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Atypical Enhancement of Gd-BOPTA on the Hepatobiliary Phase in Hepatic Metastasis from Carcinoid Tumor – Case Report

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Manuscript Preparation E
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Patient: Female, 65-year-old
Final Diagnosis: Carcinoid tumor
Symptoms: Abdominal pain
Medication: —
Clinical Procedure: —
Specialty: Radiology

Objective: Unknown etiology

Background: Carcinoid tumor is the most frequent neuroendocrine tumor (NET) that causes liver metastases. One of the best methods to assess this type of pathology is magnetic resonance imaging with hepatocyte-specific contrast media with low molecular weight gadolinium chelate Gd-BOPTA. As these lesions do not contain hepatocytes, they present as hypointense on MRI in comparison with liver tissue which enhances this type of contrast.

Case Report: In this article, we present a case of a 65-year-old female patient who was admitted to the Emergency Department with abdominal pain. Computed tomography revealed a single focal lesion in her liver. The patient underwent further evaluation using magnetic resonance imaging (MRI). The hepatobiliary phase MRI showed an unspecific homogenous enhancement of the hepatobiliary agent Gd-BOPTA. Since the lesion was interpreted as a non-characteristic lesion, the patient was discharged from the hospital with a recommendation for early follow-up. The follow-up MRI 6 months after discharge disclosed multiple liver metastases.

Conclusions: Liver metastases generally demonstrate enhancement of hepatobiliary contrast agents in the T1-weighted hepatocellular phase. Metastasis from a carcinoid tumor may also demonstrate this enhancement.

MeSH Keywords: Carcinoid Tumor • Contrast Media • Magnetic Resonance Imaging • Neoplasm Metastasis**Full-text PDF:** <https://www.amjcaserep.com/abstract/index/idArt/924280>

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Background

Neuroendocrine tumors (NETs) are neoplasms that arise from cells of the endocrine and nervous systems. Some of them are benign, while others are malignant. They frequently occur in the intestine, but they may also be found in the lung, pancreas, and other parts of the body. The intestine NET is also called a carcinoid tumor. It is the most frequent NET that causes liver metastases, especially when localized in the small intestine.

Hepatobiliary phase (HBP) magnetic resonance imaging (MRI) is gaining popularity as a diagnostic tool used to identify liver metastases. Recently, to aid in the detection of liver lesions, hepatocyte-specific contrast media with low molecular weight gadolinium chelates such as Gd-BOPTA (Multihance®) and Gd-EOB-DTPA (Primovist or Eovist®), have been developed, with each of these agents having different characteristics [1].

Hepatobiliary contrast uptake is observed in pathologies such as focal nodular hyperplasia (FNH), hepatocellular carcinoma (HCC), and in some cases of adenoma [2].

Liver metastases do not contain functioning hepatocytes or required transporters for the uptake of Gd-BOPTA and Gd-EOB-DTPA agents. These conditions result in hypointensity of the metastases during the hepatobiliary phase. This results in high contrast between imaging of enhancing liver tissue and lesions. The appropriate combination of these images using diffusion-weighted MRI can therefore facilitate detection of small liver metastases [3].

However, Ha et al. reported cases of enhanced hepatic metastases from breast cancer in HBP [4], which was probably due to contrast retention in fibrous tissue, which has also been observed in cholangiocarcinoma [5,6].

Here we present a case of Gd-BOPTA enhancement in a focal liver lesion in a patient with liver metastases from a carcinoid tumor of the small intestine.

Case Report

A 65-year-old female patient was admitted to the Emergency Department at 3 AM with diffuse abdominal pain without any past medical history. A routine laboratory examination was within normal limits.

