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Role of triple phase computed tomography in characterization of hepatic lesions

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ABSTRACT

Aim : To characterize hepatic lesions with the help of triple phase CT scan and to know the predictive accuracy of triple phase CT scan for characterization of different hepatic lesions.

Materials and Methods : A total of 60 patients were included in this observational prospective study study done in the Postgraduate Department of Radio-diagnosis and Imaging, Government Medical College, Srinagar , India. All patients underwent triple phase CECT examination and its accuracy, sensitivity and specificity was calculated

Results : In present study a total of 60 cases were included, with age ranging from 06 year to 70 years with the maximum number of cases in the age groups of 18 years – 40 years and 51 years to 60 years (21 each). 55% of cases were males and 45% were females. 15 patients were referred with a known primary malignancy and 9 CLD patients were referred for HCC screening .In the 60 patients studied ,a total of 29 (48%) cases were benign while as 31(52%) were malignant. Hemangioma was the most common benign lesion found in our study . Metastasis was the most common malignant lesion found in our study.Most common pattern of enhancement of metastasis was hypovascular enhancement in all three phases, followed by peripheral ring enhancement. Peripheral enhancement was noted in 16% of cases in arterial and occasionally in portal venous phase. Hepatocellular carcinoma was seen in 11 patients with a mean age of 53years with male predominance Heterogeneously hypervascular was the most common pattern of enhancement of hepatocellular carcinoma on arterial phase with rapid washout in the portal and delayed phase. The sensitivity and specificity of Triple phase CT in evaluation of hepatic lesions in our study was93.55% and 94.44% respectively

Conclusion : Triple Phase CT with great accuracy is highly helpful in confident diagnosis of hepatic lesions. It has a vital role in management of both benign and malignant hepatic lesions

Keywords : Hepatic Lesions, Triple phase CT , Radiology

INTRODUCTION

Hepatic diseases are common causes of morbidity and mortality in India, and are encountered frequently in day-to-day practice. Due to wide spread 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

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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 diagnose 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 diseases 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. However, it is limited by operator dependency, inability to diagnose lesions <1cm 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 pathological liver lesions[2].

Triple phase 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 help in differentiating lesions based on their vascular supply .The hepatic circulation is divided into three distinct phases namely - arterial phase, portal venousphase, 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 Delayed Phase/ Equilibrium 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. Despite the increased use of MRI over the last few years, the importance of CT prevails, chiefly due to excellent visualizations of liver anatomy, morphology of liver lesions and satisfactory delineation of relationship with adjacentstructures[3].

AIM

To characterize hepatic lesions with the help of triple phase CT scan and to know the predictive accuracy of triple phase CT scan for characterization of different hepatic lesions.

Materials and Methods

The present study "**Role of triple phase computed tomography in characterization of hepatic lesions**" was conducted in the Postgraduate Department of Radio-diagnosis and Imaging, Government Medical College, Srinagar, over a period of 24 months after obtaining clearance from ethical committee of the College , vide no : **F(Minutes-BOPGS) Acad/KU/22** . This study is an observational prospective study, where patients with liver lesions were evaluated by Triple phase CT.

All the patients with suspicion of hepatic lesions on clinical, laboratory or Ultrasonography findings were subjected to Triple Phase CT scans with arterial, portal venous and delayed phases after intravenous injection of contrast media. Evaluation of various hepatic lesions was done on the basis of enhancement pattern of the lesions and the characteristic imaging features of the lesions in different phases. The age range of the patients included in our study was 06 years to 70 years. In the pediatric age group three patients were included in the study among whom two were above 15 years and one patient aged 06 years.

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The patients with known primary malignancies with suspicion of liver metastases were also subjected to Triple Phase CT. Patients with chronic liver disease with increased AFP levels were Screened with Triple Phase CT.

INCLUSION CRITERIA

The study includes, patients with suspicious hepatic lesions on clinical or ultrasonography findings.

EXCLUSION CRITERIA

1. Patients with renal insufficiency
2. Patients with history of allergic reaction to contrast
3. Pregnant females
4. Already proven cases of hepatic lesions
5. Patients not willing to participate in the study.

METHODOLOGY

The Triple phase CT scan study was done using 256 Slice Siemens Flash Dual Source CT machine using the following scanning protocol.

TECHNICALPARAMETERES	PARAMETERES
Kvp	CareKv(ref.Kv120)
Quality reference mAs	200
Time rotation	0.5sec
Average Acquisition Time	5-7sec
Collimation	128x0.6mm
Pitch value	0.6
Scan direction	Cranio-caudal

TECHNIQUE FOR TRIPLE PHASE CT:

Acquisition phase	**Phase included**	**Scan Delay**	**Respirationphase**	**Anatomicalcoverage**
Arterial phase	YES	Bolustrig gered	Inspiration	Diaphragm through iliac artery bifurcation
Venous phase	YES	60sec.	Inspiration	Diaphragm through iliac artery bifurcation
Delayed Phase	YES	90sec.	Inspiration	Abdomen to include entire liver

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Informed consent was taken from all patients before undergoing the procedure. A 06-08 hour fasting precedes the examination. NCCT was done initially in all the cases followed by Triple phase scanning. NCCT was helpful in detecting calcification, fat and haemorrhagic areas in tumors. CECT obtained in three phases- Arterial, portal venous and equilibrium. **Arterial phase** was taken at 35-40 sec after contrast injection or 15-20 sec after bolus tracking. Lesions supplied by hepatic artery enhance maximally in this phase. **Portal venous phase** was taken at 70-80 sec after contrast injection. In this phase there is maximal enhancement of hepatic parenchyma. Hypo vascular lesions will be best evaluated in this phase.

Delayed or equilibrium phase was obtained 2-10 minutes after the contrast injection. Those tumors become visible in this phase that either lose their contrast slower than normal liver parenchyma or wash out rapidly. Non-ionic contrast (Iohexol) agent used in the study was given via intravenous route in appropriate concentration and dosage.

