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CHARACTERIZATION OF FOCAL LIVER LESIONS ON CONTRAST ENHANCED ULTRASOUND

Radiology

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ABSTRACT

Aim: The purpose of the study was to characterize the focal liver lesions on contrast enhanced USG on the basis of enhancement pattern and establishing the potential of this technique and determining sensitivity and diagnostic accuracy of this technique in comparison with CECT/biopsy. **Material and methods:** Prospective study was conducted from Oct 2018 to Mar 2020 at tertiary care hospital and CEUS was done for 34 lesions in 30 patients. Lesions characterized on the basis of enhancement pattern in arterial, portal and porto-venous phases. Final diagnosis was established on the basis of CECT or/and biopsy/FNAC of lesion (if available). **Results:** Out of 34 focal liver lesions, 24 were malignant (HCC and metastasis) and 10 were benign (hemangioma). 32 lesions were correctly characterized by CEUS examination in comparison with CECT/tissue diagnosis. Overall sensitivity, PPV and diagnostic accuracy of CEUS with 95% CI was 94.12 (80.32 -99.28), 100 (89.11 – 100%) and 94.12% (80.32 – 99.28) respectively. **Conclusion:** Our study showed that CEUS is a sensitive modality to characterize focal liver lesions. CEUS can objectively demonstrate contrast enhancement comparable and corresponding to enhancement of same lesion on CECT.

KEYWORDS

INTRODUCTION –

Liver is one of the largest solid organ of body and unique organ with rich dual blood supply. Focal liver lesions (FLL) are identifiable abnormal part of the liver. The term "lesion" rather than "mass" was preferred because "lesion" is a term that has a wider application, including both solid and cystic masses.[1] Focal Liver Lesions (FLL) are often frequently detected in routine practice, due to the increasing use of imaging methods. They must be evaluated in order to establish the diagnosis and the therapeutic strategy.

The accurate characterization and early management of liver lesions requires a collaborative approach between different disciplines including radiologist, gastroenterologist, pathologist, hepatobiliary surgeon, and oncologist.[1]

Although majority of incidentally discovered liver lesions are benign, their noninvasive diagnosis is necessary. The optimal characterization of focal liver lesions and exclusion of malignancy assumes key importance in individuals with high-risks like in patients with family history of malignancy, known case of liver cirrhosis or hepatitis.[2]

Ultrasound and CT scans are commonly performed as the first line of imaging studies in the evaluation of patients with focal liver lesions. Contrast enhanced CT (CECT) involves radiation exposure and possibility of adverse reaction due to Iodinated IV contrast. Introduction of Ultrasound contrast agents in early 1990 strengthened the role of non ionizing modality in focal liver lesions in addition to its wide use in other systems. Contrast enhanced USG is non ionizing and not known to cause any adverse effects. If contrast enhanced USG is found to be as sensitive as CECT to detect the enhancement in a focal liver lesion, the follow up of patients with focal liver lesions could be done on contrast enhanced USG.[3]

Unfortunately, dedicated imaging is often needed to characterize focal liver lesions, because most lesions demonstrate nonspecific findings at initial gray-scale ultrasonography (USG) or single-phase computed tomography (CT). Traditionally, multiphase CT or contrast enhanced magnetic resonance (MR) imaging has been resorted to as problem solving modality in the detailed evaluation of hepatic lesions. However, due to radiation and contrast related limitations with multiphase CT and because of the limited access and high cost of MR imaging, contrast agent–enhanced USG (CEUS) should be considered as a safe, noninvasive, and easily available option. Many studies conducted on contrast US suggest this modality to be sensitive, beneficial and cost effective for the evaluation of various liver lesions[2], which complement the results of cross sectional imaging and in some instances acting as an important alternative, particularly in young patients or those with renal failure, allergies to contrast agents, or claustrophobia.[2,3,4]

AIM/BACKGROUND

The aim of the study was to characterize the focal liver lesions (FLLs) on contrast enhanced sonography (CEUS) on the basis of enhancement pattern and to explore the potential of this technique for characterizing the lesions and to compare its diagnostic accuracy with CECT abdomen/histopathology.

MATERIALS AND METHODS:

This prospective study included 30 cases of solid liver lesions. Consecutive patients reporting to various Depts of tertiary care hospital for investigations and management, who were identified to have focal liver lesions on preliminary evaluation by USG Abdomen formed the patient population for this study. Patients with focal lesions of liver primarily diagnosed on USG from October 2018 to Mar 2020 were prospectively evaluated using CEUS and results were compared with CECT abdomen/histopathology (all 30 patients underwent CECT abdomen and 10 patients were having HPE).

Inclusion Criteria:

1. Patients with focal lesion of liver
2. Patients who have undergone either contrast enhanced CT scan of abdomen or FNAC/biopsy of lesion.
3. Patients older than 18 years of age.

