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Original Research Paper

Radio-Diagnosis

A COMPARATIVE STUDY OF ULTRASOUND AND TRIPHASIC CT IN FOCAL LESIONS OF LIVER WITH HISTO-PATHOLOGICAL CORRELATION WITH REVIEW OF LITRATURE.

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ABSTRACT Space occupying liver lesions present with abdominal pain, palpable abdominal mass or distention. Liver lesions include benign and malignant neoplasm, inflammatory masses, cysts and metastatic lesions. Most common benign lesion of the liver includes hemangioma whereas most common malignant lesion includes metastases followed by hepatocellular carcinoma. Ultrasound is the initial imaging modality of choice to detect and characterize liver lesions. Triple phase CT is subsequently performed for further characterization, assessment of precise extent, and detection of associated metastatic disease in cases of malignant hepatic neoplasm. A tissue diagnosis is required further to confirm diagnosis and aid management. Identification of neoplastic lesions with great accuracy, sensitivity and specificity on scans itself may help avoid unnecessary tissue sampling. Significant association between lesions and their echo patterns on ultrasound and enhancement patterns on triple phase CT can lead us to confirmatory diagnosis. In this study specific imaging characteristics are described along with histopathological correlation.

KEYWORDS : hemangioma, hepatocellular carcinoma, triple phase CT.

INTRODUCTION

Liver masses are very common and most are benign. It is therefore important to avoid unnecessary interventions for benign lesions, while at the same time ensuring accurate diagnosis of hepatic malignancies. Many cancer patients, like the general population, have incidental benign liver lesions. In planning treatment for cancer patients, it is critical to avoid inappropriate treatment decisions based on misdiagnosis of a benign lesion as a metastasis or primary liver malignancy.

With the wide spread of cross-sectional imaging, rise of incidentally detected space occupying lesions of liver has been observed. Reliable detection and characterization is essential for optimal patient management. Accuracy of imaging in context of space occupying lesions liver is paramount to avoid unnecessary biopsies.

Ultrasound is an established screening modality for detection of space occupying lesions liver. Triphasic contrast CT abdomen is used for further evaluation of inflammation, congenital anomalies, benign or malignant tumors. Ultrasound and CT abdomen are more accurate and informative modality. These imaging modalities are also less time consuming and non-invasive compared to biopsy, therefore its use is a major advancement.

MATERIAL AND METHODS

The present study was carried out in department of Radiodiagnosis at F.H. MEDICAL COLLEGE, AGRA, UP, India. The study included 50 cases which got diagnosed for space occupying lesion of liver on ultrasound . **Ultrasound** was be done on GE VOLUSON S8 and GE LOGIQ S7 ultrasound machine. Curvilinear transducer [3-5 Mhz] & linear transducer [6-13 Mhz] were used. **Triple phase CT** were performed using TOSHIBA Alexion 16 slice CT medical system. After 6hr of Nil Per Oral , diluted 30% iodinated oral contrast 1 hour prior to scan was given. Routine scanogram of abdomen was taken with breath hold in supine position. Plain scan was acquired in 5 mm slice. Non-ionic iodinated IV contrast was administered using pressure injector .100ml of contrast of 300mg/ml concentration with 25-30ml of normal saline was injected at the rate of 4ml/sec. Sagittal and coronal reconstructions were done and scan was completely reviewed directly on display console.

Arterial phase delay	20-40sec
Portal phase delay	60-90sec
Equilibrium phase /delayed phase	2-5min.

USG guided FNAC/biopsy was done after taking aseptic precaution and anesthetizing locally with 2% xylocaine injection, under ultrasound guidance samples were collected using 22 gauge hypodermic needle with 10cc syringe for Superficial lesions and 20- 22 gauge spinal needle with 10cc syringe for deeper lesions. Sample were then smeared over 5 slides following immediate fixing them with 95% ethanol. Histo-pathological results were considered as gold standard to categorize liver lesion and was compared with results of USG and Triple phase CT.

RESULTS

In present study, 50 cases were investigated by USG, Triple phase CT and Histo-pathology.

Ultrasound of 50 cases were done based on echo pattern of lesions If the patient has multiple lesions of more than 1 type of echopattern then echopattern of each type of representative lesions were noted.