Dose of intravenous contrast was given according to the weight of the patient (1.2 – 1.5 cc per kg). The injection rate was kept between 2.5-5ml/sec, rate was adjusted as such that complete contrast was administered in approximately 30 sec. One patient aged 06 years was put under sedation while performing Triple Phase CT.

STATISTICAL ANALYSIS

Data was entered in a Microsoft Excel spreadsheet. Categorical variables were summarized as Frequency and Percentage. Sensitivity, Specificity, Positive Predictive Value, Negative Predictive Value and Diagnostic Accuracy were calculated and reported in percentage.

Results

In present study a total of 60 cases were included, with age ranging from 06 year to 70 years with the maximum number of cases in the age groups of 18 years – 40 years and 51 years to 60 years (21 each). 55% of cases were males and 45% were females. 15 patients were referred with a known primary malignancy and 9 CLD patients were referred for HCC screening .

In the 60 patients studied ,a total of 29 (48%) cases were benign while as 31(52%) were malignant. Hemangioma was the most common benign lesion found in our study . Metastasis was the most common malignant lesion found in our study.

Non-Contrast CT findings of various Liver lesions (Table 1).

Table1:

Non Contrast CT Findings	Frequency	Percentage
Heterogenous	10	16.66
Hypodense	39	65.0
Isodense	11	18.33
Total	60	100

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Radiological diagnosis on basis of Triple Phase CT findings (Table 2, Fig. 1).

Table 2 :

CT Diagnosis	Frequency	Percentage
Hemangioma	5	8.33
Alveolar Echinococcosis (AE)	5	8.33
Biliarycystadenoma	1	1.66
HCC	12	20.00
CysticEchinococcosis(CE)	6	10.00
IHE	1	1.66
Liverabscess	6	10.00
Metastasis	19	31.66
HepaticCyst	5	8.33
Total	60	100

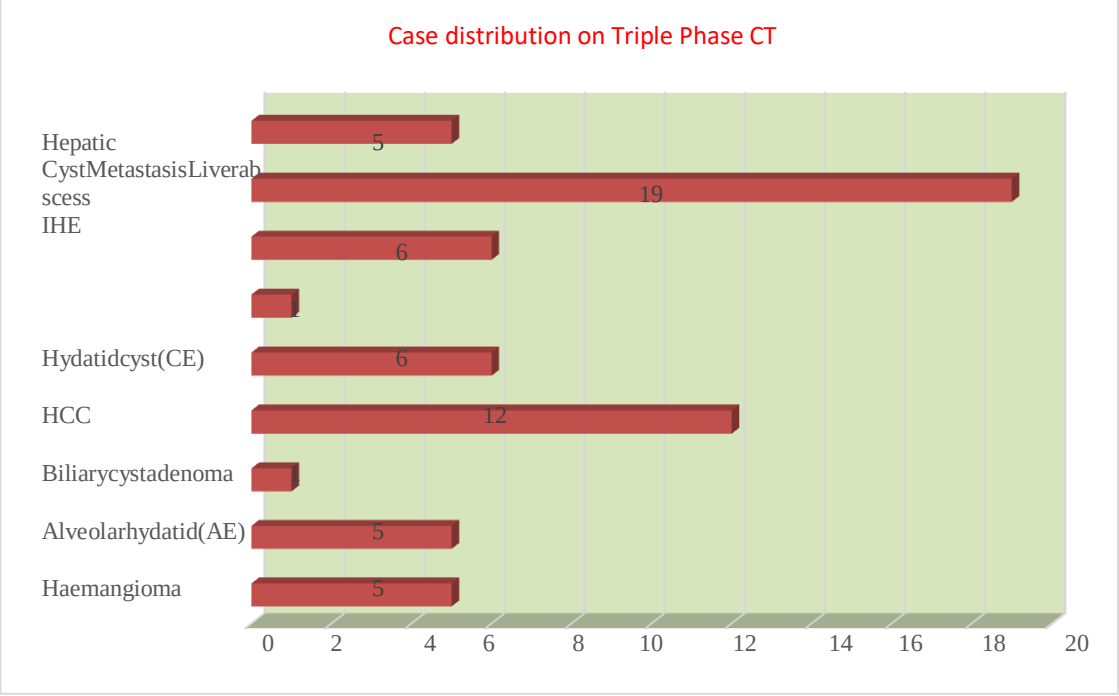

Fig.1: Depicts Radiological diagnosis on basisof triple Phase CT findings.

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Haemangioma :Pattern of Enhancement (Table 3A,3B, Fig. 2).

Arterial Phase Table 3A

Arterial Phase	Frequency (n=6)	Percentage
Peripheral nodular enhancement	04	66.6%
Hypervascular	01	16.6
Heterogeneous enhancement	01	16.6

Table 3B (Porto-Venous Phase)

Porto-venous Phase	Frequency (n =6)	Percentage
Centripetal Filling	04	66.6
Isodense	01	16.6
Heterogeneous enhancement	01	16.6

