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Characterization of Focal Hepatic Lesions: A Comparative Study of Ultrasound versus Computed Tomography

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Abstract
Introduction: *Focal Hepatic Lesionsare common findings as a result of the ever increasing use of imaging techniques in patients with nonspecific abdominal complaints. This study was undertaken to compare unenhanced ultrasound versus computed tomographyin evaluation of patients with focal hepatic lesions.*
Methods: *In this study, 100 cases of focal hepatic lesions were studied with USG and CECT abdomen. Imaging findings were evaluated and tabulated and correlated with the clinical findings, histopathological findings and follow up. The findings were checked and statistically tabulated .*
Results: *Out of a total 100 patients included for study, most patients were in age range of 41 – 60 years. Males : females ratio was 64 : 36. 23.0% patients were smokers, 15.0% patients were alcoholic. We studied approximately 233 focal liver lesions with 120 lesions being true benign and 113 lesions being true malignant. Sensitivity (%) of diagnosing benign lesions on USG was 94.44% and on CT was 97.43%, for malignant lesions it was 89% and 97%respectively. Specificity(%) of diagnosing benign lesions on USG was 98.45% and on CT was 100%, for malignant lesions it was 94.65 and 98.51% respectively*.
Conclusion*: Focal liver lesions remain a diagnostic challenge. These lesions are frequently caused by common benign, malignant and metastatic etiologies. We conclude that USG plays an important role as an initial screening modality and as an adjunct to CECT and Triphasic CT in the evaluation of focal hepatic lesions.*
Keywords: *Focal hepatic lesion, CT, USG*

I. Introduction

Focal liver lesions are defined as solid or liquid-containing masses foreign to the normal anatomy of the liver that may be told apart from the latter organ using imaging techniques(1). They may be benign, malignant or metastatic in origin. Commonly encountered benign lesions include pyogenic liver abscess, focal nodular hyperplasia, simple cyst, hydatid cyst and hemangiomas(2). Malignant lesions include Hepatocellular carcinoma, Intrahepatic Cholangiocarcinoma. Metastatic lesions include secondaries from colon, lung, breast, stomach, pancreas, prostate, etc(2).

Primary malignant neoplasms constitute a small proportion of space occupying lesions in the liver. Most of these malignant neoplasms have an insidious onset and are discovered while screening patients for non-specific upper gastrointestinal or various constitutional symptoms. The commonest malignant primary hepatic neoplasm is hepatocellular carcinoma (HCC). Other malignant hepatic neoplastic lesions like secondaries and the less frequently encountered hepatoblastoma and sarcomas are not easily differentiated from hepatocellular carcinoma by the available imaging modalities and the final diagnosis is established by histopathology.(3)
Unenhanced ultrasonography has excellent spatialand contrast resolution and may thereforeprovide useful information regarding the liverand liver masses without the use of contrastagents. Liver cysts can be identified and confidently diagnosed,and a variety of appearances of solid masses maysuggest a specific diagnosis. Hypoechoichalo or rim surrounding an echogenic or isoechoic liver mass is suggestive of probable malignancy. Multiple hypoechoic masses in the liver most oftensuggest metastases. In contrast, hemangioma is usually seen as a solid, uniformlyechogenic mass, with posterior acoustic enhancement. However in many cases further imaging with Ultrasound contrast agents or CT/MRI may be indicated to increase the diagnostic confidence or to avoid unnecessary intervention.(4)

Transient elastography has been increasingly used as a non-invasive tool for assessing liver fibrosis by measuring liver stiffness(5). It is safe and non-invasive(6). The technique is easy and rapid to use, reproducible and operator dependent(7,8).It provides both conventional images and numerical measurements of tissue elasticity which becomes clinically relevant because liver can have non-homogenous areas which may show changes in

elasticity even before the characterization of abnormalities. Elastography is promising in distinguishing hemangiomas from metastases[6].

Spiral CT offers many advantages over conventional dynamic CT[9]. It enables better spatial resolution in the direction of body axis and greater anatomic coverage during a single breath-hold[10]. With rapid introduction of multi-detector row CT scanners to the clinical environment, the use of a thinner section thickness at contrast-enhanced CT for the detection of hepatic metastases has become a routine practice[11].