The frequency distribution of echopattern of sonography of patients are summarized in **Table 1** .Maximum number of lesions were hyperechoic (38%) or heterogenous with central hypoechoic areas (38%) and least were isoechoic with peripheral nodularity (8%). Out of 50 cases 16 were benign and 34 were malignant, given in **Table 2.** Most cases were metastasis (44%) and hemangioma in benign lesion (26%) as given in **Table 3.**

Table 1: Frequency Distribution USG Echopattern

USG echo pattern	Number of lesions	%
1. HyperechoicPattern	19	38
2. HypoechoicPattern	18	36
3. IsoechoicPattern	6	12
4.Heterogenousecopatternwithperipheralhypoechoichalo	16	32
5.Heterogenousecopatternwithcentralhypoechoic areas	19	38
6.Heterogenousecopatternwithechogenicborder/ posterioracousticenhancement	8	16
7. Cysticwithperipheralnodularity	4	08

Table 2 : Distribution Of Benign/Malignant Lesions On USG

Benign/Malignant	Number	Percentage
Benign	16	32.0
Malignant	34	68.0

Table 3 : Distribution Of USG Diagnosis In Patients:

Benign/malignant findings of USG	(n=50)	%
Inconclusive	2	4.0
FNH	4	8.0
HCC	7	14.0
Hemangioma	13	26.0
Hepatoblastoma	1	2.0
Intrahepatic cholangiocarcinoma	1	2.0
Mets	22	44.0

Triple phase CT findings

The enhancement pattern of lesions in all the patients was recorded. Patients with multiple lesions, the enhancement pattern of representative lesion was considered for statistical analysis. If the patient has multiple lesions of more than 1 type of enhancement pattern then enhancement pattern of each type of representative lesions was noted.

3 phases on CT examination each showed different enhancement pattern as described in **Table 4**. In this study most of lesions demonstrated hypo/hypo/hypo pattern (40%) and pattern seen least was hyper/hypo/hypo with cleft. Among the cases 29 (58%) demonstrated hyper vascular lesion and 21 (42%) cases showed hypovasclar lesions as given in **Table 5.** Out of total 50 patients triple phase CT identified 38 (76%) cases as malignant and 12 (24%) as benign given in **Table 6.** Pathological diagnosis of triple phase CT were 26/50 cases (52%) metastasis where as hepatoblastoma and Intrahepatic cholangiocarcinoma were least (2%) as summarized in **Table 7.**

Table 4: Frequency Distribution Of Enhancement Pattern On Triple Phase CT.

Triple phase CT enhancement pattern	Number of Lesions	(%)
Hypo/Hypo/Hypo	20	40
Hyper(RIM)/Hypo/Hypo	19	38
Hypo/Hypo(Peripheral nodularity)/Hypo	2	04
Hyper(Variegated)/Hypo/Hypo(±capsule)	11	22
Hyper/Hypo/Hypo	15	30
Mixed/Mixed/Mixed	7	14
Hyper(Irregular)/hypo/Hypo(±capsule)	2	04
Hyper(puddle)/hyper(progressive fill in)/ hyper	8	16
Hyper/Hypo/Hypo(cleft)	1	02

Table 5 : Distribution Of Hypo/hyper Vascular Lesions

Vascularity	Number of Patients (n=50)(%)
Hypo	21 (42.0)
Hyper	29 (58.0)

Table 6 : Distribution Of Benign/malignant Findings Of Triple Phase CT.

Benign/malignant findings of triple phase CT	(n=50)(%)
Benign	12(24.0)
Malignant	38(76.0)

Table 7 : Distribution Of Diagnosis On Triple Phase CT

Benign/malignant	(n=50)	%
FNH	2	4.0
HCC	10	20.0
Hemangioma	10	20.0
Hepatoblastoma	1	2.0
Intrahepatic cholangiocarcinoma	1	2.0
Mets	26	52.0

HPE Examination

Given in **Table 8** on HPE , 38 (78%) were malignant and 12 (22%) were benign . Distribution of cases by HPE showed 26/50 cases (52%) metastasis where as hepatoblastoma and Intrahepatic cholangiocarcinoma were least (2%) as shown in **Table 9.**

Table 8 : Distribution Of Benign/malignant Cases By HPE

Benign/malignant	(n=50) (%)
Benign	12(24.0)
Malignant	38(76.0)

Table 9 : Distribution On HPE:

Benign/ malignant	(n=50)	%
FNH	2	4.0
HCC	9	18.0
HEMANGIOMA	10	20.0
HPATOBLASTOMA	1	2.0
INTRAHEPATICCHOLNGIO	2	4.0
METS	26	52.0

