ORIGINAL RESEARCH ARTICLE

Role of Triple Phase CT (128 slice) in Focal Hepatic Lesions

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ABSTRACT

Introduction: Hepatic lesions cannot be noticeable in a standard radiograph.Computerized Tomography CT presents more benefit of characterization and valuable preoperative reports with its detection and classification of focal liver lesions, yet, fast availability and quick scanning. Multi–detector row helical CT MDCT has transformed CT from a transaxial cross sectional technique into a 3D imaging modality with improved lesion detection. The purpose of this present study was to characterize various focal hepatic lesions using Triple phase contrast on 128 slice MDCT and provide information that could accurately determine the further choice of management, to correlate the lesions with clinical, other imaging and histopathological findings wherever applicable and to calculate the sensitivity and specificity of malignant liver lesions using Triple phase contrast CT.

Material and methods: This was a prospective hospital-based study, conducted on patients with clinically-suspected or sonologically-detected liver disease admitted to Naryana Hospital, Nellore.

Results: The results of this study indicate that the most common malignant lesion was HCC followed by Metastases as the most common benign lesion was Hemangiomas. Triple phase contrast CT was 100 % sensitive and specific in diagnosing hemangiomas, abscesses and cysts and is must for diagnosing primary malignant liver masses and hepatic incidentalomas.

Conclusion: Furthermore, the Portovenous phase images were acquired at the peak of liver enhancement is essential for detection of hypo-vascular lesions. When the cost and accessibility are essential determinantsof the modality to be used for diagnostic purposes, MDCT imaging has promising prospects.

Keywords: Hepatic Lesions, CT Scan, Radiology

INTRODUCTION

Hepatic masses are one of the various pathologies that affect the liver, forming a significant category. However, because of the widespread use of imaging modalities, liver masses are increasingly being identified. For instance, X-rays, arteriography, radionuclide scanning, ultrasound and, after 1970s, computed tomography (CT) and magnetic resonance imaging (MRI).[1]

Hepatic lesions cannot be noticeable in a standard radiograph except when calcified. For primary liver lesions diagnosis, an ultra sonogram (USG) is the most frequently performed. Nevertheless, generally, the conclusive diagnosis is not based on gray-scale data only, and a mass identified on ultrasound is usually assessed moreover with contrast-enhanced CT CECT or MRI for detailed-definition.[2] CT has more benefit of characterization and presents valuable preoperative reports. Even though recent research proves that MRI has a similar rate in detection and classification of focal liver lesions, yet, fast availability and quick scanning time made CT an excellent imaging procedure.[3]

Multi–detector row helical CT MDCT has transformed CT from a transaxial cross sectional technique into a 3D imaging modality. Whereas single - slice CT took at least 5 years to gain general acceptance, MDCT has been more rapidly accepted in the radiological community, with exponential growth in the use of these scanners in clinical practice. Major improvements (Z-axis coverage speed and longitudinal resolution) translated into rapid hepatic imaging and the use of new imaging protocols, not possible with single-slice spiral CT.[4] Thin sections, which can now be routinely used within a single breath-hold, resulted in improved lesion detection and nearly isotropic image acquisition providing high-resolution datasets available for multiplanar reformation.

Consequently, the preferred liver imaging technique should comprise high sensitivity and specificity for lesion detection, with good ability for lesion characterization, and differentiate lesions that do need further diagnostic tests/treatments from those lesions that do not. The purpose of this present study was to characterize various focal hepatic lesions using Triple phase contrast on 128 slice MDCT and provide information that could accurately determine the further choice of management, to correlate the lesions with clinical,

other imaging and histopathological findings wherever applicable and to calculate the sensitivity and specificity of malignant liver lesions using Triple phase contrast CT.

MATERIAL AND METHODS

This was a prospective hospital-based study, conducted on patients with clinically-suspected or sonologically-detected liver disease admitted to Naryana Hospital, Nellore.

The present study included all patients referred to the hospital for CT with clinically-suspected or sonologically-detected liver disease. Patients with allergic reactions to contrast material, pregnant women, and psychiatric patients were excluded.

Equipment

The patient was scanned using 128 slice multi-detector CT OPTIMA 600 (GE).

Procedure

- Preparation of patient for scan: the patient was kept nil orally for minimum 4 hours prior to the CT to avoid complications during the administration of the contrast medium.
- Risks and procedure were explained and informed consent was taken.
- Routine antero-posterior topogram of abdomen was taken initially for all patients in the supine position with breath held.
- Oral contrast was administrated to the patient and serial axial sections were taken one hour after administration of oral contrast from both domes of diaphragm to the level of pubic symphysis.
- Intravenous contrast was administrated to the patient and serial axial sections were taken a) immediately during arterial phase and again, b) during portovenous and delayed phases.
- Characterization of hepatic lesions was done.

