



ORIGINAL ARTICLE

# Role of contrast enhanced ultrasound in characterization of focal liver lesions



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## KEYWORDS

Conventional baseline sonography;  
Contrast enhanced sonography;  
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Microbubble contrast agent

**Abstract** *Aim:* The purpose of the study was to describe the enhancement patterns of focal liver lesions (FLLs) on contrast enhanced sonography (CEUS), assessing the potential of this technique for characterizing the lesions and to compare its diagnostic accuracy with conventional baseline sonography including color Doppler.

*Materials and methods:* Between August 2009 and July 2010, 50 patients with FLLs underwent gray scale sonography, color Doppler and CEUS. The enhancement patterns of these FLL's were analyzed throughout the arterial phase, the portal venous phase and the extended portal venous phase (the late parenchymal phase). The final diagnosis was established on the basis of histopathologic examination or CT/MRI imaging.

*Results:* Out of these 50 FLLs, 33 were malignant (4 hepatocellular carcinoma and 29 metastasis) and 17 were benign (5 hemangioma, 5 abscess, 2 cyst and 1 each of FNH, focal fat sparing area, focal fatty infiltration, adenoma and benign/granulomatous lesion). The enhancement patterns after injecting microbubble contrast agent allowed characterization of FLLs. The malignant lesions

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showed intratumoral and/or peritumoral vascularity during the arterial phase and perfusion defect during the late parenchymal phase. Contrast enhanced sonography improved sensitivity in detecting malignancy (CEUS vs. baseline sonography, 100% vs. 81.8%).

*Conclusion:* CEUS improves detection and characterization of FLLs. It should be used as problem solving tool in cases where conventional gray scale and color Doppler sonography are non-diagnostic.

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## 1. Introduction

Liver is a home for variety of focal lesions. Once identified, it becomes necessary to characterize these lesions as it has important therapeutic consequences. Conventional gray scale sonography lacks specificity and sensitivity; however it is the most common imaging modality for screening purposes. When augmented with color Doppler, it gives better results in characterization of lesions. It was further strengthened by introduction of microbubble contrast agents for sonography in the mid 1990s (1). Contrast enhanced ultrasound (CEUS) uses contrast agents that constitute of microbubbles of gas, stabilized with coating of a biocompatible surfactant or polymer like phospholipid or protein (2). These microbubble contrast agents are purely intravascular, safe, well-tolerated and are easy to administer, hence do not harm the patient (3). These contrast agents are not excreted by the kidneys, so, deranged renal function is not a contraindication for contrast enhanced sonography, which is an advantage over CT and MRI (4). CEUS allows accurate characterization of very small lesions where even CT and MRI may fail (5). CEUS has evolved as a problem solving tool for the characterization of focal liver lesions (FLLs). It depicts rapid dynamic changes, largely

attributed to its real time dynamic scans and high temporal resolution.

The objective of this study was to describe the characteristic enhancement patterns of various FLLs on CEUS, assessing the potential of this technique for characterizing these lesions and to compare its diagnostic accuracy with conventional baseline sonography including color Doppler.

## 2. Materials and methods

Between August 2009 and July 2010, a prospective study was conducted and included fifty patients (29 males and 21 females) with a mean age of 52 years (age range from 22 to 79 years). The inclusion criteria were (1) patients of cirrhosis being evaluated for hepatocellular carcinoma (HCC), (2) suspected liver metastasis and (3) incidental detection of focal liver lesions (FLLs) on sonography. The exclusion criteria were (1) history of allergy to drugs or other contrast agents, (2) critically ill or medically unstable patients, (3) portal vein thrombosis because of possibility of impaired hemodynamics, and (4) pregnant patients. Written informed consent was taken from all patients.

**Table 1** Diagnostic criteria for characterization of FLLs.

Focal liver lesion	Baseline gray scale and color Doppler criteria	CEUS criteria
HCC	Heterogeneous echogenicity, satellite nodules, peripheral arterial vessels with intratumoral branches	Diffuse enhancement during arterial phase with washout during portal venous and late phases, giving hypoechoic appearance
Metastasis	Heterogeneous echogenicity, but with no or few vascular signals, and peripheral hypoechoic halo	Enhancing peripheral rim, variable intralesional enhancement during arterial phase that decreases during portal venous and late phases, giving hypoechoic appearance
Hemangioma	Homogeneously hyperechoic, no or few peripheral or intranodular vessels (arterial or venous)	Nodular peripheral enhancement during arterial phase, with centripetal progression during portal venous and late phases
Focal nodular hyperplasia	Homogeneous, variable echogenicity, central arterial vessel with spoke wheel appearance	Central spoke wheel-shaped enhancement during early arterial phase that becomes homogeneous during late arterial phase, homogeneous enhancement similar to that of the liver parenchyma during portal venous and late phases, hypoechoic central region corresponding to scar during late phase
Hepatocellular adenoma	Variable echogenicity, intralesional venous signals, peritumoral venous and arterial signals, absence of central artery	Diffuse homogeneous or heterogeneous enhancement during arterial phase, enhancement similar to that of the liver parenchyma during portal venous and late phases, homogeneous or heterogeneous
Focal fatty sparing	Hypoechoic, triangular shape, segmental distribution, no vessels	Homogeneous enhancement similar to that of the surrounding liver parenchyma during all phases
Focal fatty change	Homogeneously hyperechoic, no vessels	Homogeneous enhancement similar to that of the surrounding liver parenchyma during all phases

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