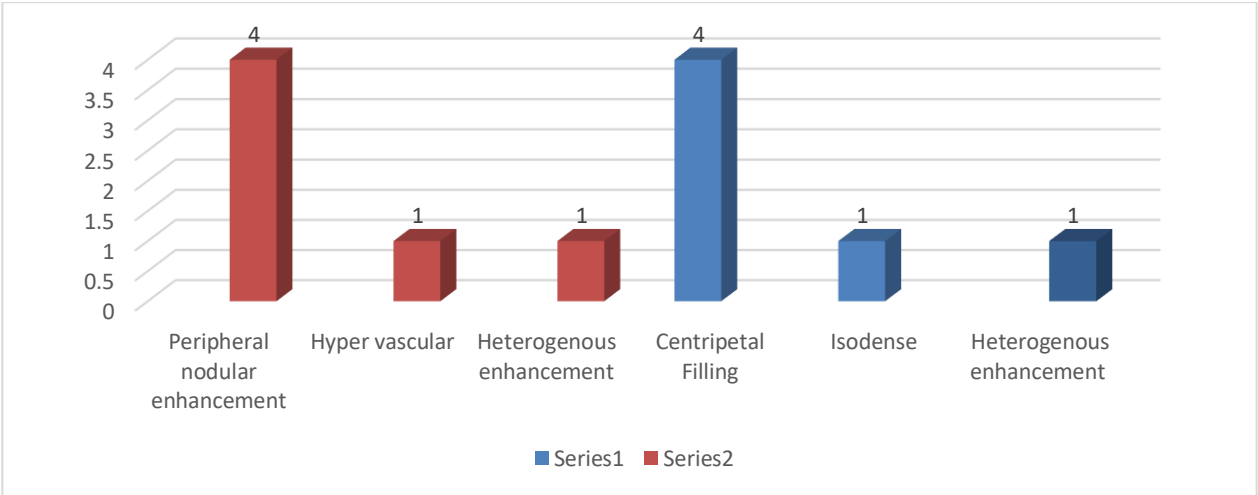

Fig. 2: Bar chart in red depicts arterial phase enhancement and blue depicts Porto-venous enhancement of hemangiomas

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Metastasis: Pattern of Enhancement (Table 4A & Table 4B)

Arterial phase. (Table 4A)

Arterialphase	Frequency(n=18)	Percentage
Hypovascular	12	66
Peripheralenhancement	03	16
Hypervascular	02	11
Heterogenous	01	02

Porto Venous Phase (Table 4B)

PortoVenous Phase	Frequency(n=18)	Percentage
Hypovascular	11	61
Isodense	04	23
Peripheralenhancement	03	16

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Hepatocellular Carcinoma: Pattern of enhancement of HCC (Table 5A & 5B)

Arterial Phase (Table 5A)

Table 5A

Arterial Phase	Frequency(n=11)	Percentage
Hypervascular(Homogenous)	03	27
Hypervascular(Heterogenous)	06	54
Isodense	02	18

Porto-Venous Phase (Table 5B)

Table 5B

Porto-venous Phase	**Frequency(n=11)**	**Percentage**
Hypovascular (washout)	09	82
Isodense	02	18

Distribution of Cases according to Pathological Diagnosis based on Histo-pathological / Cytological examination.(Table 6, Fig 3)

Table 6

PathologicalDiagnosis	**Frequency**
Metastasis	18
HCC	11
Alveolar Echinococcosis (AE)	05
Cyst Echinococcosis (CE)	05

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Liver abscess	05
BCC	01
IHE	01
NET	01
Granulomatous	01
Amoebic abscess	01

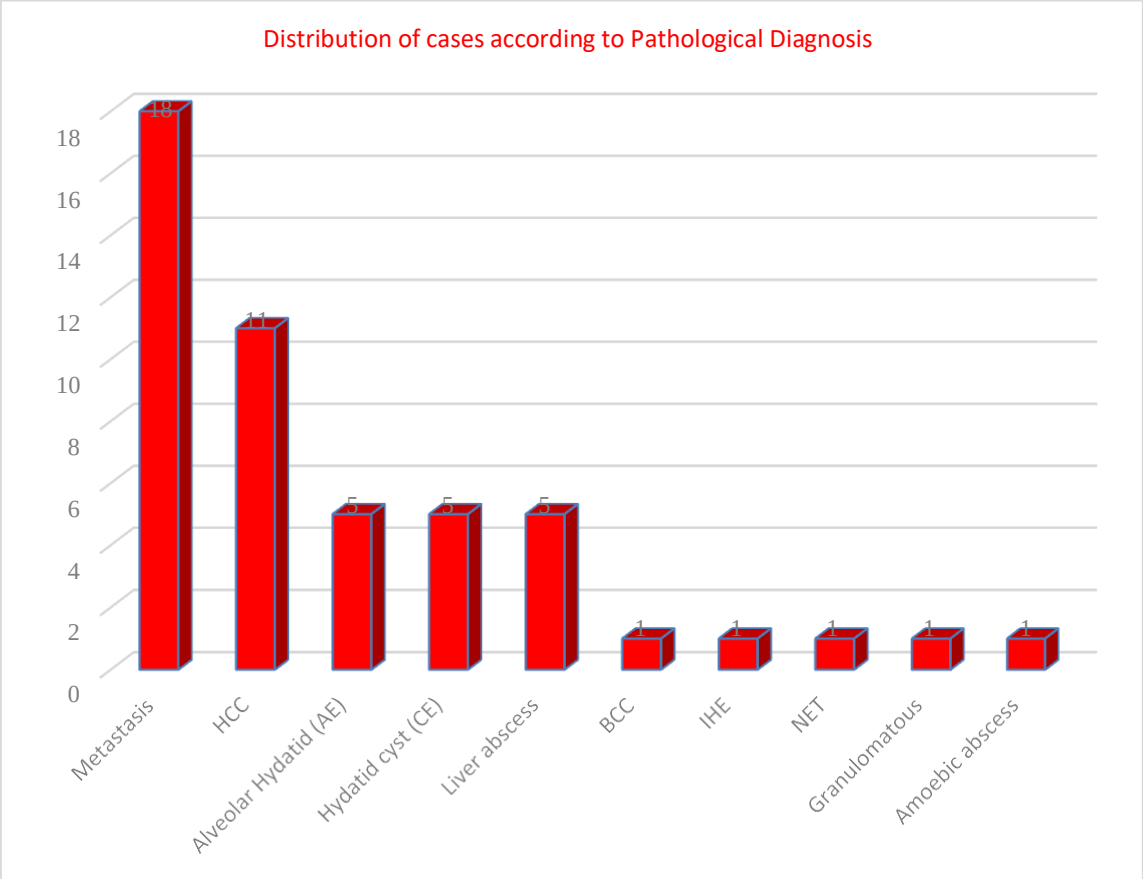

Fig.3 : Bar chart showing distribution of cases according to Pathological Diagnosis

