

EVALUATE THE UTILITY OF CT LIRADS IN ROUTINE REPORTING OF FOCAL LESION OF LIVER

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ABSTRACT

Background: Hepatocellular carcinoma (HCC) is one of the most common primary malignancies of the liver. Accurate characterization of focal liver lesions is essential for early diagnosis and appropriate management. CT Liver Imaging Reporting and Data System (LI-RADS) provides a standardized approach for reporting and categorizing hepatic lesions in at-risk patients.

Aim: To evaluate the utility of CT LI-RADS in routine reporting of focal liver lesions.

Materials and Methods: This prospective observational study was conducted in the Department of Radiodiagnosis, Maharishi Markandeshwar Institute of Medical Sciences and Research, Mullana, Ambala, from January 2025 to January 2026. A total of 50 patients with cirrhosis, chronic hepatitis B infection, hepatocellular carcinoma, or focal liver lesions detected on ultrasonography underwent triphasic CT evaluation. Lesions were categorized according to CT LI-RADS criteria and correlated with histopathological, FNAC, and biochemical findings.

Results: The mean age of patients was 58.4 ± 9.88 years, with male predominance (76%). Alcohol was the most common risk factor (72%). Lesions larger than 20 mm were seen in 76% of patients, and multiple lesions were observed in 60% of cases. Arterial phase heterogeneous enhancement was present in 34% of lesions, while portal venous washout was observed in 50% of patients. LI-RADS category LR-5 constituted the majority (52%) and showed strong correlation with hepatocellular carcinoma on histopathology. Hyperenhancing lesions were predominantly associated with malignant categories.

Conclusion: CT LI-RADS is an effective and reliable standardized reporting system for focal liver lesions, improving lesion characterization, diagnostic accuracy, staging, and clinical decision-making in patients at risk for hepatocellular carcinoma.

Keywords: CT LI-RADS, Hepatocellular carcinoma, Focal liver lesion, Triphasic CT, Liver imaging, Hepatic malignancy.

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INTRODUCTION

Hepatocellular carcinoma (HCC) is one of the most common primary malignancies of the liver and represents a major global health burden due to its increasing incidence and high mortality rate. Early and accurate diagnosis of focal liver lesions is essential because timely treatment significantly improves patient survival and prognosis. In routine clinical practice, liver lesions are frequently detected during ultrasonography, computed tomography (CT), or magnetic resonance imaging (MRI) performed for screening, surveillance, or evaluation of chronic liver disease. However, differentiating benign from malignant hepatic lesions remains challenging, particularly in patients with cirrhosis or chronic hepatitis, where

regenerative nodules, dysplastic nodules, and early HCC may show overlapping imaging characteristics [1].

Computed Tomography Liver Imaging Reporting and Data System (CT LI-RADS) was developed by the American College of Radiology (ACR) to standardize the interpretation, reporting, and categorization of liver lesions in patients at risk for HCC. Before the introduction of LI-RADS, considerable variability existed among radiologists in describing imaging findings and assessing the probability of malignancy, leading to inconsistent diagnosis and management strategies [2]. LI-RADS provides a structured lexicon and diagnostic algorithm based on major imaging features such as arterial phase hyperenhancement, washout

appearance, enhancing capsule, lesion size, and threshold growth. These features help classify lesions into categories ranging from definitely benign (LR-1) to definitely HCC (LR-5) [3].

The implementation of CT LI-RADS in routine radiological reporting has improved communication between radiologists, hepatologists, surgeons, and oncologists by creating a common standardized language. This standardization enhances diagnostic confidence and facilitates evidence-based clinical decision-making [4]. Moreover, CT remains widely available, cost-effective, and less time-consuming compared to MRI, making it a preferred imaging modality in many institutions, especially in developing countries and high-volume centers [5]. Multiphase contrast-enhanced CT plays a pivotal role in identifying the hallmark vascular characteristics of HCC, particularly arterial enhancement and delayed washout, which form the cornerstone of LI-RADS categorization [6].

