International Journal of Current Advanced Research
ISSN: O: 2319-6475, ISSN: P: 2319-6505, Impact Factor: 6.614
Available Online at www.journalijcar.org
Volume 9; Issue 07(A); July 2020; Page No.22706-22711
DOI: http://dx.doi.org/10.24327/ijcar.2020.22711.4487

Research Article

ROLE OF MDCT IN DETECTION AND CHARACTERISATION OF FOCAL LIVER LESIONS -OUR EXPERIENCE IN A TERTIARY CARE CENTRE

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A R T I C L E I N F O

Article History:
Received 4th April, 2020
Received in revised form 25th May, 2020
Accepted 23rd June, 2020
Published online 28th July, 2020

Key words:
CT,MDCT

A B S T R A C T

Aim & Objective: The study was conducted to characterize features of various hepatic lesions using triple phase CT as diagnostic modality, differentiate benign hepatic lesions from malignant, and correlate findings of triple phase CT with clinical, histopathology or post-operative findings for calculation of its efficacy.

Material & Methods: The study was carried out from October 2018 to October 2019 during which a total of 100 patients of 1-80 yrs irrespective of sex were enrolled in this cross-sectional study, and all patients underwent triple phase CT examination of abdomen using a 16 slice multi-detector CT scanner (Brilliance 16-slice ,Philips) as per the standard protocol . The accuracy, sensitivity and specificity was calculated.

Results: MDCT is a very effective tool in detecting and characterizing focal lesions of liver. Triple phase CT can be an excellent diagnostic modality for characterisation and better evaluation of hepatic masses with sensitivity of 91.3% , specificity 97.8% , PPV 91.3% and NPV 97.8% (p value<0.001 , kappa value 0.847). Malignant hepatic lesions can be diagnosed by triphasic CT with accuracy of 93 %, sensitivity and specificity of 93.3% and 92.5% respectively and with PPV and NPV of 94.9% and 90.2% respectively.

Conclusion: This study indicates MDCT to be highly sensitive in classifying the hepatic lesions into clinically relevant categories, making diagnosis and evaluation of lesion. Besides the easy availibility , cost effectiveness, *the dominance of MDCT is primarily due to its excellent visualization of early lesions and its anatomic relationship* .

INTRODUCTION

Liver is prone to various diseases including benign and malignant because of its major function of digestion, detoxification and rich blood supply by hepatic artery and portal vein[1,2]. Hence CT continues to be the workhorse of hepatic imaging and newer techniques such as biphasic and triphasic helical scanning have improved its standing. Helical computed tomography is widely accepted as the state-of-the art technology for evaluation of focal liver lesions. With the introduction of multidetector CT (MDCT), image acquisition of a larger volume of anatomy in the z axis is now possible in a shorter time (< 10 sec), with no sacrifice in image quality [3,4]. This development has created even more possibilities for varying the timing of image acquisition after contrast material injection. MDCT has the potential to further improve tumor detection and characterization because even more dramatic hepatic tumor and hepatic parenchymal enhancement differences might now be achieved.

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This technology permits examinations of abdomen in multiple phases with a single monophasic bolus of intravenous contrast material, thus improving lesion detection and characterization of the liver tumours. Detection of hepatic lesions with CT is optimized by rapid delivery of iodinated contrast material and scanning during the phase of maximum difference in attenuation characterization of both focal and diffuse pathologic conditions in the liver. Most primary and metastatic liver tumors, receives their blood from the hepatic artery , thus reverses the normal proportion of hepatic blood supply which is mainly supplied by portal vein (70%) to hepatic artery which becomes the prime source of blood supply. These difference in pattern of blood flow forms the basis of triple phase scan of liver. This technique has helped to elucidate the imaging features of primary and metastatic liver tumors. Triple phase CT is very crucial in distinguishing a benign lesion from malignant to avoid unnecessary invasive procedures especially in benign tumors like hemangioma.