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Final diagnosis based on imaging and pathological findings. It also shows the sex distribution of cases.(Table 7)

Table 7

Final diagnosis	Frequency	Male	Female
Metastasis	18	10	08
HCC	11	06	05
Hemangioma	05	03	02
Alveolar Echinococcosis (AE)	05	03	02
Pyogenic Liver Abscess	05	04	01
Cystic Echinococcosis(CE)	05	03	02
Hepatic cyst	05	03	02
Amoebic abscess	01	01	0
NET	01	0	01
BCC	01	0	01
IHE	01	0	01
Granulomatous	01	0	01
Giant hemangioma	01	0	01
Total	60	33	27

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BIOSTATIC PARAMETERS OF TRIPLE PHASE CT IN DETECTING LIVER LESIONS. (Table 8&9)

Table 8

Diagnostic utility of Triple phase CT scan in picking up a Benign lesion against a Malignant lesion.

Parameter	Estimate	95%Cis
Sensitivity	94.44%	74.24 -99.01
Specificity	93.55%	79.28 -98.21
Positive Predictive Value	89.47%	68.61 -97.06
Negative Predictive Value	96.67%	83.33 -99.41
Diagnostic Accuracy	93.88%	83.48-97.9
Likelihood ratio of a Positive Test	14.64	5.46 -39.27
Likelihood ratio of a Negative Test	0.059	0.008-0.424
Diagnostic Odds	246.5	20.77 –2926
Cohen's kappa (Unweighted)	0.87	0.59 -1.15

Table.9

Diagnostic utility of Triple phase CT scan in picking up a Malignant lesion against a Benign lesion.

Parameter	Estimate	95%Cis
Sensitivity	93.55%	79.28 -98.21
Specificity	94.44%	74.24 -99.01
Positive Predictive Value	96.67%	83.33 -99.41
Negative Predictive Value	89.47%	68.61 -97.06
Diagnostic Accuracy	93.88%	83.48-97.9
Likelihood ratio of a Positive Test	16.84	2.361 -120.1
Likelihood ratio of a Negative Test	0.07	0.03 -0.18
Diagnostic Odds	246.5	20.77 –2926
Cohen's kappa (Unweighted)	0.87	0.59 -1.15

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DISCUSSION

This study was conducted in the department of Radiodiagnosis in Government Medical College, SMHS Hospital Srinagar. The study was conducted on 60 patients with age ranging from 6 years to 70 years, maximum number of cases were seen in age range of 18 to 40 years and 51 to 60 years (35% each). This observation was in correlation with the study done by **Ahirwar et al**[4], who in their study found the age range of 01 years to 79 years with maximum number of cases in the age range of 45 years to 60 years. 55% of our cases were males and 45% were females. This also correlates with the study done by **Ahirwar et al**, who in their study found that 54% of the total cases were males and 46% were females. The number of benign lesions found in the study was 29 (48.3%).Among the benign lesions Hemangioma was the most common benign lesion found in the study. Our findings are concordant with **Ahirwar et al**, who found in their study the hemangioma was the most common benign lesion. Our Study reported 6cases(10%) of **Hemangioma** , 5 cases Cystic Echinococcosis (CE) (8.3%) , 5 cases of liver abscess (8.3%), 5 cases alveolar echinococcosis (AE) (8.3%), 5 cases of simple liver cyst(8.3%),1 case of each infantile haemangio-endothelioma, amoebic abscess and granuloma (1.6%). Out of six cases of Hemangiomas included in our study, five cases were diagnosed on Triple Phase CT. These cases were having typical imaging features of hemangioma. On NCCT four cases of Hemangioma were hypodense. Out of six lesions, four of the lesions(66.6%) on arterial phase were showing peripheral nodular discontinuous enhancement(Table 3A, & figure 2). This feature was corelating with **Kim et al**[5]and **Matilde et al**[6], who in their study found 66%of patients had peripheral nodular enhancement. These lesions were showing centripetal filling on Portal venous and delayed phases (Table 3B , Figure 2). One of the lesions was hyper vascular on arterial phase The lesion was Isodense to liver parenchyma on Porto venous and delayed phases (flash filling). A case of giant Hemangioma was seen involving right lobe of liver in segment VI measuring more than 7cm with large exophytic component .The lesion was showing heterogeneous enhancement on arterial and portal venous-phases. The lesion was suspected to be hepatocellularcarcinoma considering the heterogenous enhancement and hepatitis B status of the patient. However, the patient was followed for a period of one and a half years, as the clinical status of patient was in contrast with the radiological diagnosis **(Figure 7A & 7B)**. It was later confirmed that the lesion was giant Hemangioma by 99mTcRBC.

In our study a good number patients were found to be having **liver abscess**. Out of the 60 patients, 06 patients(10%) were diagnosed with pyogenic liver abscess on Triple Phase CT(Table 2 , Figure 1). Cyto-pathological correlation was done in all the cases who were diagnosed as liver abscesses on Triple Phase CT. One patient was confirmed to be having amoebic abscess while all the remaining patients were confirmed as the cases of Pyogenic liver abscesses(Table 6 ,Table 7 , Figure 3). Double target sign consisting of a hypodense central cavity formation which is surrounded by a high attenuation rim corresponding to enhancing wall of the abscess(inner rim) and low attenuation rim corresponding to perilesional oedema (outer rim) was seen in 2 cases of pyogenic abscess and 1 case of amoebic abscess(Figure 6). This observation correlates with the study done by **Gabata et al**[7],in which they found 43% of patients with hepatic abscess have double target sign. Pyogenic abscess was mainly multiple (4 cases,80%), 1 case was single. This is also a feature to differentiate pyogenic abscess from amoebic abscess otherwise no definite distinguishing features were delineated in our study.

