hyperenhancement followed by washout in the portal venous or delayed phases. These hallmark imaging features are reflective of the tumor's arterial neovascularization and reduced portal venous supply, distinguishing it from surrounding cirrhotic liver parenchyma [3,4]. The ability of multiphasic CT to capture these dynamic perfusion patterns makes it indispensable in lesion

characterization and noninvasive diagnosis based on established imaging criteria such as those proposed by the American Association for the Study of Liver Diseases (AASLD) and LI-RADS [5].

In patients with chronic liver disease, the liver often harbors a spectrum of nodular lesions, including regenerative nodules, dysplastic nodules, and early HCC. Differentiating among these entities is essential, as early HCC may be amenable to curative therapies such as resection, ablation, or transplantation. Multiphasic CT aids in this differentiation by assessing lesion enhancement patterns, size, margins, and ancillary features such as capsule appearance and internal architecture [6]. Furthermore, CT imaging is invaluable in staging HCC by evaluating tumor burden, vascular invasion, and extrahepatic spread, all of which are crucial determinants of prognosis and therapeutic planning [7].

Despite its advantages, multiphasic CT has certain limitations, including reduced sensitivity for detecting very small lesions (<1 cm) and challenges in differentiating atypical HCC from other hypervascular lesions. Additionally, radiation exposure and contrast-related risks must be considered, particularly in patients requiring repeated imaging [8]. Nonetheless, technological advancements such as multidetector CT (MDCT), improved contrast protocols, and post-processing techniques have significantly enhanced lesion detection and characterization [9].

Given the increasing incidence of HCC and the central role of imaging in its diagnosis, there is a growing need to evaluate the effectiveness of multiphasic CT in real-world clinical settings. This study aims to assess the imaging characteristics of hepatic lesions using multiphasic CT in patients with suspected hepatocellular carcinoma, thereby contributing to improved diagnostic accuracy and patient outcomes [10].The aim of this study is to evaluate the role of multiphasic CT in the detection and characterization of hepatic lesions in patients with suspected hepatocellular carcinoma. The objectives include assessing enhancement patterns, lesion differentiation, diagnostic accuracy, and contribution to staging and management planning of hepatocellular carcinoma.

MATERIALS AND METHODS

Study Design: Prospective observational study.

Study Duration: 6 months (e.g., January 2025 to June 2025).

Sample Size: 50 patients with clinically or radiologically suspected hepatocellular carcinoma.

Study Setting: Department of RadioDiagnosis, Maharishi Markandeshwar Institute of Medical Sciences and Research, Mullana, Haryana, India.

Inclusion Criteria:

Patients with suspected hepatic lesions on ultrasound or clinical evaluation.

Patients with known risk factors such as chronic liver disease, cirrhosis, or hepatitis B/C infection.

Age >18 years.

Exclusion Criteria:

Patients with contraindications to iodinated contrast (e.g., renal failure, contrast allergy).

Pregnant patients.

Previously treated or confirmed cases of HCC.

Statistical Analysis: We put the data into Microsoft Excel and then used SPSS software version 27.0 (SPSS Inc., Chicago, IL, USA) and GraphPad Prism version 5 to look at it. Mean ± standard deviation was used to show continuous variables, and frequencies and percentages were used to show categorical variables. The unpaired t-test was utilized to examine continuous variables between independent groups, whereas the paired t-test was employed for comparisons within the same group. The Chi-square test or Fisher's exact test was used to look at categorical variables, depending on which one was better. A p-value of less than 0.05 was seen to be statistically important.

RESULT

Table 1: Age Distribution of Patients

Age Group (years)	Number of Patients	Percentage (%)	P-value
<40	6	12%	0.032
41–50	10	20%	
51–60	18	36%	
61–70	12	24%	
>70	4	8%	
Total	**50**	**100%**	

Table 2: Gender Distribution

Gender	Number of Patients	Percentage (%)	P-value
Male	34	68%	0.041
Female	16	32%	
Total	**50**	**100%**	

Table 3: Risk Factors Associated with HCC

Risk Factor	Number of Patients	Percentage (%)	P-value
Hepatitis B	14	28%	0.02

Hepatitis C	10	20%	8
Alcoholic Liver Disease	12	24%	
NAFLD/NASH	8	16%	
Others	6	12%	
Total	**50**	**100%**	

