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Medical Review Report

CEUS : Interpretation of Focal Liver Lesions in Children

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How to use CEUS as a problem solving tool in clinical practice? A series of case studies for best practice.

- Prof. Paul S. Sidhu EFSUMB President (2017-2019)

Introduction

The use on contrast enhanced ultrasound (CEUS) in adults is well established, with experience worldwide exceeding 20 years, with numerous studies and guidelines confirming the efficacy of the technique[1;2]. Until recently there was no license for the use of ultrasound contrast agents (UCA) in children, but the application of this technique in children would have considerable benefits[3;4], predominantly in the reduction of radiation dose associated with Computed Tomography (CT) and the absence of the ill effects associated with sedation or anaesthesia of a Magnetic Resonance (MR) study, as well as the associated morbidity of contrast agents used in CT and MR imaging[3-5]. This is particularly pertinent as the currently commonly used UCA, Lumason™ (Bracco, SpA, Milan) has an excellent safety record in adults, and with mounting evidence of safety in children[6]. Furthermore a recent analysis of the safety and cost-effectiveness in children confirms that this scenario in the adults is replicated in children[7]. Recently, the Food and Drug Administration (FDA) approved the use of Lumason™ for the assessment of focal liver lesions both in the adult and pediatric patients, allowing for this technique to be deployed in children when an incidental focal liver lesion has been identified on an sonographic examination[8]. The accuracy of the use of UCA in indeterminate focal liver lesions in children has been previously investigated with favourable findings[9]. Furthermore, many practitioners, particularly in European countries have for many years used UCA 'off-label' in children, establishing the practicality and usefulness in assessing solid organ injury in blunt abdominal trauma[10].

The introduction of CEUS into regular clinical practice for children will take some time, as deployment of the traditional imaging techniques will predominant, with established experience a barrier to the implementation of the newer technique of CEUS. Nevertheless, the continued perseverance of many involved in CEUS examinations and also the growing number of pediatric-based clinicians using UCA, will drive the increased utilization of this technique. Although licensing in the United States of America is solely for focal liver lesions via the intravenous route, the intra-cavitary use for vesico-ureteric reflux is also approved. Many enterprising imagers have used Lumason™ in other organs of the body, and in particular solid organ trauma[10].

Two cases of focal liver lesions are presented illustrating the usefulness of adding a UCA to the sonographic examination as a problem-solving tool, forgoing the need for any further CT or MR imaging.

Case I

A 5-year-old boy was referred following a sonographic examination for abdominal pain, with a 2-week preceding history of fever and vomiting and an abdominal mass on clinical examination. Within the liver was a heterogeneous liver mass in segments V and VI, measuring 86 x 70 x 60mm, with no color Doppler flow detected (Figures 1 and 2). The portal vein was patent. A small amount of free fluid was seen, and small mesenteric lymph nodes identified. There was no evidence of an acute appendicitis on the scan. The exact nature of the abnormality was uncertain, and a CEUS examination was performed. A 1.2 mL dose of Lumason™ was administered and appearances were in keeping with a biloculated abscess, with peripheral rim enhancement, septations and an avascular central portion (Figures 3 and 4). The appearances of the central abscess cavity allowed for confident percutaneous catheter drainage with pus aspirated which grew *Streptococcus milleri*. The child was treated with intra-venous antibiotics and made a full recovery.

Figure 1. Heterogeneous focal liver mass.

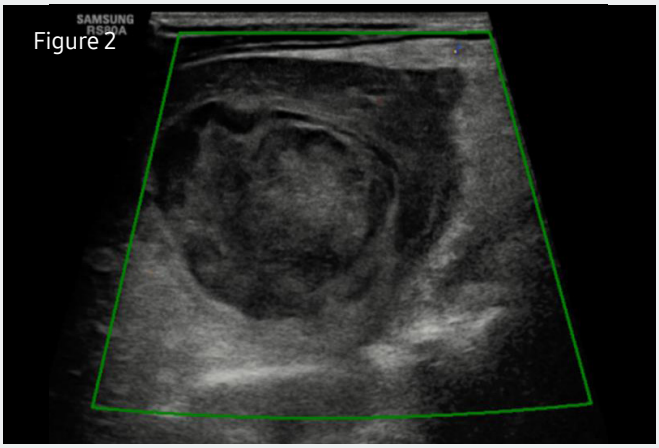

Figure 2. No color Doppler signal from the lesion.

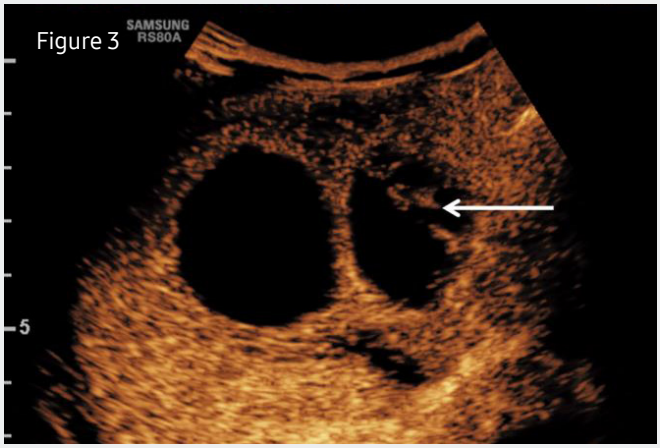

Figure 3. Portal venous phase with evidence of irregular septate (arrow).

