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MRI Features and Pathological Findings of Metastatic Renal Small Cell Carcinoma: A Rare Case Report

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Abstract

Information on magnetic resonance imaging (MRI) features of renal small cell carcinoma (SCC) is very limited in the literature due to reasons such as the very low incidence of SCCs of kidney origin and the recent development of modern imaging methods. Renal SCCs often appear as large tissue masses on imaging studies. With its very high potential for malignancy, this tumor may demonstrate extension to adjacent vascular structures, metastasis to surrounding lymph nodes, and/or distant sites at the time of diagnosis. In a 51-year-old male diagnosed with renal SCC, we present the MRI features of the brain and bone distant metastases of this tumor, as well as the mass in the kidney with pathological findings.

Keywords: Renal small cell carcinoma, magnetic resonance imaging, metastasis

Introduction

Small cell carcinomas (SCC) are most commonly seen in the lung, but with the identification of extrapulmonary SCCs, such as the gastrointestinal system and the genitourinary system SCCs, more cases have been reported.[1] In the genitourinary system, SCC is most common in the bladder and prostate, and SCC of the kidneys is extremely rare.[2] In Surveillance, Epidemiology, and End Results registry data by National Cancer Institute (USA) listed only 60 renal SCC cases between 1973 and 2013, accounting for 0.06% of all SCC cases.[3] Pathological morphology and immunohistochemical findings of renal SCC have been described in more detail in the literature.[4-6] However, due to various reasons such as the rarity of renal SCC and the recent development of advanced imaging modalities, information on magnetic resonance imaging (MRI) features of renal SCC is very limited in the literature. In this case, we present the MRI findings of renal SCC tumor and distant metastases together with pathological findings were, in our patient, diagnosed with renal SCC.

Case Presentation

A 51-year-old male who was admitted to an external center with the complaint of right flank pain was referred to our hospital upon discovery of a mass in the right kidney on ultrasonography. Laboratory workup revealed normal levels of blood creatinine, urea, hematocrit, and biochemistry values, and no hematuria was detected. Thoracic computed tomography (CT) and contrast-enhanced MRI of the abdomen (Gadoteric acid, Dotarem®, Guerbet, Paris, 0.1 mmol/kg) were performed to elucidate the structure of the mass in the right kidney and to identify potential metastases. In abdominal MRI, a mass of 8 × 7 × 6.5 cm in size was visualized in the cortical and medullary regions of the upper pole of the right kidney extending into the medial pararenal fatty tissue with an isointense signal compared to the renal parenchyma on T2W images and homogeneous hypointense signal on T1W images (Figure 1A and B). Minimal necrotic area was observed in the central part of the mass (Figure 1B). On post-contrast T1W images, the mass was minimally enhanced, much less than the normal renal cortex (Figure 1C). Apart from this, a few enlarged lymph nodes in favor of metastasis in the retrocaval area were observed. Furthermore, pelvic MRI displayed multiple enhancing bone lesions in favor of metastases with the hypointense signal on T1W and hyperintense signal on T2W images in the bilateral iliac and left femoral neck bones (Figure 1D). In thoracic CT, a 10 mm solitary pulmonary nodule was observed in the posterior segment of the right upper lobe. In order to screen for other possible metastases, positron emission tomography (PET)-CT scan and contrast-enhanced brain MRI scans were performed before the operation. PET-CT revealed a right renal gross mass, bone and lymph node metastases. Lung nodule was not considered as metastasis due to low SUV_{max} value (6.3). No metastasis was detected in the contrast-enhanced brain MRI.