Despite its advantages, the practical utility of CT LI-RADS in routine reporting continues to be evaluated. Certain lesions may demonstrate atypical imaging appearances, resulting in interobserver variability and diagnostic uncertainty. Small lesions less than 2 cm may be difficult to characterize accurately, and benign lesions such as hemangiomas or arterioportal shunts may occasionally mimic HCC [7]. Furthermore, CT has limitations in lesion detection sensitivity compared with MRI, particularly for early-stage tumors and infiltrative lesions [8]. Nevertheless, several studies have shown that LI-RADS improves reporting consistency, increases specificity for diagnosing HCC, and supports standardized treatment planning and transplant eligibility assessment [9].

Given the growing burden of chronic liver disease and HCC worldwide, evaluating the effectiveness of CT LI-RADS in daily clinical practice is highly

relevant. Assessing its diagnostic accuracy, reproducibility, and applicability in routine reporting can help determine its role in improving patient management and reducing diagnostic ambiguity. Therefore, the present study aims to evaluate the utility of CT LI-RADS in routine reporting of focal liver lesions and to analyze its effectiveness in categorizing hepatic lesions based on imaging characteristics and final diagnosis [10]. The aim of the present study is to evaluate the utility of CT LI-RADS in the routine reporting of focal liver lesions. The objectives of the study are to assess the role of CT LI-RADS in the diagnosis, staging, and standardized reporting of focal hepatic lesions; to identify the current challenges, limitations, and knowledge gaps associated with the utilization of CT LI-RADS in routine clinical practice; and to evaluate the impact of CT LI-RADS on clinical outcomes, including patient management, treatment planning, and follow-up strategies in patients with focal liver lesions.

MATERIALS AND METHODS

Study Design: Prospective observational study.

Study Population: Patients diagnosed with cirrhosis, chronic hepatitis B infection, hepatocellular carcinoma (HCC), or focal liver lesions detected on ultrasonography and undergoing triphasic CT evaluation.

Sample Size: A total of 50 cases were included in the study. Sample size was calculated at 95% confidence interval using the formula for estimation of proportion and was rounded off from the minimum required sample size of 35 subjects to 50 patients.

Study Duration: The study was conducted from January 2025 to January 2026 after obtaining approval from the Institutional Ethics Committee. The duration included patient recruitment, data collection, and thesis preparation.

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Study Place: Department of Radiodiagnosis, Maharishi Markandeshwar Institute of Medical Sciences and Research, Mullana, Ambala.

- Patients with cirrhosis secondary to congenital hepatic fibrosis.

Inclusion Criteria:

- Adults aged 18 years and above of either gender.
- Patients diagnosed with cirrhosis.
- Patients with chronic hepatitis B infection without cirrhosis.
- Patients with current or prior hepatocellular carcinoma including liver transplant candidates and post-transplant patients.
- Patients with focal liver lesions detected on ultrasonography.

Exclusion Criteria:

- Pediatric patients aged below 18 years.

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. Demographic Characteristics of Study Subjects

Variable	Category	Number of Patients	Percentage (%)	P-value
Age group (years)	40-49	11	22	<0.001
	50-59	15	30	
	60-69	14	28	
	70-79	10	20	
Gender	Male	38	76	
	Female	12	24	
Risk factors	Alcohol	36	72	
	HCV	7	14	
	HBsAg	7	14	

Mean age: 58.4 ± 9.88 years

Table 2. Clinical Profile of Study Subjects

Clinical Features	Number of Patients	Percentage (%)	P-value
Abdominal discomfort	33	66	<0.001
Weight loss	30	60	
Appetite loss	24	48	
Jaundice	21	42	
Pain abdomen	19	38	
Fever	14	28	
Lump per abdomen	12	24	
Dyspepsia	8	16	
Others	5	10	
Ascites present	34	68	

Table 3. Lesion Characteristics on CT Evaluation

Variable	Category	Number of Patients	Percentage (%)	P-value
Size of lesion	>20 mm	38	76	<0.001