For a specified examination, abdominal computed tomography (CT) was performed. The scan revealed dilated loops of the small intestine and a single focal liver lesion which required further MRI evaluation. A few days later, the MRI was carried out using the following sequences: T1 and T2-weighted spin echo, 3D T1-weighted fast field echo with fat suppression, T2-weighted fat saturation, T1-weighted field echo with and without fat suppression, diffusion weighted imaging (DWI), apparent diffusion coefficient (ADC). Dynamic contrast enhancement was performed with Gd-BOPTA with imaging in a hepatobiliary phase after 70 minutes. The image showed a single small lesion (around 1 cm in diameter) in the right lobe of the liver, hyperintense in T2-weighted imaging, with peripheral arterial enhancement without washout in other phases (Figure 1A, 1B). In T1-weighted pre-contrast imaging the lesion was hypointense (Figure 2A, 2B). In the hepatobiliary phase there was observed an unspecific homogenous enhancement of the hepatobiliary agent Gd-BOPTA (Figure 3). ADC was inconclusive due to artifacts, and together with moderate hyperintensity of the lesion in DWI, resulted in ambiguity in diffusion assessment (Figure 4). It was interpreted as a non-characteristic lesion.

After the completion of the tests, the patient was discharged with a recommendation for early check-up.

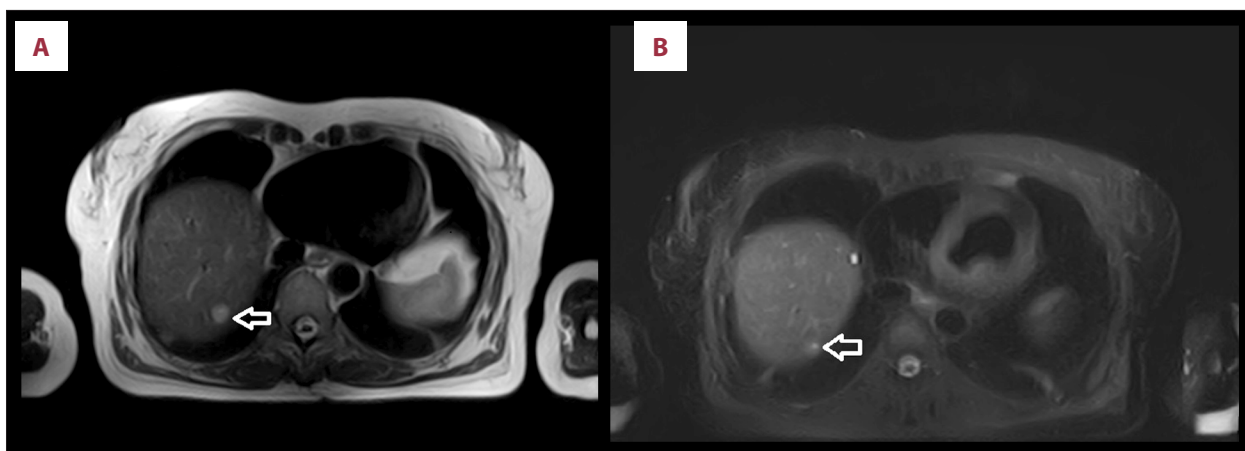


Figure 1. Hyperintensity of the lesion in T2-weighted imaging: (A) without fat saturation, (B) with fat saturation.