With this large list of conditions contributing to focal hepatic lesions one has to assess the patient clinically as well as distinguish between neoplastic and non-neoplastic nature of the lesion as detected in USG & / or CT.

The present study was undertaken to assess the sensitivity and specificity of USG including Doppler and CT including CECT and Triple phase CT in characterization of focal hepatic lesions using clinic-pathological correlation as gold standard.

II. Methods

This prospective study included 100 patients with 233 focal hepatic lesions detected on ultrasonography and computed tomography evaluation. This study has approval of the Institutional Research and Ethics Board and patients gave informed consent. A detailed clinical history was recorded of each patient as per the Proforma and relevant clinical examination was done.

Inclusion criteria

- Presence of well-defined Focal hepatic lesions on abdominal imaging (USG/CT and/or MRI).
- Lack of therapeutic intervention in the interim such as surgery or aspiration.
- Subsequent verification of the lesion type by biopsy/ aspiration, surgery, or follow-up.

Exclusion criteria

- Traumatic liver lesions
- Diffuse ill defined hepatic lesions
- Patients with previous hepatobiliary surgery or aspiration

Imaging Techniques

Requested abdominal imaging (USG/CT/MRI) was done with prior explanation of the radiological investigation and informed written consent of the patient/relatives.USG was performed on MedisonSonoace X8 machine using convex broadband 2-5 MHz probe. Liver was scanned in various planes like sagittal, parasagittal, transverse, oblique, subcostal, intercostal and coronal planes. Comprehensive scanning of other upper abdominal organs was done.

Various ultrasonographic features of focal liver lesions were observed, which included:

- Number of lesions – single or multiple.
- Location within liver – Lobar distribution (right lobe, left lobe, both lobes).
- Segmental distribution.
- Echogenicity (by comparing with that of normal liver parenchyma).
- Size, shape and margins: Exact size of lesion was measured with a note of shape of the lesion like round, oval or irregular.
- Margins of lesion were studied to be well-defined, poorly defined, regular or irregular.
- Apart from the above observations related to lesion several other important observations were made which included overall assessment of liver size, portal and hepatic veins' involvement, biliary tract and gall bladder involvement, lymphadenopathy, aorta and its branches and ascites or pleural effusion.

Color/Power doppler interrogation of the lesion was done in case of solid/complex cystic lesions for the documentation of presence or absence of intralesional flow.Real time elastography was performed on the same ultrasound unit with qualitative assessment of the lesion stiffness in comparison to surrounding hepatic parenchyma on side by side conventional and color coded elastography images. Increased lesion stiffness was depicted as predominantly blue color while green and yellow areas depicted more elasticity.

A standard protocol was adopted for performing CT abdomen which was done on Philips ingenuity core 128 multisliceunit with 768 × 768 and 1024 × 1024 matrix. at 120 kvp and 200-250 mAs. Contrast enhanced/Triphasic CT examination was done as requested by the clinical departments. Oral contrast was given as solution of water and gastrograffin maximum of 1000-1500 ml 60 minutes prior to scanning. Non contrast CT acquisition of abdomen was done in all cases prior to IV contrast. Intravenous nonionic iodinated contrast was administered in the dose of 1-1.5ml/kg. For triphasic CT, after oral and injection of intravenous contrast material, liver was scanned in arterial (scanning delay, 20-40 seconds), portal (scanning delay, 60-90 seconds), and equilibrium (scanning delay, 2-5 minutes) phases. Delayed phases after 5-10 minutes were acquired

wherever required. Routine contrast enhanced scans comprised of single breath hold scan of entire abdomen with thin section acquisition of liver sections. The obtained data sets were sent to a 3D Workstation. The data were augmented using coronal, sagittal and oblique reconstructions.

Analysis

Imaging findings on ultrasound and CT were evaluated independently by two separate radiologists blinded to the findings of other with the lesion characterization done as benign and malignant on the basis of accepted criteria listed in table no.1 tabulated and correlated with the clinical findings and histopathological findings (wherever available). Criteria for lesion designation as benign and malignant on unenhanced ultrasound (including doppler and elastography findings wherever performed) and on CECT (including triphasic CT wherever performed) are listed in the table no. 1.

Table 1.