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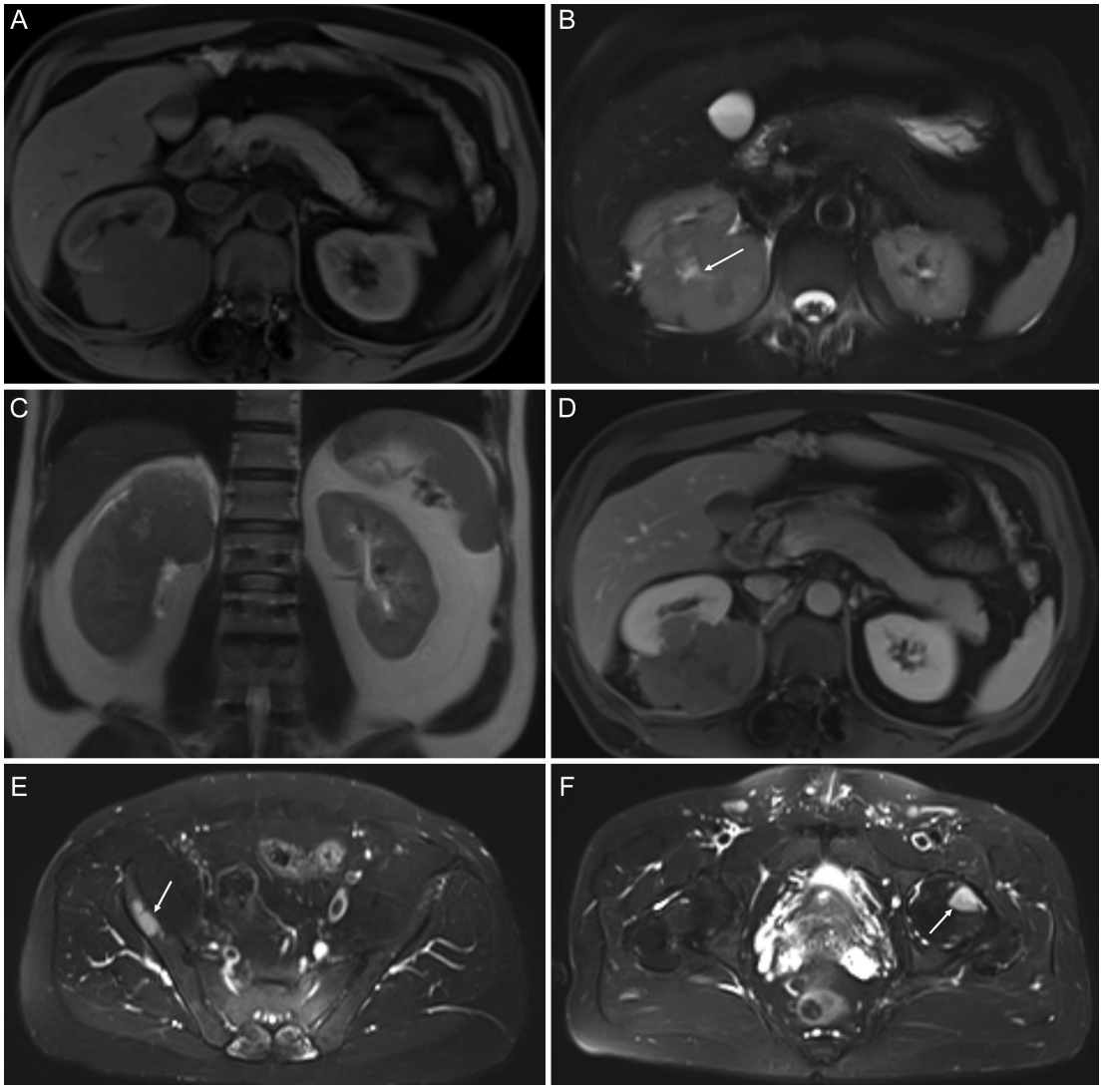

Figure 1. Lobulated contoured mass located in the upper pole of the right kidney and extending to the posterior pararenal area, homogeneous hypointense on axial pre-contrast fat-suppressed T1-weighted image (A), and isointense to renal parenchyma on axial fat-suppressed T2-weighted image (B) and coronal non-fat-suppressed T2-weighted image (C). On a T2-weighted image, hyperintensity was observed in the center of the mass in favor of minimal necrosis (white arrow). Much less minimal enhancement was observed in the contrast-enhanced fat-suppressed T1-weighted image (D). Axial fat-suppressed T2-weighted images (E, F) show pelvic bone metastases of the mass (white arrowhead).