Follow-up

Study cases were followed up clinically and radiologically as indicated. The radiological diagnosis was correlated with surgical and histopathological findings.

A complete clinical history of patients was taken including name, age, sex, and presenting complaints. Contrast CT scan findings and images were stored in a compact disk.

RESULTS

Table 1 showed that hepatocellular carcinoma (HCC) was the most common primary hepatic malignancy (30%) followed by Metastases (25%). Almost 55% of the lesions are malign. In table 2, most of the HCCs referred were either masses palpable on clinical examination or masses detected via sonography. Few of the referred cases were for the screening of known cirrhotic patients. The Male: Female ratio in our study was 5:1. Cirrhosis was present in 4 out of 12 patients (33.3 %) patients. The size of the tumor ranged from as small as 1.5 cm to as large as 18 cm. Most of the HCCs were intra-parenchymal, while 1 patient had an exophytic tumor (8.3%). Portal vein thrombosis was reported in 7 patients (58.3%), while 4 patients (33.3%) had ascites. IHBRD and capsular retraction were present in 1 patient. Most of the large and multicentric HCCs had necrosis. We observed both typical and atypical patterns of enhancement on triple-phase scans. In the arterial phase, 11 cases (91.6%) showed heterogeneous enhancement, and one case (91.6%) showed heterogeneous enhancement, and one (8.3%) did not show any enhancement. In the Porto-venous phase, 11 cases (91.6%) showed washout, 1 case (8.3%) showed persisting enhancement (no washout). In the delayed phase, 10 cases showed washout (83.3%). The most common enhancement pattern was an enhancement in the arterial phase with washout in portovenous and delayed phases (Figure 1). The next most common enhancement pattern was arterial

	N (%)
Hepatic lesions	
Hepatocellular carcinoma (HCC)	12(30%)
Metastases	10(25%)
Hemangioma	7(17.5%)
Hepatic cyst	1(2.5%)
Hydatid cyst	3(7.5%)
Abscess	5(12.5%)
Dysplastic nodules	1(2.5%)
Granuloma	1(2.5%)
Type of hepatic lesions	
Benign	18(45%)
Malignant	22(55%)

Table-1: Characteristics of studied hepatic lesions N=40

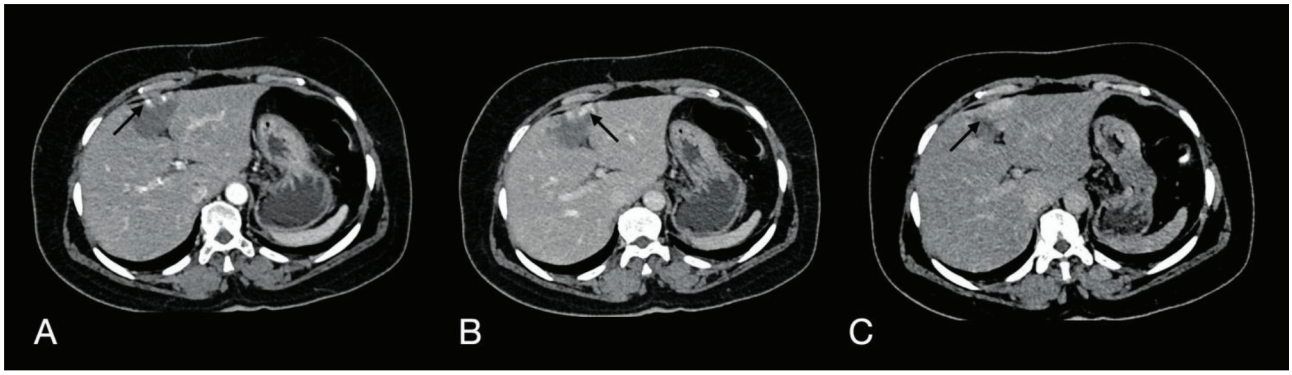

Figure-1: Well-defined hypodense lesion on arterial phase(A) showing peripheral puddling of contrast enhancement (black arrow) and centripetal enhancement on portal (B) and delayed (C) phases suggestive of Hepatic Hemangioma

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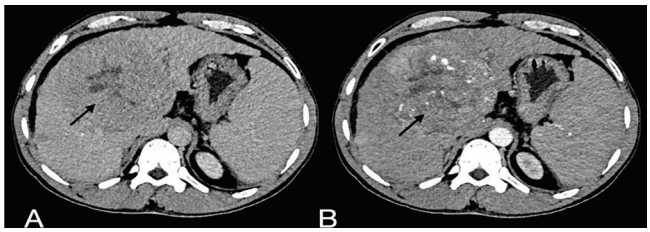