This study purports to evaluate the triple phase CT features of common hepatic lesions with emphasis on the role of different phase imaging in characterization of these lesions .

Anatomy

Liver is the largest organ in the abdomen occupying most of the right upper quadrant. It is bordered superolaterally by the surface of the diaphragm and medially by the stomach, duodenum and transverse colon. Inferiorly it is related to the hepatic flexure of colon, kidney and adrenal glands. Liver is attached to the diaphragm by falciform ligament. Superolaterally and inferolaterally coronary ligament comes together to form the right and left triangular ligament. Most surfaces of the liver are covered by peritoneal reflections with exceptions of, fossa for IVC, the fossa for the gallbladder and the bare area of the liver, posteriorly where the liver comes in direct contact with the diaphragm.

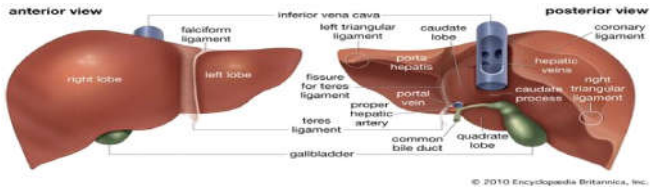


Fig 1 Normal Anatomy of Liver

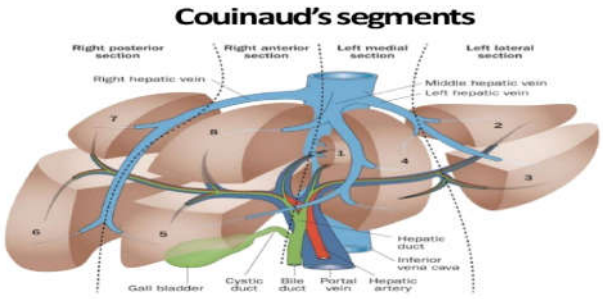


Fig 2 Segmental Anatomy of Liver

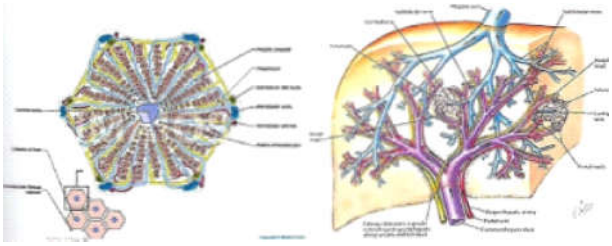


Fig 3 Hepatic Circulation

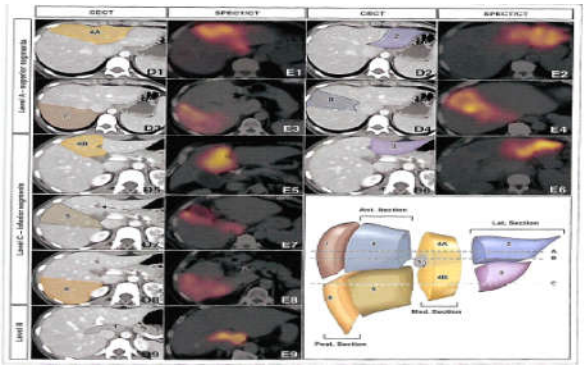


Fig 4 CT Segmental Anatomy of Liver

MATERIALS AND METHODS

This cross-sectional study was conducted in a tertiary care centrefrom October 2018 to October 2019 during which a total of 100 patients were enrolled in this cross-sectional study, and all patients underwent triple phase CT examination of abdomen using a 16 slice multi-detector CT scanner (Brilliance 16-slice ,Philips). Study population included all patients with suspicion of hepatic masses on clinical, laboratory or Ultrasonography findings. Cases of age groups 1-80 yrs were included irrespective of sex. Exclusion criteria was patients with renal failure or those with history of allergic reactions to contrast, pregnant and claustrophobic patients. The study was approved by ethical and scientific committee of the institute and all the subjects were enrolled with detailed oral and written consents.