IMAGING	**TUMOR TYPE**	
	BENIGN	**MALIGNANT**
UNENHANCED USG(4)	• Uniformly anechoic with imperceptible/thin walls and septate • Homogeneous hyperechogenicity • Hypoechogenecity with hyperechoic rind • Posterior sonic enhancement • Lesion size stability or reduction on follow up	• Hypoechoic halo • Target appearance • Hypoechoic
COLOR DOPPLER(12)	No intrinsic vascularity	Presence of internal vascularity
REAL TIME ULTRASOUND ELASTOGRAPHY (13)		Increased lesion stiffness (predominantly blue) compared to adjacent liver parenchyma
NCCT/CECT (14)	• Single/multiple homogeneous and hypo attenuating cystic lesion with a regular outline on NCCT, with no wall or content enhancement on CECT • Well-defined parenchymal interface	• Cystic lesion with thick capsule, mural nodules and internal septa with enhancement • Continuous rim enhancement or diffuse heterogeneous enhancement with ill-defined margin • Hypointense halo surrounding the peripherally enhanced portion of a solid lesion. • Vascular invasion
TRIPHASIC CT(15)	Lesions parallel blood pool enhancement	• Arterial phase hyper enhancement • Peripheral washout on portal or delayed images

The results of lesion characterization on Ultrasound and CT were tabulated with the clinics-pathological findings separately and the relevant statistical analysis was performed.

Statistical Analysis

Collected data were finally checked, edited and verified. Statistical associations were investigated using the chi-square or Fisher's exact test. Sensitivity, Specificity, Positive predictive value, Negative predictive value were calculated. All probability values were two-tailed. Statistical significance was considered as $p<0.05$.

III. Results

Out of total 100 patients enrolled for study most patients were in age range of 41 – 60 years and the mean age was 49.47±17.3 years. 64(64.0%) patients out of a total 100 were male and 36(36.0%) patients were females. Out of a total 100 patients, 23(23.0%) patients were smokers, 15(15.0%) patients were alcoholic.

Table 2: Lesion characterization on USG

Characterization	No. of lesions
BENIGN	113
MALIGNANT	84
UNDETERMINED	36
TOTAL	233

Table 3:USG sensitivity and specificity in lesion characterization

CHARACTERISATION	SENSITIVITY	SPECIFICITY
BENIGN	94.44%	98.45%
MALIGNANT	89.00%	94.65%

Table 4: Lesion characterization on CT

CHARACTERIZATION	CHARACTERIZATION
BENIGN	94
MALIGNANT	108
UNDETERMINED	8
TOTAL	210

Table 5: CT sensitivity and specificity in lesion characterization

CHARACTERISATION	**SENSITIVITY**	**SPECIFICITY**
BENIGN	97.43%	100.00%
MALIGNANT	97.00%	98.51%

On clinico-pathological correlation which included 44 patients who underwent biopsy or image guided aspiration with histopathological correlation, 16 patients who underwent surgery and 40 patients who were followed up on imaging without intervention, (duration 3- 12 months, mean- 6 months), 62 patients had true benign lesions and 38 patients had true malignant lesions.

Table 6: Breakup of ultrasound diagnosis with histopathological correlation

DIAGNOSIS	**USG (n=100)**	**HISTOPATH./ CLINICAL FINDINGS (n=100)**
LIVER ABSCESS	29	27
METASTASES	20	29
HEPATOCELLULAR CA	3	7
HEMANGIOMA	6	6
SIMPLE LIVER CYSTS	14	17
HYDATID	5	6
UNDIAGNOSED SOL's.	11	-
OTHERS	12	8

Table 7: Breakup of CT diagnosis with histopathological correlation

DIAGNOSIS	CT (n=86)	HISTOPATH./ CLINICAL FINDINGS (n=100)
LIVER ABSCESS	12	27
METASTASES	33	29
HEPATOCELLULAR CA	5	7
HEMANGIOMA	5	6
SIMPLE LIVER CYSTS	15	17
HYDATID	6	6
OTHERS	10	8

Table 8: Breakup of lesions as per final diagnosis (HP/aspiration/follow up)

DIAGNOSIS	**NO. OF CASES (PATIENTS)**	**NO. OF LESIONS**
LIVER ABSCESS	27	51
SIMPLE LIVER CYST	14	37
LIVER HYDATID	7	9
LIVER HEMANGIOMA	5	5
FOCAL FAT SPARING	3	3
FOCAL FATTY INFILTRATION	3	3
CLD WITH REGENERATIVE NODULES	3	12
LIVER PRIMARY	8	22
LIVER METASTASES	30	91
TOTAL	**100**	**233**

Table no. 9 showing Sensitivity (%), Specificity (%), PPV (%) and NPV (%) between Final Diagnosis (Radiopathological) and USG and CT diagnosis.

