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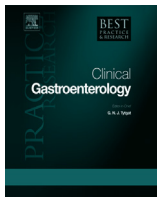

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Hepatocellular carcinoma: Diagnostic criteria by imaging techniques

Maxime Ronot, MD, PhD, Abdominal radiologists [a, b, c, *], Valérie Vilgrain, MD, PhD, Abdominal radiologists [a, b, c]

[a] Department of Radiology, APHP, University Hospitals Paris Nord Val de Seine, Beaujon, Clichy, Hauts-de-Seine, France
[b] University Paris Diderot, Sorbonne Paris Cité, Paris, France
[c] INSERM U1149, centre de recherche biomédicale Bichat-Beaujon, CRB3, Paris, France

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A B S T R A C T

Imaging plays a very important role in the diagnosis of HCC. Indeed, in high-risk patients a noninvasive diagnosis can only be obtained by imaging in presence of typical features. These features include arterial enhancement followed by washout during the portal venous and/or delayed phases on CT scan or MRI. This pattern is quite specific and has been endorsed by both Western and Asian diagnostic guidelines. However, its sensitivity is not very high, especially for small lesions. Therefore ancillary signs may be needed to increase the reliability of the diagnosis. Recent hepatobiliary MRI contrast agents seem to be interesting to improve characterization of small nodules in the cirrhotic liver.

Introduction

Like any other tumour hepatocellular carcinoma (HCC), presents with numerous, variable imaging features depending on the extension and biological behaviour. None of these features are specific, and a diagnosis is based on their combination. The diagnosis of HCC is often faced with two different clinical situations. The first occurs in a patient without known chronic liver disease. In this setting, patients

* Corresponding author. Department of Radiology, Beaujon Hospital, AP-HP, 100 Boulevard du Général Leclerc, 92118 Clichy, France. Tel.: +33 1 40 87 55 66; fax: +33 1 40 87 05 48.
E-mail address: maxime.ronot@bjn.aphp.fr (M. Ronot).

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have not received regular monitoring and tumours are often large and may have vascular invasion. In these cases imaging features are usually typical enough to obtain a reliable diagnosis or to narrow it down to a limited group of differential diagnoses. Biopsy is usually performed to confirm the diagnosis. The second much more challenging situation occurs in patients with chronic liver disease (e.g. cirrhosis or advanced liver fibrosis) under regular monitoring, generally with ultrasound (US). In these cases small lesions are found and the role of imaging is to differentiate HCC from several non-malignant cirrhosis-associated nodules (e.g., regenerative, low and high grade dysplastic nodules), benign lesions or pseudolesions that may be encountered in the cirrhotic liver (e.g., haemangiomas, focal or confluent fibrosis, transient perfusion disorders), as well as other malignant lesions, intrahepatic cholangiocarcinoma (ICC), the most common being liver metastases. In oncology, the diagnosis of malignancy usually requires tissue sampling prior to determining the therapeutic strategy. However, HCC is an exception because a non-invasive diagnosis can be achieved with imaging in these high-risk populations, explaining its key role in patient management [1–4]. Nevertheless a necessary condition is that imaging criteria must be nearly 100% specific for HCC. Therefore, biopsy is mostly indicated in indeterminate nodules that do not satisfy radiological criteria for HCC [1–3,5]. It is also important to note that while tumours less than 2 cm in diameter represented <5% of the cases in the early nineties in Europe, they now represent up to 30% of cases in Japan [1]. This trend is expected to continue to grow due to the implementation of monitoring policies in the developed countries.

HCC can be explored by US, contrast-enhanced US (CEUS), computed tomography (CT), and magnetic resonance imaging (MRI). Other imaging techniques such as angiography, CT angiography, CT portography or positron emission tomography are not routinely performed in the Western countries. The hallmark diagnostic features of HCC are early tumoral enhancement corresponding to tumour hypervascularity followed by progressive washout of the contrast agent [6–11]. Proper visualization of these features requires strict technical acquisition protocols and basic knowledge of the performance of the different imaging techniques, alone or in combination. Finally, ancillary features have been described and are useful in difficult cases. None of them are specific for the diagnosis of HCC, but they could improve or decrease the reliability of the diagnosis.

The purpose of this chapter is to review the diagnostic criteria of HCC. First, technical considerations of image acquisition and contrast agents are described. The main diagnostic features of HCC are then discussed followed by ancillary features (mainly obtained with MRI). Finally non-invasive diagnostic algorithms are also discussed.

Technical considerations

Because the diagnostic criteria of HCC are mainly based on tumour enhancement, optimization of temporal acquisition is a key factor. With CT and MRI, multiple temporal windows are chosen with specific timing (multiphasic acquisitions), whereas CEUS allows real time imaging. Tumour enhancement depends on the kinetics of the contrast agent and the injection protocol. Contrast agents can be divided into four groups according to their vascular and extravascular behaviours, thus providing complementary information.

Extracellular contrast agents (all CT contrast agents and most MRI gadolinium-based contrast agents). These agents include various iodine (CT scan) or gadolinium-based (MRI) molecules all presenting with similar kinetics. After injection, they are characterized by a vascular phase, when the molecules travel through arteries and veins mixed with blood. The molecules progressively diffuse out of the vascular compartment into the extracellular spaces but remain strictly extracellular, and therefore do not penetrate hepatocytes. These kinetics are analysed by multiphasic acquisitions, obtained before (precontrast) during, and after contrast agent administration. For MRI, three-dimensional T1-weighted GE sequences with fat signal saturation are usually used for this dynamic imaging process. Most teams use three enhanced phases: arterial, portal venous, and delayed phases. The first phase is designed to capture the arterial enhancement peak of tumours, which is crucial because HCC is characterized by neoangiogenesis. The portal venous phase is obtained during enhancement of the liver parenchyma.

The changes in the signal of the lesions during each phase is qualitatively compared to the precontrast images. When lesions show arterial phase enhancement, the terms arterial ‘wash-in’ or