The patient underwent a right radical nephrectomy. Radical nephrectomy which is commonly called cytoreductive nephrectomy is usually part of the multimodality treatment approach for patients with metastatic renal cancer. Even though nephrectomy is not curative, an improved prognosis can be achieved with combination therapy using cytoreductive nephrectomy and systemic therapy in a selected group of patients.[7] In the pathological examination, the tumor cells were small in size and showed diffuse distribution, and the renal parenchyma was infiltrated with the tumor. Increased mitosis was observed in the tumor cells (Figure 2). Immunohistochemical findings of tumor cells: synaptophysin (+), chromogranin (+), CD56 (+), Ki-67 proliferation index (45%), TTF-1 (–), RCC (–), and p63 (–) (Figure 2). A diagnosis of small cell carcinoma, a subtype of neuroendocrine carcinoma, was determined histopathologically. Chemotherapy treatment containing etoposide and cisplatin was initiated. A response in favor of complete remission was observed in the follow-up with PET-CT in the patient. Six months after the last chemotherapy treatment and approximately 1 year after tumor surgery, the patient was admitted to the emergency department with headache and vomiting complaints. Contrast-enhanced MRI of brain (Gadopentetate dimeglumine, Magnevist, Bayer Schering Pharma, Leverkusen, 0.1 mmol/kg) was performed upon discovery of a mass in the right parietal lobe on non-contrast CT examination. In the brain MRI, a 6 cm mass with a cystic component in the anterior half and a solid component in the posterior half was observed in the right parietal lobe (Figure 3). Diffusion restriction on diffusion-weighted imaging (DWI) and susceptibility signals in favor of microhemorrhage on susceptibility-weighted imaging (SWI) were observed in the solid component (Figure 3). Minimal contrast enhancement was observed in the solid part of the mass after contrast material injection. Histogram analysis of solid tumoral components on apparent-diffusion coefficient