Table 4: Enhancement Pattern on Multiphasic CT

Enhancement Pattern	Number of Patients	Percentage (%)	P-value
Arterial enhancement with washout (typical HCC)	32	64%	0.001
Arterial enhancement without washout	8	16%	
Hypovascular lesion	6	12%	
Indeterminate	4	8%	
Total	**50**	**100%**	

Table 5: Lesion Size Distribution

Lesion Size (cm)	Number of Patients	Percentage (%)	P-value
<2 cm	8	16%	0.045
2–5 cm	24	48%	
>5 cm	18	36%	
Total	**50**	**100%**	

Table 6: Associated Imaging Findings

Imaging Finding	Number of Patients	Percentage (%)	P-value
Capsular enhancement	28	56%	0.022
Vascular invasion	16	32%	
Portal vein thrombosis	10	20%	
Extrahepatic spread	6	12%	

Figure: 1. Risk Factors Associated with HCC

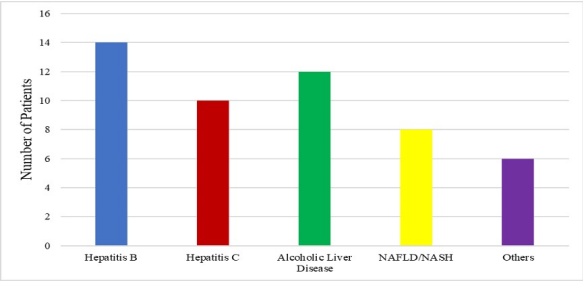

Figure: 2. Associated Imaging Findings

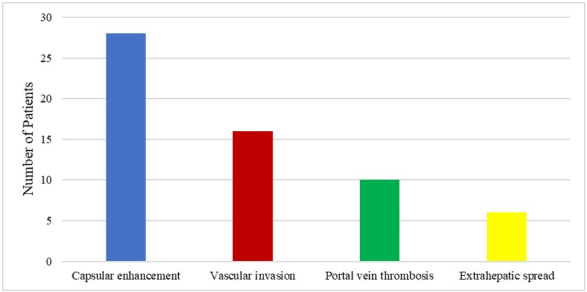

Table 1 (Age Distribution):

The majority of patients belonged to the 51–60 years age group, comprising 18 patients (36%), followed by 61–70 years with 12 patients (24%). Patients aged 41–50 years accounted for 20% (n=10), while those below 40 years and above 70 years constituted 12% (n=6) and 8% (n=4), respectively. The age distribution was statistically significant (p=0.032), indicating a higher prevalence of suspected hepatocellular carcinoma in the middle-aged to elderly population.

Table 2 (Gender Distribution):

Out of 50 patients, 34 (68%) were males and 16 (32%) were females, demonstrating a clear male predominance. The difference in gender distribution was statistically significant (p=0.041), suggesting that hepatocellular carcinoma is more commonly observed in males compared to females.

Table 3 (Risk Factors):

Hepatitis B was the most common risk factor, observed in 14 patients (28%), followed by alcoholic liver disease in 12 patients (24%) and hepatitis C in 10 patients (20%). Non-alcoholic fatty liver disease/non-alcoholic steatohepatitis (NAFLD/NASH) was present in 8 patients (16%), while other causes accounted for 6 patients (12%). The association between risk factors and disease occurrence was statistically significant (p=0.028).

Table 4 (Enhancement Pattern on Multiphasic CT):

Typical arterial phase hyperenhancement with subsequent washout was noted in 32 patients (64%), making it the most common imaging pattern. Arterial enhancement without washout was seen in 8 patients (16%), while hypovascular lesions and indeterminate patterns were observed in 12% (n=6) and 8% (n=4) of cases, respectively. This distribution was highly significant (p=0.001), reinforcing the diagnostic value of multiphasic CT in identifying characteristic HCC features.

Table 5 (Lesion Size Distribution):

Most lesions measured between 2–5 cm, seen in 24 patients (48%), followed by lesions >5 cm in 18 patients (36%). Smaller lesions (<2 cm) were detected

in 8 patients (16%). The size distribution showed statistical significance (p=0.045), indicating that most patients presented with intermediate to large-sized lesions at diagnosis.

Table 6 (Associated Imaging Findings):

Capsular enhancement was the most frequent associated imaging finding, present in 28 patients (56%). Vascular invasion was identified in 16 patients (32%), while portal vein thrombosis and extrahepatic spread were seen in 20% (n=10) and 12% (n=6) of cases, respectively. These findings were statistically significant (p=0.022), highlighting the role of multiphasic CT in assessing tumor aggressiveness and staging.