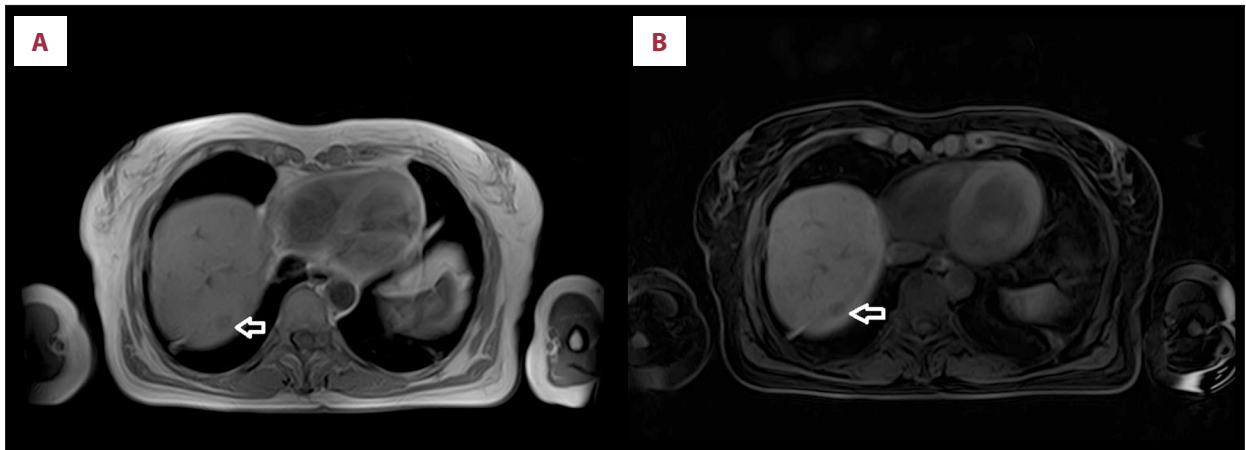


Figure 2. Hypointensity of the lesion in T1-weighted pre-contrast imaging: (A) in-phase, (B) with fat saturation.

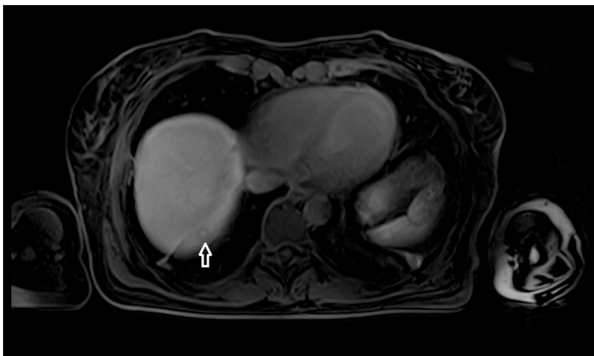


Figure 3. Unspecific homogenous uptake of Gd-BOPTA in the hepatobiliary phase 70 minutes after administration of the contrast agent. The lesion demonstrates “target sign” – hyperintensity in the central area and hypointensity in the surrounding rim.

Six months after the initial presentation another MRI with the same parameters was performed. The control examination revealed multiple liver metastases with still visible T1-weighted

hepatospecific agent enhancement in the primary lesion (Figures 5–8).

An ultrasound-guided liver biopsy disclosed metastases typical for carcinoid tumor. A positron emission tomography (PET) scan revealed a carcinoid tumor in small intestine loops. The patient has been admitted to the Oncology Department for a further treatment.

Discussion

A key assumption about hepatobiliary contrast media is its ability to distinguish focal nodular hyperplasia (FNH) and adenoma, to identify HCCs, to evaluate biliary anatomy, and to detect small liver metastases [2]. Enhancement of hepatobiliary agents is usually observed in lesions containing functional hepatocytes, for example as seen in FNHs [3].