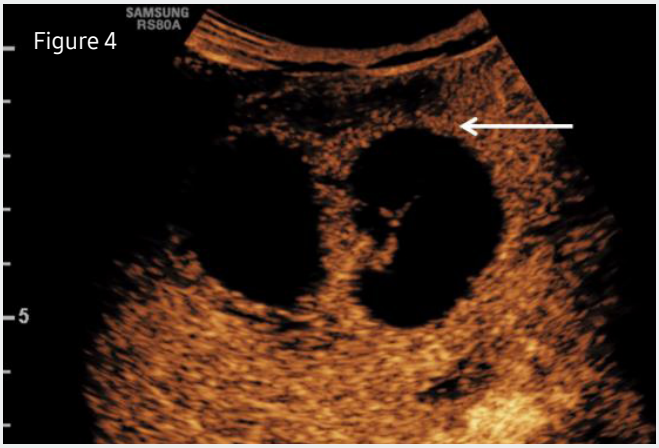

Figure 4. Hyper enhancement of the wall of the abscess (arrow).

Case II

A 16 year old boy presented with two focal lesions on a routine sonographic examination following a bout of upper abdominal pain. At the age of 4 years a medulloblastoma was successfully managed, and at the age of 15 years a meningioma was resected. On the baseline sonographic examination, two lesions were identified on a background of hepatic-steatosis; a small (7mm) low-reflective area adjacent to the gallbladder fossa, thought to be focal fatty sparing, and a larger (34 x29mm) low-reflective, irregular area in segment V of the liver, with increased vascularity (Figures 5 and 6). A CEUS examination was performed with 2.4 mL of Lumason™ injected with early central spoke-wheel enhancement present, a general hyper-enhancement of the entire lesion in the early portal venous phase, and retention of the UCA in the late portal venous phase consistent with the classical features of focal nodular hyperplasia, with a central non-enhancing scar visible (Figures 7 and 8). The lesion remains stable on follow-up.

Figure 5. A low reflective irregular focal liver lesion with a background of a fatty liver.

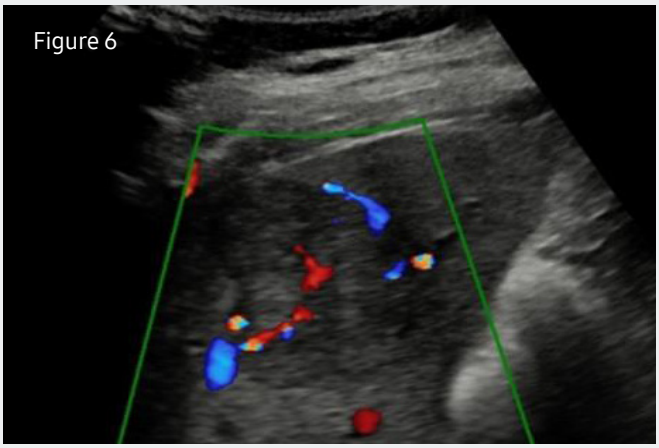

Figure 6. Central color Doppler flow is noted in the distribution as shown.

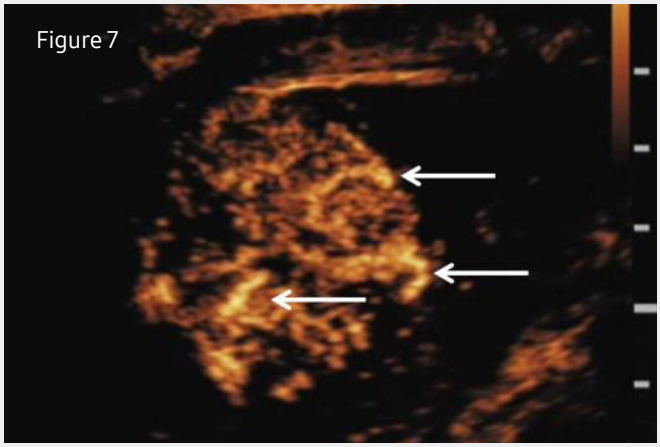

Figure 7. The early arterial phase with hyper enhancing of the lesion in comparison to the background liver, and with the classical spoke wheel appearance (arrows) of focal nodular hyperplasia.

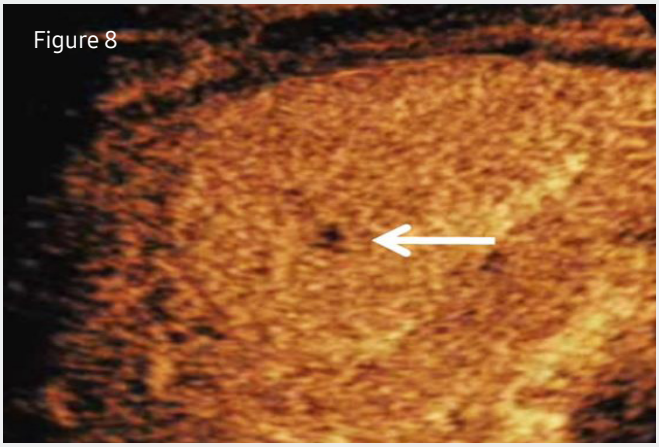

Figure 8. Late portal venous phase with the lesion remaining iso-enhancing with the background liver with a non-enhancing central scar visible (arrow), in keeping with focal nodular hyperplasia.

Conclusion

These two pediatric cases illustrate the utility of using CEUS in problem solving, with minimal discomfort to the child, aside from the insertion of an intravenous cannula. The dynamic real time nature of the sonographic examination allows the examiner to formulate an opinion over a matter of minutes. In both these cases a confident forward management plan on the sonographic findings alone enabled appropriate patient management.

Supported Systems

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