In our study 05 (8.33%) cases out of 60 cases were diagnosed as **Cystic Echinococcosis(CE) /Hydatid Cyst (Table 2 , Figure 1 & Figure 4).** All of these cases were confirmed by HPE(Table 6, Figure 3). On questioning the patients, it was found that most of the patients belonged to upper reaches of the Kashmir Valley and were actively involved in cattle & sheep rearing. 60% of the patients diagnosed with hydatid cyst were found to have positive serology. All the lesions were hypodense on NCCT, 40% of the patients showed internal membranes and 60% of the cases showed peripheral wall calcifications. One of the cases who was previously diagnosed with hydatid cyst presented with fever and abdominal pain showed peripherally enhancing lesion with air foci within the cavity, was diagnosed as infected hydatid cyst which was later confirmed by

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HPE. Another patient was found to be having a peripheral left lobe cystic lesion with daughter cysts within, with dilated left lobe Intra-Hepatic Biliary Ducts. The lesion was exophytic and had irregular crenated margins.The patient had moderate ascites ; therefore, diagnosis of ruptured hydatid cyst was made. This was later confirmed on HPE and ascitic fluid analysis. One of the patients diagnosed as hydatid cyst on triple phase CT, was showing mildly enhancing wall,however no calcifications, internal membranes or daughter cysts were seen. Hydatid serology was also negative. The patient was later diagnosed with biliary cyst adenocarcinoma (BCC) on histopathological examination.

In our study 8.33% of the total number of cases were diagnosed as **Alveolar Echinococcosis (AE)/ Alveolar hydatid**(Table 2 , Figure 1 , 5A, 5B & 5C). On questioning the patients, it was noted that most of the patients with the Alveolar Hydatid Cyst belonged to the higher reaches of the Valley. Two out five patients diagnosed with Alveolar hydatid on CT, later were found to have positive hydatid serology. 4 of the cases were found to be heterogenous with internal and peripheral cystic areas. Remaining 1 case was found to be hypodense on NCCT. Out of 4 patients who showed calcifications, 3 cases showed peripheral and central calcific foci and 1 case showed peripheral calcification**s.** This observation correlates with the study made by **Brunetti et al**[8]**,** who in their study found central calcifications were present in most of the cases of alveolar hydatid. 4 (80%) of the patients had no post contrast enhancement while as the remaining 01 case showed subtle postcontrast enhancement on delayed phase. All the patients showed lesions with irregular and infiltrating margins. One of the patients had metastatic brain hydatid lesion. None of the patients had atrophy or capsular retraction which is in contrast to the study done by **Kantarciet al**[9], who in their study found capsular retraction and associated parenchymal atrophy were associated features of AE. The reason for this contradiction could be small sample size in our study.

In our study among the malignant lesions, most common lesion to be found was **Metastasis** (30% of total cases).Second most common lesion in our study was **Hepatocellular Carcinoma** (18.3%) and followed by a single case (1.6%) each of **Biliary Cyst-adenocarcinoma** and **Neuroendocrine Tumour**. This result of our study correlates with the study done by **Abbas et al**[10]**,** who studied 39 patients and found most common neoplasm encountered was metastasis which accounted for 38% followed by HCC which accounted for 23%.

In our study 31.6% of the patients were diagnosed with **metastasis** on Triple Phase CT(Table 2 , Figure 1), however on Histopathological correlation 30% were found to be Metastasis(Table 6 , figure 3). One case was diagnosed with metastasis on Triple Phase CT, the lesion was showing peripheral enhancement on delayed phase and the patient was known case of Ca Colon but the lesion was later found to be Hepatic granulomatous disease on Cytopathological Correlation.

In our study, out of 18 cases of **metastasis** (Figure 10), Colorectal cancer was the most common primary malignancy accounting for 27.7% followed by Breast Malignancy which accounted for 22.2%, Primary Bowel NET and Pancreatic Adeno-carcinoma each accounted for 11.11%. Other cases of Primary malignancies include Renal Cell Carcinoma, Renal Vein leiomyosarcoma, Esophageal Carcinoma. Our study group spectrum was also correlating with **Matilde et al**[11] who studied 53 cases of Metastasis and found majority of metastasis were having colorectal carcinoma (17) as primary followed by pancreatic carcinoma (11). Our study group result spectrum is also correlating with the study done by **Leeuwen et al**[12] who studied 58 patients of metastasis and found most common primary for liver metastasis was colorectal cancer.

Enhancement pattern:

Pattern of enhancement was studied in **arterial phase** by categorizing the pattern of enhancement as hypovascular, hypervascular, heterogeneous, homogenous and peripheral enhancement in relation to the liver. In our study, most common pattern of enhancement was hypo vascular accounting to 66% of the cases followed by peripheral rim enhancement accounting for 16%. 11% of the cases were showing hypervascular enhancement and 5% showed heterogeneous enhancement(Table 4A) . According to **Honda et al**[16]**,** who studied 28 cases of metastasis , observed that the most common pattern of enhancement of metastases in arterial phase was hypo vascular (60%) followed by peripheral ring enhancement(28%). These results were correlating with our

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study.

In our study , the majority of lesions in **portal venous phase** were hypovascular in appearance accounting for 61%, followed by Isodense (23%)(Table 4B).This result of our study correlates with the study of **Honda et al**, who in their study found that 57% of the cases were hypovascular in Portal Venous Phase.

