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STANDING WAVE ARTIFACTS - MAGNETIC RESONANCE IMAGING OF A GIANT HEPATIC HEMANGIOMA: A CASE REPORT

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ABSTRACT

Background: Artifacts are by-products of magnetic resonance imaging (MRI) that may lead to misdiagnosis and confusion or if not distinguished correctly. However, some specific patterns of artifacts can aid in diagnosis. **Case presentation:** We present a case of a giant hepatic hemangioma (GHH) with standing wave artifacts appearing sausage-like or quasi-circular signal loss inside the lesion on T2-weighted, diffusion-weighted images or apparent diffusion coefficient (ADC) maps at 3.0T. Imaging the patient at 1.5T mitigates the artifacts arising at 3.0T. We consider standing wave artifacts could be observed in GHHs due to the large amount of blood fluid and the increased size of the abdomen. **Conclusion:** This case illustrates standing wave artifacts might be helpful for the MRI diagnosis or differential diagnosis of GHHs and demonstrates the imaging findings associated with it.

KEYWORDS: standing wave artifacts, giant hepatic hemangioma, magnetic resonance imaging.

1. INTRODUCTION

Standing wave artifacts are related to inhomogeneity in the high radiofrequency (RF) B1 transmit fields during MRI.[1] Generally, standing wave artifacts are visible in ascites. However, the clinical significance of standing wave artifacts associated with liver lesions is presently unclear and they have been rarely reported in liver lesions in the literature.[2] We report a case of a Giant Hepatic Hemangioma with standing wave artifacts at 3.0TMR to illustrate standing wave artifacts might be helpful for the MRI diagnosis or differential diagnosis of GHH and demonstrate the imaging findings associated with it.

2. Case report

A 21-year-old female presented to her local hospital with a complaint of postprandial bloating. A giant mass was revealed in the left lobe of the liver during MRI and based on the initial diagnosis of liver undifferentiated embryonal sarcoma. She was transferred to our hospital for further investigation and treatment. In the physical examination, there were hepatomegaly and tenderness in the left upper quadrant. On admission, the patient's notable laboratory values included a decreased hemoglobin level of 100 g/L and an increased D-dimer level of 15.05 μg/mL.

Due to clinical concern for liver diseases, MRI examinations and a contrasted-enhanced CT examination were reordered for further investigation. MR imaging at 3.0T demonstrated a giant mass measuring 26×13×33 cm in the left liver, particularly notable on the T2-weighted and diffusion-weighted images, with sausage-like signal loss in the center of images (**Figure 1a and 1b**, respectively).

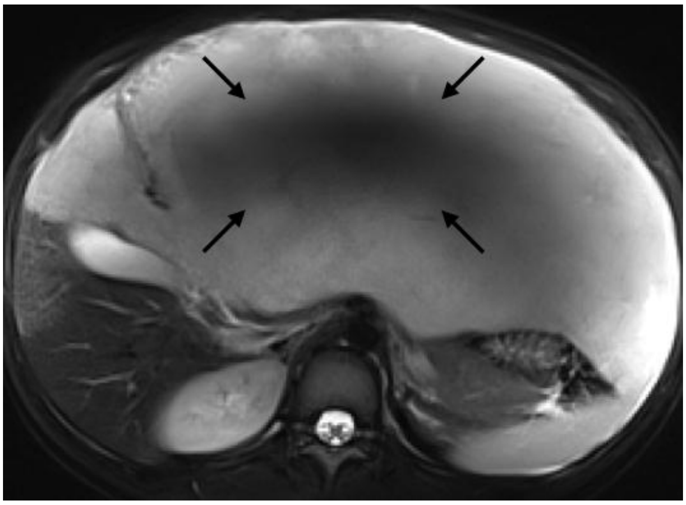

Figure 1a.

