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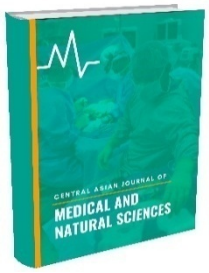

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Magnetic Resonance Tomography in Diagnostics and Differential Diagnostics of Focal Liver Lesions

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ABSTRACT: Differential diagnosis of focal liver lesions remains a difficult problem. In difficult diagnostic cases, MRI (with intravenous contrast) can be of decisive importance, which allows you to identify the characteristic features of the display of various liver neoplasms and plan an adequate treatment tactics.

Keyword : MRI, liver, neoplasms

The importance of the functions of the liver in the human body is well known; therefore, it can be said that the liver (along with the lungs) is the most frequently examined organ in a significant number of human diseases. The widespread introduction of modern methods of ultrasound studies in practical health care makes it possible to identify a large number of various, including volumetric, pathological processes in the liver, however, their differential diagnosis can be significantly complicated due to the small size of the foci, the absence of characteristic signs, or atypical manifestations. In these cases, it is advisable to use more complex diagnostic methods: spiral (multispiral) computed tomography (CT), angiography, magnetic resonance imaging (MRI).

Assessment of the state of the liver is of particular importance in cancer patients, when the rational tactics of treatment and the corresponding prognosis of the disease are directly determined by both the volume of the primary tumor process and the presence or absence of metastases (in the liver). At the same time, it is a known fact that about 50% of small-focal (up to 1.0-1.5 cm in diameter) formations in the liver of patients with malignant tumors are benign (hemangiomas, cysts) [4]. This circumstance forces us to pay the most serious attention to the problem of differential diagnosis of such foci (for example, in order to prevent an unreasonable refusal from radical surgery). Differential diagnosis of larger formations in the liver is also not always simple and unambiguous (given the variety of representations of formally identical processes).

Hepatocellular carcinoma

In the CIS countries, primary liver cancer does not exceed 3-5% of all malignant tumors. There are several macroscopic types of tumor processes: nodal type - an encapsulated, expansively growing node

(with fairly clear boundaries), in the later stages with the development of satellite nodules or intraorgan metastases; infiltrative type - a neoplasm without clear boundaries (diffuse) or lobular; multicentric type - in the form of several nodes of the same type of similar size; mixed type - observed in about 25% of cases.

The variety of macroscopic manifestations of hepatocellular carcinoma (HCC) also determines the variety of its picture on MRI. Tumor size and / or the number of tumor nodes are best assessed by the totality of manifestations of the process in T1 and T2 sequences, as well as in postcontrast T1 sequences. Most often, HCC manifests itself as hypointense on T1 and moderately hyperintense on T2 images, however, the spectrum of tumor manifestations is quite wide: from hypointensity to hyperintensity, both on T1 images and in T2 mode. Small tumors (less than 1.5 cm) can be detected only after the administration of contrast agents. That is why intravenous contrasting with gadolinium preparations, which is carried out according to the standard technique, is of decisive importance. The study begins immediately after intravenous administration of 15-20 ml of gadolinium.

As a rule, HCC is a hypervascular neoplasm and in the arterial phase it is contrasted diffusely inhomogeneously throughout the tumor volume. It can be emphasized that such contrasting heterogeneity persists in the subsequent phases - venous and delayed. This is the main distinguishing feature that makes it possible to differentiate HCC and, for example, metastases, which are contrasted mainly along the periphery in the arterial phase. As mentioned above, the shape and size of the tumor lesion can be very diverse, as well as the contours of the focus: clear, partially clear, indistinct; however, the internal structure of the neoplasm, as a rule, is heterogeneous (occasionally due to inclusions of fat).

Another characteristic feature of HCC is tumor infiltration of the venous system (usually the portal). This sign (i.e. venous thrombosis) is demonstrated by up to 50% of all observations, more often with large and infiltrative tumors. It is manifested by the lack of contrasting of the corresponding venous trunks in certain phases of the study.

Often, with HCC, a pseudocapsule can be detected, hypo-intense in T1- and moderately hyperintense in T2-sequences, with an increase in the signal during contrasting (in delayed phases).

In general, it can be emphasized once again that diffuse heterogeneous contrasting of the entire tumor volume in the arterial phase is the most characteristic sign that allows one to suspect HCC.

Metastases

Revealing The development of metastatic foci in the liver can be associated with certain difficulties due to the diversity of their morphological structure and corresponding physicochemical characteristics. Metastases can be isoechoic on ultrasound, iso-dense on CT, and isointensive on T1 and T2 images (without contrast), i.e., not detected with a simplified diagnostic approach. And then, if multiple metastatic lesions of the liver are detected during surgery, this fact becomes an unpleasant surprise not only for surgeons and diagnostic doctors, but also for the patient himself. We have observed a number of such cases, in particular, with pancreatic tumors.

