ORIGINAL RESEARCH PAPER

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"A STUDY ON TRIPLE PHASE COMPUTED TOMOGRAPHY IN SONOGRAPHICALLY DETECTED FOCAL HEPATIC LESIONS"

KEY WORDS: Triple Phase Computed Tomography, Focal Hepatic Lesions, Ultrasonography

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ABSTRACT

Triple Phase Computed Tomography is an effective non-invasive investigation to study focal hepatic lesions and associated pathology. Although Ultrasonography is usually the first line of investigation in focal hepatic lesions, its cross sectional capabilities are limited. The present study was undertaken to determine the role of Triple Phase Computed Tomography in patients with suspected focal hepatic lesions detected on ultrasonography. There were 100 suspected cases of focal hepatic lesions evaluated by Triple phase Computed Tomography.

INTRODUCTION

Hepatic diseases are common causes of morbidity and mortality in India, and are encountered frequently in day-to-day practice. Due to widespread use of diagnostic imaging modalities, Hepatic lesions are incidentally discovered even in asymptomatic patients. The differential diagnosis of hepatic disease is broad due to wide group of pathologies affecting the liver. The diagnostic features of most of these lesions have considerable overlap with each other and require further specific characterization and differentiation.

It is critical to reliably detect and diagnose hepatic lesions and outline appropriate line of management. The objectives of hepatic imaging are to diagnosis hepatic pathology, its characterization, staging, evaluation of biliary ductal system, response to treatment, and the assessment of vascular anatomy for surgical approach.

Ultrasonography is the first line of investigation for suspected hepatic disease and frequently identifies asymptomatic focal hepatic disease incidentally. It is useful to detect the site and number of lesions and also involvement and infiltration of the lesion into vasculature. Therefore, it has an essential role in screening of patients with hepatic pathology. It is limited by operator dependency, inability to diagnose lesions <1 cm and low specificity.[1] The presence of diffuse hepatic disease also lowers the sensitivity of Ultrasonography for the detection of focal lesions. Similarly, pseudo-lesions, such as focal fatty infiltrations or focal fatty sparing are sometimes difficult to differentiate from other pathology liver lesions.[2]

Multiphasic Helical Computed Tomography (CT) allows more precise detection and characterization of focal hepatic lesions. Owing to the unique dual blood supply of liver from Hepatic Artery (20%) and Portal Vein (80%), the patterns of differential contrast uptake helps in differentiating lesions based on their vascular supply. The hepatic circulation is divided into three distinct phases namely - arterial phase, portal venous phase, and equilibrium (venous) phase. Using the Triple-phase technique, CT is used to study the liver during these three distinct hepatic circulatory phases.

The first phase evaluates the arterial phase, which corresponds to the hepatic arterial system. The second phase corresponds to uptake of contrast by the portal venous system and is termed as the portal venous phase. During the third phase, the hepatic veins which remained unenhanced during the early arterial and portal venous phases, are now enhanced. This phase is termed as the hepatic venous phase. With ideal acquisition timing and thin collimation, the lesions are differentiated according to their enhancement pattern in the different perfusion phases, thus permitting improved lesion detection and characterization. CT also provides the opportunity to screen the entire abdomen and pelvis for associated pathology, metastasis, ascites, vasculature and bony lesions.

Its limitations, however, are high radiation dose and a low sensitivity for the detection of lesions smaller than 1 cm. Despite the increased use of MRI over the last few years, the importance of CT prevails, chiefly due to excellent visualization of liver anatomy, morphology of liver lesions and satisfactory delineation of relationship with adjacent structures. [3]

MATERIALS AND METHODS

This was a prospective study conducted in Department of Radiodiagnosis, G.R. Medical College and J.A. Group of Hospitals, Gwalior from June 2016 to October 2017, on 100 patients with suspected hepatic neoplasm or previous images depicting hepatic lesions with non-specific appearances. Relevant history of illness, significant clinical findings, liver function tests, serum viral markers of all patients were recorded. Previous investigations were also reviewed.

Inclusion criteria:

1.Patients with clinically suspected focal or multiple hepatic lesions, irrespective of age and sex.

Exclusion criteria:

1. Known allergy to contrast agent.
2. Renal insufficiency
3. Pregnant females
4. Hyperthyroidism
5. Patients not willing to participate in the study
6. All patients with history of trauma.
7. Patients with simple hepatic cyst, polycystic hepatic lesions, abscess, hydatid cyst, vascular lesions other than hemangioma were excluded from this study. However, careful examination was done not to exclude cystic neoplasm.
8. Patients with cholangiocarcinoma arising from biliary hilum and CBD lesions were excluded from this study.

STATISTICAL ANALYSIS

All the data collected were computed using MS-Excel (2010) and descriptive statistics were analyzed using the same. All the statistical analysis was done using MedCalc ® v12.5 for windows statistical software.

RESULTS

A total of 100 patients were included in the study. Out of these 100 patients 74 were male & 26 were female. The age of patients ranged from 2 to 79 years with mean (±SD) 52.46±13.89 years. Most of the patients were of the age group > 50 years (65.38%).

The higher age (> 50 yrs) was found highly significant to metastasis (χ^2 =56.7, p-value = 0.00001). Similar observation was also made by **Rahaman et al (2013)**[4], who described the mean age for occurrence of metastasis was 51±14.6years.

Male predominance was noted in our study (57.7%). In this study, gender and final diagnosis of the patient was found to be significantly related (p=0.01.) as malignant lesions was more seen among males. **Riccardo et al**[5] described that benign lesions are

more common among females and malignant lesions are more common in males.