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	<20 mm	12	24
Number of lesions	Multiple	30	60
	Solitary	20	40
Location of lesion	Both lobes	28	56
	Right lobe	12	24
	Left lobe	10	20
Non-contrast CT appearance	Hypodense	48	96
	Isodense	2	4

Table 4. Contrast-Enhanced CT Findings

CT Findings	Category	Number of Patients	Percentage (%)	P-value
Arterial phase	Heterogeneous enhancement	17	34	<0.001
	Non-enhancing	13	26	
	Peripheral nodular	10	20	
	Homogeneous enhancement	10	20	
Portal venous phase	Washout	25	50	
	Non-enhancing	13	26	
	No significant change	7	14	
	Centripetal filling	5	10	
Delayed phase	No significant change	35	70	
	Progressive centripetal filling	6	12	
	Washout	5	10	
	Capsular enhancement	2	4	
	Non-enhancing	2	4	

Table 5. Vascular Invasion, LI-RADS Staging, and Histopathology

Variable	Category	Number of Patients	Percentage (%)	P-value
Portal vein invasion	Present	4	8	<0.001
	Absent	46	92	
Hepatic vein invasion	Present	2	4	
	Absent	48	96	
LI-RADS staging	LR-1	7	14	
	LR-2	6	12	
	LR-3	4	8	
	LR-4	7	14	
	LR-5	26	52	
Histopathology	HCC	27	54	
	Hemangioma	6	12	
	Dysplastic nodule	5	10	
	Regenerative nodule	4	8	
	Not done	8	16	

Table 6. Correlation of LI-RADS Staging with Histopathology and Arterial Enhancement

LI-RADS Category	Histopathology / Enhancement Pattern	Number of Patients	Percentage (%)	P-value
LR-1	Lipoma / Simple cyst	7	14	<0.001
LR-2	Hemangioma	6	12	
LR-3	Regenerative nodule	4	8	
LR-4	Dysplastic nodule / HCC	7	14	
LR-5	HCC / Multicentric HCC	26	52	
Hyperenhancing lesions	37	74	0	
Non-enhancing lesions	13	26	0	

Chi-square = 31.58; df = 4

Figure: 1. Distribution of Presenting Clinical Symptoms Among Study Subjects

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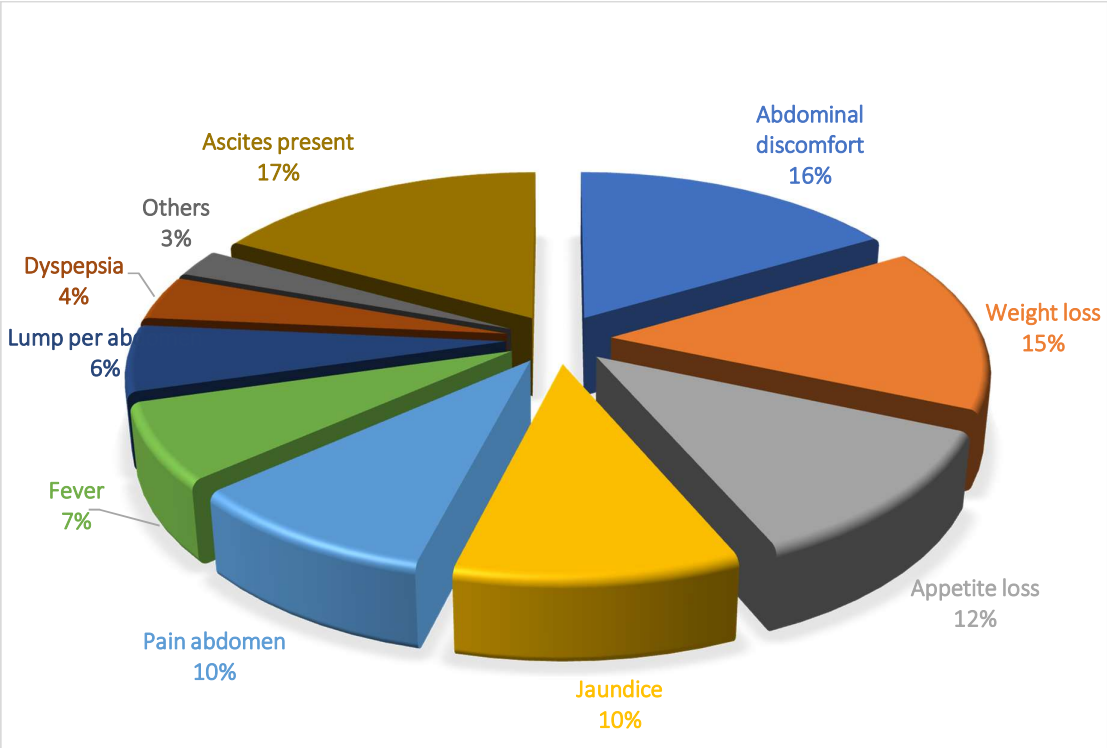