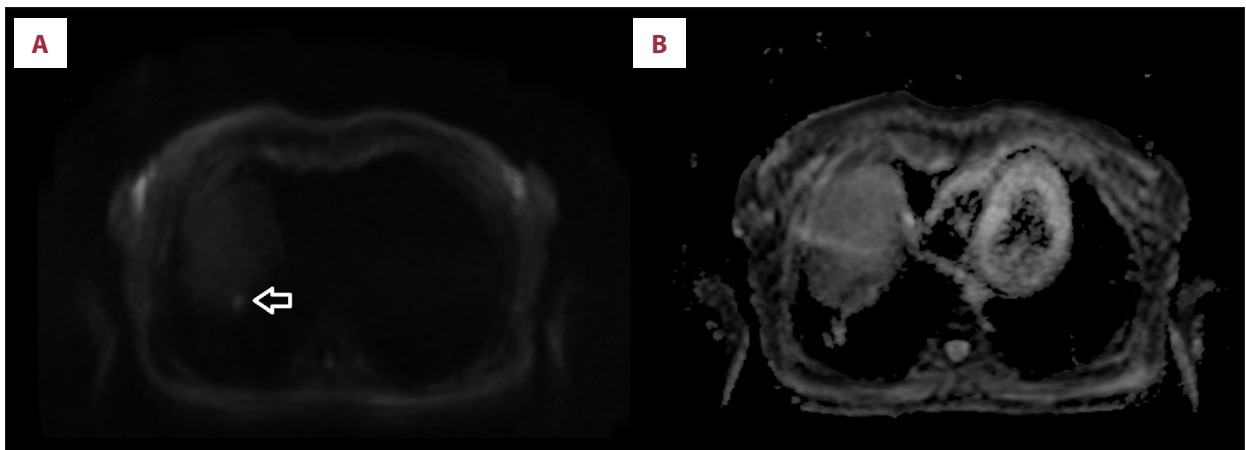


Figure 4. (A) Moderate hyperintensity of the lesion in diffusion weighted imaging (DWI at $b=800 \text{ s/mm}^2$) and (B) inconclusive apparent diffusion coefficient (ADC) result in ambiguity in diffusion assessment.

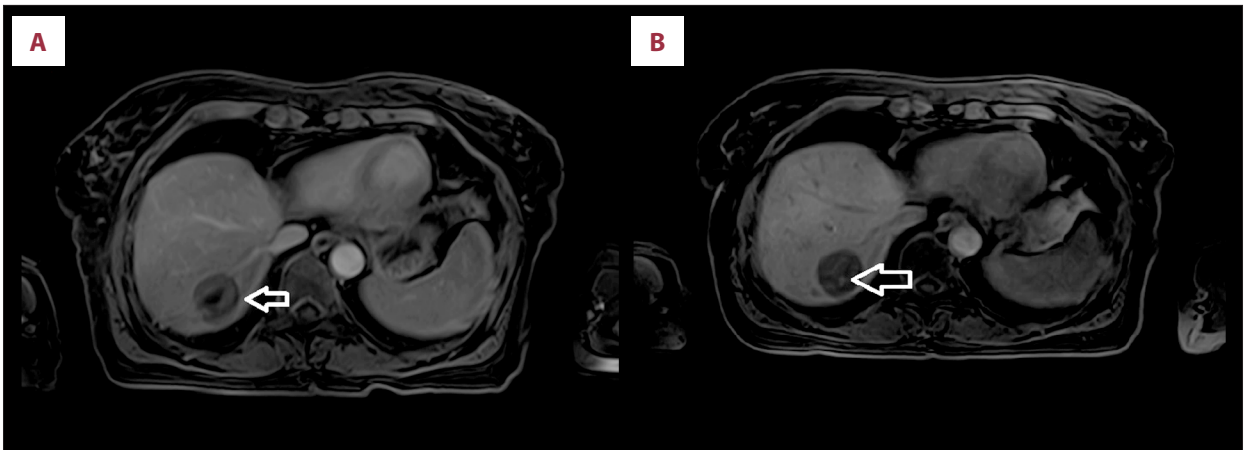


Figure 5. T1-weighted fast field echo with fat suppression shows still visible primary lesion: (A) right after the administration of hepatospecific contrast media, (B) with Gd-BOPTA enhancement after 70 minutes.