The correlation between USG echo pattern and HPE diagnosis are as shown below in **Table 10.**

The X^2 test revealed significant association between USG echo pattern and HPE diagnosis. Hypoechoic pattern was found significantly associated with metastasis ($\chi 2 = 7.03$, $p=0.022$) where as heterogeneous echo pattern with central Hypoechoic areas has been found associated significantly with HCC ($\chi 2 = 25$, $p<0.001$) and Heterogeneous echo pattern with echogenic border/posterior acoustic enhancement was found to be significantly associated with hemangioma ($\chi 2 = 13.94$, $p=0.016$).

The correlation between CT enhancement pattern and HPE diagnosis are as shown in **Table 11** below. The X^2 test revealed significant association between triple phase CT and HPE diagnosis Hypo/Hypo/Hypo enhancement pattern was found significantly associated with metastasis. Hyper (Variegated)/ Hypo/ Hypo (±capsule) enhancement pattern was found significantly associated with HCC. Hyper (puddle)/ hyper (progressive fill in)/ hyper or iso enhancement pattern was found significantly associated with hemangioma.

Diagnostic accuracy of USG for findings of benign/malignant in comparison to gold standard HPE is 72% with a sensitivity of 76.32% , specificity of 58.33%, PPV of 85.29% and NPV of 43.75% as given in **Table 12.** Diagnostic accuracy of Triple phase CT for findings of benign/malignant in comparison to gold standard HPE is 92% with a sensitivity of 94.74% , specificity of 83.33%, PPV of 94.74% and NPV of 83.33% as given in **Table 13**

Table 10: Correlation Between USG Echo Pattern And HPE Diagnosis

USG echo pattern	Number	HPE Diagnosis						χ2	P Value
		FNH	HCC	Hemangioma	Hepatoblastoma	Intrahepatic Cholangiocarcinoma	Metastasis		
Hyper echoic Pattern	19	1(5.3)	3(15.8)	4(21.1)	0(0.0)	0(0.0)	11(57.9)	2.27	0.90
Hypoechoic Pattern	18	0(0.0)	3(16.7)	1(5.6)	0(0.0)	1(5.6)	13(72.2)	7.03	0.022
Isoechoic Pattern	6	0(0.0)	0(0.0)	1(16.7)	0(0.0)	2(33.3)	3(50.0)	16.35	0.006
heterogeneous pattern with peripheral Hypoechoic halo	16	0(0.0)	2(12.5)	1(6.2)	0(0.0)	2(12.5)	11(68.8)	9.55	0.089

Heterogeneous pattern with central Hypoechoic Areas	19	2(10.5)	8(42.1)	2(10.5)	1(5.3)	2(10.5)	4(21.1)	25.07	<0.001
Heterogeneous pattern with echogenic border/posterior acoustic Enhancement	8	0(0.0)	0(0.0)	5(62.5)	0(0.0)	1(12.5)	2(25.0)	13.94	0.016
Cystic with peripheral Nodularity	4	0(0.0)	0(0.0)	0(0.0)	1(25.0)	0(0.0)	3(75.0)	13.94	0.016

Table 11 : Correlation Between Triple Phase CT Enhancement Pattern And HPE Diagnosis

CT enhancement pattern	Number	HPE Final Diagnosis						$\chi 2$	P value
		FNH	HCC	Hemangioma	Hepatoblastoma	Intrahepatic cholangiocarcinoma	Metastasis		
Hypo/Hypo/Hypo	20	0(0.0)	1(5.0)	1(5.0)	0(0.0)	1(5.0)	17(85.0)	15.944	0.007
Hyper(RIM)/Hypo/Hypo	19	1(5.3)	2(10.5)	1(5.3)	0(0.0)	0(0.0)	15(78.9)	10.519	0.062
Hypo/Hypo(Peripheral nodule)/Hypo	2	0(0.0)	0(0.0)	0(0.0)	0(0.0)	0(0.0)	2(100.0)	1.923	0.860
Hyper(Variegated)/Hypo/Hypo (±capsule)	11	1(9.1)	5(45.5)	0(0.0)	1(9.1)	0(0.0)	4(36.4)	14.412	0.013
Hyper/Hypo/ Hypo	15	1(6.7)	7(46.7)	3(20.0)	0(0.0)	0(0.0)	4(26.7)	14.094	0.015
Mixed/Mixed/ Mixed	7	0(0.0)	1(14.3)	0(0.0)	0(0.0)	2(28.6)	4(57.1)	14.506	0.013
Hyper(Irregular)/hypo/Hypo(±capsule)	2	0(0.0)	1(50.0)	0(0.0)	0(0.0)	1(50.0)	0(0.0)	13.831	0.017
Hyper(puddle) hyper(progressive fill in)/hyper or Iso	8	0(0.0)	0(0.0)	7(87.5)	0(0.0)	1(12.5)	0(0.0)	30.655	<0.01
Hyper/Hypo/ Hypo(cleft)	1	1(100)	0(0.0)	0(0.0)	0(0.0)	0(0.0)	0(0.0)	24.490	<0.01