	USG diagnosis				**CT diagnosis**			
	Sensitiviy (%)	**Specificiy (%)**	**PPV (%)**	**NPV (%)**	**Sensitiviy (%)**	**Specificity (%)**	**PPV (%)**	**NPV (%)**
Liver abscess	96.3	97.0	92.85	98.7	91.66	100.0	100.0	98.8

Hemangioma	100.0	99.0	83.0	100.0	100.00	100.0	100.0	100.0
Simple Cysts	87.5	99.0	93.3	97.7	100.00	100.0	100.0	100.0
Hydatid cysts	100.0	100.0	100.0	100.0	100.00	100.0	100.0	100.0
Primary malignant liver tumors	85.7	98.0	75.0	98.9	85.71	100.0	100.0	98.9
Liver secondaries	90.0	100.0	100.0	95.8	90.00	97.2	93.1	95.8

IV. Discussion

Focal liver lesions are common on pathologic or imaging evaluation of the liver and include a variety of malignant and benign neoplasms, as well as congenital and acquired masses of inflammatory and traumatic nature. Evaluation of focal liver lesions is a complex issue which is often the major focus of the cross sectional imaging study.[3]

In our study majority of patients were between the age range of 41-60 years (35%). In a study of 40 patients conducted by Gopalakrishnan et al, 2014, the youngest patient was of age 19 years and the oldest of age 84 years with a mean age of 52 years with majority being in the age group of 50-60 years [11].

In our study out of a total 100, 64% were males and 36% were females. Gopalakrishnan et al, 2014[11] in their study of 40 patients had a majority of males who numbered 26 (65%) and 14 (35%) were females with the male to female ratio being 1.8:1. 23% were found to be smokers of which 91% were males. 15% of patients had history of alcohol abuse all of them being males.

In our study final USG diagnosis showed USG sensitivity/specificity for liver abscess, hydatids, hemangiomas, simple cysts, primary malignancies and liver secondaries to be 96.3%/97%, 100%/100%, 100%/99%, 87.5%/99%85.7%/98% and 90%/97.21% respectively. This is in close correspondence to the study conducted by Kumar et al, 2014[2] where final US sensitivity/specificity were concluded to be 100%/100% for abscesses, 100%/97.28% for hydatids, 90%/100% for hemangiomas, 80%/100% for simple cysts, 83.33%/97.72% for primary liver malignancies and 100%/97.29% for liver secondaries. (Table 10)

Table 10.

AUTHORS (Kumar et al.) n=50	**USG SENSITIVITY**		**USG SPECIFICITY**	
	BY AUTHOR (Ref No.)	**OUR STUDY**	**BY AUTHOR**	**OUR STUDY**
Liver Abscess	100%	96.3%	100%	97%
Hydatid	100%	100%	97.28%	100%
Hemangioma	90%	100%	100%	99%
Simple Cysts	80%	87.5%	100%	99%
Primary malignancies	83.33%	85.7%	97.72%	98%
Liver secondaries	100%	90%	97.29%	100%

In another study conducted by Thimmaiah VT et al, 2013[16] USG sensitivity and specificity was found to be 90.9%/93% for liver abscess, 75%/98% for liver hydatids, 40%/99% for simple liver cysts, 50%/98.9% for hemangiomas, 80.6%/90.5% for primary liver tumors and 76.9%/92.4% for liver secondaries respectively.

The final CT diagnosis in our study revealed CT sensitivity/specificity to be 91.66%/100% for liver abscess, 100%/100% for liver hydatids, 100%/100% for Hemangiomas, 100%/100% for simple cysts, 100%/100% for primary liver malignancies and 90%/99% for liver secondaries. These findings were in concordance with the study conducted by Kumar et al, 2014[2]where CT sensitivity/specificity was concluded as100%/100% for liver abscess, 100%/97.28% for hydatids, 100%/100% for hemangiomas, 80%/100% for simple liver cysts, 100%/100% for primary liver malignancies and 100%/100% for liver secondaries. (Table 11)

Table 11.

