ORIGINAL RESEARCH PAPER

Radiodiagnosis

DIAGNOSTIC EFFICACY OF ULTRASOUND AND TRIPLE PHASE CT IN EVALUATION OF FOCAL LIVER LESIONS

KEY WORDS: Liver, TPCT, USG, Focal Liver Lesions

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ABSTRACT

It is important to apply a systematic approach in the diagnosis and management of focal liver lesions which is possible thorough clinical history and physical examination, relevant laboratory and radiological investigations, and histopathology.[1,2] Although, histopathology is the gold standard in making the final diagnosis yet it is not always feasible being invasive[3]. Over the past few years dynamic CT and USG has become the main diagnostic modality for diagnosis of focal liver lesions[4]. As both of these techniques vary in terms of sensitivity, specificity and accuracy which affects the diagnosis, staging and treatment planning[5-7]. The current study aims to study various imaging pattern of focal liver lesions and correlate between ultrasonographic and Triple phase CT findings in arriving at a specific diagnosis before surgery or biopsy.

INTRODUCTION

Ultrasonography (USG) is commonly used real time scan with many advantages which can be easily be maneuvered providing easy visualization of vascular landmarks. With its doppler and color flow capabilities, ultrasound imaging will remain an important modality for hepatic imaging, especially in the evaluation of portal vein patency and hepatic artery thrombosis. Multi-detector helical acquisition triple phase computed tomography (TPCT) systems allow complete data acquisition of the upper abdomen in 5–10 s and a choice of section thickness post acquisition[8]. Unenhanced imaging is valuable for assessing diffuse hepatic changes, like fat infiltration and iron deposition, and focal changes, like calcification and hemorrhage[9]. Contrast-enhanced imaging following IV administration of water-soluble contrast medium is widely used for the detection and characterization of focal lesions[10]. The normal liver parenchyma is homogeneous with attenuation values of 54–60 HU.[11] Detection of hepatic abnormalities by CT is dependent on differentiating normal from pathological altered hepatic tissue. Generally, a difference of at least 10HU between the abnormal and normal regions of the liver must be present for accurate detection of liver lesions.[12]

A combination of both techniques when judiciously used can answer many clinical questions rather than a conclusive diagnosis with a single technique. The present study aims at evaluating the correlation between TPCT and USG findings in diagnosis of various focal liver lesions.

MATERIALS AND METHODS

A prospective study with 110 nonconsecutive patients was conducted between January 2018 to December 2019 at Jayarogya hospital GR Medical college Gwalior. Patients with clinically suspected focal liver disease (positive symptoms / altered LFT) , with previous imaging studies depicting hepatic lesions or normal patients with abnormal hepatic imaging were included , while those with renal failure (raised serum creatinine), history of allergic reactions to contrast media, pregnant and claustrophobic individuals were excluded from the study. Oral and written consent was taken, complete evaluation was done with clinical history and examination, laboratory data, Ultrasonographic evaluation and color doppler findings, Triple phase CT findings, Histopathology and Follow up. Histopathology findings were considered as the gold standard for arriving at final diagnosis.

Ultrasonography of liver imaging was obtained with ALOKA PRO A6 USG machine using convex 3-5 MHz and linear 7-12 MHz array transducer. Triple-phase helical CT images of the liver were obtained with on 128 Slice CT Siemens Somatom-AS. Once unenhanced helical CT had been performed through the entire abdomen, 80-100 mL of contrast Iohexol was injected intravenously with 18- gauge cannula at a rate of 5mL/sec with an automated pressure injector. For the arterial phase, the delay between the start of contrast material administration and helical scanning was 15-20 seconds. For the portal phase, the delay between the start of contrast material administration and helical scanning was 35-40 seconds. For the delayed phase, the delay between the start of contrast material administration and helical scanning was 70-80 seconds.

The Statistical software SAS 9.2, SPSS 15.0, Stata 10.1, MedCalc 9.0.1 were used for the analysis of the data and Microsoft word and Excel have been used to generate graphs, tables etc[13]. Diagnostic statistics viz. Sensitivity, Specificity, PPV, NPV , Accuracy and Cohen kappa were computed to find the correlation of US diagnosis Vs CT diagnosis.[14] Significance level for the tests was determined at 95% Confidence interval.

