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Case Report

Combined therapy for managing a clear cell renal cell carcinoma in a horseshoe kidney: A case report☆,☆☆

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ABSTRACT

The upper urinary tract is the most common human organ system affected by congenital anomalies. A Horseshoe kidney is a fusion anomaly, it can be described as a fusion across the midline of 2 distinct functioning kidneys. The incidence of renal tumors in a Horseshoe kidney is higher than in the normal population.

We present a 60-year-old male patient with a history of Horseshoe kidney and a diagnosis of clear cell renal cell carcinoma who underwent a combined therapeutic approach, guided by interventional radiology. This approach involved selective transarterial embolization and microwave ablation. Three months after surgery and with abdominal MRI follow-up, there is evidence of a non-viable tumor, indicating a favorable response to the intervention.

Introduction

The upper urinary tract is the most common human organ system affected by congenital anomalies [1]. They can be classified by the type of renal anomaly according to form, position, number, and development of the urinary collecting system [1]. A Horseshoe kidney is a fusion anomaly, it can be described as a fusion across the midline of 2 distinct functioning kidneys [1], it is the most common congenital anomaly of the upper urinary tract, and it is detected mostly as an incidental finding on computed tomography (CT) or ultrasound (US) examination [2]. A Horseshoe kidney can be found in one in 400 adults [3], it is twice as common in men than it is in women [4]. The incidence of renal tumors in a Horseshoe kidney is higher than in the normal population [2].

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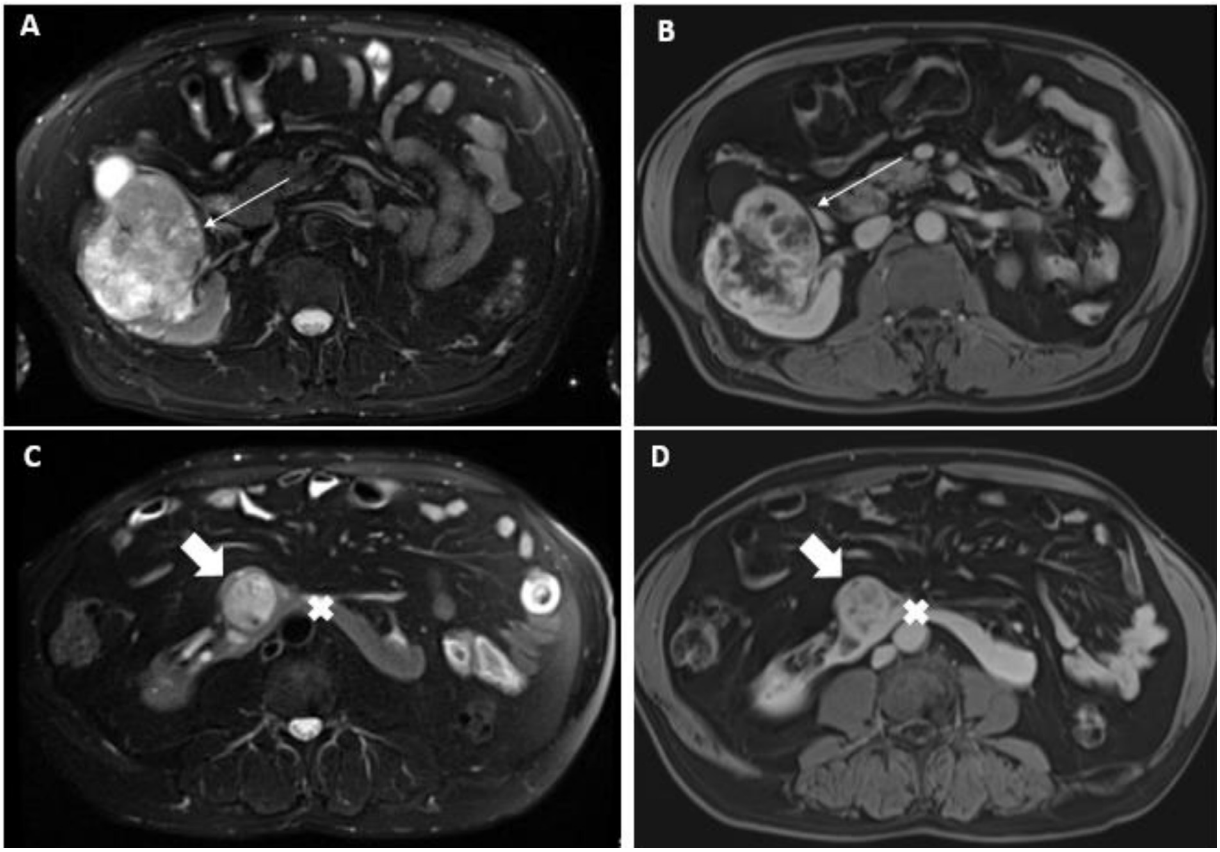

