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Magnetic resonance imaging of pancreatic metastases from renal cell carcinoma

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ABSTRACT

Pancreatic metastases are rare but are thought to be most commonly from renal cell carcinoma (RCC). These metastases can present many years after the initial tumor is resected, and accordingly, these patients require prolonged imaging follow-up. Although the computed tomographic findings of these metastases have been extensively reviewed in the literature, little has been written about the magnetic resonance imaging appearance of these metastases. Pancreatic metastases from RCC are typically T1 hypointense and T2 hyperintense. After intravenous administration of gadolinium, they are typically hypervascular and less commonly hypovascular. Chemical shift and diffusion-weighted imaging can aid in the diagnosis of these metastases.

1. Introduction

Pancreatic metastases are rare and represent approximately 2%–5% of malignant tumors within the pancreas in clinical series [1] and have a reported incidence of 1.6% to 11% in autopsy series [2]. Renal cell carcinoma (RCC), melanoma, lung cancer, and colorectal cancer are known to metastasize to the pancreas, with metastases from RCC thought to be most common in recent studies [3,4]. RCC is also the most common primary tumor leading to a single pancreatic mass [1]. Up to 80% of patients with pancreatic metastasis from RCC will have no other sites of metastatic disease [5].

Metastases from RCC can be found at the time of initial diagnosis or more frequently during follow-up imaging after surgery [6]. These metastases may occur either early or late. Late recurrence is not uncommon, occurs in more than 10% of patients who have been disease-free for more than 10 years after nephrectomy [7], and is associated with better prognosis than early metastases [8]. In fact, RCC is the primary tumor that metastasizes to the pancreas following the greatest disease-free survival time [9]. For this reason, patients with a history of RCC require prolonged follow-up imaging for greater than 10 years. Follow-up can be accomplished using either computed tomography (CT) or magnetic resonance imaging (MRI), both equally appropriate according to the American College of Radiology Appropriateness Criteria [8], although CT is more widely used as it is more readily available in most centers. With the increasing use of MR for abdominal imaging, pancreatic RCC metastases may also be identified incidentally on MRI even after official follow-up imaging is no longer performed or on MRI done for other indications.

Accordingly, the recognition and characterization of pancreatic metastatic disease are essential. Although there are many reports in the literature regarding CT findings of pancreatic metastasis from RCC, little has been written about the MRI appearance of these metastases. It is important to be able to identify pancreatic metastatic lesions, which can have specific MRI features and can mimic other lesions, as we will illustrate.

2. Symptoms

The symptoms of pancreatic metastasis are varied. In a literature review by Sellner et al. examining RCC metastases to the pancreas, 35% of patients were asymptomatic, and the pancreatic metastases were discovered incidentally [10]. However, patients can present with symptoms similar to those of pancreatic adenocarcinoma such as nausea, abdominal or back pain, weight loss, obstructive jaundice, or pancreatitis [5]. Because many patients with pancreatic metastases are asymptomatic, imaging plays a critical role in detection and characterization of these lesions. In symptomatic patients, imaging is often useful to help distinguish between metastatic disease and pancreatic adenocarcinoma.

3. Distribution and morphology

Pancreatic metastases do not have a predilection for any particular part of the pancreas [11]. Three patterns of metastatic involvement of the pancreas have been described [6]. The most common appearance of all types of pancreatic metastases (50%–73%) is as a solitary lesion. A second pattern of involvement is diffuse pancreatic involvement/enlargement, seen in 15%–44% of all pancreatic metastases. The least common appearance, seen in 5%–10% of pancreatic metastases, is multiple

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discrete pancreatic lesions. However, a different distribution was discovered in a study by Hoshino et al. which specifically reviewed the literature of metastatic RCC to the pancreas and found that the majority of the lesions had a solitary configuration, while others demonstrated a multifocal appearance, and none were seen to have diffuse enlargement of the pancreas [3]. As diffuse RCC metastases are seen in practice, this leads to the conclusion that they are the least common pattern, as opposed to other types of pancreatic metastases.

Solitary metastases can have a varied appearance. Many present without obvious mass effect on the adjacent pancreatic parenchyma or pancreatic duct (Fig. 1). Others mimic primary pancreatic adenocarcinoma, causing distortion of the pancreatic parenchyma, and compression or obstruction of the common bile duct (when located in the pancreatic head) or the pancreatic duct (Fig. 2). The appearance of multiple metastatic lesions throughout the pancreas has been more frequently identified in patients with primary RCC, as compared with other primary malignancies, and has been reported to range from 20% to 45% [2] of patients with metastases (Figs. 3 and 4).

4. MRI features

The signal intensity and enhancement features of metastatic RCC to the pancreas often resemble those of the primary neoplasm [6,12,13]. On T1-weighted (T1W) fat-suppressed (FS) images, pancreatic metastases from RCC typically demonstrate hypointense T1 signal intensity relative to the pancreatic parenchyma, and on T2-weighted (T2W) images, they are usually hyperintense [14] (Figs. 2 and 5).