DISCUSSION

The present study demonstrated that the majority of patients (36%) belonged to the 51–60 years age group, followed by 61–70 years (24%), with a statistically significant association (p=0.032). This finding is consistent with the study by Park et al., who reported peak incidence of hepatocellular carcinoma in the fifth and sixth decades of life, attributing this to the long-standing effects of chronic liver disease and viral hepatitis [11]. Similarly, El-Serag et al. observed that HCC incidence increases with age due to cumulative hepatic injury and fibrosis progression [12]. Thus, our findings align with established epidemiological trends indicating that HCC predominantly affects middle-aged and elderly individuals.

A marked male predominance (68%) was observed in our study, which was statistically significant (p=0.041). This is comparable to the findings of Njei et al., who reported a higher incidence of HCC in males, likely due to greater exposure to risk factors such as alcohol consumption and hepatitis infections [13]. Additionally, Bosch et al. suggested that androgenic hormones may play a role in hepatocarcinogenesis, further explaining the gender disparity [14]. Therefore, our results corroborate the global pattern of male predominance in HCC cases.

Regarding risk factors, hepatitis B infection (28%) was the most common, followed by alcoholic liver disease (24%) and hepatitis C (20%), with a significant association (p=0.028). This is in agreement with the study by Perz et al., which highlighted hepatitis B and C as the leading etiological factors for HCC worldwide [15]. Similarly, Morgan et al. reported a strong correlation between chronic viral hepatitis and HCC development, particularly in developing countries [16]. The contribution of NAFLD/NASH (16%) in our study also reflects the emerging trend noted by Younossi et al., emphasizing the increasing burden of metabolic liver disease in HCC pathogenesis [17].

In the evaluation of enhancement patterns on multiphasic CT, the majority of lesions (64%) exhibited arterial phase hyperenhancement with washout, which was highly significant (p=0.001). This classical imaging feature is well documented in the literature. According to Forner et al., arterial hypervascularity with venous washout is the hallmark of HCC and forms the basis of noninvasive diagnostic criteria [18]. Similarly, Kim et al. reported that this pattern has high specificity for HCC, particularly in cirrhotic livers [19]. Our findings reaffirm the diagnostic reliability of multiphasic CT in identifying characteristic vascular behavior of HCC.

The lesion size distribution in our study showed that 48% of patients had lesions measuring 2–5 cm, while 36% had lesions >5 cm (p=0.045), indicating that most cases were diagnosed at an intermediate to advanced stage. This is comparable to the observations of Llovet et al., who noted that delayed diagnosis often results in larger tumor sizes at presentation, especially in regions lacking routine surveillance programs [20]. The relatively lower proportion of small lesions (<2 cm) in our study further emphasizes the need for early screening in high-risk populations.

Associated imaging findings such as capsular enhancement (56%), vascular invasion (32%), portal vein thrombosis (20%), and extrahepatic spread (12%) were also statistically significant (p=0.022). These findings are in line with the study by Bruix and Sherman, who emphasized that vascular invasion and extrahepatic dissemination are key indicators of advanced disease and poor prognosis [1]. Similarly, Sangiovanni et al. highlighted the importance of imaging in detecting these features for accurate staging and treatment planning [2]. The presence of capsular enhancement in more than half of the cases in our study further supports its role as a characteristic feature of progressed HCC.

Overall, the findings of the present study are consistent with previously published literature, reinforcing the pivotal role of multiphasic CT in the detection, characterization, and staging of hepatocellular carcinoma. The statistically significant associations observed across demographic, etiological, and imaging parameters highlight the reliability of this modality in clinical practice.

CONCLUSION

Multiphasic computed tomography (CT) plays a crucial role in the comprehensive evaluation of hepatic lesions in patients with suspected hepatocellular carcinoma. In the present study, it demonstrated high effectiveness in detecting and characterizing lesions based on their vascular enhancement patterns, particularly arterial phase hyperenhancement with portal venous washout, which remains a key diagnostic hallmark. The modality also proved valuable in assessing lesion size, number, capsular enhancement, vascular invasion, and extrahepatic spread, thereby aiding in accurate staging and treatment planning. The significant association of demographic factors and underlying risk factors such as hepatitis B, hepatitis C, and alcoholic liver disease further emphasizes the importance of targeted imaging in high-risk populations. Despite certain limitations in detecting very small lesions, multiphasic CT remains a reliable, widely available, and non-invasive imaging tool, significantly contributing to early diagnosis, prognostication, and management of hepatocellular carcinoma in routine clinical practice.

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