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Evaluation of focal liver lesions using triple phase contrast computed tomography among Indian patients

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Abstract:
Detecting and characterizing FLL remains a significant challenge in clinical practice. Therefore, it is of interest to evaluate the patients with FLL using TPC-CT. 80 patients spanned for around 18 months to correlate between CT scan findings & final diagnosis. We found male dominancy with high sensitivity for diagnosing hepatocellular carcinoma (HCC) at 73.7%, hemangioma's at 94.1%, and metastases at 98.4%, whereas specificity for diagnosing all cases when the typical enhancement pattern for each lesion type was considered. We conclude that, tri-phasic CT can be widely accepted CT protocol used for assessing LL, allowing for the detection and characterization of most FL abnormalities (AB-N) across various pathological scenarios and stages of disease.

Keywords: Triphasic computed tomography (CT), detection, characterization, focal liver lesions (FLL), AB-N & hepatocellular carcinoma (HCC).

Background:
Research has shown that, among the various liver pathologies (LP), liver masses are particularly significant **[1]**. Studies have shown that until they are calcified, liver lesions (LL) are not visible on conventional radiographs. As an initial investigation to evaluate LL, U/S is often employed **[2]**. A study has shown that, FLL can be either benign or malignant, and their prevalence varies significantly across geographic regions & ethnic groups **[3]**. These lesions are often benign and may be monitored with examinations in patients without a history of cancer or chronic liver disease (CLD) **[4]**. In up to 52% of the general population, benign hepatic tumors (BHT) have been reported **[5]**. Detecting and characterizing FLL remains a significant challenge in clinical practice. These abnormalities, increasingly identified through diagnostic imaging, require precise differentiation to guide appropriate treatment decisions. Therefore, it is of interest to report & evaluate role of CT in managing FLL & its contributions to clinical decision-making.

Materials and Methods:
A prospective observational study was carried out at the KIMS, Karad, Maharashtra, with 80 patients spanning all age groups who were clinically suspected of having FLL or whose prior imaging had shown non-specific focal hepatic lesions (DFHL). The patients were examined using Triphasic (TP) CT after their personal data, including age and sex, had been recorded. Along with histology, surgical results, ultrasound, and follow-ups, the TP-CT examination's findings were compared to the lesions' visibility and enhancement patterns. In order to avoid any potential issues with the contrast medium, patients were urged to refrain from eating or drinking for four hours before the CT scan, according to the imaging protocol. Before the trial, the patient was informed about the risks associated with contrast delivery and their agreement was taken. At first, all patients were placed in supine position. Sections were taken in the hepatic arterial phase (HAP) for 40 seconds, the portal venous phase (PVP) for 60 seconds & delayed phases for 3 to 5 minutes. The pictures were reconstructed at a resolution of 2.5 mm as shown in (**Figure 1 & 2**).

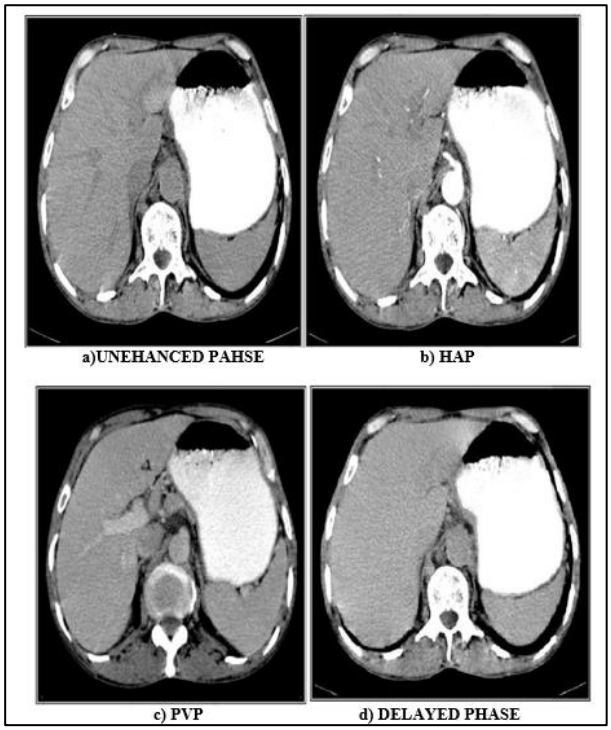

Figure 1: Distribution of benign (BE)/ malignant (MALI)

Table 1: Age distribution

AGE (years)	FREQUENCY	PERCENT (%)
0-9 years	0	0
10-19 years	0	0
20-29 years	3	3.75
30-39 years	6	7.5
40-49 years	17	21.25
50-59 years	26	32.5
60-69 years	25	31.25
70-79 years	3	3.75
80-89 years	0	0
TOTAL	80	100