RESULTS

Out of 110 patients, 65 males and 45 females with age ranging from 2 months to 75 years were present. The spectrum of study included Liver metastasis, Hepatocellular Carcinoma, Liver Abscess, Hydatid Cyst, Hepatic Hemangioma, Hepatoblastoma, Intrahepatic Cholangiocarcinoma, Hepatic Adenoma and Focal Nodular Hyperplasia *(Figure 1)* .The final diagnosis was based on clinical history, examination, investigation, laboratory data, USG, TPCT finding *(Figure 2.)* , histopathology ,post-operative finding and follow up.

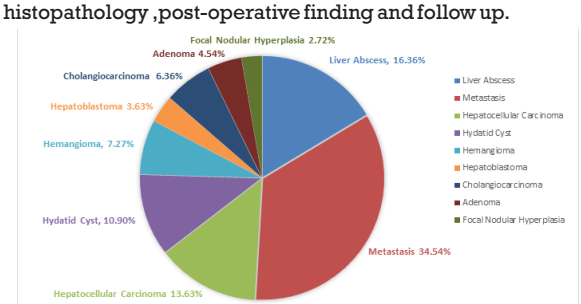

Figure 1. Distribution percentage of patients with final diagnosis among 110 patients

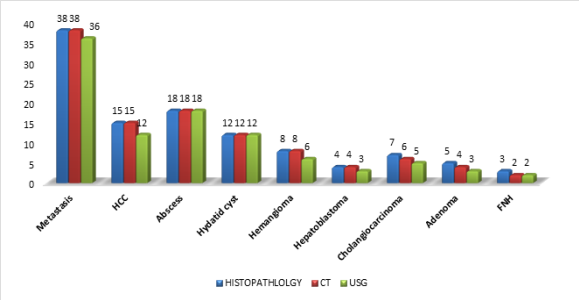

Figure 2. Diagnosis with USG and CT against Final Diagnosis (Histopathology).

Table 1. Diagnostic value of USG for focal hepatic lesions

	Sensitivity	Specificity	PPV	NPV	Accuracy	P value	Prevalence	kappa
Metastasis	78.95	100.00	100.00	90.00	90.91	<0.01	34.55	0.83
HCC	71.43	98.95	92.31	96.91	91.82	<0.01	13.64	0.77
Abscess	100	94.57	78.26	100.00	95.45	<0.01	16.36	0.85
Hydatid cyst	100.00	98.97	92.31	100.00	99.08	<0.01	11	0.91
Hemangioma	75.00	98.06	75.00	98.06	96.40	<0.01	7.21	0.73
Hepatoblastoma	75.00	98.96	75.00	98.96	98.00	<.0.01	4.00	0.74
Adenoma	60.00	90.03	75.00	100.00	95.00	<0.01	4.55	0.65
Cholangiocarcinoma	71.43	97.2	97.89	97.89	96.00	<0.01	7.00	0.82
FNH	66.67	100.00	99.07	100.00	99.09	<0.01	3.00	0.80

Table 2. Diagnostic value of TPCT for focal hepatic lesions

	Sensitivity	Specificity	PPV	NPV	Accuracy	P value	Prevalence	kappa
Metastasis	100.00	100.00	100.00	100.00	100.00	<0.01	34.55	1.00
HCC	100.00	97.89	98.18	93.33	98.18	<0.01	13.64	0.90
Abscess	100.00	97.83	90.00	100.00	98.18	<0.01	16.36	0.94
Hydatid cyst	85.71	100.00	100.00	97.96	98.18	<0.01	12.73	0.91
Hemangioma	100.00	99.02	88.89	100.00	99.09	<0.01	7.27	0.94
Hepatoblastoma	100.00	99.09	66.67	100.00	99.09	<0.01	1.82	0.88
Adenoma	80.00	99.00	100.00	99.06	99.09	<0.01	4.91	0.88
Cholangiocarcinoma	87.50	99.00	100.00	99.06	99.09	<0.01	6.36	0.92
FNH	66.67	100.00	99.07	100.00	99.09	<0.01	3.00	0.80