Fig. 1 – (A and C) are T2-weighted with fat saturation. (B and D) are T1-weighted with fat saturation and contrast enhancement. Thin arrows in A and B highlight a neoplastic mass, hyperintense in T2 and enhanced with contrast in the right kidney's upper pole. In (C and D), thick arrows indicate another synchronous tumor with similar characteristics. The 'X' denotes the fusion of the lower kidney poles due to horseshoe kidney anatomy.

Kidney cancer accounts for 5% of malignancies and it is the sixth most common cancer in men [5]. The most prevalent type, clear cell renal cell carcinoma (ccRCC), is characterized by genetic mutations in factors governing the hypoxia signaling pathway [6]. Partial nephrectomy has been the standard of care for managing T1 kidney tumors (<7 cm) due to better outcomes compared with radical nephrectomy, especially in patients with comorbidities [5,7]. However, there are patients with upper urinary tract congenital anomalies for whom it becomes crucial to offer different treatment modalities when conventional surgical approaches cease to be an option.

We present the case of a 60-year-old male patient with a history of Horseshoe kidney and a diagnosis of clear cell renal cell carcinoma. The patient underwent laparoscopic radical nephrectomy, with residual viable tumor and hemorrhagic complications during surgery. Subsequently, interventional radiology played a pivotal role in the decision to pursue a combined therapeutic approach encompassing selective transarterial embolization and microwave ablation.

Case report

We present the case of a 60-year-old male patient who initially presented to the emergency department due to the first episode of sudden macroscopic hematuria without any other associated symptoms. The patient has a significant medical history, including an anatomical variant known as a horseshoe kidney and bilateral nephrolithiasis. Additionally, he has been diagnosed with arterial hypertension and is currently undergoing treatment with an angiotensin-converting enzyme inhibitor. The patient has a history of open nephrolithotomy through bilateral lumbar incisions.

Abdomen and pelvic magnetic resonance imaging (MRI) were performed (Fig. 1), revealing including horseshoe kidneys with fusion at their lower poles. Moreover, on the right side of the horseshoe kidney there was a solid mass with regular borders, thick septa with contrast enhancement and restriction in the diffusion sequences, characterized by a mixed component and signs of infiltration into the renal sinus without compromising the arterial or venous structures. This mass abutted the hepatic capsule in segment VI but did not demonstrate direct infiltration into the Gerota's fascia. Simultaneously, another neoplastic-looking mass was observed near the fusion of the lower poles, suggesting a synchronous tumor, with extension into the renal sinus; although vascular structure infiltration was not evident. Bilateral renal cysts were also noted, while no other nodular lesions were detected. Further complexities included variations in the renal sinus configuration, with vascular structures originating from the right common iliac artery. The examination revealed prominent left para-