Table 12 : Diagnostic Accuracy Of USG

USG	HPE Diagnosis		
		Malignant	Benign
	Malignant	29	5
	Benign	9	7
Sensitivity (95%CI):	76.32 %(59.76%-88.56%)		
Specificity (95%CI):	58.33 %(27.67%-84.83%)		
PPV (95%CI):	85.29 %(74.37%-92.06%)		
NPV (95%CI):	43.75 %(26.97%-62.09%)		
Accuracy (95%CI):	72.00% (57.51%-83.77%)		

Table 13 : Diagnostic Accuracy Of Triple Phase CT

Triple phase CT	HPE Diagnosis		
		Malignant	Benign
	Malignant	36	2
	Benign	02	10
Sensitivity (95%CI): 94.74 %(82.25%-99.36%)			
Specificity (95%CI): 83.33 %(51.59%-97.91%)			
PPV (95%CI): 94.74 %(83.52%-98.46%)			
NPV (95%CI): 83.33 %(55.90%-95.18%)			
Accuracy (95%CI): 92.00 %(80.77%-97.78%)			

ULTRASOUND ECHOPATTERNS

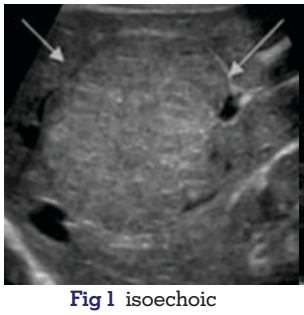

Fig 1 isoechoic

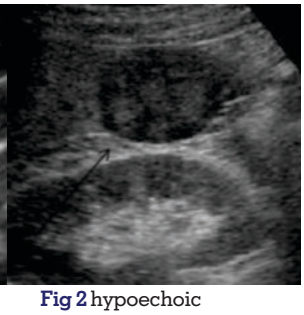

Fig 2 hypoechoic

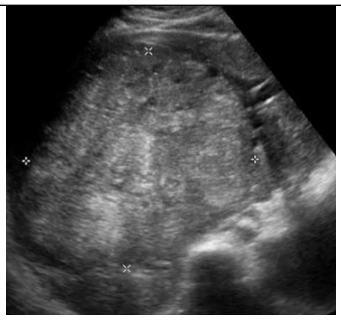

Fig 4 heterogeneous

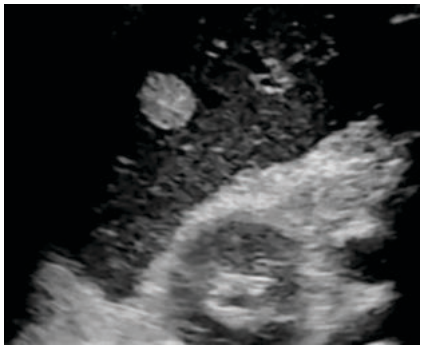

Fig 3 hyperechoic

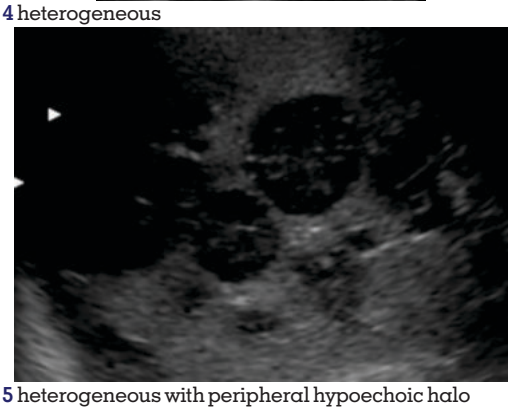