Table 3- Overall diagnostic value of TPCT and USG

Statistical measures	USG	CT
Sensitivity	77.61	91.09
Specificity	97.41	99.16
Accuracy	95.86	98.89
Kappa value	0.78	0.90
Positive predictive value	87.45	96.33
Negative predictive value	96.86	99.01

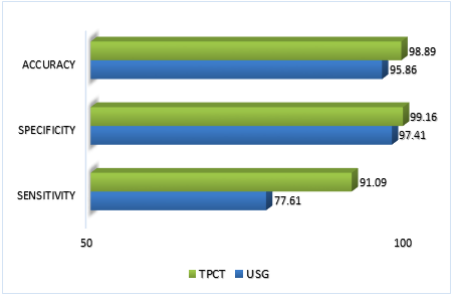

Figure 3. Overall sensitivity, specificity and accuracy of USG and TPCT for diagnosing hepatic lesions

As seen with USG out of all the lesions 48.4% were multiple , 51.6% were single, 33.3% were hypoechoic ,66.6 % were heterogenous and 9 % showed calcification. In TPCT, 56.36 were single , 43.63 were multiple , 71 % were enhancing, 36 % with no enhancement , 12 % showed calcifications.

DISCUSSION

In a study conducted by *Minami et al*[15], the liver is the organ second most commonly affected by metastatic disease. In present study 38 lesion of metastasis were detected on TPCT (accuracy 100% and kappa 1). 36 lesions showed enhancement of wall. 30 lesions were found to be hypodense, while 6 was found to be hyperdense and showed heterogenous enhancement. 36 lesions presented as mixed echo pattern on USG (accuracy 92.73% and kappa 0.83).Target appearance was seen in 18 lesions. USG incorrectly diagnosed 2 metastatic lesions as primary hepatic mass which were diagnosed to be metastasis from pancreatic cancer and thyroid cancer.

Out of 15 cases of HCC, 12 cases were correctly diagnosed on USG. 4 cases were hypoechoic, 8 heterogenous and 10 had hypoechoic capsule. 3 cases with necrotic core were misdiagnosed as abscess. A total of 15 cases were diagnosed by TPCT . All lesions showed early enhancement in arterial phase with rapid washout in portovenous phase. 10 lesions had capsular enhancement in delayed phase, similar findings were described by Lee et al ,2004.[16] 9 cases had portal vein thrombosis. *Saini et al* has described that the tumor thrombus is another one of the characteristic features of HCC. Thus it was found that triple phase imaging with arterial, portovenous and delayed phases was advantageous in the evaluation of HCC with accuracy 98.18 % and kappa value of 0.95.

All 18 cases of hepatic abscess were correctly diagnosed on USG out of which 8 cases appeared to be hypoechoic, in 5 cases heterogenous and in 5 cases internal septations were seen. On TPCT all the 18 lesions appeared to be hypodense and on contrast administration wall enhancement was seen with central nonenhancing core of the abscess in all the phases.

Out of 12 cases of Hydatid cyst, 8 showed internal laminated membranes and septations. USG was superior to TPCT in demonstrating detached membranes and hydatid sand. TPCT demonstrated calcifications in 6 lesion. USG detected calcifications in 4 lesions. CT was superior in demonstrating the calcification. In the studies by *El-Tahir et al*[17], CT was superior in demonstrating calcification.

All 12 cases were diagnosed on CT and USG to be hydatid cyst showing significant correlation between both modalities .

8 cases of hemangioma were diagnosed, with 1 case being of giant hemangioma *(Figure 3)*. The lesions on USG varied from mixed to solid appearance with hyperechoic pattern and shapes varied from irregular to round. On non-contrast CT the lesions were hypodense in attenuation with irregular to smooth wall appearance. Lesions showed peripheral puddling in arterial phase and gradually progressive centripetal enhancement in delayed phase. Punctate areas of calcifications were seen in one lesion.