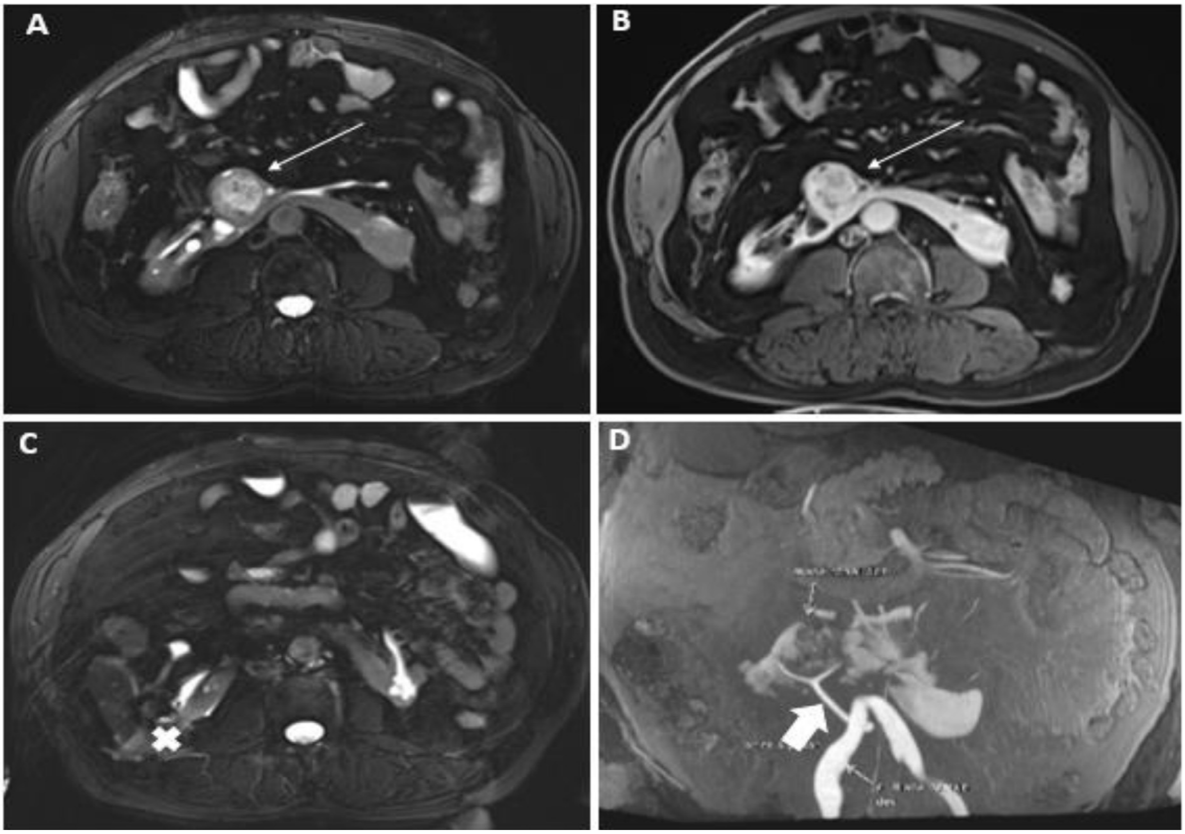

Fig. 2 – (A and C) are T2-weighted with fat saturation. Image B is T1-weighted with fat saturation and contrast enhancement. (D) is a multiplanar reconstruction from magnetic resonance angiography. Thin arrows in A and B indicate the persistent presence of the synchronous tumor at the junction of both lower kidney poles. The 'X' in (C) indicates post-surgical changes following a prior partial nephrectomy, particularly in the upper pole of the right kidney. Thick arrow in (D) shows depicts an accessory renal artery originating from the right common iliac artery, providing blood supply to the tumor.

aortic lymph nodes with a short axis measuring less than 15 mm, displaying nonspecific characteristics in an oncological context, and no evidence of lymph node conglomerates or adenopathy. Prostate examination indicated heterogeneity in signal intensity within the peripheral zone without discernible foci of restricted diffusion, necessitating correlation with PSA levels. Lastly, an extensive colon diverticulum was identified without any signs of inflammation. Furthermore, a chest CT scan was performed to assess the presence of nodules, lymphadenopathy, or bony involvement with no evidence of metastatic disease.