Figure: 2.Lesion Characteristics on CT Evaluation

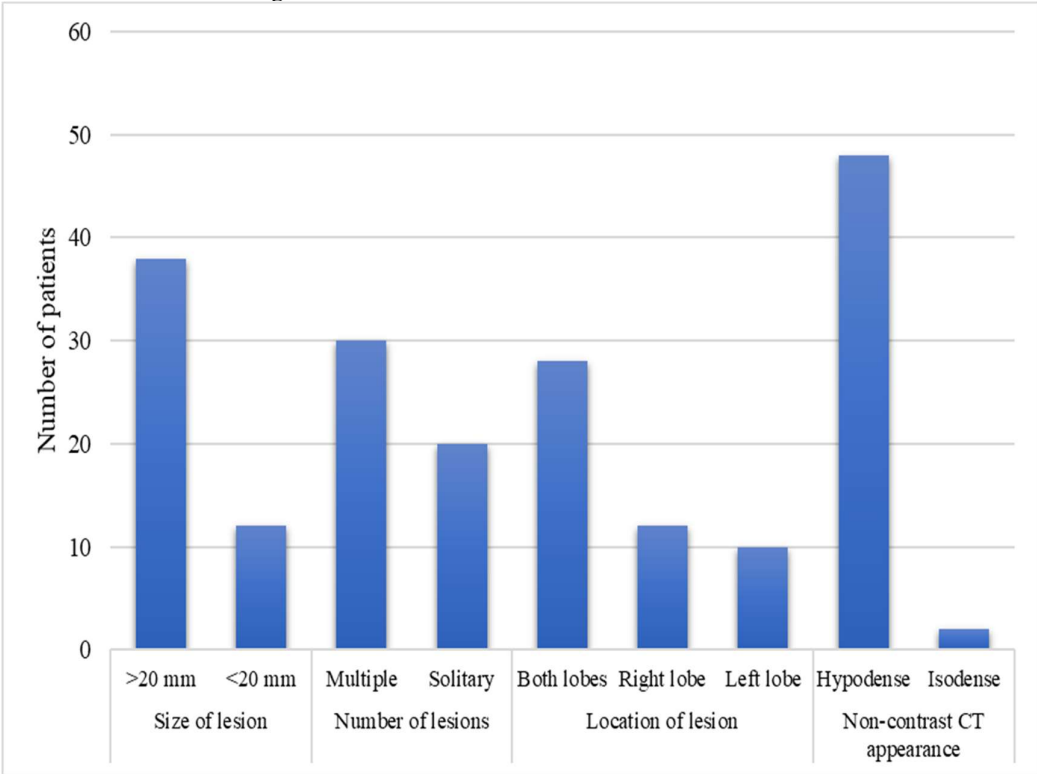


Figure: 3.Contrast-Enhanced CT Findings

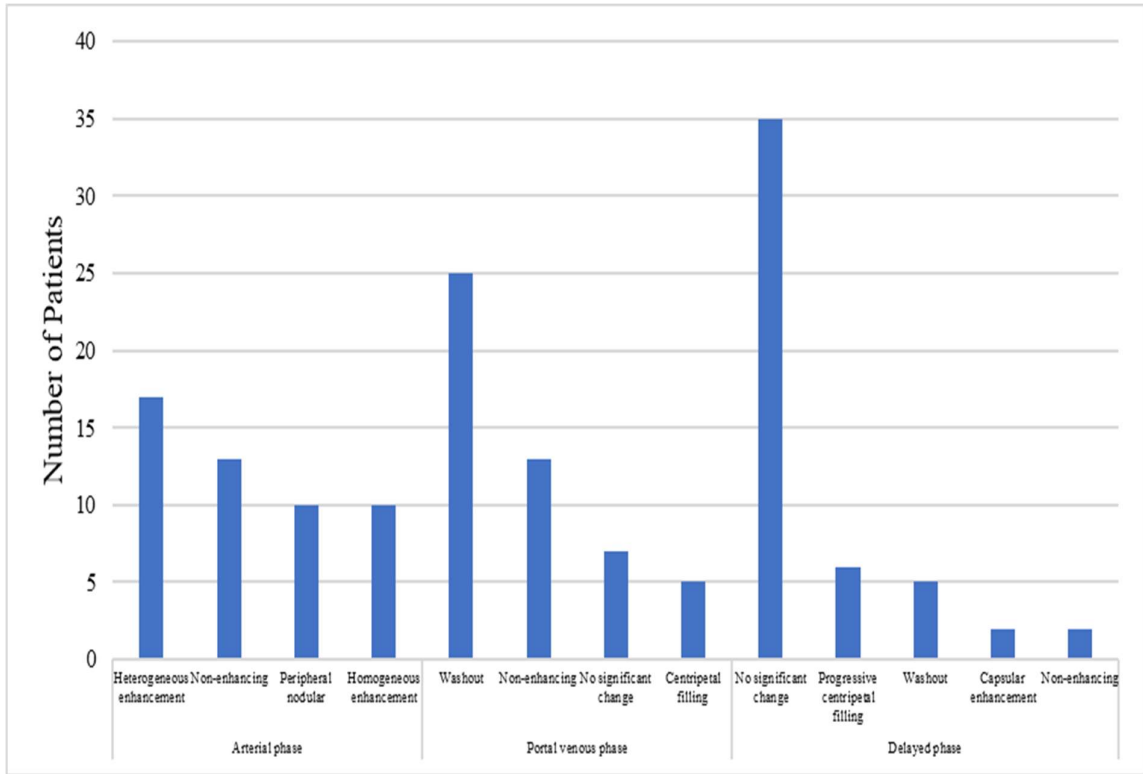


Figure: 4.Vascular Invasion, LI-RADS Staging, and Histopathology

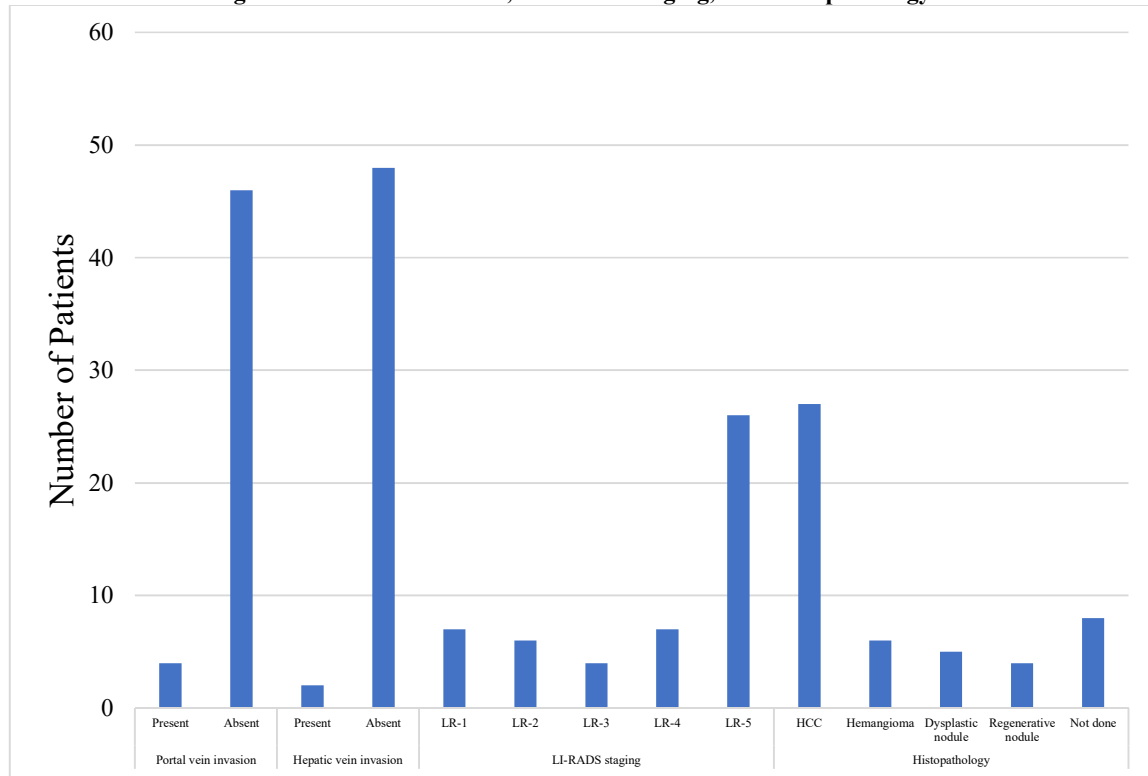


Table 1. Demographic Characteristics of Study Subjects

A total of 50 patients were included in the study. The majority of patients belonged to the 50–59 years age group comprising 15 (30%) patients,

followed by 60–69 years in 14 (28%) patients, 40–49 years in 11 (22%) patients, and 70–79 years in 10 (20%) patients. The mean age of the study

population was 58.4 ± 9.88 years. Male predominance was observed with 38 (76%) male patients, while females constituted 12 (24%) cases. Alcohol consumption was identified as