Technique: Triple phase CECT

Arterial phase was taken at 35-40 sec after contrast injection or 15-20 sec after bolus tracking. Lesions supplied by hepatic artery enhanced maximally in this phase .Hepatic or late portal phase was obtained at 70-80 sec after contrast injection or 50-60 sec after bolus tracking. Hepatic veins enhanced in this phase with maximal enhancement of hepatic parenchyma. Hypo-vascular lesions were best evaluated in this phase. 2-10 minutes after the contrast injection Delayed or equilibrium phase was obtained. Those tumors became visible in this phase that either lost their contrast slower than normal liver parenchyma or washed out rapidly[4].

Contrast agent used in the study was Diatrizoate-meglumine and Diatrizoate sodium 76% both orally and i.v. Water of low density oral contrast material, 1000 to 1500 cc was given 30 min prior to procedure. Dose of intravenous contrast varied according to weight of the patient (1.2-1.5 cc per kg) The injection rate was kept between 2.5-5 ml/sec, rate was adjusted as such that complete contrast is administered in approximately 30 sec. (for 125 mL of contrast with 4mL/sec and for 150 mL with 5mL/sec)

Statistical Methods

Data so obtained were subjected to statistical analysis. Results were evaluated for the best modality through which benign and malignant lesions can be differentiated. Data analysis was done by SPSS software® version 16.0. Descriptive statistical analysis, which included frequency and percentages, was used to characterise the data. Association with the factors was tested for significance using chi-square test and p <0.05 was considered statistically significant.

RESULTS

Table 1 Age distribution of the patients studied

Age (in years)	Frequency	Percentage
0-29	05	5
30-59	81	81
60-80	14	14
Total	100	100.0

Table 2 Gender distribution of the patients studied

Gender	Number	Percentage
Male	47	47
Female	53	53
Total	100	100

Table 1 Age wise distribution of patients

Age	No of patients	Percent (n=100)
<20	3	3.0%
21-30	2	2.0%
31-40	29	29.0%
41-50	30	30.0%
51-60	22	22.0%
>60	14	14.0%
Total	100	100.0%

Table 2 Sex wise distribution of patients

Sex	No of patients	Percent (n=100)
Female	46	46.0%
Male	54	54.0%
Total	100	100.0%

Figure 1 Diagnosis based on triphasic CT

Diagnosis	No of patients
Metastasis	35
Hemangioma	24
HCC	13
Cholangiocarcinoma	9
Adenoma	6
FNH	3
Cirrhosis (RN)	2
Infantile hemangioendothelioma	1
Hepatoblastoma	1
Biliary cystadenoma	1
Abscess	1
Mesenchymalhamartoma	1
Lymphoma	1
PSC	1
Hepatic peliosis	1

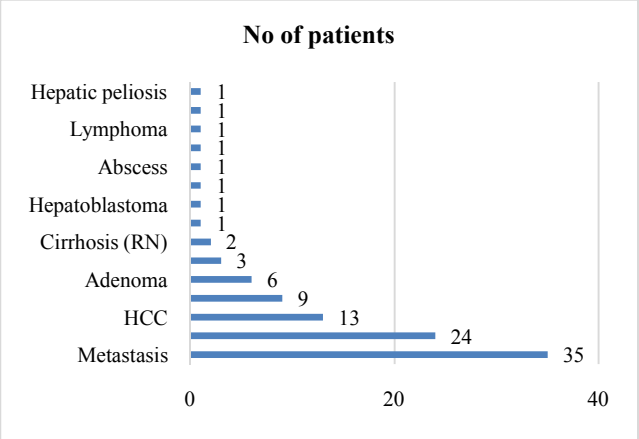


Figure 2 Final diagnosis as per histopathology report

Diagnosis	No of patients
Metastasis	36
Hemangioma	23
HCC	13
Cholangiocarcinoma	9
Adenoma	7
FNH	3
Cirrhosis (RN)	3
Biliary cystadenoma	2
Hepatoblastoma	1
Infantile hemangioendothelioma	1
Lymphoma	1
Hepatic peliosis	1