Based on the above, it was considered to proceed with laparoscopic radical nephrectomy for the patient, and along with treatment with Dutasteride and Tamsulosin. It's important to note that the surgical procedure was reported as technically challenging due to vascular anatomical variants, a tendency for easy bleeding, and fibrosis from previous interventions. The pathology results revealed clear cell renal cell carcinoma.

Three months after surgery, an abdominal contrast-enhanced angioMRI was requested (Fig. 2), revealing a horseshoe kidney with post-surgical changes in the upper pole of the right kidney. Furthermore, a persistent mass suggestive of neoplastic involvement, potentially indicative of renal cell carcinoma, was noted in the lower pole of the right kidney extending towards the interpolar region and involving the renal sinus. This lesion was surrounded by an inferior polar artery originating from the right common iliac artery. No signs of intra-abdominal metastatic involvement were identified.

The urology department, as primary medical team, decided to request an assessment by the interventional radiology service. After reviewing the patient's images and considering their anatomical variations, the interventional radiology team recommended embolization and tumor ablation.

How did we do it?

The combined procedure started with embolization (Fig. 3). The right common femoral artery was accessed using a 5 French introducer, and a Simmons 1 catheter was advanced to the artery emerging from the right common iliac artery, which was the main artery supplying the renal lesion. A Progreat 2.8 French microcatheter was advanced to selectively catheterize the feeding artery, and selective embolization was carried out, using Lipiodol and 355–500-micron particles. Additionally, temporary selective occlusion with Gelfoam was performed to protect blood supply to the left kidney. Subsequently, angiography of the main right and left renal arteries originating from