Fig 5 heterogeneous with peripheral hypoechoic halo

TRIPLE PHASE CT

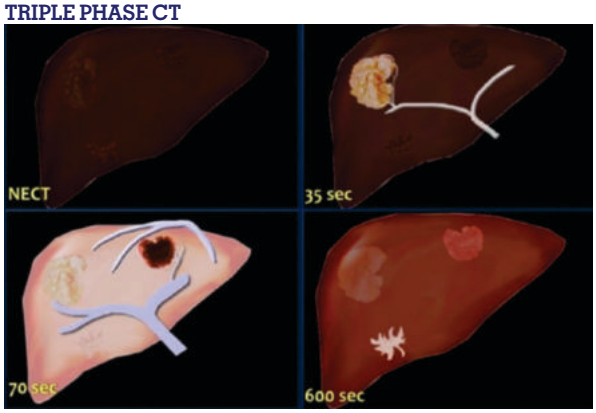

Fig 6 Schematic diagram showing enhancement patterns of lesions in different phases depending on their source of feeding vessels and tissue components .

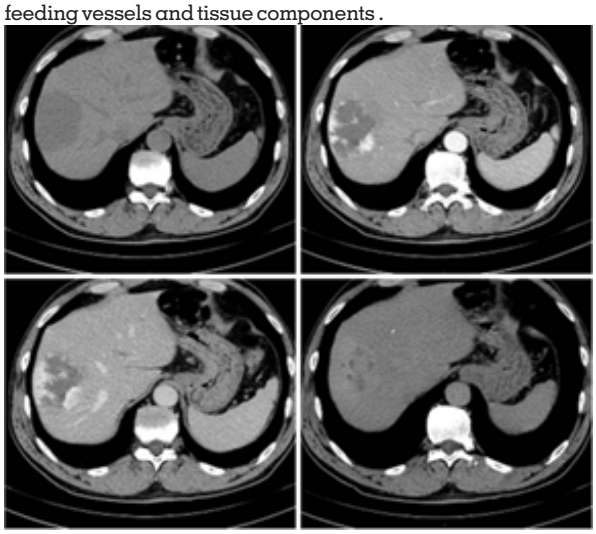

Fig 7 Triple phase ct showing well defined hypoattnuating right hepatic sol in plain scan with peripheral nodular enhancement in arterial phase with progressive fill in in subsequent phases consistent with hemangioma

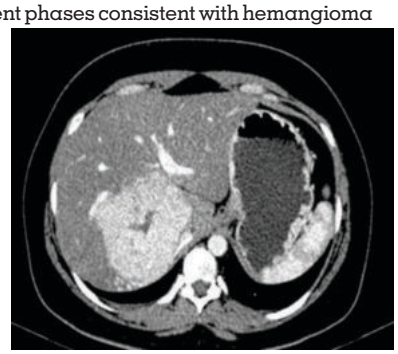

Fig 8 Large right hepatic sol with avid contrast enhancement in arterial phase and low attnuating central scar which show enhancement in portal phase and delayed phase due to hold up of contrast by fibrous scar tissue.

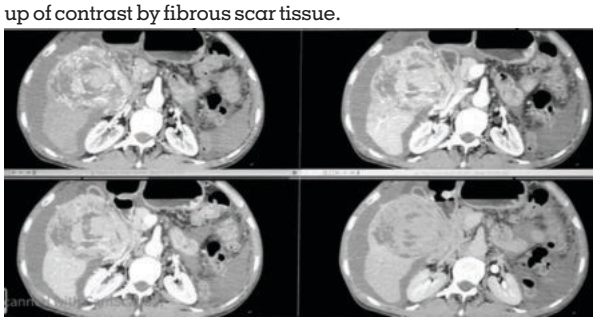

Fig 9 Large right hpatic sol showing heterogenous arterial enhancement with venous washout .there is prsence of enhancing capsule consistent with hcc in background cirrhosis.