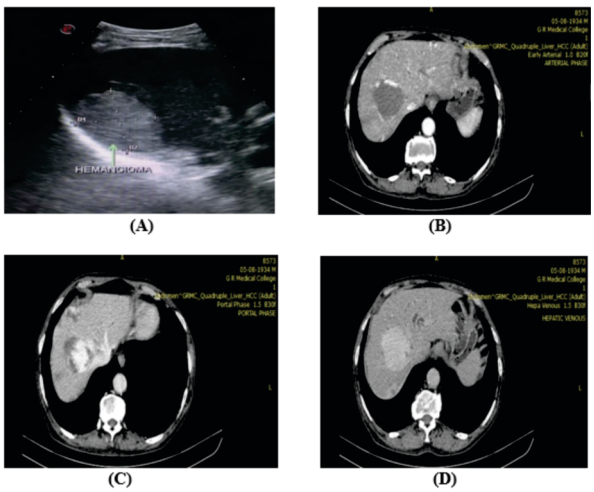

Figure 4. A. USG shows typically well-defined hyperechoic lesions. B. CT Arterial Phase: typically show discontinuous, nodular, peripheral enhancement and progressive centripetal filling C & D)

Out of 7 cases of Cholangiocarcinoma, On USG 5 cases appeared as hypoechoic lesion with irregular margins, 2 were misdiagnosed as metastases. While on CT all the lesions were hypodense and showed delayed enhancement, and were correctly diagnosed.

Out of 4 cases of Hepatoblastoma, 3 were correctly diagnosed with USG , 1 was misdiagnosed as abscess. On CT all 4 lesions were hypodense on non-contrast , demonstrated heterogenous enhancement in arterial phase and were hypodense in portovenous and delayed phases.

Out of 5 cases of Adenoma, 4 cases presented as hypodense on plain CT, in arterial phase lesion enhanced heterogeneously and became isodense in PV and delayed phase. On follow up diagnosis was adenoma. 1 case was misdiagnosed on CT as abscess. On USG only 3 were correctly diagnosed, and 2 cases were misdiagnosed as abscess.

Among 3 cases of FNH , On Ultrasound and TPCT 2 cases were correctly diagnosed while 1 case was diagnosed as indeterminate hepatic mass probably being HCC on both modalities. On USG 2 lesions were well marginated heterogenous and showed central scar. On TPCT 2 lesions showed bright enhancement except for the central scar, in the delayed phase the lesion was is oattenuating with enhancement seen in the central scar.

Overall, hydatid cysts and liver abscess have typical appearance on USG as well as CT, both the modalities having high sensitivity and specificity. Hence, Hydatid cyst and abscess when diagnosed by one modality further investigation may not be needed. However, subsequent to treatment, for liver abscess follow up is easier with USG. In the case of metastasis, hemangioma, HCC and cholangiocarcinoma, TPCT is superior to USG, as these lesions have specific enhancing patterns on triple phase study. CT can accurately show the exact extent of a focal lesion and can delineate adjacent organs.

Our study on 110 cases showed an overall accuracy of 98.89% in diagnosing various lesions by TPCT study (with p value <0.1, kappa value 0.90), and 95.86% on Ultrasound (with p value <0.1, kappa value 0.78). This shows significant correlation between ultrasound and Triple phase CT in diagnosis of various focal liver lesions.

CONCLUSION

In essence, USG and TPCT are the modalities having comparable specificity and sensitivity, TPCT being slightly more accurate than USG in evaluation of focal hepatic lesions. Ultrasound should be the first choice because it is widely available, cost effective, non-invasive and free from radiation. When ultrasound is not confirmatory help of TPCT may be performed in atypical cases to know the exact extent of the lesion prior to surgery. For follow up, USG is the adequate modality in most of the situations.

Clinical diagnosis based on examination can be very inaccurate, hence radiological investigations using ultrasonography and computed tomography can help us to arrive at an accurate diagnosis most of the times.

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