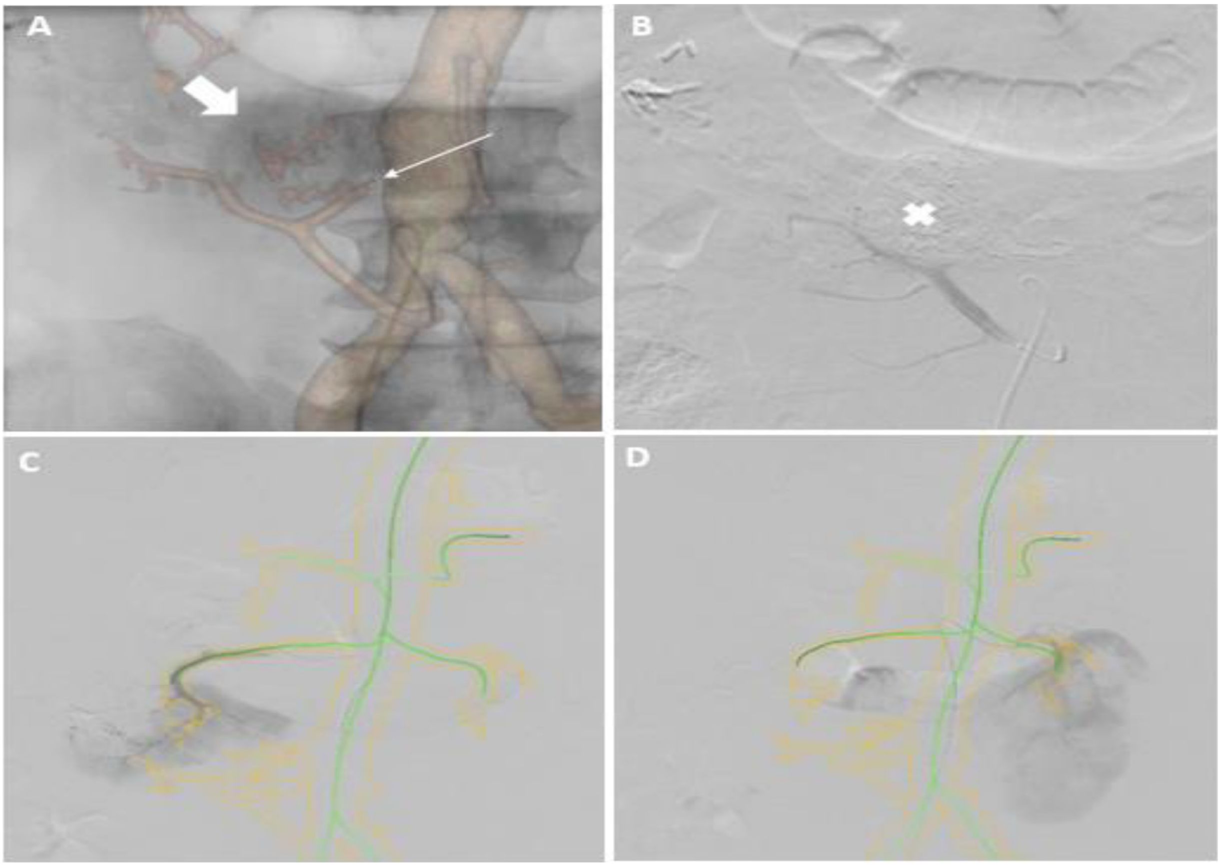

Fig. 3 – Digital substraction angiography images. (A) represents selective catheterization of the accessory renal artery supplying the tumor, guided by a mask derived from previous MR angiography. The thick arrow highlights the tumoral "flush," while the thin arrow indicates the tip of the microcatheter. (B) shows angiographic result after embolization, with complete disappearance of the tumoral "flush," marked with an 'X.' (C and D) depict angiographies of the right and left main renal arteries, respectively, revealing no branches contributing flow to the tumor.

the aorta was performed, but no other vascular supply to the renal lesion was observed.

Afterwards, on the same bed, the patient was positioned in a prone decubitus position, and the Needle Assist Software was used to guide a 15 Gauge - 19 cm microwave needle through the entire mass (Fig. 4). Using a 140-watt protocol for 6 minutes, a 4 cm diameter and 5.6 cm long, microwave ablation was performed. On post-procedure cone-beam CT control, no immediate procedural complications were identified.

Follow-up

After 3 months, the patient underwent an abdominal MRI for a follow-up assessment of the disease, with no evidence of viable tumor (Figs. 5 and 6).

Discussion

The upper urinary tract is the most common human organ system affected by congenital anomalies [1]. A Horseshoe kidney is a fusion anomaly, it can be described as a fusion across the midline of two distinct functioning kidneys [1].

The incidence of renal tumors in a Horseshoe kidney is higher than in the normal population [2]. The most prevalent type, clear cell renal cell carcinoma (ccRCC), is characterized by genetic mutations in factors governing the hypoxia signaling pathway [6]. Partial nephrectomy has been the standard of care for managing T1 kidney tumors (<7 cm) due to better outcomes compared with radical nephrectomy, especially in patients with comorbidities [5,7]. However, there are patients with upper urinary tract congenital anomalies for whom it becomes crucial to offer different treatment modalities when conventional surgical approaches cease to be an option.

Percutaneous ablation is a recommended alternative treatment for renal-cell carcinoma [8]. Radiofrequency ablation and cryoablation have shown good long-term results for early tumors [9]. However, microwave ablation is increasingly used and has slightly better technical and local tumor control rates compared to other methods, with lower major complication rates [10].

Microwave ablation is a recommended, safe, and minimally invasive treatment for RCC [11]; in liver masses, it has surpassed radiofrequency ablation and cryoablation in efficiency [12]. Image-guided ablation with computer-assisted naviga-