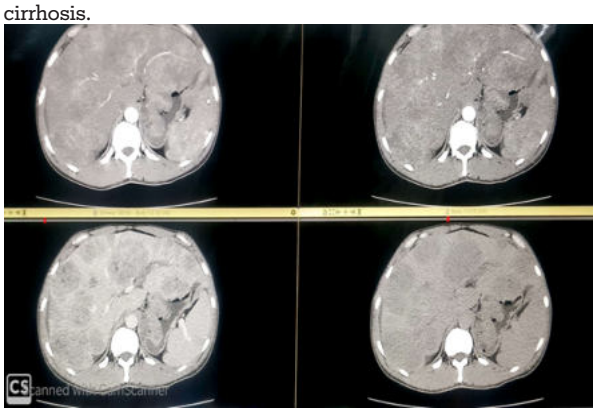

Fig 10 Multiple variabl sized sol involving both lobes of liver.

These are hyoattenuating on plane scan with nonenhancement on arterial phase appearing hypoattenuating in portal venous phase enhancing rest of liver parenchyma.these features favore hypovascular metastases.

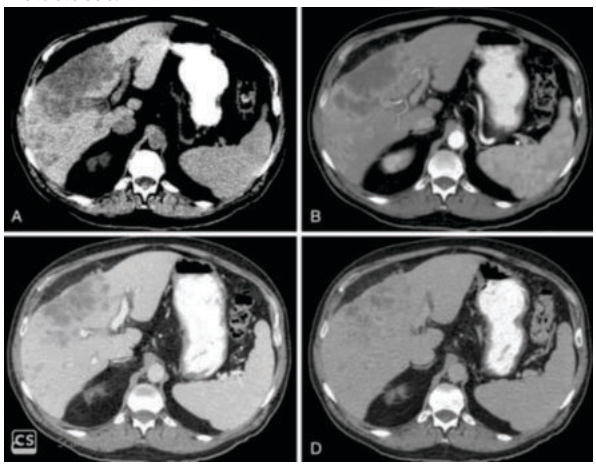

Fig 11 A hypoattenuating hepatic sol of sagment iv showing mild peripheral arterial phase enhancement with increased enhancement in portal phases and complete enhancement in delayed phase senwith capsular retraction keeping with intrahepatic chaolangiocarcinoma.

DISCUSSION

Ultrasound:

In present study, **hyperechoic pattern** was noted in 19 lesions. Out of which, 4 (21.1%) were hemangioma, 3 (15.8%) were HCC, 11 (57.9%) were metastasis and 1 (5.3%) of FNH were seen. The hyperechoic pattern was statistically insignificant (p=0.90) in characterizing the lesion. **Itai et al (1983)**[6] reported that 66% of hemangioma are hyperechoic with the rest being Hypoechoic (28%) and mixed echoic (6%). **Hashemi et al (2008)**[7] reported that 87.8% of hemangioma and 66.7% of HCCs were hyperechoic while 54.1% of metastases were Hypoechoic. **Fukuda et al (1992)**[4] described US pattern of HCC according to the size with lesions > 3cm appearing as hyperechoic heterogeneous and lesions <3 cm appearing as Hypoechoic with peripheral halo and posterior acoustic enhancement. **Riccardo et al**[11] reported that hyperechoic metastasis was seen in carcinoids, Kaposi sarcoma, islet cell tumor. Since hyperechoic pattern is seen in multiple conditions including benign and malignant lesions, hyperechoic pattern could not be correlated for a specific liver pathology.

In present study, **Hypoechoic pattern** were seen in 18 lesions.

Among them, 3 (16.7%) cases were HCC, 13 (72.2%) cases were having metastasis and 1 (5.6%) case of Intrahepatic cholangiocarcinoma and hemangioma. The enhancement pattern was statistically significant (p=0.022) in characterizing metastasis.

Itai et al (1983)[6] reported that 28% of the patients with hemangioma are Hypoechoic**. Fukuda et al (1992)**[4] described the US pattern of HCC according to the size, with lesions > 3cm appearing as hyperechoic, heterogeneous and lesions <3 cm appearing as Hypoechoic with peripheral halo and posterior acoustic enhancement. **Werenecke et al(1992)**[14] reported that most of the metastasis are hypoechoic or with peripheral halo. **Bussane et al**[1] reported that Intrahepatic cholangiocarcinoma appear hyperechoic, Hypoechoic, Isoechoic or heterogeneous. Since, Hypoechoic pattern is seen in multiple conditions including benign and malignant lesions, Hypoechoic pattern could not be correlated for a specific liver pathology.

In present study **Isoechoic pattern** was seen in 6 lesions. It was seen in 3 (50.0%) cases of metastasis and 2 (33.3%) of Intrahepatic cholangiocarcinoma and 1 (16.7%) case was of hemangioma. The association of metastasis with Isoechoic lesions was statistically significant in the study (p=0.006) .