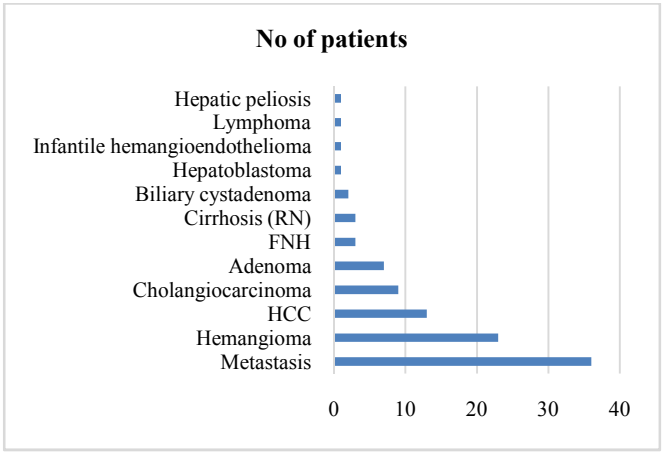


Fig 3 Diagnosis based on triphasicCT

Diagnosis	Female	Male
Adenoma	7	0
Biliary cystadenoma	2	0
Cholangiocarcinoma	0	9
FNH	3	0
HCC	3	10
Hemangioma	16	7
Hepatic peliosis	0	1
Hepatoblastoma	0	1
IHE	0	1
Lymphoma	0	1
Metastasis	15	21
(RN) Cirrhosis	0	3

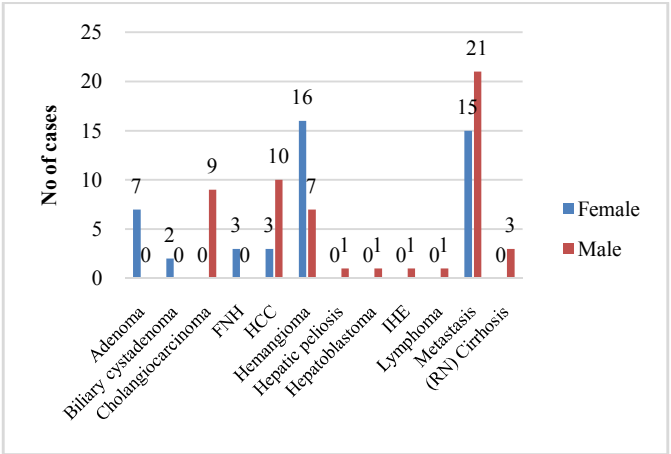


Figure 4 Sex wise distribution of patients in different hepatic lesions

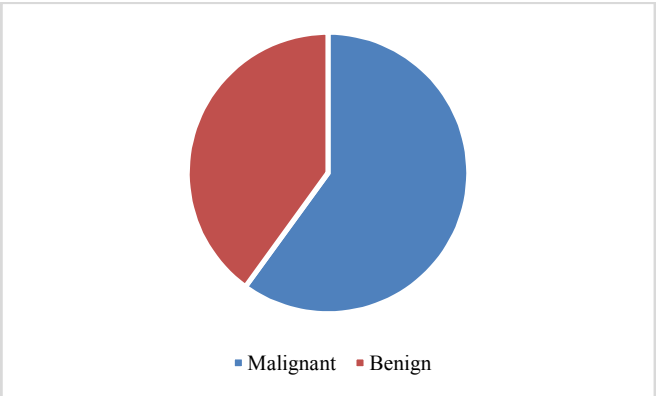


Figure 5 Total number of benign and malignant hepatic lesions obtained in the study population.