Hepatocellular carcinoma:

Among the malignant lesions, the second common lesion was hepatocellular carcinoma accounting for 18.3% of the total patients (Table 2 , Figure 1).The age of the patients ranged from 25-65 years with mean age being 53 years. This result correlates with the study conducted by **Baron et al**[13]**,** in which the age range was17-83 years and the mean age was 58years.The results of our study also correlate with results of the study conducted by **Hwang et al**[17]**,** who in their study of 45 patients, found the age range of 31-71 years with mean age of 52 years.

In our study, the male to female ratio was 6:5. **Baron et al**. and **Hwang et al.** found in their studies that there is a greater incidence of HCC in males , with ratios of 51:15 and 39:6, respectively. **This variation could be because of small sample size in our study**.

AFP levels were found to be raised in 05 patients. 09 out of the total patients were having underlying CLD. Five patients were hepatitis B&C positive.

Enhancement pattern:

A total of 11 HCC cases were examined for various patterns of enhancement.09 lesions (81%) displayed hypervascular enhancement in the **arterial phase**, with 06 of them being heterogeneously hypervascular and 03 being homogeneously hyper vascular (Table 5A , Figure 8A & Figure 9A).Our study's pattern of arterial phase enhancement was consistent with the study done by **Baronet al**[13]**,** in which 80 % of HCC cases displayed hyperattenuation (hypervascularity) in the arterial phase with 39.4% of those being heterogeneous and 39.4% being homogeneous.84 HCC cases were included in the study of **Juncos et al**[14]. The pattern of enhancement shown by these patients was, hyperattenuation (83%), isoattenuation (7%,), and hypoattenuation (6%) to the liver parenchyma in arterial phase, which was consistent with our study.

Heterogeneously hypervascular was the predominant **arterial phase** enhancement pattern in our investigation, accounting for 54% of cases out of 11 cases which is in correlation with the study done by **Karahanetal**[15] in which they studied 30 patients and found that 46% of the lesions demonstrated heterogeneous hypervascular enhancement in arterial phase. Out of 11 participants in our study group, in **portal venous phase** the pattern of enhancement: 82% were hypovascular, 18% were Iso-dense(Table 5B). Our study was in coherence with the study of **Baron et al**, who in their study found 21% of the cases as hyper dense (hypervascular), 10% were Iso-dense,and 69% were hypodense (hypovascular).

Late Capsular enhancement was found in 6 patients (54%) ,this observation correlates with **karahan et al**, who in their study found 57% of the patients were showing late capsular enhancement(Figure 8B).

Vascular involvement:

In 63% (7cases) of HCC cases, we found portal vein thrombosis (bland + tumour) (Figure 9B),which correlates with the observation made by **Leeuvenet al** where they found portal vein involvement to be 57%**.** Our findings are not consistent with the finding of **Karahan et al** who found in their study, 50% of cases showing the portal vein thrombosis. The reason for the higher portal vein thrombosis in patients with HCC in our study could be because of delayed screening in HCC patients. The second reason could be delayed reporting to tertiary care centers**.**The sensitivity and specificity of Triple phase CT in evaluation of hepatic lesions in our study was 93.55% and 94.44% respectively(Table 8 & 9). This proves that CT is highly sensitive while

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evaluating hepatic lesions. Also, the specificity of Triple phase CT in evaluating both benign and malignant lesions is significantly high. Triple phase CT can be considered a reliable diagnostic tool in distinguishing a benign lesion from a malignant one. Thus, helps in avoiding unnecessary invasive procedures in benign lesions like hemangioma. CT offers the advantage of characterization of lesion and provides important preoperative information. The positive predictive value in our study was 96.67% while as negative predictive value was 89.47%. Diagnostic accuracy in evaluation of hepatic lesions in our study was 93.8%.The sensitivity and specificity, NPV and Diagnostic Accuracy of our study correlates with the study done by **Ahirwar et al**[4]who found in their study that sensitivity, specificity, positive predictive value and negative predictive value of Triple Phase CT in diagnosing liver lesions was 92.3%, 92.5%, 94.9% and 90.2% respectively.

Conclusion

Triple Phase CT with great accuracy is highly helpful in confident diagnosis of hepatic lesions. It has a vital role in management of both benign and malignant hepatic lesions and also proved beneficial in reaching primary malignancy diagnosis in cases of liver metastasis from unknown primary. It evaluates the hepatic lesions in three different phases which helps in better understanding of the vascular property of the tumor, helping in diagnosis as well as management protocol.

In the developing countries like ours, where the cost & accessibility are essential determinants of the modality to be used for diagnostic purposes, TRIPLE PHASE CT has promising prospects.