Figure-2: Large well-defined hypodense lesion in left lobe of liver(black arrow) showing characteristic Arterial enhancement and wash out on portal phase suggestive of Hepatocellular carcinoma

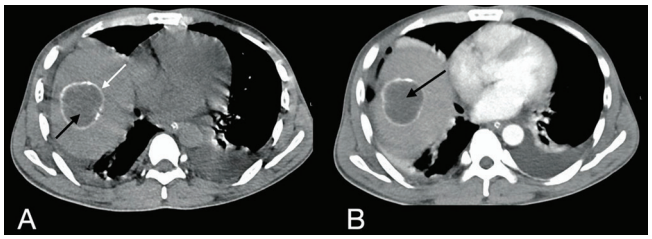

Figure-3: Well-defined hypodense lesion in right lobe of liver (black arrow) with peripheral wall calcification(white arrow) and no enhancement suggestive of Hydatid cyst.

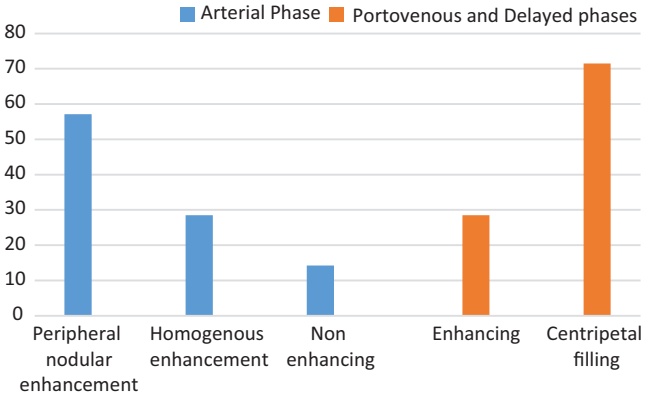

Figure-4: Enhancement pattern of Hemangioma

Sex incidence	
Male	83.3%
Female	16.6%
Portal vein thrombosis	
Presence	58%
Absence	42%
Cirrhosis	
Presence	33%
Absence	67%
Arterial phase	
Enhancing	91.6%
Non-enhancing	8.33%
Portal phase	
Enhancing	8.33%
Washout	91.6%
Delayed phase	
Complete washout	83.3%
Incomplete washout	16.6%

Table-2: Characteristics of Hepatocellular carcinoma (HCC) N=12

Age incidence (years)	
30-50	10%
50-70	70%
70-90	20%
Primary malignancy	
Colon	40%
Pancreas	20%
Stomach	10%
Rectum	10%
HCC	10%
Unknown	10%
Arterial phase	
Enhancing	80%
Non-enhancing	20%
Porto venous phase	
Enhancing	70%
Non-enhancing	10%
Washout	20%
Delayed phase	
Enhancing	20%
Washout	80%

Table-3: Characteristics of hepaticMetastases N=10

Calcification	
Presence	33%
Absence	67%
Septation	
Presence	67%
Absence	33%
Location	
Right lobe	80%
Left lobe	20%
Rupture	
Ruptured	20%
Unruptured	80%
Portal vein thrombosis	
Presence	40%
Absence	60%

Table-4: Characteristics ofliver abscesses N=5

enhancement with persisting portovenous enhancement (no washout), which was seen in 4 cases (5.6%). One case (1.4%) showed peripheral enhancement in all phases, while another case did not show arterial enhancement and so was detected in the portovenous and delayed phases.

As for metastases (Table 3), The most common primaries detected were colorectal and caecal malignancies (41%), followed by pancreas (20%), hepatocellular (10%), gastric (10%), unknown (10%) carcinomas. Peripherally enhancing hypovascular metastases constituted 80% of cases (Figure 2). Table 3 showed the characteristics of liver abscesses. Hepatomegaly was present in 77.8 %. No enhancement in hydatid cysts (Figure 3). Most of the abscesses in our study were solitary 4 (80%). The rupture was present in 1 patient (20%). All abscesses in our study showed peripheral enhancement. Portal vein thrombosis was seen in 40 %

of the cases. The right lobe was involved in 80% of cases, and isolated left lobe involvement was there in 20 % of the cases. Our patients had more solitary haemangiomas (81%) than multiple haemangiomas (19%). Peripheral nodular enhancement (PNE) in the arterial phase was present in 4 cases (57.1%), while 1 haemangioma (14.2%) was not showing enhancement in the arterial phase. A total of 5 haemangiomas (71.5%) were showing centripetal filling in portovenous and delayed phases (Figure 4).