the most common risk factor in 36 (72%) patients, whereas Hepatitis C virus (HCV) and Hepatitis B surface antigen (HBsAg) positivity were observed in 7 (14%) patients each. The demographic distribution showed statistical significance ($p < 0.001$).

Table 2. Clinical Profile of Study Subjects

Among the presenting clinical symptoms, abdominal discomfort was the most common complaint seen in 33 (66%) patients, followed by weight loss in 30 (60%) patients and appetite loss in 24 (48%) patients. Jaundice was observed in 21 (42%) patients, while pain abdomen was present in 19 (38%) cases. Fever was noted in 14 (28%) patients, lump per abdomen in 12 (24%) patients, dyspepsia in 8 (16%) patients, and other symptoms in 5 (10%) patients. Ascites was present in 34 (68%) patients. The association of clinical features among study subjects was statistically significant ($p < 0.001$).

Table 3. Lesion Characteristics on CT Evaluation

On CT evaluation, lesions measuring more than 20 mm were observed in 38 (76%) patients, whereas lesions less than 20 mm were seen in 12 (24%) patients. Multiple lesions were more common, occurring in 30 (60%) patients, while solitary lesions were identified in 20 (40%) patients. Bilobar involvement was the predominant site of lesion distribution in 28 (56%) patients, followed by right lobe involvement in 12 (24%) patients and left lobe involvement in 10 (20%) patients. On non-contrast CT, hypodense lesions were the most frequent finding, seen in 48 (96%) patients, while only 2 (4%) lesions appeared isodense. These findings were statistically significant ($p < 0.001$).