AUTHORS (Kumar et al.) n=50	**CT SENSITIVITY**		**CT SPECIFICITY**	
	BY AUTHOR	**OUR STUDY**	**BY AUTHOR**	**OUR STUDY**
Liver Abscess	100%	91.66%	100%	100%
Hydatid	100%	100%	97.82%	100%
Hemangioma	100%	100%	100%	100%
Simple Cysts	80%	100%	100%	100%
Primary malignancies	100%	100%	100%	100%
Liver secondaries	100%	90%	100%	99%

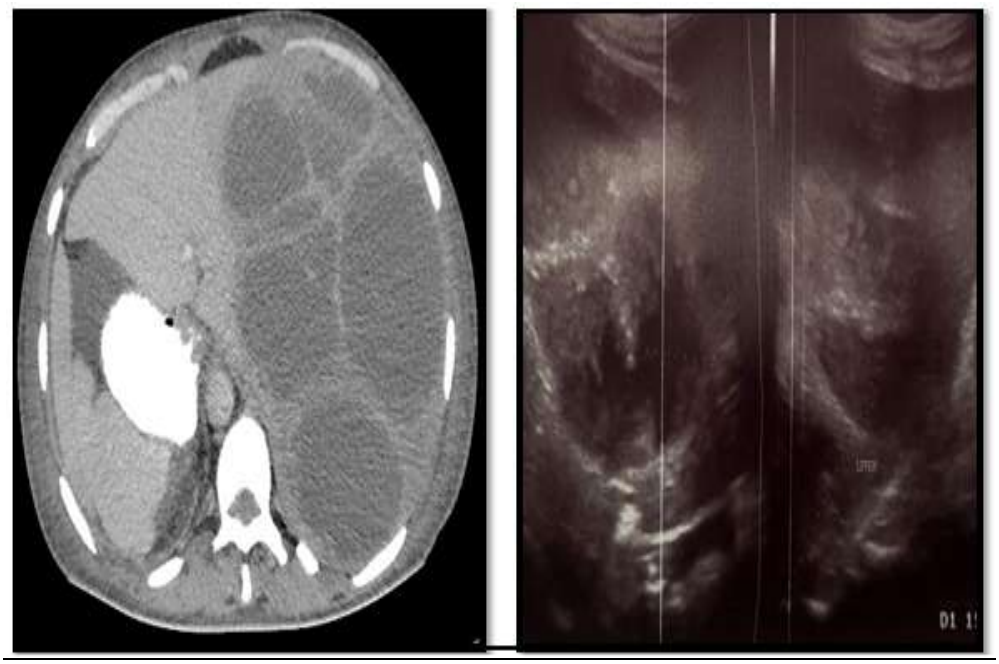
In our study CT sensitivity and specificity for lesion characterization is comparable to study done by Catal et al[17] which showed spiral CT had sensitivity of 88% and specificity of 89% in diagnosing malignant lesions.

V. Conclusion

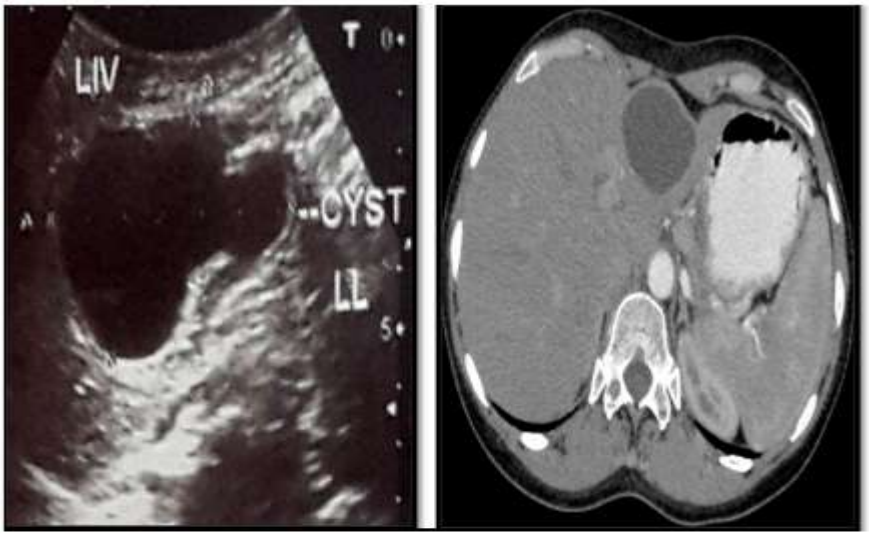
This study shows that unenhanced ultrasound in conjunction with ancillary findings of color Doppler and elastography can be the initial modality of choice in evaluation of focal hepatic lesions and can guide the need for further investigation/intervention. CECT/Triphasic CT is a modality with high diagnostic accuracy and can serve as problem solving tool in cases with equivocal ultrasound findings. However this study being single centeric with small sample size and inherent bias a larger sampled multicenteric study is advisable to corroborate our findings