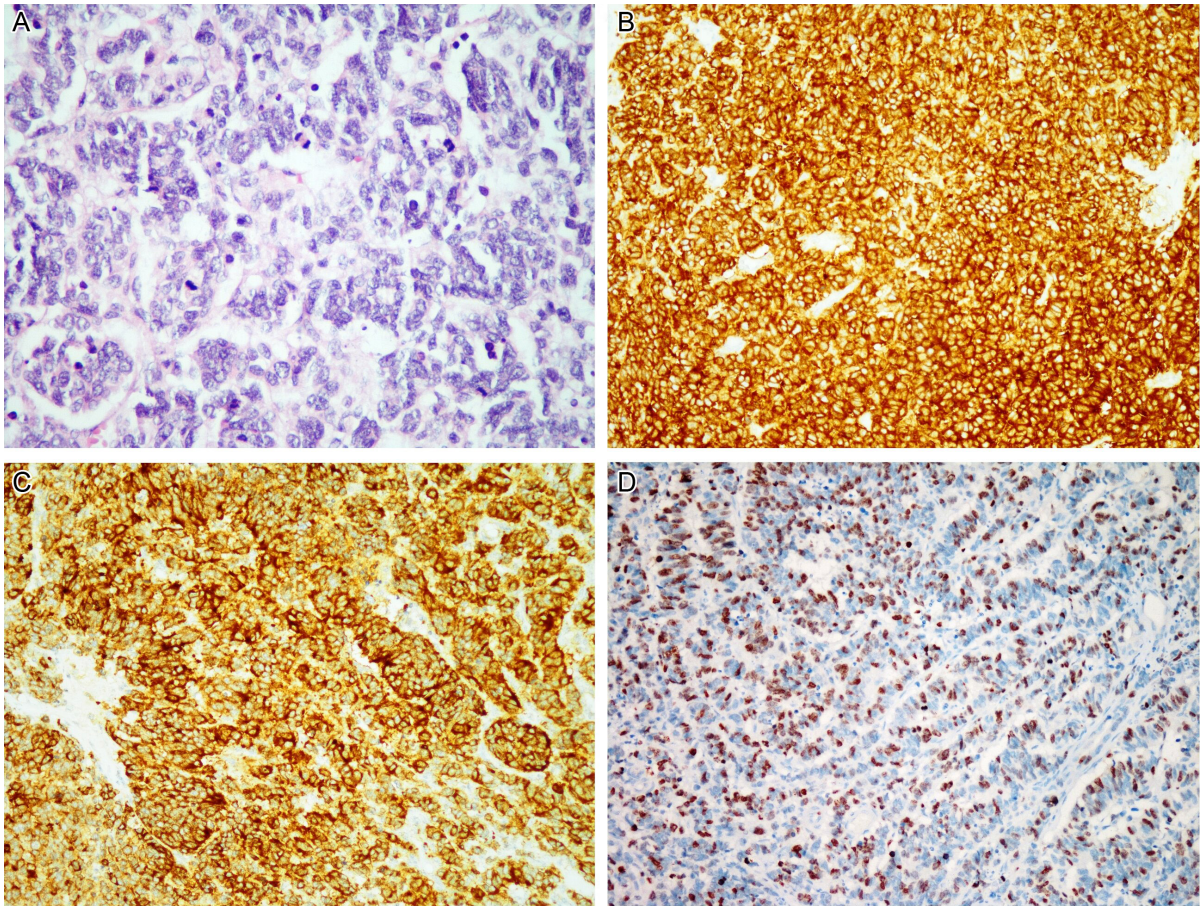

Figure 2. Microscopic examination (H&E, ×400) shows an increased number of mitoses in tumor cells (A). In immunohistochemical examination (IHC, ×200), tumor cells showed diffuse synaptophysin (B) and chromogranin (C) staining. The photomicrograph (IHC, ×400) shows a 45% immunohistochemical staining level for the Ki-67 proliferation index (D).

(ADC) map was performed and ADC_{max} 766 × 10^{-6} mm^2/s, ADC_{mean} 550 × 10^{-6} mm^2/s, ADC_{min} 385 × 10^{-6} mm^2/s values were calculated. Apart from this mass, 2 more minimally enhancing brain lesions less than 1 cm in size which showed diffusion restriction on DWI and contained few intratumoral dot-like susceptibility signals on SWI were identified in the left cerebral hemisphere and right superior cerebellar peduncle. When no other origin consistent with malignancy was detected in the patient who underwent PET-CT after MRI, intracranial masses were evaluated in favor of renal SCC metastases. Chemotherapy and radiotherapy treatments were applied to the patient who refused surgery. Control brain MRI examination was performed 6 months later, which revealed a partial reduction in size of the mass located in the right parietal lobe. Also, no enhanced solid component was observed in the mass. It was noted that the other 2 lesions defined in the previous MRI had completely regressed. We do not have further data about his prognosis as the patient had good overall health status and did not return for his follow-up.