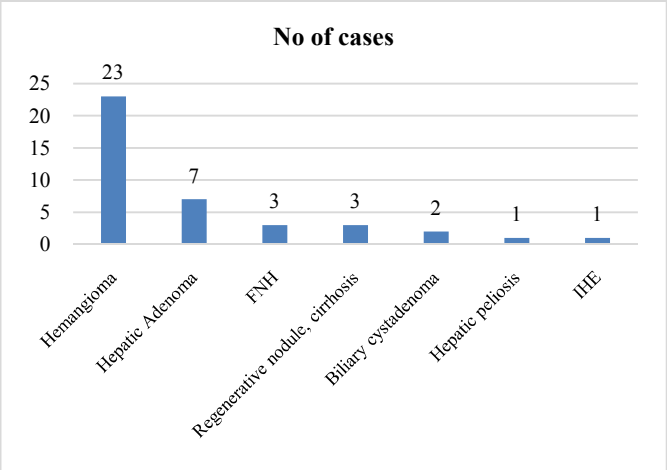


Figure 6 Total number of benign lesions obtained in the study population

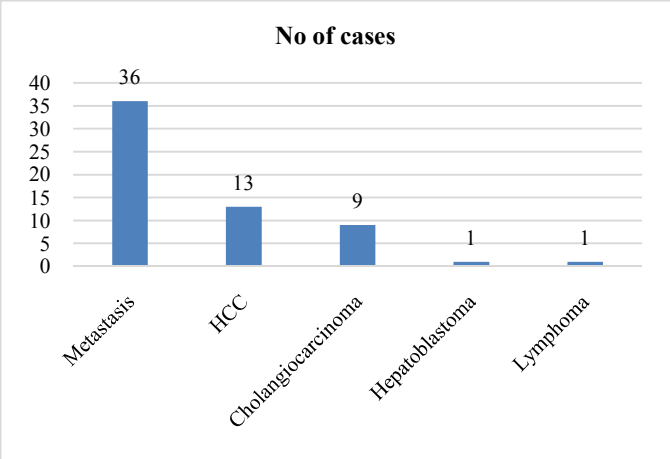
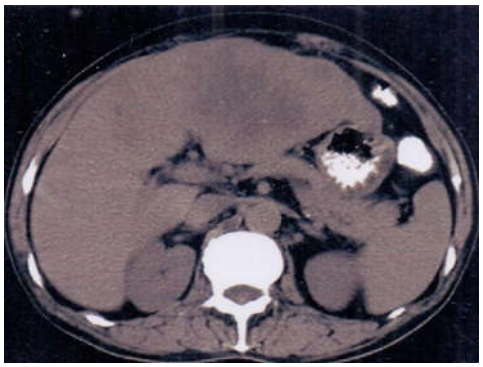
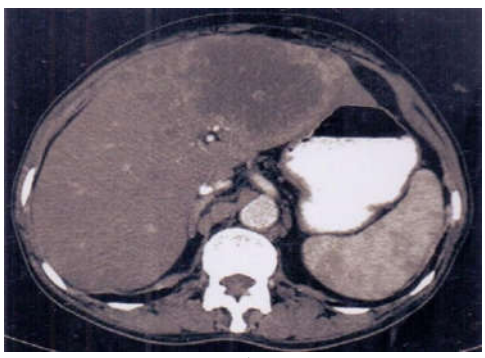


Figure 7 Total number malignant lesions obtained in the study population.



Unenhanced Phase



HAP

Fig 8 HCC with satellite nodules.