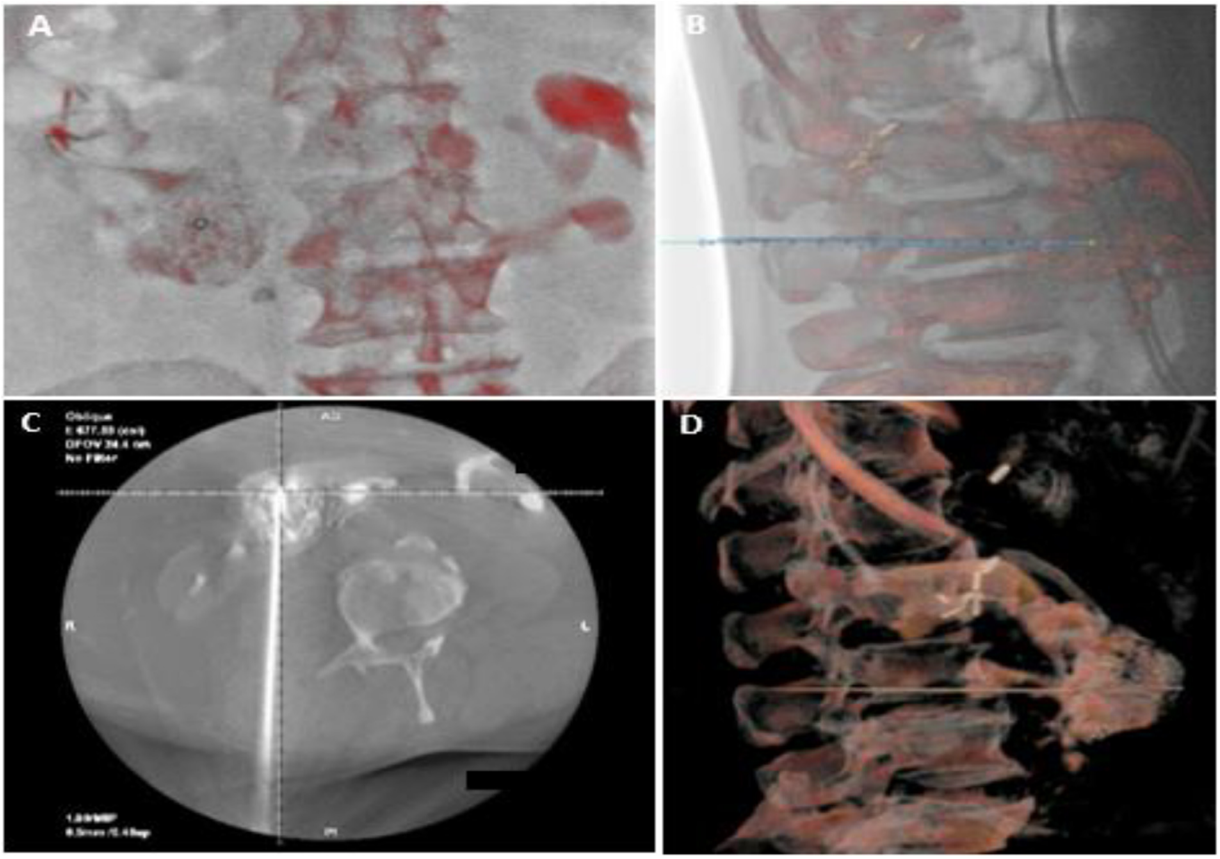

Fig. 4 – (A and B) are derived from digital subtraction angiography, leveraging the tumor opacification generated by prior Lipiodol administration; they depict the procedural planning phase using the Needle Assist software. (C and D) are axial and 3D reconstructions, acquired using Cone Beam CT. They illustrate the trajectory of the microwave ablation needle as it traverses through the lesion.