In present study **Heterogeneous echopattern with peripheral hypoechoic halo** was seen in 16 lesions. Individually, it was seen in 2 (12.5%) cases of HCC, 11 (68.8%) cases of metastasis and 2 (12.5%) cases of intrahepatic cholangiocarcinoma and 1 (6.2%) case of hemangioma. Association of heterogeneous echopattern with peripheral hypoechoic halo with metastasis was statistically insignificant (p=0.089) in present study. **Werenecke et al(1992)**[14] described that a metastasis washalo could be detected in 88% of malignant lesions and in 14 of benign lesions. The sonographic halo sign was particularly helpful in distinguishing hemangiomas (n = 29) from metastases (n = 43).**Choi et al (1989)**[2] described other sonographic characteristics of hepatocellular carcinoma were peripheral hypoechoic halo (52%), lateral shadow (26%), posterior acoustic enhancement (44%) and mosaic pattern (24%) of the mass. Hence, lesions with heterogeneous echopattern with peripheral hypoechoic halo could be correlated with malignant lesions particularly for metastatic lesions.

In present study, **Heterogenous echopattern with central hypoechoic foci** were seen in 19 lesions, out of them 2 (10.5%) cases were hemangioma, 2 (10.5%) case was FNH, 8 (42.1%) cases belonged to HCC, 4 (21.1%) cases were metastasis, 2 (10.5%) cases were intrahepatic cholangiocarcinoma and 1 (5.3%) case of hepatoblastoma. In present study, heterogeneous lesion with hypoechoic areas were significantly associated with HCC (p<0.001) . **Tanaka et al (1983)**[12] reported that US appearance of hepatocellular carcinoma is variable. Hypoechoic tumpresent corresponds to a solid tumpresent without evidence of tumpresent necrosis. Hyperechoic lesions were caused by fatty metamorphosis within the tumpresent.

In present study, **heterogeneous echopattern with echogenic borders or posterior acoustic enhancement** was seen in 8 lesions. Out of them 5 (62.5%) were haemangioma, 2 (25.0%) were metastasis and 1 (12.5%) was intrahepatic cholangiocarcinoma. Heterogeneous echopattern with echogenic borders or post acoustic enhancement (p=0.016) pattern was found to have statistically significant association with hemangioma. In support of findings **Hashemi et al (2008)**[7] had distinguished cavernous hemangioma from malignant neoplasms using US and color doppler appearances. They reported that posterior acoustic enhancement was seen in 78% of hemangiomas, as compared to 24.4%in metastases and 13.3% in HCCs.

In present study, **cystic echopattern with peripheral nodularity** was seen in 4 lesions. Out of which 3 cases (75%) were of metastasis. Significant statistical association was found with this echopattern and metastasis (p=0.016) **Fedrele et al (1981)**[3] observed that in cystic metastasis, increased wall thickness, mural nodules, septations and fluid filled levels were seen which excludes simple cyst. They observed that USG demonstrate cystic lesions more clearly than CT scan.

Triple Phase CT:

In present study, **hypo/hypo/hypo** enhancement pattern was seen in 20 lesions in which 1(5%) case was HCC, 17 (85.0%) cases were metastasis , 1(5%) case was Intrahepatic Cholangiocarcinoma and 1 (5%) case was hemangioma. Significant association was found between hypo/hypo/hypo enhancement pattern and metastasis (p=0.007). Same observation was also made in the study by **Van heeuwan et al (1996)**[13] and **Gualdi GF(1998)**[5] in which they found that hypo/hypo/hypo pattern was significantly associated with malignant lesions, however few benign conditions like partially fibrosed hemangioma may also show this type of pattern. Present findings are consistent with the observation made by **Van Van heeuwan et al (1996)**[13] and **Gualdi GF(1998)**[5]

In present study, **hyper (rim)/hypo/hypo** enhancement pattern was seen in 19 lesions in which 2 (10.5%) cases were HCC and 15 (78.9%) cases were metastasis, 1 (5.3%) case was FNH and 1 (5.3 %) case was hemgioma. Hyper (rim)/hypo/hypo enhancement pattern was found to be insignificantly associated to metastasis (p=0.062). **Van Heeuwan et al (1996)**[13] in their study found that this enhancement pattern was found only in metastasis cases and not in other malignant or benign lesions.