Table 4. Contrast-Enhanced CT Findings

During the arterial phase of contrast-enhanced CT, heterogeneous enhancement was the most common pattern observed in 17 (34%) patients, followed by non-enhancing lesions in 13 (26%) patients. Peripheral nodular enhancement and homogeneous enhancement were each noted in 10 (20%) patients. In the portal venous phase, washout was identified in 25 (50%) patients, whereas 13 (26%) lesions remained non-enhancing. No significant change was observed in 7 (14%) patients and centripetal filling was noted in 5 (10%) patients. In the delayed phase, no significant change was observed in 35 (70%) patients, progressive centripetal filling in 6 (12%) patients, washout in 5 (10%) patients, and capsular enhancement as well as non-enhancing lesions in 2 (4%) patients each. The contrast-enhanced CT findings demonstrated statistical significance ($p < 0.001$).

Table 5. Vascular Invasion, LI-RADS Staging, and Histopathology

Portal vein invasion was present in 4 (8%) patients, while hepatic vein invasion was noted in 2 (4%) patients. The majority of patients showed no evidence of vascular invasion. According to LI-RADS categorization, LR-5 lesions constituted the largest group with 26 (52%) patients, followed by LR-1 and LR-4 categories with 7 (14%) patients each, LR-2 in 6 (12%) patients, and LR-3 in 4 (8%) patients. Histopathological examination revealed hepatocellular carcinoma (HCC) in 27 (54%) patients, hemangioma in 6 (12%) patients, dysplastic nodules in 5 (10%) patients, and regenerative nodules in 4 (8%) patients, while histopathology was not performed in 8 (16%) patients. These findings were statistically significant ($p < 0.001$).

Table 6. Correlation of LI-RADS Staging with Histopathology and Arterial Enhancement

Correlation of LI-RADS categories with histopathology demonstrated that LR-1 lesions corresponded to benign lesions such as lipoma and simple cysts in 7 (14%) patients, while LR-2 lesions correlated with hemangioma in 6 (12%) patients. LR-3 lesions were associated with regenerative nodules in 4 (8%) patients, whereas LR-4 lesions represented dysplastic nodules or probable HCC in 7 (14%) patients. LR-5 lesions showed a strong association with hepatocellular carcinoma and multicentric HCC in 26 (52%) patients. Hyperenhancing lesions were observed in 37 (74%) patients, while non-enhancing lesions were seen in 13 (26%) patients. A statistically significant association was noted between LI-RADS staging and histopathological findings with a chi-square value of 31.58 and degrees of freedom of 4 ($p < 0.001$).

DISCUSSION

In the present study, the majority of patients belonged to the age group of 50–59 years (30%) with a mean age of 58.4 ± 9.88 years, and there was a marked male predominance (76%). These findings are consistent with the epidemiological profile of hepatocellular carcinoma (HCC) and chronic liver disease reported in previous literature. Similar observations were made by Kim et al. [11], who reported a mean age of 57.2 years with male predominance accounting for nearly 70% of cases in patients undergoing CT LI-RADS evaluation. Likewise, Elsayes et al. [12] observed that HCC and focal hepatic lesions were more commonly identified in middle-aged and elderly males due to higher prevalence of alcohol-related liver disease and viral hepatitis in this group. In the current study, alcohol was identified as the most common risk factor (72%), followed by HCV and HBV infections (14% each). This finding correlates with the study conducted by Tang et al. [13], who demonstrated alcohol-related cirrhosis as the predominant etiological factor in patients evaluated using LI-RADS criteria. The increasing burden of

alcohol-induced chronic liver disease in developing countries may explain this similarity.

Regarding the clinical profile, abdominal discomfort (66%), weight loss (60%), and appetite loss (48%) were the most common presenting complaints in the present study. Ascites was present in 68% of patients, indicating advanced chronic liver disease in a significant proportion of subjects. Similar findings were documented by Chernyak et al. [14], who reported abdominal pain, constitutional symptoms, and ascites as frequent clinical manifestations in patients with hepatic malignancies evaluated through multiphasic CT. Fowler et al. [15] also observed that constitutional symptoms such as anorexia, weight loss, and abdominal discomfort were highly prevalent among patients categorized as LR-4 and LR-5 lesions. The presence of ascites and jaundice in a substantial proportion of cases further emphasizes the association between advanced cirrhosis and malignant transformation.