References

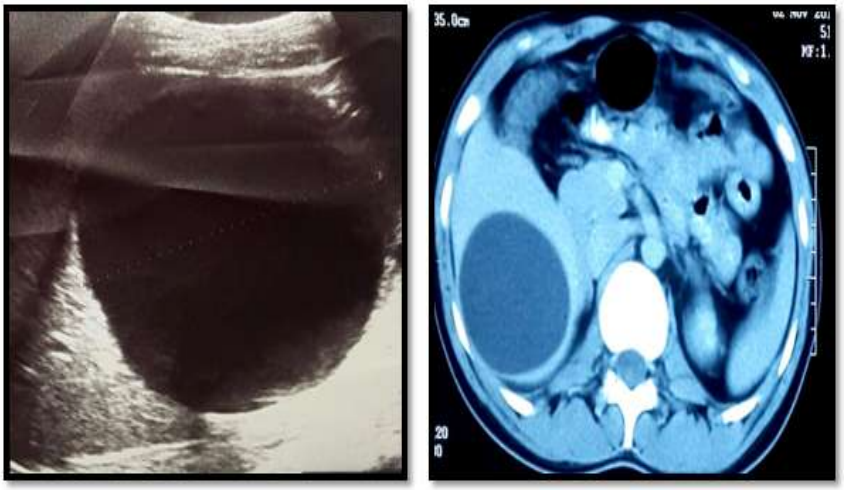
[1]. Pons F, Llovet JM. Approaching focal liver lesions. Rev EspEnferm Dig 2004; 96: 567-577.
[2]. Kumar PB, Hegde P, Kumar BNK et al. A Comparative Study of Ultrasound and CT findings in Focal Liver Lesions. Int J Biol Med Res. 2014; 5(3): 4362-4369.
[3]. Gupta DK, Carachi R. Paediatric Oncology (Surgical and Medical Aspects). 2007: 28-29.
[4]. Wilson SR, Jang HJ, Kim TK, Burns PN. Diagnosis of Focal Liver Masses on Ultrasonography Comparison of Unenhanced and Contrast-Enhanced Scans. J Ultrasound Med 2007; 26:775–787
[5]. Foucher J, Chanteloup E, Vergniol J et al. Diagnosis of cirrhosis by transient elastography (FibroScan): a prospective study. Gut 2006;55: 403–8.
[6]. Davies G, Koenen M. Acoustic radiation force impulse elastography in distinguishing hepatic haemangioma from metastases. 2011,84:939–943.
[7]. Gallotti A, D'Onofrio M, Mucelli RP. Acoustic radiation force impulse (ARFI) technique in ultrasound with Virtual Touch tissue quantification of the upper abdomen. Radiol Med 2010;115:889–97.
[8]. Takahashi H, Ono N, Eguchi Y et al. Evaluation of acoustic radiation force impulse elastography for fibrosis staging of chronic liver disease: a pilot study. Liver Int 2009;30:538–45.
[9]. Horton KM, Bluemke DA, Hruban RH, et al. CT and MR imaging of benign hepatic and biliary tumors. Radiographics 1999; 19: 431-51.
[10]. Onishi H, Murakami T, Kim T et al. Hepatic Metastases: Detection with Multi–Detector Row CT, SPIO- enhanced MR Imaging, and Both Techniques Combined. Radiology: 2006;239:1.
[11]. Gopalakrishnan S, Sethurajan, Adaikappan et al. Real Time Ultrasonography Evaluation of Focal Liver Lesions: A Cross- Sectional Study. International Journal of Scientific Study. 2014;2:7.
[12]. Nino-Murcia M, Ralls PW, Jeffrey RB Jr, Johnson M. Color flow Doppler characterization of focal hepatic lesions. AJR Am J Roentgenol.1992 Dec;159(6):1195-7.
[13]. Sandulescu L, Padureanu V, Dumitrescu C. A Pilot Study of Real Time Elastography in the Differentiation of Focal Liver Lesions. Current Health Sciences Journal. Vol. 38, No. 1, 2012.
[14]. Heiken JP. Distinguishing benign from malignant liver tumours. Cancer Imaging (2007) 7, S1_S14. DOI: 10.1102/1470-7330.2007.9084
[15]. Oliver JH, Baron RL: State of the art, helical biphasic contrast enhanced CT of the liver: Technique, indications, interpretation, and pitfalls. Radiology 1996; 201:1-14.
[16]. Thimmaiah VT.Evaluation of Focal Liver Lesions by Ultrasound as a Prime Imaging Modality.Sch. J. App. Med. Sci., 2013; 1(6):1041 -1059.
[17]. Catala V, Nicolau C, Vilana R, Pages M, Bianchi L, Sanchez M, Bru C. Characterization of focal liver lesions: comparative study of contrast-enhanced ultrasound versus spiral computed tomography. European radiology. 2007 Apr 1;17(4):1066-73.



