Gastrointestinal radiology

MR angiography in abdominal neoplasms

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Abstract. The role of magnetic resonance angiography (MRA) in the evaluation of vascular involvement was studied in 55 patients with abdominal neoplasms. A 2D time-of-flight (TOF) technique was used in all patients. A 3-D TOF technique was used in 18 patients. All patients underwent CT and MR examinations before MRA. Also, MR angiograms were compared with digital subtraction angiography in 22 cases, with Doppler US in 13 cases, and with surgical findings in 20 cases. In all patients with liver neoplasms (n = 29) MRA demonstrated the absence of flow in the infiltrated segments. Percutaneous neovascularization was observed in 12 patients. Portal vein involvement was correctly detected in 27 patients. In all cases MRA demonstrated the relationship between the tumor and venous structures. Portosystemic shunts were visualized in 20 of 21 patients with portal hypertension. Venous cava thrombosis (3 cases), compression (5 cases), and displacement (2 cases) were correctly demonstrated. In renal (n = 6) and adrenal gland (n = 3) tumors renal vein compression was correctly detected in 2 cases, displacement in 1 case, and thrombosis in 3 cases, with only 1 false-positive finding. In 7 patients with pancreatic tumors MRA demonstrated splenic vein thrombosis in 2 cases and compression in 2 cases, with one false-positive finding. Our results indicate that MRA provides precise information regarding venous vascular involvement in abdominal neoplasms, but preoperative arterial mapping is still problematic.

Key words: MRA – Abdomen – Neoplasms

Introduction

The noninvasive ability of magnetic resonance (MR) to visualize vascular structures without contrast agents has been well known since its first clinical applications [1–5]. The use of magnetic resonance angiography (MRA) for imaging abdominal blood vessels has developed relatively slowly. This is due to the technical difficulties in dealing with respiratory and peristaltic motion, and from the different flow direction and velocity in abdominal vessels. Recently, technical developments have occurred, resulting in an increased reliability of MRA and an expansion of its clinical applications, not only in the brain [6–8], but also in the abdomen [9–17]. A variety of MR techniques are being evaluated and developed for use in abdominal MRA. These techniques include phase contrast, echo-planar and time-of-flight (TOF) methods. With the use of selective presaturation pulses and maximum-intensity projection techniques 2D TOF MRA is the most useful and reliable method currently available for MRA in the abdomen [9–10].

The relationship between abdominal neoplasms and their adjacent vascular structures is of a great importance from a surgical point of view, because this information is crucial in determining the correct therapeutic approach. The purpose of this study was to evaluate the role of 2D TOF MRA to define vascular involvement in patients with abdominal neoplasms.

Materials and methods

A total of 55 patients with suspected vascular involvement due to abdominal tumors were studied by MRA. The neoplasm was localized in the liver in 29 patients, in the pancreas in 7, in the kidney in 6, and in the adrenal glands in 3. In addition, 7 patients with lymphomas and secondary retroperitoneal lymphadenopathies, 2 patients with recurrent gastric and ovarian tumors, and a patient with a primary tumor of the inferior vena cava (IVC) were studied.

The following parameters were evaluated: in liver neoplasms, the involvement of the hepatic artery and veins, the splenoportal axis, the superior mesenteric vein, and the IVC; in renal and adrenal gland tumors,
Fig. 1a-d. Large hepatic tumor in a cirrhotic liver. Dynamic CT a shows the tumor and a neoplastic vessel inside the tumor from the hepatic artery. MR angiogram b shows the enlargement of the portal vein and the more distal portion of the hepatic artery (arrow) with neoplastic vessels (arrowheads). Single MR angiogram c allows better evaluation of hepatic artery and left gastric artery with perfect correlation with digital subtraction angiography (DSA) d.

Table 1. Results with magnetic resonance angiography (MRA) in series of 29 liver tumors. C compression; D displacement; E encasement; T thrombosis; GS gold standard (digital subtraction angiography, duplex or surgery); IVC inferior vena cava

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<th>C</th>
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<th>MRA</th>
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<tbody>
<tr>
<td>Portal vein</td>
<td>6</td>
<td>5</td>
<td>2</td>
<td>14</td>
<td>27</td>
<td>27</td>
</tr>
<tr>
<td>Hepatic veins</td>
<td>6</td>
<td>4</td>
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<td>–</td>
<td>10</td>
<td>10</td>
</tr>
<tr>
<td>IVC</td>
<td>5</td>
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The relationship between the tumor and the vessels was classified by two radiologists as compression (reduction in the vessel lumina without flow abnormalities), displacement (changing in the major-vessel axis in relation to the tumor), encasement (vessel surrounded by the tumor for more than 270°), or thrombosis (absence of flow in the vessel).

The results of the MRA were compared with the findings of digital subtraction angiography (DSA) in 22 cases, surgical findings in 20 cases, and Doppler US in 13 cases. The MR imaging was performed with a 1.5 T whole-body imaging system (Siemens, Erlangen, Germany). Prior to MRA all patients were previously imaged with...