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Original Article

Efficacy of contrast enhanced grey scale ultrasound in characterisation of hepatic focal lesions: A pilot study

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ABSTRACT

Background: Contrast enhanced ultrasound (CEUS) has recently gained widespread acceptance as an adjunct to conventional grey scale ultrasound. The present pilot study was undertaken to evaluate the efficacy of this technique in characterisation of hepatic focal lesions.

Methods: Adult patients who had at least one focal liver lesion underwent ultrasound evaluation in regular and contrast mode before and after intravenous administration of sulphur hexafluoride. The diagnoses were confirmed by comparison with a reference standard (multidetector CT), response to treatment or pathological correlation.

Results: The rate of correct diagnosis for unenhanced ultrasound was 54%, CEUS was 72% and multidetector CT (MDCT) was 92%. A comparison of unenhanced ultrasound versus CEUS using the McNemar test yielded a p value of 0.0704 (>0.05). However, comparison of CEUS versus MDCT using the McNemar test yielded a p value of 0.0265 (<0.05). Additionally, comparison of unenhanced ultrasound versus MDCT using the McNemar test yielded a p value of <0.0001.

Conclusion: CEUS increases diagnostic efficacy over unenhanced ultrasound but does not have any significant advantages over MDCT. Currently it may be used as a problem solving tool in atypical haemangiomas, echogenic focal liver lesions, contrast sensitivity and to avoid multiple studies utilising ionising radiation.

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Introduction

Ultrasound is a widely available imaging technique which is particularly useful in non-invasive evaluation of abdominal solid organs. In recent years contrast enhanced ultrasound (CEUS) techniques have added another facet to conventional grey scale ultrasound. This technique shows tissue perfusion and patterns of enhancement in various phases after intravascular injection of a microbubble contrast agent. Like conventional grey scale ultrasound it is free from the risks associated with ionising radiation and it has the advantage over iodinated contrast media that it has no risk of nephrotoxicity.[1]

Very little work has been carried out in this fascinating modality due to the fact that till very recently ultrasound contrast agents (UCAs) had not been licenced for use in our country. These agents are tiny bubbles of gas in a supporting shell. The characterisation of liver focal lesions is an established use of CEUS. The present study was a pilot study to evaluate and characterise hepatic focal lesions using contrast harmonic imaging with the UCA sulphur hexafluoride.

Materials and methods

Subject population: The subjects were the patients who had been referred for a contrast enhanced ultrasound study after detection of a focal lesion in the liver in a previous ultrasound study.

Inclusion criteria: Adult patients in the age group of 20–70 years who had at least one hepatic focal lesion detected in the liver in a previous ultrasound study were included in the study. Availability of informed consent for the intravenous administration of contrast media was essential for inclusion.

Exclusion criteria: UCAs have been associated with ventricular ectopic beats and have been known to cause increased capillary permeability in animal models. Moreover, adequate information regarding safety in pregnancy is not available. Patients with diffuse liver disease, cardiac disease and pregnant women were therefore excluded from the study. Patients who had iodinated contrast administration in the previous 48 h, lithotripsy in the previous 72 h and liver biopsy in the previous 24 h were also excluded from the study.

Procedure and imaging: Ultrasound imaging was carried out before and after IV administration of sulphur hexafluoride in regular and contrast mode. Relevant frozen images and cine loops were recorded. Patients were monitored for 30 min after completion of imaging. A provisional diagnosis was made on the basis of unenhanced and contrast images.

Baseline ultrasound: All subjects underwent a baseline scan documenting the liver focal lesion and its characteristics including dimensions, shape, number, margins, echogenicity, posterior enhancement, shadowing and calcification, if any.

Contrast administration: All patients received sulphur hexafluoride intravenous contrast media. Sulphur hexafluoride (SonoVue, Bracco Imaging SpA, Milan) is available as a lyophilised powder in vials which are reconstituted with 5 ml saline. The reconstituted solution has 8 μl sulphur hexafluoride in microbubbles per ml. Each patient received 2.5 ml of this solution followed by a 10 ml saline flush.

Contrast enhanced ultrasound: Coded harmonic contrast imaging was carried out on a Logiq P5 ultrasound scanner (GE Healthcare). Routine imaging was carried out using a convex probe (transmitting frequency 4.0 MHz, mechanical index 0.1) and focus set at the region of interest. Using the timer video clips were recorded in DICOM format.

Follow up/confirmation of diagnosis: Confirmation of the diagnosis was by further imaging (by a reference standard) or response to treatment or by pathological correlation.

Reference standard: The reference standard for the study was triple phase multidetector contrast enhanced computed tomography.

Image reading: All images were read by an onsite investigator and a blinded remote investigator. The images were evaluated using established criteria.[2] The diagnosis was arrived at by consensus in case there was a discrepancy between the two readings. Investigators described the final diagnosis and allotted one of the following five groups – hepatocellular carcinoma, metastasis, haemangioma, other benign lesion and other malignant lesion.

Results

A total of 50 patients of hepatic focal lesions were evaluated by contrast enhanced ultrasound using the contrast agent sulphur hexafluoride. There were 27 male patients and 23 female patients in an age range of 26–69. There were 16 cases of hepatocellular carcinoma, 16 cases of metastases, 9 cases of haemangioma, 7 cases of other benign lesions and 2 cases of other malignant lesions. The various diagnoses arrived at by different modalities (unenhanced ultrasound, contrast enhanced ultrasound and multidetector CT) are summarised in Table 1. Observers also collated the rate of correct diagnosis in cases of malignant lesions and benign lesions. The findings are summarised in Table 2.

As has been summarised above the rate of correct diagnosis for unenhanced ultrasound was 54%, CEUS was 72% and MDCT was 92%. A comparison of unenhanced ultrasound versus CEUS using the McNemar test yielded a p value of 0.0704 (>0.05). However, comparison of CEUS versus MDCT using the McNemar test yielded a p value of 0.0265 (<0.05). Additionally, comparison of unenhanced ultrasound versus MDCT using the McNemar test yielded a p value of <0.0001.

As is clear from the foregoing the correct rate of diagnosis was greater for CEUS as compared to unenhanced ultrasound. However this difference was not statistically significant and may have arisen due to chance. Similarly the correct rate of diagnosis was greater for MDCT as compared to CEUS. This difference was statistically significant. However, the correct rate of diagnosis was greatest for MDCT as compared to unenhanced ultrasound. This difference was markedly statistically significant.

Discussion

Ultrasound contrast agents are composed of small gas bubbles which enhance echo from blood. Specialised imaging techniques are required for CEUS which employ a low Mechanical