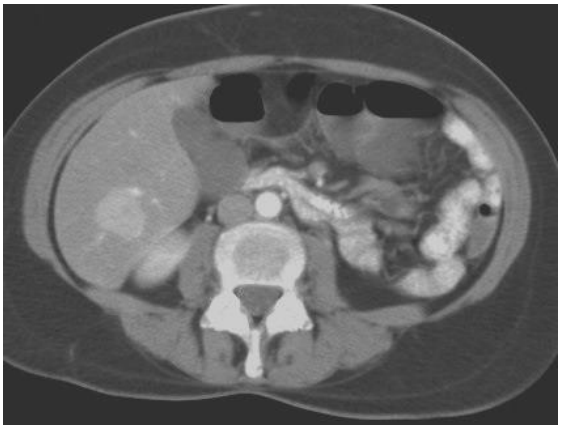
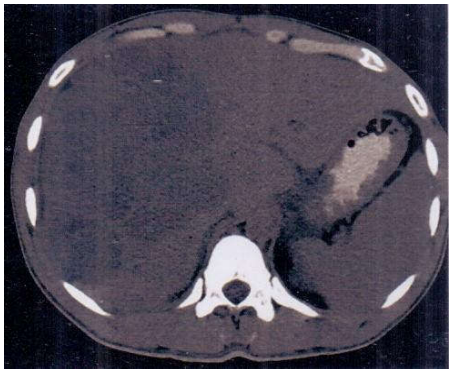
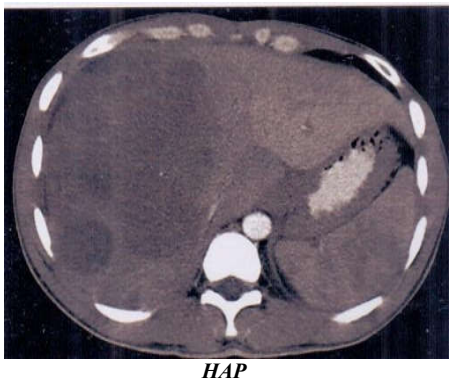


Figure 9 CECT Abdomen reveals focal well defined lesion enhancing in the arterial phase

Hypo/Hypo/ Hyper pattern of enhancement.