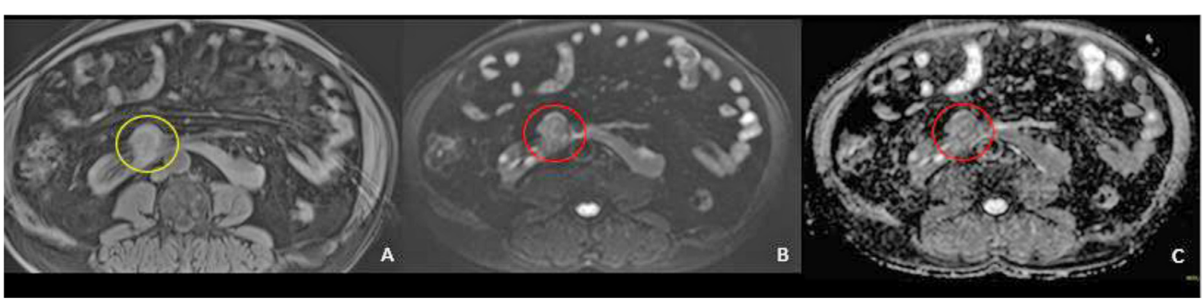

Fig. 5 – (A) Simple T1 image revealing intralesional hyperintensity (yellow circle), anticipated due to the ablative procedure, elucidated by detritus and hemorrhagic debris. (B and C) In the TRACE and ADC diffusion sequences, no restricted areas are observed (red circle).

tion is gaining popularity. This case shows guided microwave ablation after selective renal artery embolization as a feasible, fast and minimally invasive option for small ccRCC in a 60-year-old patient with horseshoe kidney, in whom laparoscopic nephrectomy did not attain the expected outcomes.

Nevertheless, the kidney's high perfusion and heat dissipation characteristics require a different approach to ablation. The heat-sink effect from nearby blood vessels can limit the effectiveness of thermal ablation [11]. Preoperative superselective renal artery embolization can enhance the effectiveness of ablation by concentrating heat in lipiodol deposits. Therefore, combined therapy improves heat conduction to peripheral tissues, reducing recurrence and metastasis.

Complete response and accurate probe placement are crucial factors in RCC ablation. Sequential combination therapy has been common, but using advanced software to guide simultaneous therapy can maximize their synergistic effect and improve therapeutic efficacy [13].

