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Centrifugal (inside-out) enhancement of liver hemangiomas: A possible atypical appearance on contrast-enhanced US

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Abstract

Objective: To report the prevalence and to describe the atypical centrifugal (inside-out) appearance of contrast-enhancement of liver hemangiomas on contrast-enhanced sonography.
Materials and methods: Baseline and SonoVue®-enhanced ultrasonography of 92 patients with 158 liver hemangiomas – considered atypical at grey-scale examination and confirmed by computed tomography, magnetic resonance imaging and ultrasound follow-up – were reviewed in consensus by two experienced radiologists, who evaluated baseline echogenicity and the dynamic enhancement pattern of each lesion looking for the presence of central enhancing foci in the arterial phase followed by a centrifugal (inside-out) enhancement in the portal-venous and late phases.
Results: After administration of SonoVue®, 12/158 hemangiomas (7.6%) (size range: 1–7 cm; mean: 3.2 cm) in seven patients (5 women, 2 men; age range: 34–71 years, mean: 50.8 years) showed a central enhancing focus in the arterial phase followed by a centrifugal enhancement in the portal-venous and late phases. In all cases centrifugal enhancement was incomplete at contrast-enhanced sonography, whereas computed tomography and/or magnetic resonance imaging were able to depict a complete and homogeneous fill-in.
Conclusion: Radiologist should be aware that centrifugal (inside-out) appearance on contrast-enhanced sonography is a rare but possible feature of liver hemangioma.

Keywords: Liver; Hemangiomas; Liver neoplasms; US; Ultrasound; Contrast media; Pulse inversion harmonic imaging

1. Introduction

Hemangioma is the most common benign tumour of the liver, with a prevalence ranging from 1–2% to 20% among the general population and a higher prevalence in females than in males (ratio 2:1–5:1) [1]. The differential diagnosis between hemangiomas and other hepatic tumours is of clinical relevance, especially in cancer patients, since hemangioma is frequently an incidental finding of abdominal ultrasound (US) scan. Unfortunately, hemangiomas may not show typical features on B-mode US, described as homogeneous, hyperechoic mass with well-defined margins and posterior acoustic enhancement, thus making the right diagnosis a difficult task [2].

Contrast-enhanced sonography (CEUS) is being increasingly used as first-line tool for both detecting and characterising hepatic liver lesions [3–8]. In particular, some studies have demonstrated that contrast-enhanced sonography (CEUS) is helpful in diagnosing hepatic hemangiomas, including those assessed as atypical at baseline US [9]. Nonetheless, atypical imaging findings of hemangiomas may also occur when contrast agents are administered. For example, centrifugal (inside-out) enhancement pattern of hemangiomas is described on dynamic contrast-enhanced computed tomography (CT) and magnetic resonance imaging (MRI) [10].

The objective of this study was to report the prevalence and to describe the atypical inside-out appearance of hepatic hemangiomas on CEUS, assessing the potential of this technique for characterising these lesions.

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2. Materials and methods

2.1. Patients and lesions

The institutional review board gave approval for the entire study. A retrospective analysis was performed of the records of all patients referred to our Institution between January 2003 and February 2006 who underwent CEUS for the assessment of liver hemangioma with atypical appearance at baseline US scan. The initial selection criteria for the study were (1) a definite diagnosis of hepatic hemangioma, (2) absence of typical appearance at baseline US scan (hyperechoic lesions with homogeneous echotexture, well-defined margins and posterior wall enhancement) and (3) a contrast-enhanced US of the liver. A total of 92 patients (57 women, 35 men; age range: 21–79 years, mean: 52.2 years) with 158 hepatic hemangiomas (size range: 1–11 cm; mean: 3.2 cm) were retrieved.

2.2. Standard of reference

In all cases the final diagnosis was made by means of multidetector-row computed tomography (MDCT) and/or magnetic resonance imaging (MRI) findings and at least 1 year US follow-up.