Discussion

The World Health Organization classifies neuroendocrine tumors into 3 groups: well differentiated (true carcinoids), moderately differentiated (atypical carcinoids), and poorly differentiated (small cell carcinomas).[8] Although small cell carcinomas occur frequently in the lung, 2-5% of them occur in the extrapulmonary regions and are called extrapulmonary small cell carcinoma (EPSCC).[9] EPSCC is most common in the gastrointestinal and genitourinary systems but has been described in almost every organ in the body.[10] SCC is mostly observed in the prostate and bladder in the genitourinary system, while it is seen much less frequently in the kidney.[2] Due to the low incidence of renal SCC, information on imaging findings of renal SCC is quite limited in the literature. The available data are based on a few cases and patient data, and are predominant on the pathological findings of renal SCC.[5,6] Renal SCC is mostly seen in middle-aged and elderly people. The most common symptoms are back pain, low back pain, or hematuria.[11] Renal SCC usually presents as large tissue masses with well-circumscribed or irregular borders on imaging. In our case, it was remarkable that the signal characteristic of the mass was quite homogeneous in T1W and T2W images in MRI. Post-contrast images showed less enhancement in the mass than renal parenchyma. There may be small necrosis areas in the mass central, as in our case.[12] Extension to the renal vein or inferior vena cava in the form of thrombosis, metastasis to surrounding lymph nodes, and/or distant sites may occur.[12-14] After adjuvant chemotherapy, our patient developed new brain metastases. The masses showed minimal enhancement on post-contrasted images, significant diffusion restriction on DWI, and microhemorrhages on SWI. In the histogram analysis of the ADC map, low ADC values were calculated. SCCs are histopathologically composed of large