Table 2: Gender distribution

Gender	Number	Percent
Male	49	61.25
Female	31	38.75
Total	80	100

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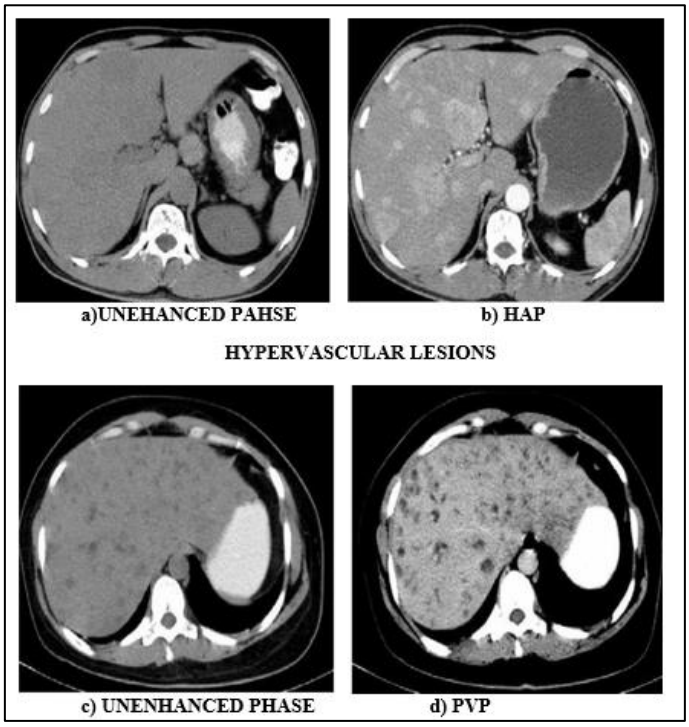

Figure 2: Distribution of HY-L

Exclusion criteria:

[1] Pregnant women

[2] Those who were contraindicated for CT (i.e. hemo-dynamically unstable patient, allergic to contrast media and deranged renal function *etc.*,)

Statistical analysis:

Diagnostic statistics was assessed for sensitivity, specificity, positive predictive value (PPV), negative predictive value (NPV) & accuracy.

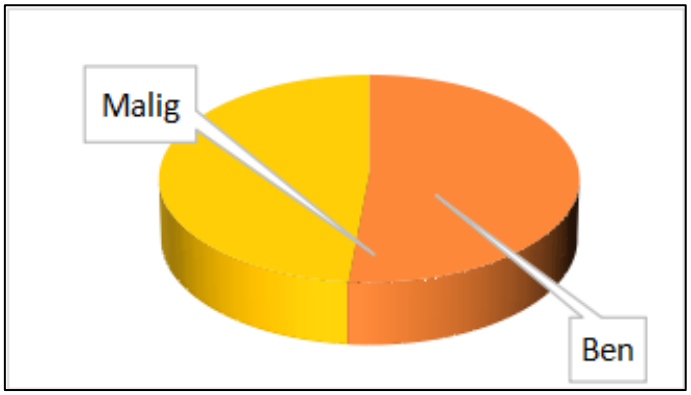

Figure 3: Distribution of benign (Be)/ Malignant (Mali)

Table 3: Distribution of HP-L & HY-L

Group	Number	Percentage
Hypo vascular Lesions(HP-L)	176	58.90%
Hyper vascular Lesions(HY-L)	123	41.10%
Total	299	100%

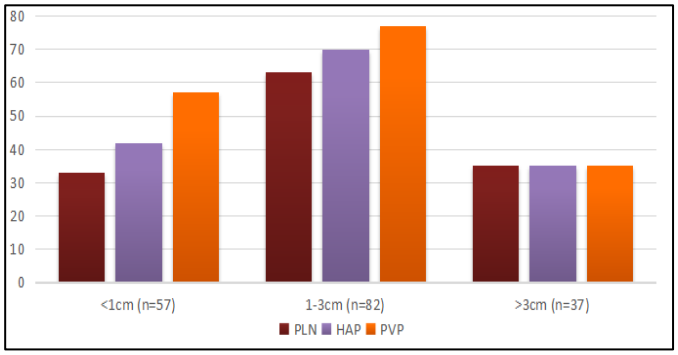

Figure 4: Distribution of Hy-L

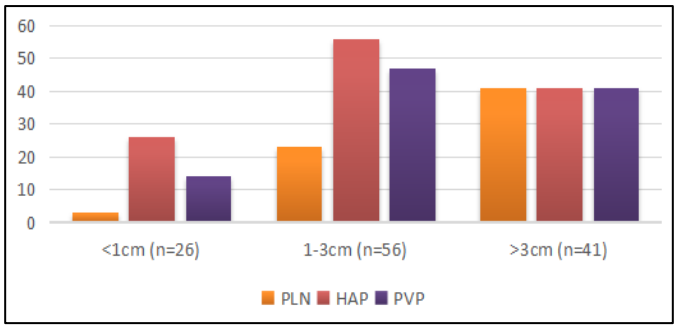

Figure 5: Distribution of HP-L

Results:

Table 1 show that, majority of the patients were from 60-69 years of age (31.25%).**Table 2** shows male dominancy with 49 patients in number (61.25%) which was followed by female patients with 31 in number (38.75%) respectively. **Table 3** shows that, out of 299 patients 176 showed in HP-L (58.90%) while the remaining 123 showed in HY-L (41.10%) respectively. **Figure 1** shows distribution of benign & malignant lesion. **Figure 2** shows distribution of HP-L & HY-L respectively. **Figure 3** shows distribution of malignant and benign tumor. **Figure 4** shows distribution of HY-L among 3 groups *i.e.*, PLN, HAP and PVP. **Table 4** shows that maximum number of malignant lesion was seen in 18 patients (100%) with metastases, followed by A (variegated)AA (capsule) in 14 patients (100%) with intrahepatic CCA, then hyper A/A in 5 patients (24%) with HCC and finally, hyper(incomplete)/A/A in 2 patients (100%) with intrahepatic CCA respectively whereas for benign lesion A(puddles)/A/A showed maximum cases with 64 in number (100%) for hemangiomas, followed by A/A/A/ (cleft) with 4 patients (100%) for FNH respectively. **Table 5** shows that abscess, adenoma, cyst, HCC, hemangioma , FNH , intrahepatic CCA and metastases all showed statistically significant difference in co-relation of CT and final diagnosis as the p value was <0.001 and <0.003 respectively. **Figure 5** shows distribution of HP-L among PLN, HAP and PVP respectively.

Table 4: Correlation with final diagnosis & HY-L

Enhancement patterns	Malignant lesions			Benign lesions		
	No	%	Final Diagnosis	No	%	Final Diagnosis
A(puddles)/A/A (n=64)	0			64	100	Hemangiomas
A/A/A(cleft) (n=4)	0			4	100	FNH
A(variegated)/A/A(capsule)(n=14)	14	100	HCC	0		
hyper(incomplete)/A/A (n=2)	2	100	Intrahepatic CCA	0		
mixed/mixed/mixed (n=18)	18	100	Metastases	0		
hyper/A/A (n=21)	5	24	HCC			
	15	72	Metastases			
				1	4.5	Adenoma

Table 5: Correlation of CT & final diagnosis

Diagnosis	Sensitivity	Specificity	PPV	NPV	Accuracy	p value
Abscesses	100	100	100	100	100	<0.001
Adenoma	0	100	0	99.6	99.6	<0.003
Cysts	100	100	100	100	100	<0.001
HCC	73.7	100	100	98.2	98.3	<0.001
Hemangioma	94.1	100	100	98.3	98.6	<0.001
FNH	100	100	100	100	100	<0.001
Intrahepatic CCA	100	100	100	100	100	<0.001
Metastases	98.4	100	100	98.9	99.3	<0.001

Discussion:

Although the liver receives 80% of its blood supply from the portal vein and 20% from the HA, primary and secondary neoplastic LL derive their blood supply from the hepatic artery. In the hepatic arterial phase (HAP), HY-L is easily identifiable against the minimally enhancing liver parenchyma (LP). During the PVP, most HL appears as HP-L, contrasting with the strongly enhancing normal LP. The conspicuity of a lesion during HAP or PVP depends on its vascularity. In our study, out of the total 299 FLL seen in 80 patients there were 176 HP-L & 123 HY-L accounting for 59% & 41% of the total (n=299) lesions respectively. On the PVP a greater number of HP-L was identified with greater lesion conspicuity than on other phases especially when lesion was less than 3cm in size. No statistically significant difference was seen between PVP and HAP when size were >3cm. In addition to this, we identified a greater number of hyper-vascular lesions during the HAP compared to PVP & unenhanced phase (UE-P), particularly for lesions smaller than 3 cm. The UE-P scans demonstrated lower sensitivity in detecting small lesions due to the difficulty in distinguishing them from UE-P vessels and biliary dilation. Larger lesions were visible across all phases, with most differences observed in lesions smaller than 3 cm. TP-CT enhancement patterns showed 100% sensitivity and specificity for the identification of abscesses, cysts, FNH and intrahepatic CCA. However, sensitivity varied for HCC (73.7%), HMG (94.1%) and Metastases (98.4%), with 100% specificity observed for typical enhancement patterns of each lesion type.

Our findings align with the study by Miller *et al.* found that a larger number of lesions were detected on the HAP than on other phases for lesions smaller than 2 cm and conspicuity of these lesions was higher on the HAP, with significant statistical differences observed between PVP and HAP, PVP and UE-P, HAP and UE-P for lesions smaller than 3 cm. In our study, we grouped lesion sizes as <1 cm, 1-3 cm and >3 cm, while Miller *et al.* categorized them as <1 cm, 1-2 cm, 2-3 cm and >3 cm **[6]**. Our study was also correlated well with the study done by van Leeuwen *et al.* they identified 11 enhancement patterns, with 6 of these consistently associated with benign conditions and 3 consistently associated with malignant conditions and the other 2 patterns were due metastases & HMG **[7]**.

Conclusion:

TP-CT can be a widely accepted CT protocol used for assessing LL, allowing for the detection and characterization of most FL AB-N across various pathological scenarios and stages of disease. Despite growing competition from MRI in recent years, CT remains pivotal in diagnosing liver diseases. Its widespread use is largely attributed to its ability to provide clear visualization of the liver's anatomical relationships and its position relative to neighboring organs.

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