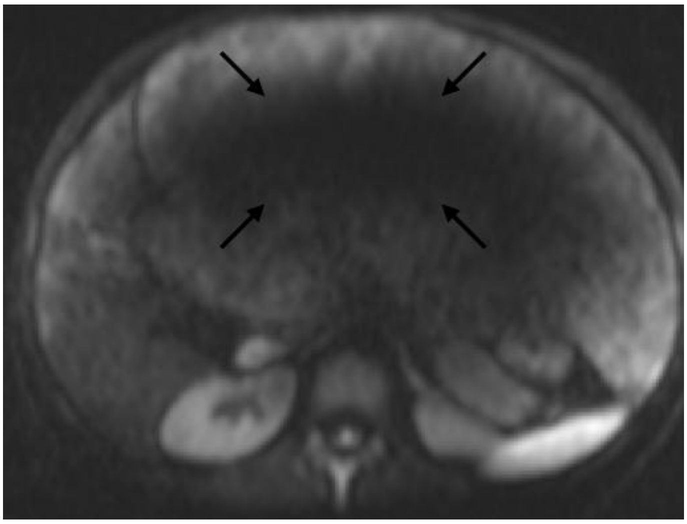

Figure 1b.

Figure 1: Axial views of the hemangioma from magnetic resonance imaging. T2-weighted (a, arrows) and diffusion-weighted (b, arrows) images show a sausage-like signal void in the center of the images at 3.0T. ADC map (c, arrows) shows quasi-circular signal loss in the center of image at 3.0T. T1- weighted post contrast (d) image reveals mild enhancement of the lesion. The artifacts arising at 3.0T were mitigated on the T2-weighted image at 1.5T(e).

ADC map also showed quasi-circular signal loss in the center of image (**Figure 1c**).

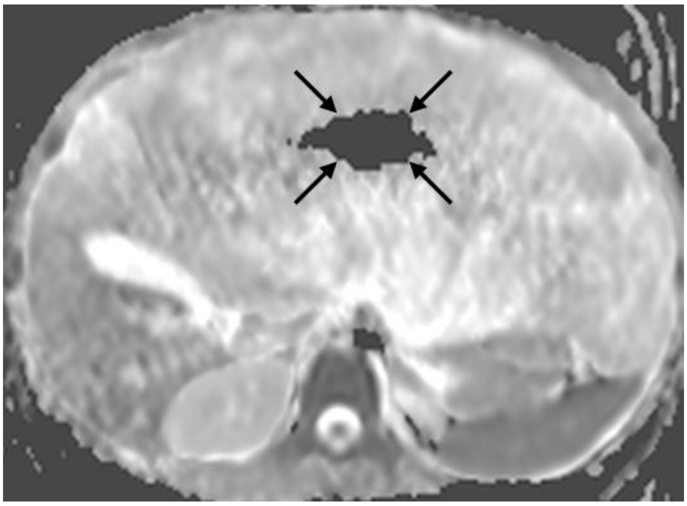

Figure 1c.

Contrast-enhanced T1 image demonstrated mild enhancement of the lesion (**Figure 1d**).

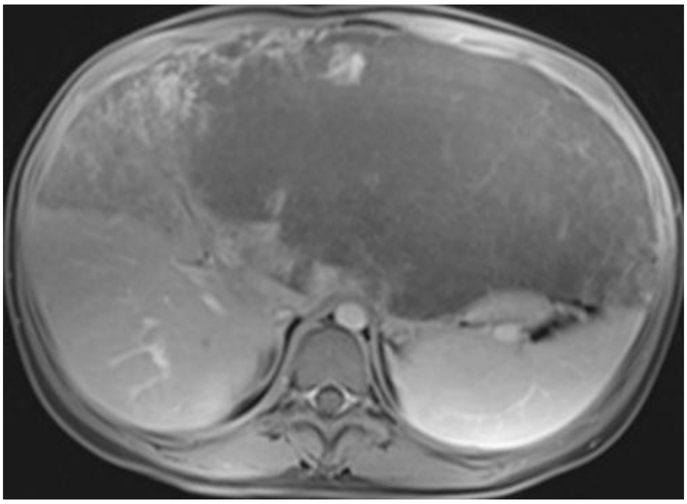

Figure 1d.