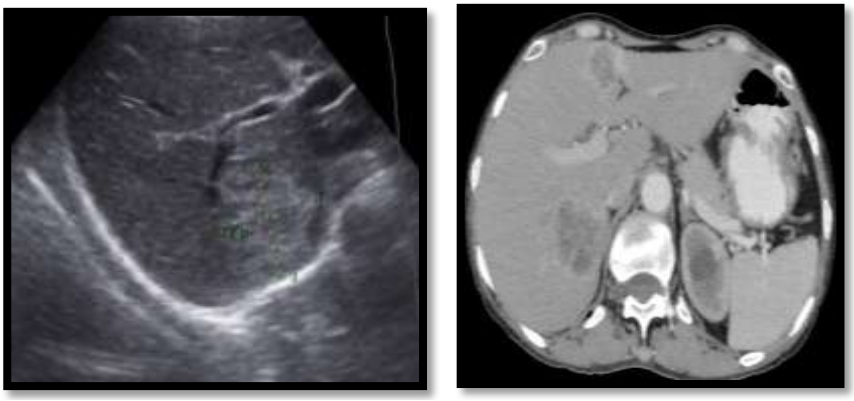
Figures 1, 2: Showing CECT and USG images pf multiple liver abscesses in right lobe of liver in same patient



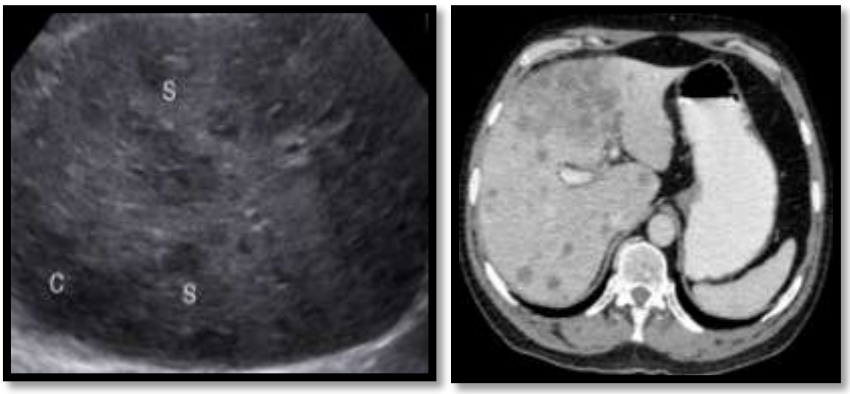
FIGURES 3, 4: Showing USG and CECT images respectively of Simple Liver Cyst in a 36 year old female patient



FIGURES 5, 6: Showing USG and CECT images of Hydatid Cyst in a young male patient of 20 years age



FIGURES 7, 8: Showing USG and CECT images of Liver Metastases from a known Primary of Carcinoma Rectum in a 60 years old female patient.



FIGURES 9, 10: Showing USG and TRIPHASIC CECT Portal Phase images of HCC in a 65 years old male patient.