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Representative Cases

1. Cystic Echinococcosis/ Hydatid Cyst (Fig 4)

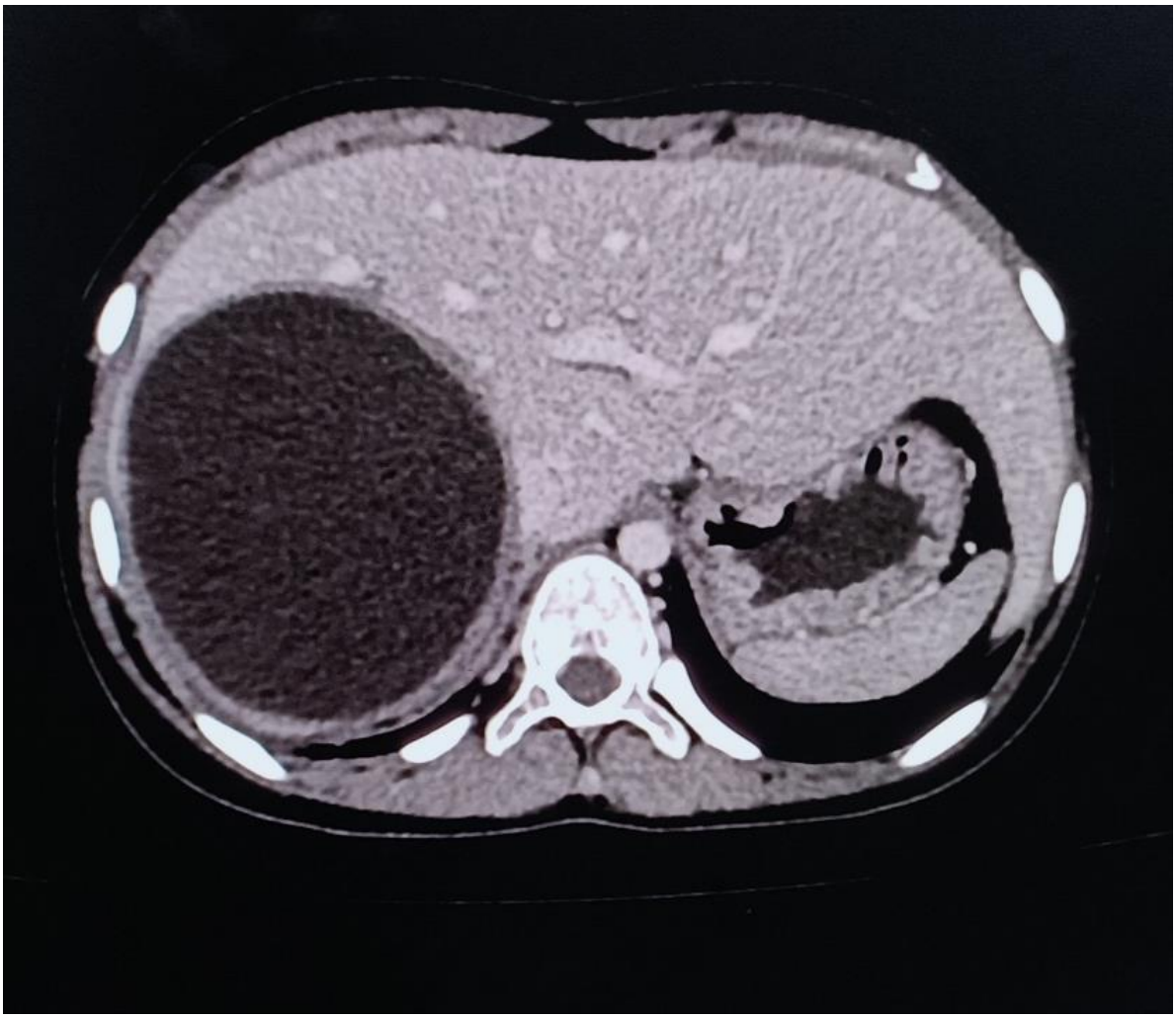

Fig.4

Axial Porto Venous Phase (Fig.4) showing large hypodense cystic lesion in right lobe of liver, no internal septations are seen. The patient had positive hydatid serology.

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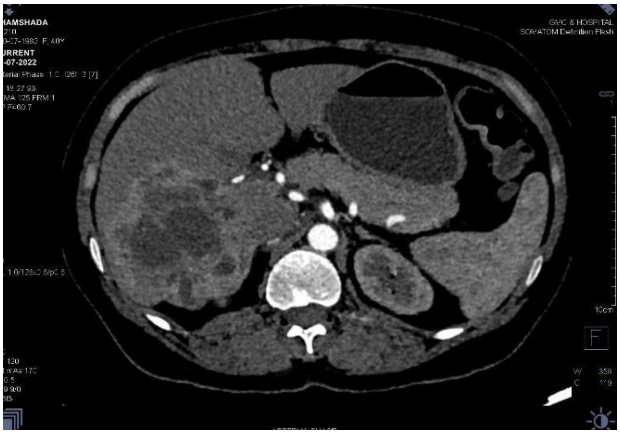
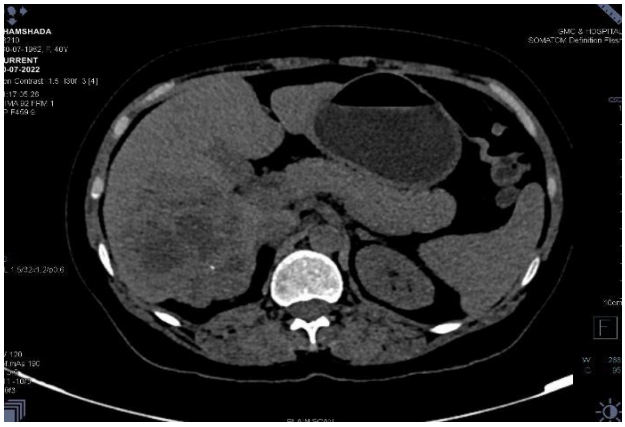
2. Alveolar Echinococcosis (AE) (Fig.5A,5B,5C)



(5A)



(5B)

(5C)

Axial Non-Contrast CT (Fig.5A) showing heterogeneously solid cystic lesion with infiltrative margins in segment VI and VII with foci of calcifications. Axial Post contrast Arterial Phase (Fig.5B) and Porto Venous Phase (Fig.5C) showing no post contrast enhancement.