Imaging the patient at 1.5T mitigated the artifacts arising at 3.0T and a marked hyper-intensity was showed on the T2-weighted image (**Figure 1e**).

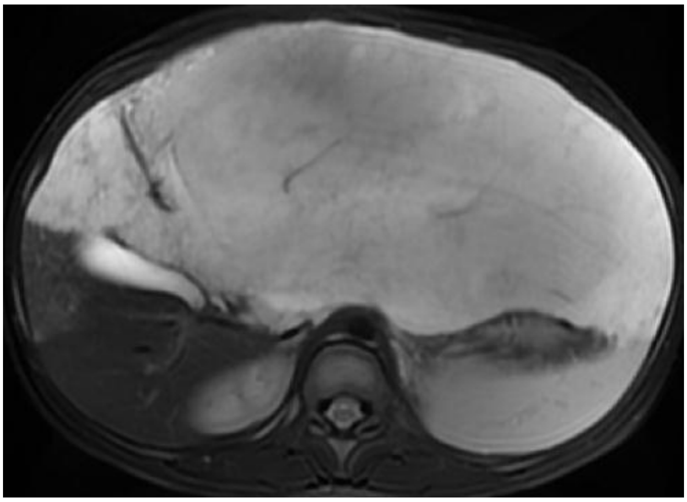

Figure 1e.

Therefore, standing wave artifacts were confirmed. Although atypical enhancement findings, a GHH was suspected due to a marked T2 hyper-intensity and standing wave artifacts. Contrast-enhanced abdomen CT was performed one week prior to it and showed the hypo-density mass in the left liver compressing the stomach (**Figure 2a**), the left hepatic artery (**Figure 2a**), and the portal vein (**Figure 2b**).

Figure 2: Axial images of enhanced computed tomography. The hemangioma compressed the gastric outlet (a, white arrow), hepatic artery (a, black arrow) and portal vein (b, arrow).

The patient underwent a left hepatectomy (Figure 3) and histopathological examination revealed that the tumor was composed of various sizes of cavernous hemangioma tissues. The patient had no major postoperative complications and returned to normal life on the 4th month follow-up.

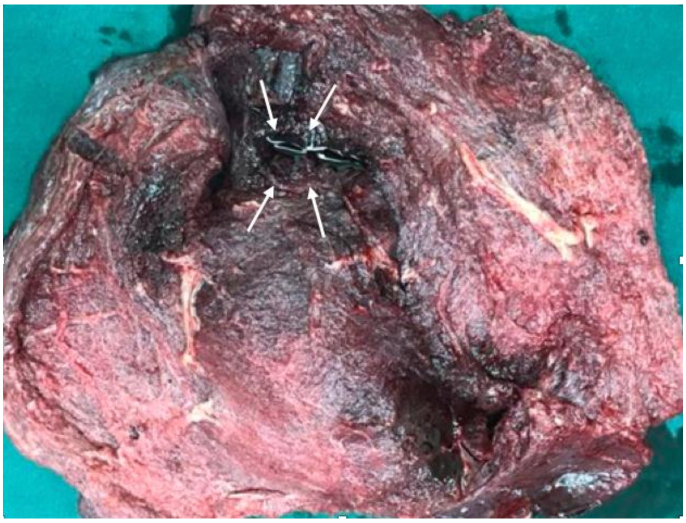

Figure 3: Surgical treatment of the patient with a liver hemangioma. At surgery, a giant hemangioma was identified (Fig. 3a). Macroscopic view of the mass at autopsy shows dilated blood sinus (Fig. 3b, arrows).

3. DISCUSSION

Standing wave artifacts are related to inhomogeneity in the high radiofrequency(RF) B1 transmit fields during MRI, particularly marked at body MR imaging because of the need to cover a large field of view (FOV).[3] A typical example of standing wave artifacts is observed in patients with cirrhosis and ascites. The clinical significance of standing wave artifacts in liver lesions is presently unknown.[4] To date, standing wave artifacts have been rarely reported in the giant hepatic hemangioma (GHH) in the literature.