There are two ways to overcome this problem: firstly, using intravenous contrast (with ultrasound, CT or MRI), assessing the state of the liver in different phases of blood flow; secondly, using an expanded number of MR pulse sequences. The ideology of the first approach, i.e. contrasting, is clear: the blood supply to metastasis cannot be absolutely identical to the blood supply to the surrounding liver parenchyma, and contrasting is designed to reveal this (with ultrasound, CT or MRI). The ideology of the second approach, that is, the use of an extended number of MR-pulse sequences, is based on the fact that the physicochemical characteristics of the metastatic tissue cannot be absolutely identical to the corresponding characteristics of the surrounding normal liver parenchyma. This difference can

(and theoretically should) be detected by some MR pulse sequence. The first approach is now generally accepted.

Our protocols for liver examination (before the introduction of contrast) include the modes "T2-NL8TE transversal and coronal", "T1 -transversal". After injection of 15-20 ml of contrast agent (Magnevist, Omniscan), we perform and evaluate T1-transverse sections in arterial, venous and delayed phases (after 2-3 minutes, maximum after 10 minutes).

MR manifestations of metastases in the T1 and T2 sequences are very diverse. The boundaries of the foci may be partially clear and indistinct. Their shape is often irregular, but can be round or oval. Metastatic foci are usually somewhat hypointense in the T1 mode and slightly hyperintense in the T2 mode. Some metastases (eg, necrotic, islet cell tumors of the pancreas, pheochromocytoma, kidney cancer) have a high signal in the T2 mode, which may resemble the manifestation of hemangiomas.

In general, MR manifestations of metastases without contrasting are rather nonspecific, but it is the use of intravenous contrasting that makes them specific, when in the arterial phase a very characteristic symptom of ring-shaped enhancement along the periphery of the focus (rim symptom) is revealed. It is this symptom that makes it possible to confidently distinguish between metastases and non-metastases. It is believed that the annular enhancement reflects the features of the arterial (parasitic) blood supply to metastasis due to the surrounding parenchyma.

MR manifestations of hypovascular and hypervascular metastases are somewhat different from each other. Thus, hypo-vascular metastases are usually hypointense in T1 and often isointensive in T2 sequences. After the introduction of contrast, they are usually better visible in the venous phase, in the delayed phase, the contours of the focus are blurred, and it seems to decrease in size due to peripheral enhancement.

Hypervascular metastases are displayed in a slightly different way, since they usually have a high signal in the T2 mode and a pronounced peripheral enhancement during contrasting, followed by filling in the central parts of the focus. Metastases of kidney cancer, carcinoid, melanoma, islet cell tumors of the pancreas are referred to as hypervascular. Metastases of breast, lung and intestinal cancers can be hypervascular.

In some cases, differential MR diagnostics of metastases is not very simple. Small hypervascular metastases (up to 1.5 cm) can be contrasted quickly and uniformly, maintaining hyperintensity for about one minute. Small hemangiomas behave in the same way at first, but their state of hyperintensity lasts longer (up to 10 minutes).

In the presence of multiple vague, but outwardly similar small foci in the liver, one can only indirectly assume their nature if at least one of them exhibits properties typical of hemangiomas or metastases.

In general, the following contrasting features are characteristic of metastases: intense peripheral (annular) enhancement in the arterial phase (rim symptom), uniform rim thickness, jaggedness of the inner rim borders (not lumpiness), peripheral rim washout in the presence of more central contrast.

Hemangiomas

As you know, hemangiomas are the most frequently detected focal lesions in the liver. Small hemangiomas are usually round, larger ones are lobed. Their contours are clear, even or wavy. On T1 images, hemangiomas are hypointense, on T2 images, they are hyperintense (but to a lesser extent than cysts).

Most their characteristic feature during intravenous contrasting is a lumpy (nodular) enhancement along the periphery of the focus, slowly increasing over time, and complete or almost complete contrasting of the entire focus for a period of less than 10 minutes. At the same time, there are certain differences in contrasting hemangiomas of different sizes. According to the summary data presented in

the works of R. Semelka et al., Hemangiomas are divided into small (up to 1.5 cm), medium (1.5-5 cm) and large (over 5 cm in diameter). At the same time, there are 3 types of their contrasting:

type 1 - uniform contrasting (enhancement) of the entire focus as a whole immediately after the administration of a contrast agent;

type 2 (the most common) - peripheral lumpy (nodular) strengthening with a gradual uniform filling of the entire focus;

type 3 - similar to the previous one, but with the presence of uncontrolled lacunae or a central scar.

Contrast type l is observed only with small hemangiomas, types 2 and 3 - with foci of any size, type 3 occurs, as a rule, with large hemangiomas.

It can be emphasized once again that the most characteristic feature of contrasting hemangiomas in the arterial phase is the formation of an intermittent nodular ring around the circumference of the focus. Filling of the entire focus usually occurs within 1-2 minutes. Over time, the degree of enhancement, of course, decreases, but this occurs evenly (homogeneously), without signs of peripheral or heterogeneous washout.

