We report a case of a 28-year-old woman with hepatocellular adenoma and correlate findings of pathology and magnetic resonance (MR) imaging with gadolinium ethoxybenzyl diethylenetriaminepentaacetic acid (Gd-EOB-DTPA) enhancement. In the hepatobiliary phase, the peripheral region of the tumor that corresponded with proliferating hepatocytes with steatosis showed slight hypointensity compared with the surrounding liver parenchyma, and the central region of the tumor that corresponded with cellular areas showed isointensity.

Keywords: gadolinium ethoxybenzyl diethylenetriaminepentaacetic acid, Gd-EOB-DTPA, hepatocellular adenoma

Introduction

Hepatocellular adenoma is a benign hepatic neoplasm composed of cells that closely resemble normal hepatocytes. Use of a recently available liver-specific contrast medium for magnetic resonance (MR) imaging, gadolinium ethoxybenzyl diethylenetriaminepentaacetic acid (Gd-EOB-DTPA), has become common in the evaluation of hepatocellular lesions.1-5 The medium accumulates in partially benign hepatocellular nodules.5 However, few reports describe the findings of Gd-EOB-DTPA-enhanced MR imaging for hepatocellular adenoma,2 and to the best of our knowledge, no reports detail their correlation with pathological findings. We report a case of hepatocellular adenoma, focusing on the correlation of findings from radiology and pathology.

Case Report

A 28-year-old woman was admitted to our hospital for work-up of myasthenia gravis. She had undergone surgery for uterine cervical carcinoma \textit{in situ} 10 months previously. Her family history was unremarkable, and she had no history of oral contraceptive use. A computed tomographic (CT) scan incidentally revealed a mass of low density, 5 cm in largest dimension, in the left lobe of her liver. The lesion center showed isodensity and its periphery, low density, compared with the density of surrounding normal liver parenchyma. On dynamic study, the center of the lesion was hypervascular in the hepatic arterial-dominant phase, and the peripheral area of the lesion was slightly enhanced. In the late phase, the center of the lesion was isodense, and the peripheral area of the lesion showed low density (Fig. 1). A T1-weighted in-phase MR image showed the periphery of the lesion as hyperintense, and an opposed-phase MR image showed a drop-out signal that indicated fat content (Fig. 2). A central part of the lesion also showed a drop-out signal. A T2-weighted MR image showed the lesion as either iso- or hyperintense compared with the surrounding normal liver parenchyma. T1-weighted (T1WI) parameters (in-phase and opposed-phase) were: repetition time (TR)/echo time (TE), 120/4.76, 2.38 ms; flip angle, 75°; one averaging; matrix, 256×140; parallel acquisition technique (PAT) factor, 2, with a generalized autocalibrating partially parallel acquisition (GRAP-
Fig. 1. Pre-contrast computed tomographic (CT) images: (a) pre-contrast, (b) arterial-dominant phase, (c) equilibrium phase. CT images show a mass with low density, 5 cm in largest dimension, in the left lobe of the liver. The peripheral areas of the lesion showed low density (arrows) and the center of the lesion, isodensity (asterisk), in pre-contrast and equilibrium phase images. The center of the lesion was slightly hypervascular in the arterial-dominant phase.

Fig. 2. Pre-contrast T₁-weighted magnetic resonance (MR) images. (a) On T₁-weighted in-phase MR imaging, the peripheral area of the lesion was hyperintense (arrows). (b) The opposed-phase sequence shows signal drop-out, which indicates lipid content (arrows).

PA) algorithm; slice thickness, 6 mm; slice gap, 1.2 mm; and acquisition time, 13 s. T₂WI parameters were: TR/TE, 3600/99 ms; flip angle, 150°; echo train length, 29; matrix, 256×75 (%); slice thickness, 6 mm; one averaging; PAT factor 2 with GRAPPA algorithm; and acquisition time, 14 s. T₂WI was performed while subjects held their breath.