When the wavelength of RF field is on the same order of magnitude as the dimension of the patient, noticeable variations in the B1 transmission field can occur to produce areas of increased or decreased signal intensity.[5] The wavelength of RF field at 128 MHz is 234 cm in the air. However, water or water-containing tissues has a rather high dielectric constant, which reduces both the wavelength and speed of electromagnetic radiation. At 3.0T MR, the RF field wavelength was reduced from 234 cm in the air to about 26 cm in most human tissues.[6] The size of wavelength is approximately the size of the FOV for body imaging and can result in a standing wave effect (often incorrectly called a “dielectric resonance” effect).[7]

Hepatic hemangiomas are benign and are usually small, but they are considered giant if they exceed 10 cm in diameter.[8] Microscopically, the hemangiomas are distinctive, being composed of a predominance of cystically dilated vascular spaces, a characteristic of cavernous hemangiomas.[9] This water-containing tissue reduces the wavelength and speed of electromagnetic radiation. In our case, axial T2-weighted, diffusion-weighted images, and ADC map (**Figure 1a, 1b and 1c**, respectively) show signal loss in the center of the images because the wavelength of the RF transmission field is on the same order of magnitude as the dimension of the patient. The resulting variations in the RF transmission field result in focal areas of decreased signal intensity. Imaging the patient at 1.5T (**Figure 1e**) mitigates the artifacts arising at 3.0T because the wavelength is approximately 52 cm in the water-containing tissue and larger than the size of the patient (axial dimension) at 1.5T, while 26 cm at 3.0T which approaches the size of the patient. Standing wave artifacts were confirmed during this correction process. Besides lowering the field strength, there are other solutions to alleviate standing wave artifacts: dielectric pads, multichannel transmit arrays and RF shimming.

At 3.0T MR, standing wave artifacts could be observed in GHH due to the large amount of blood fluid and the increased size of the abdomen. Standing wave artifacts appear sausage-like or quasi-circular signal loss in the center of images on axial T2-weighted, diffusion-weighted images, and ADC maps. Imaging the patient at 1.5T can mitigate the artifacts arising at 3.0T. Standing wave artifacts may be used as a diagnostic clue for GHH. Besides, we consider that standing wave artifacts could be helpful for differentiating GHH from giant solid liver lesions such as hepatocellular carcinomas and this assumption needs further verification.

The patient had a trauma history one month prior to admission. As we know, B lymphocyte derived from bone marrow pluripotent stem cells. When they were stimulated by pathogenic factors, such as inflammatory and trauma, they proliferated and differentiated a large numbers of plasma cells, synthesize antibodies and played a humoral immune function. Maybe some errors happened during it and led to hemangioma.

The clinical presentations and lab examinations of hemangioma are atypical. Correct preoperative diagnosis depends more on medical imaging. The Hepatic Hemangioma shared similar and characteristic imaging patterns despite of differences in histological subtypes.

CONCLUSION

Giant hepatic hemangioma was rare, but it should be considered in the differential diagnosis in any patient with a soft distended abdominal mass. The medical imaging provides more valuable information contributing to the diagnosis. The timely and correct diagnosis could help some patients avoiding unnecessary radiation and biopsies.

With case illustrates that standing wave artifacts might be helpful for the MRI diagnosis or differential diagnosis of GHHs and demonstrates the imaging findings associated with it.

Abbreviations

GHH: Giant Hepatic Hemangioma

ADC: Apparent Diffusion Coefficient

MRI: Magnetic resonance imaging

FOV: Field of view

RF: Radiofrequency

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None

Conflict of interest

The authors indicate that this study was not sponsored and there was no financial relationship with any organization. The authors declare that we have no conflict of interest.

Consent for publication

We obtained a written informed consent was from the patient for the publication of this case report with the accompanying images. A copy of the written consent is available.

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