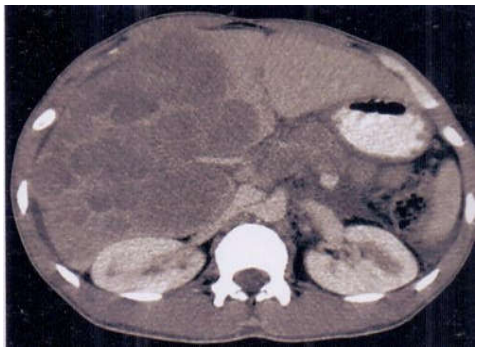


Unenhanced Phase



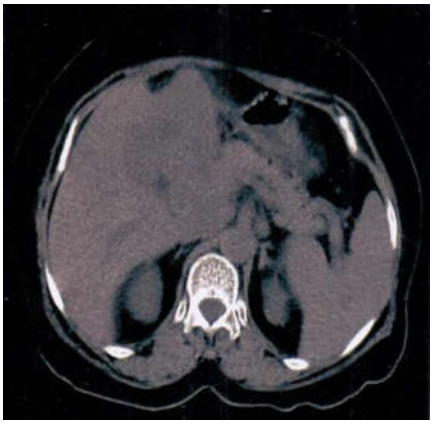
HAP

Fig 10 Hepatic Metastases

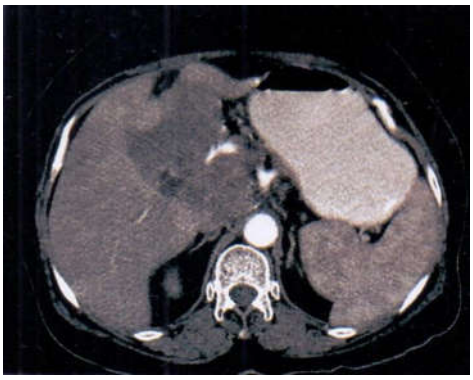


Late PVP

Hyper (incomplete)/A/A pattern of enhancement



Unenhanced Phase



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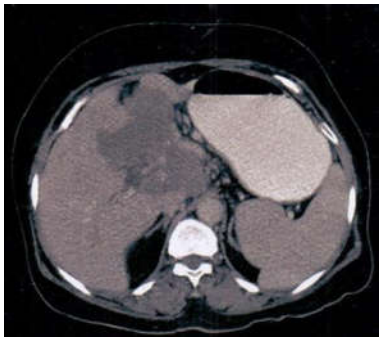
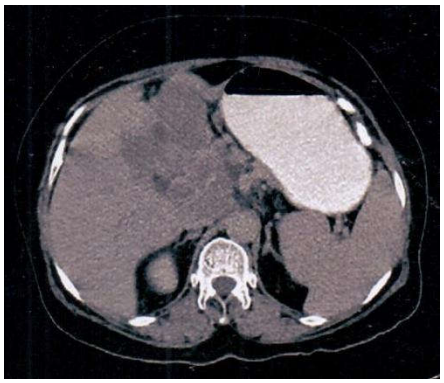


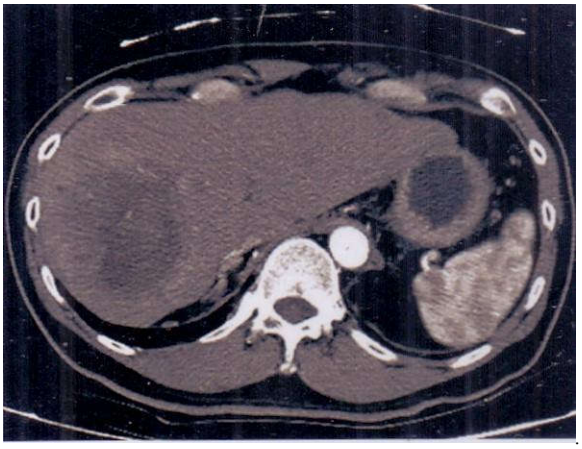
PVP



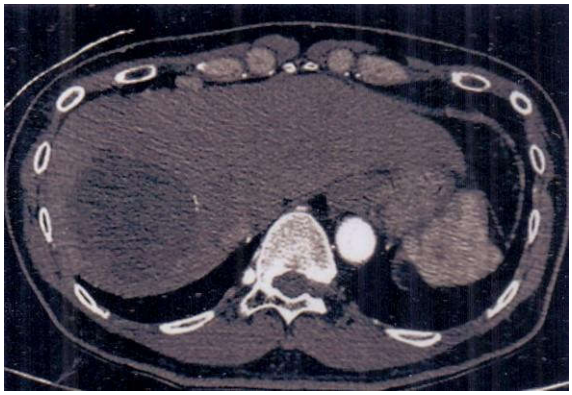
Delayed phase

Fig 11 Intrahepatic cholangiocarcinoma.

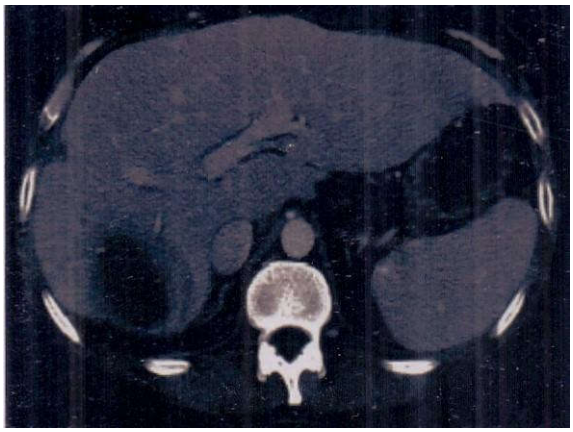
Hyper (rim)/Hypo/Hypo pattern of enhancement.



Early HAP



Late HAP



PVP

Fig 12 Abscess with complete peripheral rim enhancement.