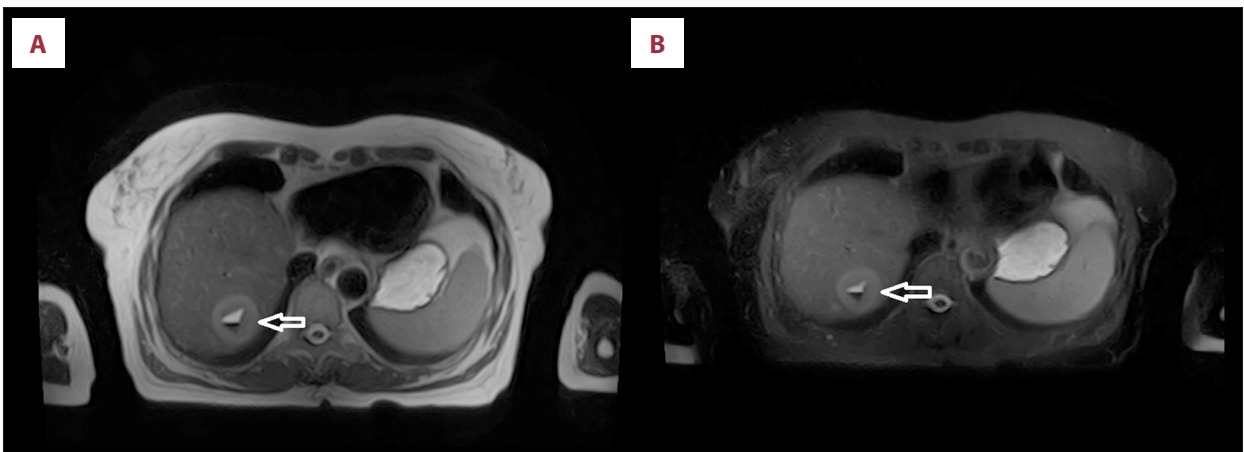


Figure 6. T2-weighted imaging shows moderate hyperintense lesion with markedly higher signal in the center: (A) image without fat saturation, (B) image with fat saturation.

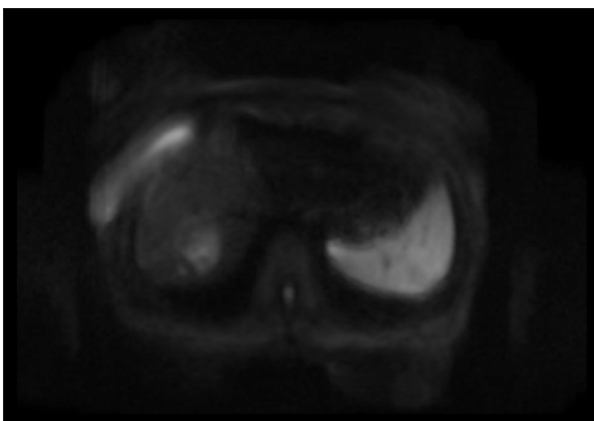


Figure 7. Irregular hyperintensity of the primary lesion in DWI (b=800 sec/mm²).

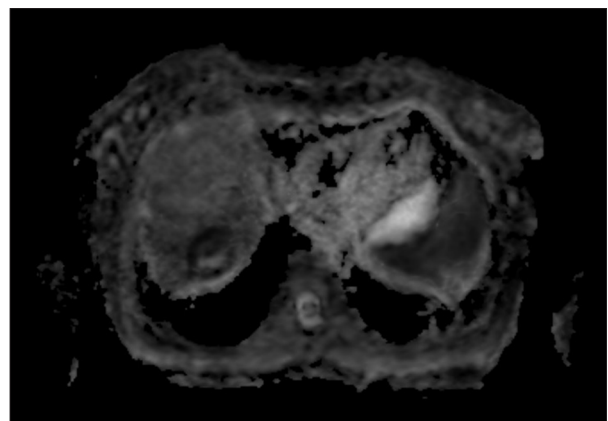


Figure 8. Low peripheral signal corresponding to diffusion restriction and hyperintense center of the primary lesion corresponding to necrosis and fibrosis in ADC imaging.

Liver metastases do not show enhancement in the hepatocellular phase because of the lack of hepatocytes. For this reason, metastases frequently show hypointensity compared to the functional liver tissue [7]. However, several cases of liver metastases from primary tumors from a colon, a stomach, a pancreas, and a breast have been described as showing enhancement of hepatobiliary contrast agents [4,8,9]. These lesions demonstrated “target sign”, i.e., hyperintensity in the central area and hypointensity in the surrounding rim.