In the assessment of lesion characteristics, lesions larger than 20 mm constituted 76% of cases, while multiple lesions were observed in 60% of patients. Bilobar involvement was the most common location (56%), and hypodense lesions on non-contrast CT were seen in 96% of cases. Similar observations were reported by Mitchell et al. [16], who found that larger lesions with bilobar distribution were significantly associated with higher LI-RADS categories and increased likelihood of malignancy. Another study by Kielar et al. [17] demonstrated that hypodense appearance on non-contrast CT and multiplicity of lesions strongly correlated with HCC and multicentric disease. The predominance of lesions larger than 20 mm in the present study may reflect delayed presentation and diagnosis, which is common in resource-limited settings.

Contrast-enhanced CT findings in the present study demonstrated heterogeneous arterial enhancement in 34% of cases and portal venous washout in 50% of patients, while delayed phase washout and capsular enhancement were also identified in several cases. These imaging characteristics are recognized as hallmark features of HCC in LI-RADS criteria. Similar findings were reported by Bashir et al. [18], who observed arterial phase hyperenhancement and delayed washout as the most reliable imaging features for diagnosing HCC on triphasic CT. According to An et al. [19], arterial hyperenhancement combined with washout significantly increases the specificity of LI-RADS for HCC diagnosis. The present study also demonstrated progressive centripetal filling in a subset of lesions, which corresponded predominantly to hemangiomas, thereby supporting the usefulness of enhancement patterns in differentiating benign from malignant lesions.

The present study revealed portal vein invasion in 8% and hepatic vein invasion in 4% of patients, indicating vascular invasion in advanced lesions. LI-RADS categorization showed that LR-5 lesions formed the majority (52%), and histopathological examination confirmed HCC in 54% of patients. These findings are in agreement with the study by Sirlin et al. [20], who demonstrated that LR-5 lesions have a very high positive predictive value for hepatocellular carcinoma and are frequently associated with vascular invasion and advanced disease. Similar results were also observed in previous multicentric studies where LR-5 lesions showed excellent correlation with histopathological diagnosis of HCC. The strong association between LI-RADS staging and histopathological findings in the current study, with significant chi-square statistics, highlights the diagnostic reliability of CT LI-RADS in routine reporting.

Furthermore, the correlation between LI-RADS categories and enhancement characteristics in the present study demonstrated that hyperenhancing lesions were predominantly associated with LR-4 and LR-5 categories, whereas non-enhancing lesions corresponded mainly to benign lesions. This observation supports the diagnostic accuracy of arterial phase imaging in identifying malignant transformation. Comparable findings were reported by Kim et al. [11] and Chernyak et al. [14], who emphasized that arterial hyperenhancement remains one of the most important major features in LI-RADS classification. Overall, the findings of the present study reinforce the utility of CT LI-RADS as a standardized and effective reporting system for focal liver lesions, improving diagnostic confidence, communication, and clinical decision-making in patients at risk for hepatocellular carcinoma.

CONCLUSION

The present study demonstrated that CT LI-RADS is a reliable and effective standardized reporting system for the evaluation of focal liver lesions in patients at risk for hepatocellular carcinoma. The majority of malignant lesions showed characteristic imaging features such as arterial phase hyperenhancement, portal venous washout, and delayed phase changes, which correlated well with higher LI-RADS categories and histopathological findings. LR-5 lesions showed strong association with hepatocellular carcinoma, highlighting the diagnostic accuracy of CT LI-RADS in routine clinical practice. The system also improved lesion characterization, staging, and communication between radiologists and clinicians, thereby aiding appropriate patient management and follow-up planning. Additionally, CT LI-RADS helped differentiate benign from malignant lesions using standardized imaging criteria. Despite certain limitations in smaller or atypical lesions, CT LI-RADS proved to be a valuable tool in routine

radiological reporting, contributing to early diagnosis, treatment planning, and improved clinical decision-making in patients with focal hepatic lesions.

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