We injected a rate of 2 mL/s of Gd-EOB-DTPA (0.025 μmol/kg) via the antecubital vein, followed by 40 mL of physiological saline. Dynamic study included the hepatic arterial-dominant phase, por-
Fig. 3. Gd-EOB-DTPA-enhanced magnetic resonance (MR) images: (a) pre-contrast, (b) arterial phase, (c) hepatobiliary phase (20 min after injection). Dominant-phase arterial MR image shows hypervascularity of the central area (asterisk) of the lesion and faint enhancement in the peripheral area (arrow). In the hepatobiliary phase, 20 min after injection of contrast medium, the central area of the lesion was isointense compared with the surrounding normal liver parenchyma. The peripheral area of the lesion, which consisted of a proliferation of hepatocytes with steatosis, was slightly hypointense. A hypointense band at the boundary between the peripheral and center areas (arrowhead) can be observed.
enhanced MR imaging for hepatocellular adenoma. Giovanoli and colleagues reported all lesions of hepatic adenomatosis to be hypointense compared with surrounding normal liver parenchyma in the hepatobiliary phase.\(^2\) Huppertz and associates reported 2 hyperintense adenomas in the hepatobiliary phase.\(^4\) Our case demonstrated the center of the lesion as isointense and its peripheral region as hypointense compared with the surrounding normal liver parenchyma in the hepatobiliary phase. Thus, the findings of Gd-EOB-DTPA-enhanced MR imaging for hepatocellular adenoma can vary. Lewin’s group described 3 histological forms of liver adenomatosis-steatotic, peliotic, and mixed.\(^6\) We speculated that variable enhancement patterns depended on histological characteristics.

In the present case, the peripheral area of the lesion consisted of a proliferation of hepatocytes that showed extensive macro- and microvesicular steatosis, and the center of the lesion consisted of hepatocytes without atypia arranged in 2 or 3 sheets and cords. Therefore, we thought the difference in enhancement between the peripheral and central areas in the lesion was influenced by the degree of hepatocyte proliferation. Using a sequence similar to that of our dynamic study, Yamamoto and associates reported no significant difference in the enhancement ratio between the area of fatty liver and normal parenchyma.\(^7\) In our case, we also observed enhancement of a proliferation of hepatocytes with steatosis, but the chemical shift selective method saturated the steatotic component. Therefore, the peripheral area of the lesion showed hypointensity. On the other hand, the density of the center of the lesion was similar to that of normal functioning hepatocytes. The lesion in the present case was partly steatotic.

Gd-EOB-DTPA accumulates in normal functioning hepatocytes in the hepatobiliary phase, but hepatic lesions that lack normally functioning hepatocytes are thought to be defective.\(^8\) In our patient, the center of the lesion consisted of hepatocytes lacking in atypia arranged in sheets, and there was no bile duct. This pathological finding led us to
speculate that hyperintensity resulted from an uptake of Gd-EOB-DTPA in the center of the lesion that disturbed excretion of the contrast medium. However, the center of the lesion showed isointensity. Although Gd-EOB-DTPA generally accumulates in benign hepatocellular lesions, its accumulation has been reported in a part of hepatocellular carcinomas in the hepatobiliary phase.1 The teams of Kitao9 and Narita10 reported that expression of OATP1B3 determines the uptake of Gd-EOB-DTPA in the hepatobiliary phase in hepatocellular carcinomas, and Kitao’s group reported that the expression of MRP3 determines the excretion of Gd-EOB-DTPA in the hepatobiliary phase in hepatocellular carcinomas.9 To the best of our knowledge, the expression of transporters in benign hepatocellular nodules is not reported. We speculated that the presence of these transporters may be a reason for the isointensity observed in the center of the lesion. Therefore, it is believed that distinguishing hepatocellular carcinoma from hepatocellular adenoma is difficult using Gd-EOB-DTPA. We report a case of hepatocellular adenoma focusing on any correlation between findings of Gd-EOB-DTPA-enhanced MR imaging and pathology. We believe that the findings in the hepatobiliary phase of hepatocellular adenoma were influenced by histological type in the current results.

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References