Ha et al. showed a relationship between atypical enhancement of Gd-BOPTA in the hepatobiliary phase and coagulative necrosis [4]. Moreover, other authors have emphasized the impact of fibrosis and large interstitial spaces in tumor composition, which could retain contrast media for a long time [9].

In our study, we report a unique case of a liver metastasis from a carcinoid tumor in the small intestine which presented enhancement of Gd-BOPTA in the hepatocellular phase 70 minutes after the intravenous administration of Gd-BOPTA. Interestingly, the hepatobiliary contrast agent uptake had already been revealed in the small size lesion (9 mm) and surprisingly did not increase in the follow-up examination despite multiple enlargements of the primary lesion.

References:

1. Donato H, França M, Candelária I, Caseiro-Alves F: Liver MRI: From basic protocol to advanced techniques. *Eur J Radiol*, 2017; 93: 30–39
2. Ferreira Francisco FA, Eiras de Araújo AL, Oliveira Neto JA, Braz Parente D: Hepatobiliary contrast agents: Differential diagnosis of focal hepatic lesions, pitfalls and other indications. *Radiol Bras*, 2014; 47(5): 301–9
3. Thian YL, Riddell AM, Koh D-M: Liver-specific agents for contrast-enhanced MRI: Role in oncological imaging. *Cancer Imaging*, 2013; 13(4): 567–79
4. Ha S, Lee CH, Kim BH et al: Paradoxical uptake of Gd-EOB-DTPA on the hepatobiliary phase in the evaluation of hepatic metastasis from breast cancer: Is the “target sign” a common finding? *Magn Reson Imaging*, 2012; 30: 1083–90
5. Jeong HT, Kim MJ, Chung YE et al: Gadoxetate disodium-enhanced MRI of mass-forming intrahepatic cholangiocarcinomas: imaging-histologic correlation. *Am J Roentgenol*, 2013; 201(4): 603–11
6. Mamone G, Marrone G, Caruso S et al: Intrahepatic mass-forming cholangiocarcinoma: Enhancement pattern on Gd-BOPTA-MRI with emphasis of hepatobiliary phase. *Abdom Imaging*, 2015; 40(7): 2313–22
7. Goodwin MD, Dobson JE, Sirlin CB et al: Diagnostic challenges and pitfalls in MR imaging with hepatocyte-specific contrast agents. *Radiographics*, 2011; 31(6): 1547–68
8. Granata V, Catalano O, Fusco R et al: The target sign in colorectal liver metastases: An atypical Gd-EOB-DTPA “uptake” on the hepatobiliary phase of MR imaging. *Abdom Imaging*, 2015; 40: 2364–71
9. Kim YK, Lee JM, Kim CS: Gadobenate dimeglumine-enhanced liver MR imaging: Value of dynamic and delayed imaging for the characterization and detection of focal liver lesions. *Eur Radiol*, 2004; 14: 5–13

This finding suggests that there is a potential retention of hepatobiliary contrast media in other liver metastases from carcinoid tumors. However, this was a single case study, and this finding has not been previously described. Other available cases present a paradoxical uptake in larger liver metastases, whereas in our case a small-sized metastasis was presented. Thus, enhancement of hepatobiliary contrast media in a small focal lesion of the liver does not exclude a possible metastasis, and pathology consideration.

Conclusions

Liver metastases demonstrate enhancement of hepatobiliary contrast agents in the T1-weighted hepatocellular phase. A metastasis from a carcinoid tumor may also have this presentation. Good knowledge of enhancement characteristics in the hepatobiliary phase allows for the differentiation between liver lesions and hepatocytes, and may prevent misinterpretation of liver MRIs.

Conflicts of interest

None.