Exclusion Criteria:

1. Patient not giving consent for contrast enhanced USG.
2. Patients with non availability of either CECT study or histopathological examination.
3. Patients with suboptimal CEUS study either due to poor breath hold, suboptimal administration of intravenous contrast, suboptimal

visualization of area of interest.
4. Patients who have undergone interventional or surgical treatment for the enhancing focal liver lesions.
5. Lesion lesser than 1 cm of size.

Methods and data collection:
a) Freshly prepared microbubbles of Sulfur Hexafluoride (Sonovue, Bracco) from lypholised powder and given solvent was used as a bolus dose of 4 to 5 ml followed by 5 ml of 0.9 % normal saline with a 16/18 G IV cannula in antecubital vein.

b) Study was conducted on GE Logiq F8 USG machine, using curvilinear probe of 4-6 MHZ

c) Scanning started with conventional B-mode selected on the USG machine to identify the target lesion. The scanner is then switched to low mechanical index (MI) contrast-specific imaging mode. A dual screen format showing a low MI B-mode image alongside the contrast-only display is selected to aid anatomic guidance.

d) Representative images and video clips were saved on the hard disk of scanner/ workstation of the department for future reference. The pattern of enhancement on CECT abdomen was compared. Histopathological examination in available cases were taken as reference for available cases. All findings endorsed on proforma based data sheet for collating data.

Statistical Analysis:
CEUS enhancement and CT enhancement of FLLs were considered as primary outcome variables. Age, gender, pre-contrast HU of lesion, post contrast HU of lesion, enhancement pattern on . CT enhancement or histopathology (if available) was considered as gold standard and CEUS enhancement was considered as screening test. The sensitivity, specificity, predictive values and diagnostic accuracy of the screening test along with their 95% confidence interval (CI) were presented.

P value < 0.05 was considered statistically significant. IBM SPSS version 22 was used for statistical analysis.

RESULTS -
This prospective study included a total of 30 patients with the total of 34 lesions for final analysis.

The patients in study ranged in age from 24 years to 83 years (table 1) with mean age of the study population being 53.43 ± 13.44 years. (95% CI 48.41 to 58.45). Among the study population, 22 (73.33%) participants were male and 8 (26.67%) participants were female.

Among the distribution of the lesions under study, 21(61.76%) lesions were in the right lobe, 11 (32.35%) were in the left lobe and 2 (5.88%) were distributed in both lobes. The CEUS was performed for 34 lesions out of which 2 patients were excluded during image analysis due to non conclusive /non specific enhancement pattern seen on CEUS images as lesion was deeply placed and small in size. The diagnosis assigned on CEUS basis were compared with final diagnosis of patients on the basis of CECT available for 34 lesions) and histopathological examination (available for 10 lesions) as shown in table 1.

Table 1: Diagnosis distribution of FLLs

Diagnosis	CEUS	CECT	HPE/FNAC	Final Diagnosis
Hemangioma	10	10	-	10
Hepatocellular carcinoma (HCC)	08	09	2	09
Metastasis	14	15	8	15

The enhancement pattern on CEUS had overall sensitivity of 94.12% (95% CI 80.32% to 99.28%) as compared to the CECT/histological examination. Positive predictive value was 94.12% (95% CI 80.32% to 99.28%), and the total diagnostic accuracy was 94.12% (95% CI 80.32% to 99.28%). Diagnostic accuracy of characterizing hemangioma is similar in CEUS and CECT (sensitivity 100%; and positive predictive value 100%). Diagnostic accuracy of contrast enhancement patterns in characterizing HCC in CEUS (sensitivity 88.9 %) is slightly lower when compared to that of CECT and diagnostic accuracy of CEUS for metastatic lesions in liver was comparable to CECT (93.33 %).

Case of hemangioma (Fig 1 and 2) - 36 year female presented with epigastric pain. Found to have approx 10-12 cm sized lesion in Right lobe of the Liver on USG evaluation. She underwent triple phase CT of the abdomen for evaluation of the lesion followed by contrast enhanced USG. Lesion was found to be hemangioma of liver.

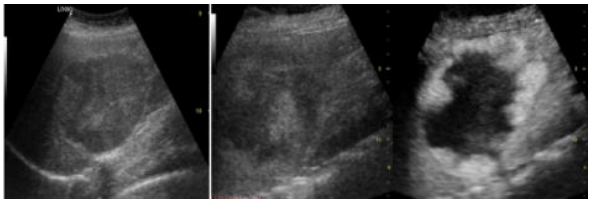

Figure 1: Gray scale image showing heteroechoic lesion with non continous peripheral filling/enhancement with centripetal fillingon CEUS examination.