DISCUSSION

In our study hepatocellular carcinoma (HCC) was the most common primary hepatic malignancy and the most common hepatic lesion that was referred for dedicated MDCT examination. Capsular enhancement described as a classical feature of HCC was seen only in 3 cases (36 %), as our study comprised predominantly of multicentric and diffuse infiltrating HCCs.Our study was correlating best with Cho et al.[5], where 83% of HCC showed a hyper attenuating pattern in the arterial phase. Other studies such as those conducted byBaron et al[6] and Karahan et al[7] included 66 HCC and 30 HCC respectively. Hyperattenuationin the arterial phase was seen in 78.8 % of the cases by Baron et al[6], and 56 % of the cases by Karahan et al.[7] With respect to enhancement pattern in portovenous phase, our study was correlating best with the study done by Karahan et al where 88% of tumours were hypoattenuating, 12% were hyper attenuating and none showed isoattenuation. Baron et al reported 69 % of the tumours were hypoattenuating in portovenous phase, 21% were hyper attenuating and 10% were isoattenuating to the normal liver parenchyma.[6] However, Cho and his colleagues reported a much lower proportion of cases that were hypoattenuating (39%) with the majority of the tumours being isoattenuating (54%) and around 7% of the case being hyper attenuating.[5] In the delayed phase, our study best correlated with Karahan et al[7], in which 83% of cases were hypoattenuating, 14% of tumors were isoattenuating and 3% were hyper attenuating. Yet, according to Cho et al, 39% were hypodense, 54% were isodense and 7% were hyper dense to the normal liver parenchyma.[5] Portal vein thrombosis prevalence (58.3%) was also in concordance with the findings of Karahan et al (50%).[7] Marin et al diagnosed 52 cases using 64-row detector MDCT with a sensitivity of 96%[8], while Kim et al had a sensitivity of 94.4%[9], and Ronzoni et al recorded a sensitivity of 95.5%.[10] Our study had a sensitivity of 100%.

In the current study peripherally enhancing hypovascular metastases constituted 80% of cases and best correlated with Matilde et al in whom 86.25% of metastases were hypovascular. A previous study showed that 7.1 % of the metastatic lesions as Hyper vascular.[11] We had one case of indeterminate liver lesions in known primaries that were not enhancing in the arterial phase. Ultrasound was useful for characterizing them into metastases.Metastases had a variable pattern of enhancement in the portovenous phase. The most common pattern was peripherally enhancing hypovascular lesions which were better appreciated in the portovenous phase as compared to the arterial phase. In our study, 70% were hypovascular and peripherally enhancing. Honda et al reported that 57% of lesions were hypovascular, showing peripheral enhancement.[11] In the current study, delayed phase enhancement patterns for hepatic metastases were washout in 80% of cases. Some studies advise dual-phase CT after contrast injection is sufficient for detection and characterizing hepatic metastases.[11]

One haemangioma in our study was not showing characteristic peripheral nodular enhancement, but it was filling on portovenous and delayed phases. The reason could be that there were hyalinization and thrombus of the vascular channels in the haemangiomas. Sonography helped in diagnosing it.In the arterial phase, 57.1% of the lesions showed a peripheral nodular pattern of enhancement, 28.5% were homogenously enhancing and 14.2% were hypodense. This was correlating with the findings of Kim et al reported that 68 % of the cases were showing a peripheral nodular enhancement and 2% were hypodense.[9] However, in that previous study, there were a higher proportion of lesions that were homogenously enhancing in the arterial phase. In the portovenous phase, 71.5 % of lesions showed a centripetal globular filling of contrast with the rest (28.5%) being homogeneously hyper dense. In contrast, Kim et al reported that only 49 % of the cases were showing a peripheral globular filling in with 43 % of cases being isodense to the liver parenchyma in portovenous phase.[9]

All the abscesses in our study showed necrosis and peripheral enhancement.The peripheral enhancement of the abscess was best demonstrated in the portovenous phase, the enhancement pattern of the abscess in the arterial phase was similar to that of portovenous in almost all cases.To the best of our knowledge, no study has been conducted with a Triple phase MDCT protocol to compare CT results of liver abscesses.

In our study, most commonly hydatid cysts were large cysts with peripherally placed daughter cysts. The second most common pattern was cysts with multiple internal septations. Sonography improved diagnostic confidence in diagnosing the liver hydatid cysts since the septations were better visualized.

CONCLUSION

The results of this study indicate that the most common malignant lesion was HCC followed by Metastases as the most common benign lesion was Hemangiomas. Triple phase contrast CT was 100 % sensitive and specific in diagnosing hemangiomas, abscesses and cysts and is must for diagnosing primary malignant liver masses and hepatic incidentalomas. Furthermore, the Portovenous phase images were acquired at the peak of liver enhancement is essential for detection of hypo-vascular lesions. When the cost and accessibility are essential determinants of the modality to be used for diagnostic purposes, MDCT imaging has promising prospects.

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