Out of total, 20 patients had history of regular alcohol intake (20%), 4 used oral contraceptives regularly (4%) and 40 had primary cancer elsewhere (40%). There was statistically significant association between intake of alcohol and hepatocellular carcinoma (p=0.000001). Our observation was consistent with **Boffeta et al (2006)**[6] in their study, they have found significant association between intake of alcohol and hepatocellular carcinoma.

38 patients had abnormal LFT (38%), 20 had HbsAg +ve (20%) and 6 had HBC +ve (6%). There was a significant association between alcohol and HCC (χ^2 = 26.43, p-value=0.00001). Abnormal LFT was found significantly associated to both HCC and metastasis (χ^2=14.2, p-value=0.0001), HbsAg +ve was associated with HCC (χ^2=35.25, p-value=0.00001) and HCV +ve was also found to be associated with HCC (χ^2=29.96, p-value=0.000001). The presence of cirrhosis was found highly significantly associated with HCC (χ^2=35.25, p-value=0.000001).

Though only 5 out of 18 (27.7%) cases of HCC were positive for HCV, it correlated with study by **R. Kumar et al (2008)**[7] in which HCV was seen in 22% of cases with hepatocellular carcinoma.

Cirrhosis:

In malignant cases, cirrhosis was significantly associated with HCC (p=0.000001). **Arun et al (2010)**[8] described that approximately 70%-90% of patients with HCC have an established background of chronic liver disease and cirrhosis.

A. USG FINDINGS

Statistically significant association was noted between isoechoic echopattern, heterogeneous echopattern with peripheral hypoechoic rim and metastasis. Hyperechoic pattern and heterogeneous echopattern with echogenic borders or posterior acoustic enhancement was associated with hemangioma; heterogeneous echopattern with hypoechoic foci was associated with hepatocellular carcinoma and metastasis, cystic echopattern with peripheral nodularity was associated with metastasis.

Further, in comparison to the gold standard HPE, the sensitivity of USG was 69.90% and specificity was found to be 72.26%.

B.TRIPLE PHASE CT FINDINGS

The pattern of enhancement is three pattern description that includes appearance of the lesion in each phase (eg. hypo/hypo/hypo). Among the total 100 patients, 48 had hypovascular lesions (48%) while 52 were hyper vascular lesions (52%). Among the 48 patients with hypovascular enhancement, the following patterns were appreciated:

Table 1 : Frequency distribution of Triple phase CT enhancement pattern and hypovascularity in hepatic neoplasm patients.

Triple-phase CT enhancement pattern in Hypovascular lesions	No. of Patients (n=48) (%)
hypo/hypo/hypo	44 (91.6%)
hyper(rim)/hypo/hypo	38 (79.16)
hypo/hypo(peripheral nodularity)/hypo	4 (8.3)

Among the 52 patients with hypervascular pattern ,the pattern was as follows:

Triple-phase CT enhancement pattern in Hypervascular lesions	No. of Patients (n=52) (%)
hyper(variegated)/hypo/hypo (±/- capsule)	22 (42.3)
hyper/hypo/hypo	30 (57.6)
mixed/mixed/mixed	12(23.07)
hyper(irregular)/hypo/hypo (± capsule)	6(11.5)
hyper (puddle)/hyper (progressive fill in)/hyper or iso	12 (23)
hyper/hypo/hypo (cleft)	2(3.8)

Table 2 : Frequency distribution of Triple phase CT enhancement pattern and hyper vascularity in hepatic neoplasm patients.

Of total 100 patients, Triple-phase CT identified 20% lesions as benign and 80% lesions as malignant.

The Triple-phase CT identified final diagnosis in all 100 cases (100.0%). The most frequent lesion diagnosed was metastasis (59%).

Table 3 : Distribution of final diagnosis of Triple phase CT in hepatic neoplasm patients

Benign/Malignant - Triple phase CT	(n=100) (%)
Benign	20 (20%)
FNH	2 (2%)
HCC	18 (18%)
Hepatoblastoma	1 (1%)
Metastasis	59 (59%)
Intrahepatic cholangiocarcinoma	2 (2%)

On Triple-phase CT, 9 types of enhancement patterns were analyzed. Hypervascular lesions showed 6 enhancement patterns namely hyper/hypo/hypo pattern, hyper (variegated)/hypo/hypo (± capsule) pattern, mixed/mixed/mixed pattern, hyper (irregular)/hypo/hypo (± capsule) pattern, hyper (puddle)/hyper (progressive fill in)/hyper/iso pattern, hyper/hypo/hypo (cleft) pattern. Hypovascular lesions showed 3 enhancement patterns which were hypo/hypo/hypo pattern, hyper(rim)/hypo/hypo pattern and hypo/hypo (peripheral nodule)/hypo pattern.

Both hypo/hypo/hypo (χ2=30.76, p-value=0.000001) and hyper(rim)/hypo/hypo (χ2=14.47, p-value=0.0001) were found significantly associated to metastasis. In contrast, both hyper (variegated)/hypo/hypo (+/- capsule) (χ2=22.45, p-value=0.000003) and hyper/hypo/hypo (χ2=21.17, p-value=0.000005) were found significantly associated with HCC. Hyper (puddle)/hyper (progressive fill in)/hyper or iso was found significantly associated to hemangioma (χ2=32.40, p-value<0.001). Hyper/hypo/hypo (cleft) enhancement pattern was associated with FNH (χ2=25.49, p-value<0.001).

Triple-phase CT showed an 89.9% sensitivity and 95.34% specificity compared to the Gold standard HPE.

CONCLUSIONS

We conclude that Triple-Phase CT is a better imaging modality and technique than US to differentiate benign and malignant lesions and also for their better characterization.

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