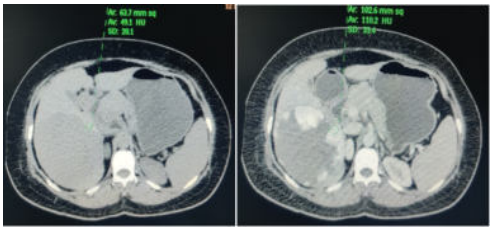

Figure 2: NCCT showing well defined hypodense mass On PV phase, lesion showing non continous peripheral enhancement with centripetal filling typical of hemangioma.

Liver Mets in a biopsy proven case of carcinoma rectum-

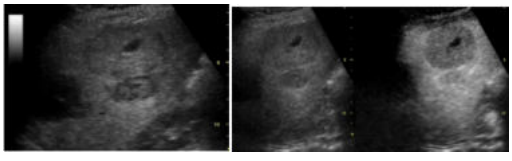

Figure 3: Segment VI lesion on CEUS showing enhancement with central non-enhancing area.

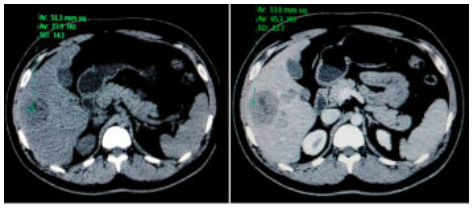

Figure 4: Multiple SOLs with largest SOL showing enhancement on CECT with small central non enhancing area.

DISCUSSION
Most FLLs are detected incidentally during routine abdominal imaging examinations for other conditions (e.g., ultrasound), in staging or follow-up examinations in oncologic patients, or in the setting of surveillance programs for chronic liver disease.[5,6]

Characterization of focal liver lesions forms a vital element in the majority of radiological practices. The accurate characterization of a focal liver lesion requires the assessment of morphological characteristics as well as enhancement patterns and vascularity within the lesion. Therefore, administration of a contrast agent, demonstrating the intratumoral vascularity and blood flow gives essential information for the characterization of focal liver lesions.(6)
Ultrasound is widely used as the primary imaging method in the diagnostic workup of abdominal conditions, although contrast-enhanced computed tomography (CECT) and magnetic resonance imaging (CEMRI) represent the gold standard in various diagnostic algorithms for the assessment of focal liver lesions. Over the last 15 years, continuously increasing evidence has emerged that contrast-enhanced ultrasonography (CEUS) may contribute to the characterization of FLLs in comparable results with CECT and CEMRI.[7]

CEUS is also a new addition to LI-RADS (Liver Imaging Reporting and Data System) with official approval of the CEUS LI-RADs

algorithm by the ACR (American college of Radiology) LI-RADS Steering Committee on June 24, 2016.(8) CEUS LI-RADS is a comprehensive system for standardizing the acquisition, interpretation, reporting, and data collection of CEUS examination for evaluating focal liver lesions detected in patients at high risk for HCC(9,10). LI-RADS was developed by ACR to address the challenges of the liver imaging in patients at risk for HCC and to provide a framework for assigning probability of HCC and other malignancy to imaging findings in patients at risk for HCC[10,11].

We compared the enhancement of the focal liver lesions on CEUS for those lesions which showed enhancement on the CECT. The CEUS enhancement in the porto-venous phase (at 60 seconds) was taken as the most important criteria for distinguishing between malignant and benign FLLs in the portal and late venous phases, where the malignant FLLs have a wash-out pattern and the benign FLLs are hyper/isoechoic (12).

In our study, we compared diagnostic accuracy and sensitivity of CEUS in comparison to CECT/histopathological examination and results of our study were comparable with previous studies(5,6,13,14) and confirmed the excellent performance of CEUS for FLLs. USG evaluation of any FLLs detected during routine USG examination can be easily augmented with CEUS examination in the same setting without moving the patient and without any exposure of patient to ionized radiations and iodinated contrast media.

There were few limitations of our study. The study population size was small and in patients with multiple liver lesions only single lesion was evaluated by CEUS.

CONCLUSION

Contrast enhanced ultrasound is a promising modality with results comparable to contrast enhanced CT in focal liver lesions. Contrast enhanced sonography can potentially augment the diagnostic efficacy of ultrasonography in focal liver lesions, by virtue of its non–invasive, non–irradiating and real time imaging capability. CEUS holds promising utility as a first-line imaging technique in the non-invasive characterization of focal liver lesions, when a focal liver lesion is first detected on USG in clinical practice. It would also be a reliable alternative imaging study in patients with FLL and poor renal function, who cannot undergo contrast studies using iodinated or gadolinium-based contrast media.

The present study shows that CEUS can predict the enhancement pattern of the focal liver lesion accurately with comparable results to contrast enhanced CT. Therefore, it can be incorporated in follow up imaging of focal liver lesions as a complimentary modality to routine USG.

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