DISCUSSION

Simple cyst: On CT, a hepatic cyst demonstrates homogeneous hypoattenuation (water attenuation) around 0-10 HU. The wall is usually imperceptible, and the cyst does not enhance after intravenous administration of contrast material.

Hepatic Abscess*:*The "double target sign" is a characteristic imaging feature of hepatic abscess demonstrated on contrast-enhanced CT scans, in which a central low attenuation lesion (fluid-filled) is surrounded by a high attenuation inner rim and a low attenuation outer ring[5,6] The inner ring (abscess

membrane) demonstrates early contrast enhancement which persists on delayed images, in contrast to the outer rim (oedema of the liver parenchyma) which only enhances on the delayed phase[6]. The "cluster sign" is a feature of pyogenic hepatic abscesses[6]. It is an aggregation of multiple low attenuation liver lesions in a localised area to form a solitary larger abscess cavity

HCC: The mass enhances vividly during late arterial (~35 seconds) and then washes out rapidly, becoming indistinct or hypoattenuating in the portal venous phase, compared to the rest of the liver. They may be associated with a wedge-shaped perfusion abnormality due to arterioportal shunts (APS), and this, in turn, can result in a focal fatty change in the normal liver or focal fatty sparing in the diffusely fatty liver[8]. A halo of focal fatty sparing may also be seen around an HCC in an otherwise fatty liver[7].Portal vein tumor thrombus can be distinguished from bland thrombus by demonstrating enhancement.

FNH: A multiphase liver CT is ideal[9]. On the non-contrast series, the lesion is usually hypo- or isoattenuating but may appear hyperattenuating if the rest of the liver is fatty. A hypoattenuating central scar can be seen in up to 60% of lesions >3 cm in size [9].FNH demonstrates bright homogeneous arterial contrast enhancement except for the central scar which remains hypoattenuating[9]. Enlarged central arteries may be seen. In the portal venous phase, the lesion becomes hypo/isoattenuating to liver and poorly visualised in many studies. FNH is generally not associated with fat, calcification or haemorrhage. The fibrotic scar demonstrates enhancement on delayed scans in up to 80% of cases[9].

Adenoma: The attenuation of these tumours is variable, depending on[10]:

- fresh haemorrhage: may be hyperattenuating
- fat content may render the mass hypoattenuating

In general, they are well marginated and isoattenuating to the liver. On contrast administration, they demonstrate transient relatively homogenous enhancement returning to near isodensity on portal venous and delayed phase image[10,11].If the rest of the liver shows diffuse fatty infiltration, then they will appear hyperattenuating.Calcification may be seen in areas of old haemorrhage 5-10% of cases[11].

Hepatic metastases: Liver metastases are typically hypoattenuating on unenhanced CT, enhancing less than surrounding liver following contrast[12]. If there is concomitant hepatic steatosis, then the lesions may be iso- or even slightly hyperattenuating. Enhancement is typically peripheral, and although there may be central filling in, on portal venous phase, the delayed phase will show washout; helpful in distinguishing a metastasis from a haemangioma[12].Some primaries have a tendency to produce hyper-enhancing metastases, including renal cell carcinoma, thyroid carcinoma, neuroendocrine tumours, etc .

Findings

Triple phase CT proved to be an excellent diagnostic modality for characterisation and better evaluation of hepatic masses with sensitivity of 91.3%, specificity 97.8% , PPV 91.3% and NPV 97.8% (p value <0.001, kappa value 0.847).Malignant hepatic lesions can be diagnosed by triphasicCT with accuracy of 93%, sensitivity and specificity of93.3% and 92.5% respectively and with PPV and NPV of 94.9% and 90.2% respectively.

CONCLUSION

This study indicates MDCT to be highly sensitive in classifying the hepatic lesions into clinically relevant categories, making diagnosis and evaluation of lesion. Besides the easy availability , cost effectiveness, *the dominance of MDCT is primarily due to its excellent visualization of early lesions and its anatomic relationship* .

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