In present study, **hypo/ hypo (peripheral nodule)/hypo** enhancement pattern was seen in 2 lesions both were metastasis in the liver with primary elsewhere. However, association of this type enhancement pattern with metastasis had no statistical significance as seen (p=0.86).

In present study, **hyper (variegated)/hypo/hypo (+/- capsule) enhancement pattern** was seen in 11 lesions in which 5/11 (45.4%) were HCC, 4/11 (36.4%) cases were metastasis and 1(9.1%) each of FNH and hepatoblastoma. Presence or absence of capsular enhancement was also considered in this pattern. The association of this enhancement pattern with HCC was statistically significant (p=0.013) and correlated with the findings of **Matildie Nino-Murcia et al(1995)**[9], where they observed the variegated enhancement patterns in the arterial phase were associated with HCC with a PPV of 90% and specificity of 98%. The abnormal variegated appearance wasdue to abnormal internal vessels.

In present study, **hyper/hypo/hypo** enhancement pattern were seen in 15 lesionsin which 3 (20.0%) cases were hemangioma, 7 (46.7%) cases were HCC patients, 4 (26.7%) cases were metastasis, 1 case (6.7%) was FNH. The enhancement pattern was statistically significant (p=0.015) and associated with HCC. The same observation was also seen in study done by **Van leeuwen et al (1996)**[13] in which they found that all hepatocellular carcinoma patients and 44 % cases of metastasis showed this enhancement pattern. However, variegated pattern of flow in HCC was not considered in this study. In present study, variegated pattern of flow was also considered which is actually a type of hyper/hypo/hypo pattern. Hence, the observation of this study very well correlated with the study of **Van leeuwen et al**[13]**.**

In present study, **mixed/mixed/mixed enhancement pattern was seen in 7 lesions.** Among which 1 (14.3%) had HCC, 4 (57.1%) cases had metastasis and 2 (28.6%) cases had Intrahepatic Cholangiocarcinoma. The enhancement pattern

was significantly associated with metastasis (p=0.013). **Van leeuwan et al (1996)**[13] observed that this enhancement pattern was seen only in metastasis as also seen in present study.

In present study, **hyper (irregular)/hypo/hypo (+/- capsule) enhancement pattern** was seen in 2 lesions in which 1(50.0 %) was intrahepatic cholangiocarcinoma and 1(50.0%) was HCC. It was not associated with any benign lesions. Capsular retraction and late capsular enhancement was also associated with intrahepatic cholangiocarcinoma. Hence presence of this enhancement pattern is significantly associated with intrahepatic cholangiocarcinoma (p=0.013). **Yong Eun Chung et al (2009)**[15] observed that the classical imaging finding in mass forming type of cholangiocarcinoma was homogeneous attenuation, irregular peripheral enhancement with gradual centripetal enhancement, capsular retraction, the presence of satellite nodules and vascular encasement without theformation of a grossly visible tumor thrombus.

In present study, **hyper (puddle)/hyper (progressive fill in)/hyper or iso pattern** was seen in 8 lesions in which 1 was of intrahepatic chaolangiocarcinoma and rest of 7 lesions were hemangioma. Hence presence of this enhancement pattern is significantly associated with Hemangioma (p<0.001). Van **leeuwan et al (1996)** and **Yun et al(1999)** also observed that peripheral nodular high attenuation in arterial and portal venous phases of Triphasic CT is the most useful contrast enhancement pattern in making a correct diagnosis of hemangioma. Present study also correlated with observation made by **Van leeuwan et al**[13]

In present study, 1 case with FNH (100%) showed hyper/hypo/hypo (cleft) type of enhancement pattern. The association of hyper/hypo/hypo (cleft) pattern was statistically significant (p<0.001). Same pattern was not seen in any of the benign or malignant lesions. **Van leeuwan et al(1996)**[13] in a prospective study observed this pattern in all cases of FNH.

CONCLUSION

Diagnostic accuracy of USG for findings of benign/malignant in comparison to gold standard HPE is 72% with a sensitivity of 76.32% , specificity of 58.33%, PPV of 85.29% and NPV of 43.75%.

Diagnostic accuracy of Triple phase CT for findings of benign/malignant in comparison to gold standard HPE is 92% with a sensitivity of 94.74% , specificity of 83.33%, PPV of 94.74% and NPV of 83.33%

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