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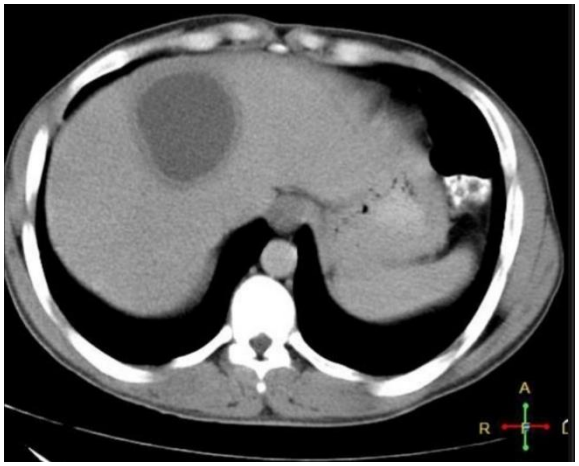
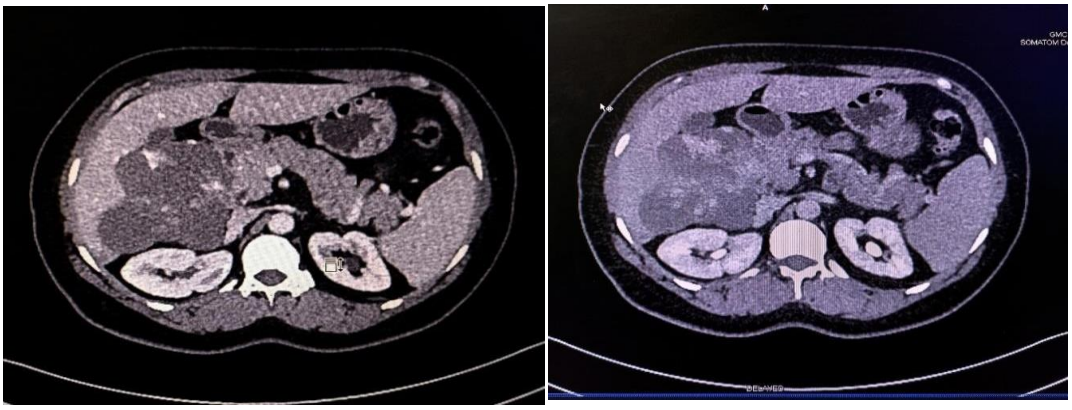
3. Liver Abscess(Fig.6)



(Fig.6)

Axial delayed phase (Fig.6)showing peripherally enhancing lesion in right lobe of liver in a female patient of 60 years.The lesion is showing double target sign.

4. Giant Hemangioma (Fig.7A,7B)



(7A) (7B)

Axial Arterial Phase (Fig 7A) depicting large lobulated exophytic lesion in right lobe of liver showing peripheral discontinuous enhancement.

On Axial Porto Venous Phase (Fig7B) the lesion shows progressive centripetal filling.

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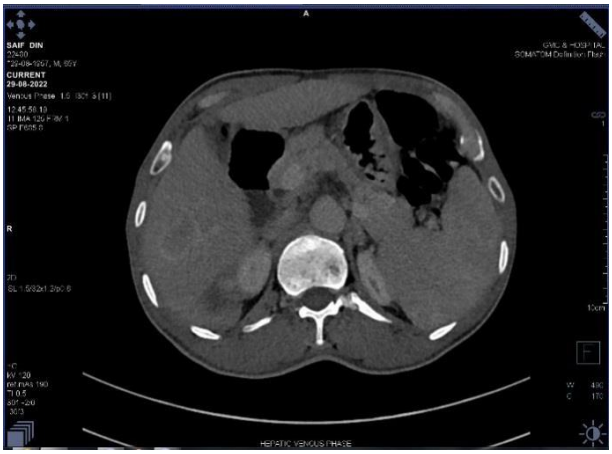
5. HepatocellularCarcinoma. (Fig8A,8B)

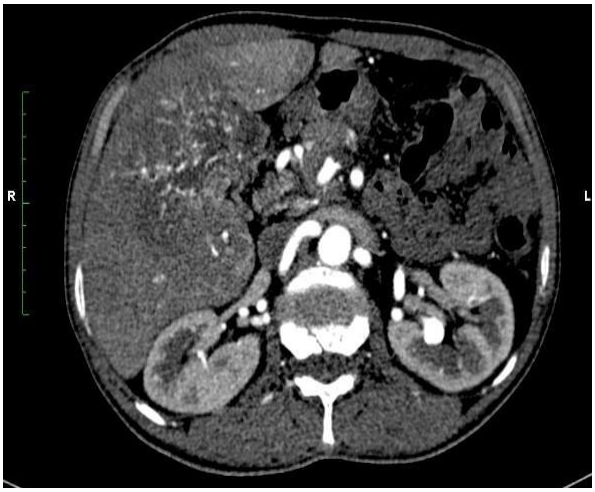
(8A)



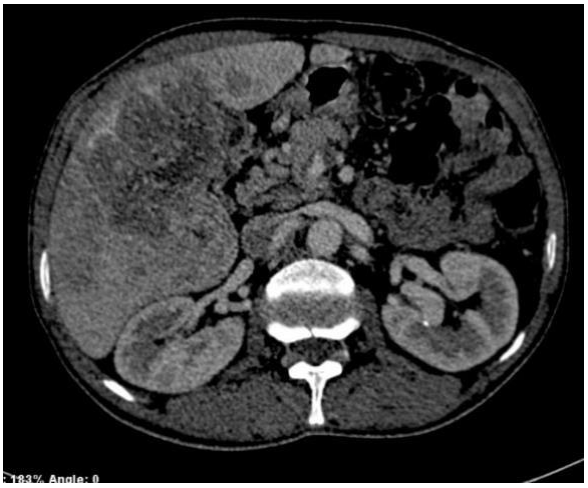
(8B)

Axial arterial phase (Fig 8A) showing hyper enhancing lesion in right lobe of liver with background CLD. Axial delayed phase (Fig 8B) showing non peripheral washout (capsular enhancement).

6. HepatocellularCarcinoma (Fig9A,9B)



(9A)



(9B)

Axial arterial phase (Fig 9A) showing hyper enhancing lesion in right lobe of liver.

On Axial delayed phase (Fig9B) the lesion is showing washout. There is associated portal vein thrombosis.

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7. Metastasis (Fig 10)

Fig 10

Axial post-contrast delayed phase (Fig.7) showing multiple peripherally enhancing lesions in both lobes of liver. Patient was known case of renal vein leiomyosarcoma.

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