CT studies were performed by means of a multidetector (40-slice) Philips Brilliance scanner (Royal Philips Electronics, Andover, MA, USA) with the acquisition of non-enhanced and contrast-enhanced images – after administration via a 18- or 20-G needle cannula in an antecubital vein of the right arm of a dose of 1.5 mL/kg of body weight of iomeprol (400 mg I/mL) (Iomeron Bracco, Milan, Italy) at a rate of 4 mL/s by power injector – including hepatic arterial-dominant phase (25–35 s from injection of intravenous bolus of contrast material), portal-venous-dominant phase (60–80 s), and equilibrium phase (2–5 min or even longer).

The MRI protocol included pre-contrast axial breath-hold T2-weighted FSE sequences either with or without fatsaturation and unenhanced and gadobenate-dimeglumine-enhanced spoiled T1-weighted sequences. Contrast-enhanced study was obtained after the administration of an IV bolus of 0.1 mmol/kg of gadobenate-dimeglumine (MultiHance, Bracco, Milan, Italy) injected at a flow rate of 2–2.5 mL/s and flushed by 20 mL of sterile saline solution acquiring images until 10–20 min from beginning injection of contrast material.

Strict imaging criteria were employed including nodular peripheral enhancement followed by centripetal fill-in, change to isodensity on CT or isointensity on MRI with the blood vessels and a complete fill-in in the late phase on contrast-enhanced images. In particular, since nodular peripheral enhancement followed by centripetal fill-in could not be used as imaging diagnostic criteria for hemangiomas showing inside-out contrast-enhancement pattern, in these latter cases in order to confirm the final diagnosis the following criteria were used: change to isointensity on MRI and isodensity on CT with the blood vessels on contrast-enhanced images with a complete fill-in in the late phase, high signal intensity on T2-weighted images, and lack of interval 6–12 months increase in size at US follow-up.

2.3. US technique

Scanning was performed by one experienced radiologist using either an HDI 5000 unit (ATL, Bothell, Washington, USA) or an iU22 unit (Philips Ultrasound, Bothell, Washington, USA) both of them provided with a C5-2 convex array probe and Pulse Inversion imaging software. A baseline survey examination, including a colour/power Doppler analysis, was performed. Once set the US scan parameters – such as focal zone and time gain compensation – were not changed throughout a study. The US contrast agent used in the present study was a sulphur hexafluoride-based compound (SonoVue® Bracco, Milan Italy) injected intravenously as a bolus in a 2.4 mL (equivalent to a 0.003 mL/kg for 70 kg body weight) followed by 5 mL of normal sterile saline flush, by using a 20- or 22-gauge peripheral intravenous cannula. A low frame-rate (5 Hz) and a very low mechanical index (MI = 0.05–0.09) were used. One focus was positioned below the level of the lesion. Each exam lasted about 5 min after bolus injection. In patients with multiple lesions a 2.4 mL further bolus of SonoVue® was administered for each lesion, with an interval time at least of 15 min to allow for contrast clearance of the previous contrast injection. No contrast agent was appreciable either in the liver parenchyma or hemangiomas before starting a new examination. According to our institutional policy, all patients gave their full written informed consent before CEUS examination and the procedure followed was in accord with the Declaration of Helsinki.

2.4. Image analysis

Digital cineloops were registered both during baseline and post-contrast US scanning in the arterial (i.e., 10–35 s from beginning of contrast agent bolus injection), portal-venous (i.e., 55–80 s from beginning of injection), and late (i.e., 235–260 s from beginning of injection) phases. All cineloops were digitally stored as raw-data in a PC-based workstation connected to the US units via a standard Ethernet link. Two radiologists experienced in contrast-enhanced US studies of the liver, blinded to the final diagnosis and not involved in the scanning reviewed all cineloops off-line. The two readers evaluated by consensus the baseline echogenicity and the dynamic enhancement pattern of each lesion in the arterial, portal-venous, and late phases in comparison with adjacent liver parenchyma.

The following parameters were considered:

- Baseline echogenicity of the lesions (hypoechoic, isoechoic, and mixed lesions);
- Echotexture of the lesions, divided into homogeneous and inhomogeneous;
- Changes in the echogenicity and enhancement pattern after contrast injection.

Homogeneity and progression of enhancement were also evaluated. In particular the fourth selection criterion for our