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Review Article

Current methods of focal liver lesion diagnosis

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ABSTRACT

Introduction: The widespread availability of non-invasive radiological and diagnostic imaging techniques significantly contributed to the detectability of focal lesions in the liver. Ultrasonography, computed tomography (CT) multidetector CT (MDCT), conventional magnetic resonance imaging (MRI), diffusion-weighted magnetic resonance imaging (DW-MRI) and isotope imaging are used for focal liver diagnosis.

Aim: This article reviews the available methods for diagnosing focal liver lesions on the basis of current literature.

Discussion: The diagnostic precision of a conventional ultrasound test in detecting and differentiating focal hepatic lesions is estimated at 62%. Its sensitivity for the detection of metastases ranges from 40% to 80%. If the majority of metastatic tumors are small, the sensitivity of ultrasound tests decreases dramatically to 20% for foci smaller than 1 cm.

Multi-phase hepatic CT is the current standard that effectively diagnoses 63%–87% of focal changes in the liver. In many cases, standard MRI is sufficient for differentiating between benign and malignant tumors, but the results are often inconclusive. DW-MRI has emerged as a highly promising technique for oncological imaging, and it is used at various stages of oncological treatment.

The discussed method does not require the administration of intravenous contrast, therefore, it is easy to repeat and useful in patients who suffer from severe renal dysfunctions and are at the risk of nephrogenic systemic fibrosis.

In diagnosis of hepatic metastases, the sensitivity of 18F-FDG-PET/CT scans reaches up to 96%, and their specificity is estimated at 75%.

Conclusions: Among various imaging techniques diffusion-weighted imaging has emerged recently as a highly promising one.

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1. Introduction

The widespread availability of non-invasive radiological and diagnostic imaging techniques significantly contributed to the detectability of focal lesions in the liver. Accidentally detected benign tumors occur in around 15% of the healthy population,[24] and the probability that focal changes are malignant in persons with no cancer history does not exceed 1%.[13,24] It is estimated that around 20% of focal liver lesions (which are not simple cysts) observed in patients with malignancies are benign, but such changes are regarded as metastases until they are ruled out. Metastatic tumors account for 95% of all hepatic malignancies, while primary tumors for only 5%.

The liver is the second most common site of metastasis after regional lymph nodes.[16] In around 90% of cases, liver metastases are multifocal. The size of metastatic foci may vary, and it may exceed 10 cm. Lesions smaller than 2 mm are not detected by the available imaging methods.

Subject to the degree of vascularization, metastases are classified as richly or weakly vascularized. Richly vascularized (hypervascular) tumors are characterized by rapid, early contrast wash-in, and they are more enhanced that the remaining liver parenchyma in the arterial phase of dynamic magnetic resonance imaging (MRI) after intravenous contrast administration. Due to a higher wash-out rate, a rapid drop in signal intensity is observed in metastases in later phases of dynamic MRI (computed topography – CT), and ultimately, those lesions become hypointensive compared to a normal liver.

The more frequently encountered weakly vascularized metastases are characterized by low blood flow in the tumor, and their contrast enhancement remains low at all stages of a dynamic exam. Hypovascular metastases are most often caused by colorectal cancer, pancreatic cancer, lung cancer, pharyngeal carcinoma, melanoma, ovarian cancer, breast cancer, cervical cancer and liposarcoma. Infiltrations in non-Hodgkin lymphoma and Hodgkin lymphoma are also hypovascular.

The liver is also affected by benign tumors which are often very difficult to differentiate from malignant neoplasms. The most common benign lesions are cysts (5%–10% of the population), hemangiomas (5%–20%),[13,24] foci of fatty degeneration and focal nodular hyperplasia (around 3%). Less frequent benign tumors include adenomas (mostly in women using hormonal contraceptives, 3–4/100,000)[24] and abscesses. In most cases, hepatic metastases have to be differentiated from hemangiomas owing to their similar appearance in imaging tests and the high frequency of hemangioma occurrence.

2. Aim

This article reviews the available methods for diagnosing focal liver lesions on the basis of current literature.

3. Discussion

3.1. *Ultrasonography*

Ultrasonography with or without contrast agents is the most common and generally the first imaging method used to examine the parenchymal organs of the abdomen, including the liver. The diagnostic precision of a conventional ultrasound test in detecting and differentiating focal hepatic lesions is estimated at 62%.[13] Its sensitivity for the detection of metastases ranges from 40% to 80%,[9,13,31] subject to the tumor's diameter and the examiner's experience, and it rarely exceeds 80%. It should be noted, however, that the majority of metastatic tumors are small, and the sensitivity of ultrasound tests decreases dramatically to 20% for foci smaller than 1 cm.[13]

Intraoperative ultrasound (IOUS) imaging, which requires probes with a frequency of 7.5 MHz and higher, is characterized by improved spatial resolution, and it supports the detection of surface-located tumors with a diameter of only 2 mm.

Elastography is a new non-invasive technique that complements a basic ultrasound exam. This method has been most often applied to characterize breast tumors.[6] It is also used to examine patients with chronic liver diseases.

3.2. *Computed tomography*

A CT scan of the liver without the intravenous administration of contrast media has limited diagnostic value.[1] Multi-phase hepatic CT (MDCT) is the current standard that effectively diagnoses 63%–87% of focal changes in the liver.[25]

3.3. *Magnetic resonance imaging*

MRI is emerging as the most accurate method for detecting and differentiating focal liver lesions.[16,17,30] It provides better contrast between different soft tissues than CT, and the latest MRI scanners offer spatial and temporal resolution comparable with that of CT. MRI has a small number of absolute contraindications, such as a heart pacemaker, a metallic foreign body in the eye or cochlear implants.

Conventional MRI, including T1-weighted imaging with and without contrast enhancement, T2-weighted imaging, fat suppression sequences (SPAIR – spectral attenuation with inversion recovery, STIR – short T1 inversion recovery, chemical shift imaging) and MR angiography support determinations of the size and location of hepatic tumors (including in relation to blood vessels and bile ducts) and, to a certain extent, evaluations of tumor tissue composition. In many cases, standard MRI is sufficient for differentiating between benign and malignant tumors, but the results are often inconclusive.

MRI scans performed with the use of hepatotropic contrast agents which are captured and excreted by the hepatocytes support the differentiation of tumors which contain normal hepatocytes from lesions that do not contain hepatocytes or contain abnormal hepatocytes.

Hepatotropic contrast agents improve the detectability of small (<1 cm) focal liver lesions. In patients affected by renal failure, contrast agents containing gadolinium may cause nephrogenic systemic fibrosis (NSF); therefore, kidney function has to be examined before the administration of a contrast