It should be noted that small hemangiomas contrasting in type 1 may not differ from small HCC or metastases. Although it is believed that tumor foci are rapidly increasing, they turn pale faster than hemangiomas.

A few words about some of the advantages of using MRI over CT in the diagnosis of hemangiomas. With the help of MRI, it is often possible to differentiate hemangiomas, cysts and metastases even without intravenous contrasting according to the hyperintensity in the T2 mode and clarity of outlines characteristic of cysts and hemangiomas. This allows you to avoid intravenous injections of contrast agents and, in particular, bolus CT-contrasting (with additional, unnecessary radiation of the patient during the 3-4 phases of the study). MRI provides an image of the entire liver in the same contrasting phase, which is important when examining patients with multiple focal changes in the liver (for the purpose of differential diagnosis).

Cysts

Cysts are common, usually multiple and asymptomatic. It is important to note that commonplace cysts always have the same signal intensity as cerebrospinal fluid (for all sequences). Cysts are usually the most easily diagnosed lesions in the liver, which are uniformly hypointense in T1 and uniformly hyperintensive in T2 modes. They have clear, even contours (sometimes a thin wall is differentiated), the structure of the cysts is homogeneous, they do not respond to intravenous contrast. In some cases, for a confident differential diagnosis with poorly vascularized metastases, it is possible to assess the state of the detected foci within 3 — 4—5 minutes after intravenous contrast enhancement. Metastatic foci, unlike banal cysts, react to contrast in one way or another.

Nodular hyperplasia

After hemangiomas, nodular hyperplasia is considered the second most common benign neoplasm of the liver. Nodular hyperplasia is regarded as a vascular malformation associated with nodes of hepatocellular hyperplasia, in other words, as a hyperplastic reaction to arterial malformation.

Typically, nodular hyperplasia is displayed as a mass, slightly hypointense in T1- and slightly hyperintense in T2-, as well as almost isointense in both T1- and T2-modes. In its central sections in 10-49% of observations, a stellate scar (hypointense in T1 and hyperintensive in T2) is detected.

The use of intravenous contrasting allows you to identify very characteristic features of nodular hyperplasia, namely, an intense, uniform strengthening of the entire node in the arterial phase, while the scar remains hypointense (in T1-mode); rapid washout of contrast (after about 1 min), as a result of

which the node becomes isointense; a gradual increase in the degree of contrasting of the central scar - it becomes hyperintense in delayed phases (after 2-3 minutes), which resembles the nature of contrasting hemangiomas (from the periphery to the center).

The described features of the manifestation of nodular hyperplasia are considered very characteristic and may allow avoiding additional diagnostic measures.

Adenoma

Liver adenoma is a benign tumor made up of cells that resemble normal hepatocytes. According to the literature, adenomas are most common in young women using oral contraceptives (i.e. high doses of estrogen). A characteristic feature of these tumors is a tendency to spontaneous hemorrhage and necrosis with the development of corresponding associated complications. Some authors mention the possibility of malignant transformation of adenomas. That is why the most adequate method of their treatment is surgical.

Without contrast, MR manifestations of adenomas are nonspecific. The tumor can be practically iso-intensive in T1- and T2-modes (showing similarity to normal liver parenchyma) or moderately hypointense in T1- and moderately hyperintense in T2-mode. Areas of internal hemorrhage (if any) are displayed with a significant increase in signal on T1 and T2 images.

When contrasting, adenomas become entirely hyperintense already in the arterial phase, but quickly turn pale in the parenchymal phase (within about 1 min), which resembles the manifestations of nodular hyperplasia.

Adenoma and nodular hyperplasia can be distinguished by the following features: the presence of a pseudocapsule, internal hemorrhages and adipose tissue elements is characteristic of adenomas; a central stellate scar is considered a characteristic feature of nodular hyperplasia.

In general, the differential diagnosis of focal changes in the liver using MRI in most cases seems to be a solvable problem. In difficult cases, several tactical options are possible: the first (the simplest, but controversial) - dynamic observation within a period of up to 3 months (with a reevaluation of all the data obtained), the second - puncture biopsy of the focus under the control of ultrasound or CT, the third - preventive destruction of doubtful foci (diameters up to 1.0-1.5 cm) using various interventional procedures (such as radiofrequency ablation).

In conclusion, it should be said that the high diagnostic capabilities of MRI in assessing focal liver lesions do not underestimate the capabilities of other diagnostic methods - for example, ultrasound or spiral (multispiral) CT - but can only supplement them in some cases. Therefore, the role of MRI, in our opinion, should be limited to the use in complex differential diagnostic situations, when the possibility of obtaining additional information or confirmation of already obtained data can have a decisive impact on planning the patient's treatment tactics.

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