Most renal cell metastases to the pancreas are hypervascular, demonstrating intense enhancement on early gadolinium-enhanced images, and either remain hyperintense or become isointense to pancreatic parenchyma on delayed contrast-enhanced imaging sequences [6,15,16]. The predominantly hypervascular appearance of pancreatic metastases from RCC makes them difficult to distinguish from neuroendocrine tumors. The clinical history of prior RCC and the absence of symptoms related to hormonal activity favor the diagnosis of a metastasis; however, in patients with Von Hippel Lindau disease, neuroendocrine tumors should still be suspected even when there is a history of RCC. When small, metastatic RCC lesions typically demonstrate uniform enhancement (Fig. 5). Larger lesions may also demonstrate homogeneous enhancement, but often demonstrate ring enhancement caused by central necrosis (Fig. 4). Studies examining CT findings of pancreatic metastases from all primary malignancies found that lesions smaller than 1.5 cm typically enhanced homogeneously, while those 1.5 cm or larger typically demonstrated ring enhancement [11,17]. However, a study by Vincenzi et al., which examined the MRI appearance of metastases from RCC only, found homogeneous enhancement in lesions up to 2–2.5 cm in size and heterogeneous enhancement with areas of central hypointensity (reflecting central necrosis) evident only in lesions over 2–2.5 cm [9], suggesting that RCC metastases can show homogenous enhancement in larger-sized lesions compared to metastases from other types of tumors.

While the majority of pancreatic metastases from RCC are hypervascular, some are hypoenhancing and appear similar to pancreatic adenocarcinoma, especially when associated with pancreatic ductal dilatation and upstream atrophy (Fig. 2). However, these metastases typically do not infiltrate or encase the peripancreatic arteries or veins [9] or have significant peripancreatic adenopathy [18], which helps differentiate them from primary pancreatic adenocarcinoma.

The clear cell variant accounts for approximately 80% of RCCs. Some clear cell RCC metastases contain intracellular lipid, which can be detected with chemical shift MRI as a drop of signal on out-of-phase images (Figs. 4, 6, and 7) [19,20]. The presence of intracellular lipid

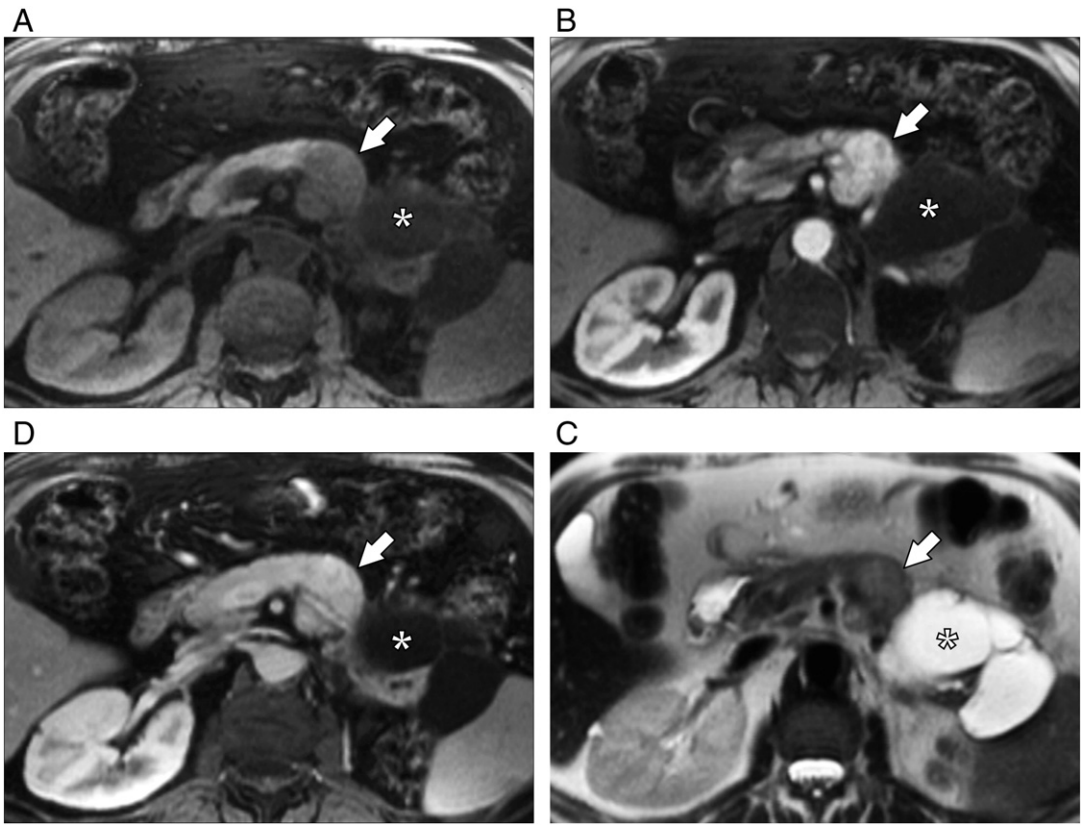

Fig. 1. A 60-year-old male with history of RCC, clear cell type, and left nephrectomy, with a single metastasis to the pancreatic body. Axial T1W FS gradient echo (GE) (a) and contrast-enhanced arterial (b) and venous (c) T1W FS GE images demonstrate a T1 hypointense mass with nearly homogenous arterial hyperenhancement which persists on delayed images (arrows). Axial T2W image (d) shows that the mass is isointense to slightly hyperintense to the remaining pancreatic parenchyma (arrow). Multiseptated T2 hyperintense lesions within the distal pancreatic body and tail (asterisk) are most consistent with pseudocysts in this patient with prior pancreatitis.