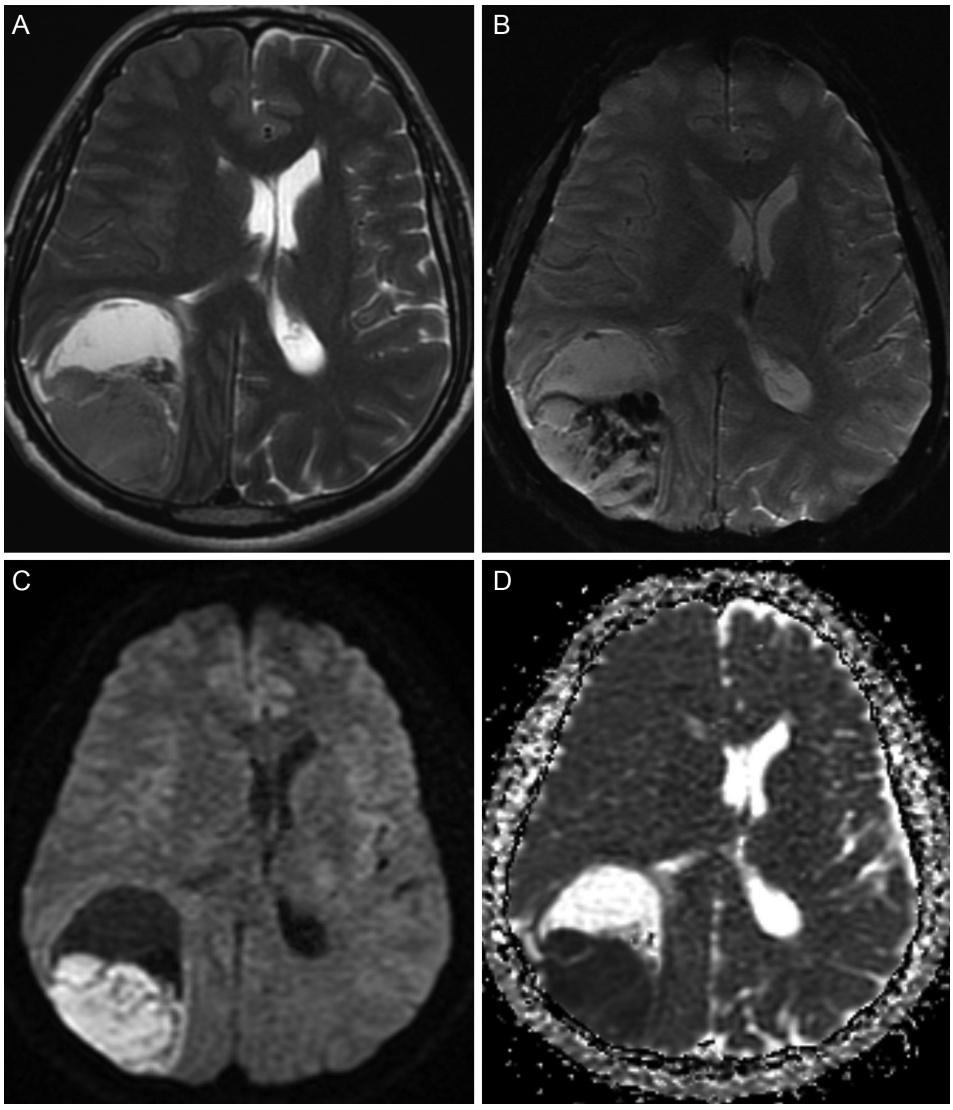

Figure 3. Axial T2 -weighted image (A) shows a metastatic mass with the cystic-solid component in the right parietal. Susceptibility-weighted image (B) shows susceptibility signals as hypointense areas representing hemorrhage. DWI (C) and the corresponding ADC map (D) show obvious restricted diffusion in the solid components of the mass.

nuclei cells with high cellularity and almost no cytoplasm. These factors restrict the diffusion of water molecules and result in glare in DWI and low ADC values. We think that the presence of microhemorrhages in the tumor is due to many factors such as the highly aggressive nature of SCC and the systemic treatments applied.

Renal cell carcinoma (RCC) is the most common primary tumor of the kidney and should be considered first in the differential diagnosis of a solid kidney tumor. Clear cell RCC is the most common subtype that accounts for 70% of all RCCs. These tumors originating from the renal cortex are T1AG iso-hypointense and T2AG hyperintense in imaging, and they are hypervascular lesions that are significantly enhanced in post-contrast sequences.[15] They have a very heterogeneous appearance due to large areas of hemorrhage, necrosis, cystic components, or calcification.[15] In our case, the MRI signal characteristics of the mass were quite homogeneous, with a T2AG signal isointense with renal parenchyma and minimal enhancement in contrast-enhanced imaging. These imaging features are atypical for clear cell RCC and should bring the suspicion of another tumor in the differential diagnosis. Also, renal lymphoma should be considered in the differential diagnosis. Lymphoma is usually a hypovascular tumor and can be primary or secondary. The presence of accompanying extranodal lymphatic foci and generally multifocal or diffuse pattern of renal involvement in secondary renal lymphoma may help in the differential diagnosis.[16] Primary renal lymphoma, which is extremely rare, is usually seen as a single focal in the kidney in adults.[17] Overlapping imaging features with renal SCC can make differential diagnosis difficult. Even with a very large lymphoma mass size, central necrosis is unlikely, as in our case.[12] Also, the presence of bone

metastases in our case is not in favor of a diagnosis of renal lymphoma.

Although imaging provides useful information in the differential diagnosis of renal masses, imaging is of clinical importance for staging and the final diagnosis is again based on pathological examination. SCC tumor cells are round or oval-shaped under light microscopy and a small amount of cytoplasm and obvious nuclear mitosis can be observed.[6] Positive neuroendocrine markers such as synaptophysin, chromogranin, NSE, CD 56, and CD99 in immunohistochemical staining are important for the diagnosis of SCC.[5] The positive expression profile of 2 or more neuroendocrine markers plays an important role in the diagnosis and differential diagnosis of renal SCC.[18] Since Ki-67 proliferation index reflects tumor cellular proliferation, it is a widely used biomarker in clinical practice. Ki-67 in immunohistochemical examination in renal SCC tumor can be used to predict the malignancy degree and prognosis of the tumor rather than the diagnosis.[19] Since lung SCC is much more common than renal SCC, the possibility of metastasis to the kidney from other possible SCC foci, especially the lung, should be included in the differential diagnosis, and the possibility of metastasis should be ruled out with systemic imaging methods.

Conclusion

Renal SCC is an extremely rare tumor with an aggressive behavior. The imaging findings of renal SCC are non-specific but imaging plays an essential role in staging and that the entity should be considered in the differential of a renal mass with atypical imaging findings and/or aggressive behavior. Although the main diagnosis of renal SCC is based on pathology, the definition of more detailed modern imaging findings of the tumor may contribute to the diagnosis.

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