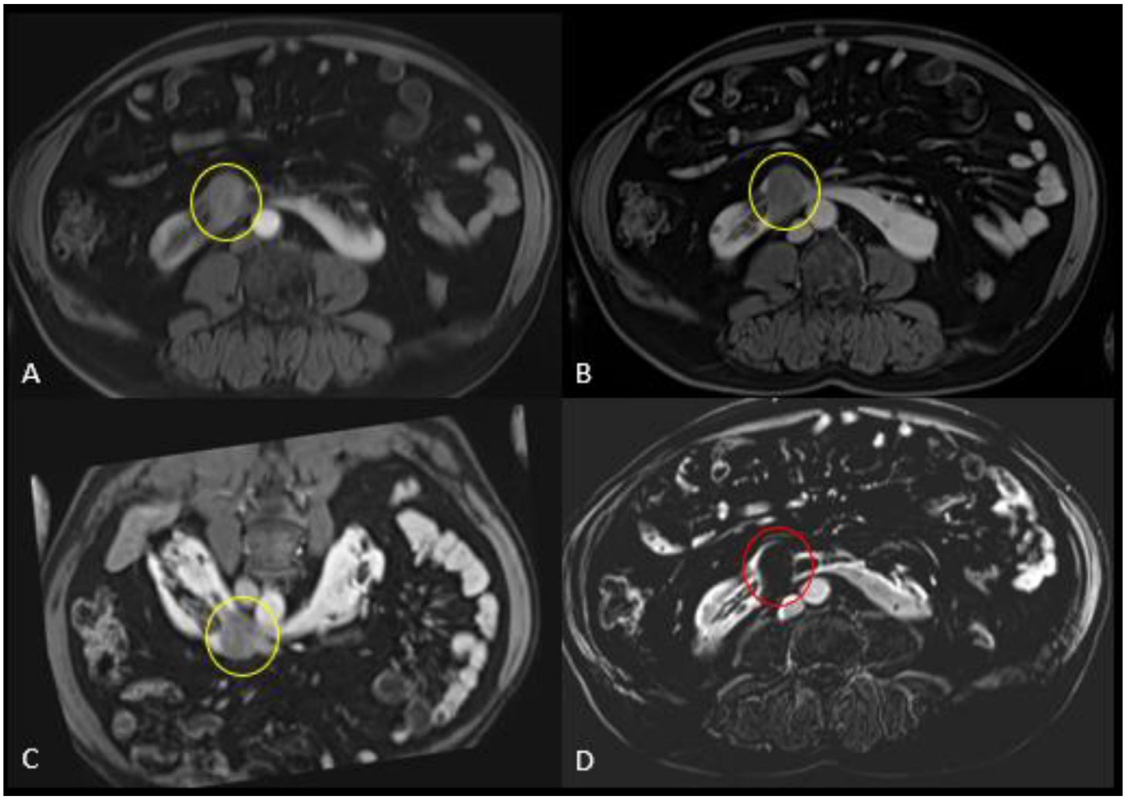

Fig. 6 – (A-C) Post-contrast T1 images in arterial and venous phases do not reveal any pathological intralesional enhancement. In (C) the relationship of the lesion with retroperitoneal vascular structures can be observed in a coronal oblique reconstruction, also without pathological enhancement (yellow circle). (D) Subtraction in the arterial phase demonstrates improved sensitivity to abnormal enhancement; however, once again, no pathological enhancement is visualized (red circle), consistent with a nonviable tumor.

Conclusion

Our approach for this particular ccRCC in a patient with a horseshoe kidney involved selective transarterial embolization and microwave ablation. After 3 months of treatment and with abdominal MRI follow-up, there is evidence of a nonviable tumor, indicating a favorable response to the intervention. This combined therapy emerges as a viable option for patients in whom other therapeutic approaches prove to be unsuccessful, especially for those with a high risk of difficult surgical procedures and bleeding complications during conventional surgery.

Patient consent

The reported case was reviewed and approved, and individual patient consent was obtained following institutional guidelines.

REFERENCES

[1] Houat AP, Guimarães CTS, Takahashi MS, Rodi GP, Gasparetto TPD, Blasbalg R, et al. Congenital anomalies of the upper urinary tract: a comprehensive review. Radiogr Rev Publ Radiol Soc N Am Inc 2021;41(2):462–86.
[2] Alamer A. Renal cell carcinoma in a horseshoe kidney: radiology and pathology correlation. J Clin Imaging Sci 2013;3:12.
[3] O'Brien J, Buckley O, Doody O, Ward E, Persaud T, Torreggiani W. Imaging of horseshoe kidneys and their complications. J Med Imaging Radiat Oncol 2008;52(3):216–26.
[4] Glodny B, Petersen J, Hofmann KJ, Schenk C, Herwig R, Trieb T, et al. Kidney fusion anomalies revisited: clinical and radiological analysis of 209 cases of crossed fused ectopia and horseshoe kidney. BJU Int 2009;103(2):224–35.
[5] Bahadoram S, Davoodi M, Hassanzadeh S, Bahadoram M, Barahman M, Mafakher L. Renal cell carcinoma: an overview of the epidemiology, diagnosis, and treatment. G Ital Nefrol Organo Uff Della Soc Ital Nefrol 2022;39(3):1–6.

[6] Wolf MM, Kimryn Rathmell W, Beckermann KE. Modeling clear cell renal cell carcinoma and therapeutic implications. Oncogene 2020;39(17):3413–26.
[7] Zini L, Perrotte P, Capitanio U, Jeldres C, Shariat SF, Antebi E, et al. Radical versus partial nephrectomy. Cancer 2009;115(7):1465–71.
[8] Ljungberg B, Albiges L, Abu-Ghanem Y, Bensalah K, Dabestani S, Fernández-Pello S, et al. European Association of Urology guidelines on renal cell carcinoma: the 2019 update. Eur Urol 2019;75(5):799–810.
[9] Spiliopoulos S, Marzoug A, Ra H, Ragupathy SKA. Long-term outcomes of CT-guided percutaneous cryoablation of T1a and T1b renal cell carcinoma. Diagn Interv Radiol 2021;27(4):524–8.
[10] Zhou W, Arellano RS. Thermal ablation of T1c renal cell carcinoma: a comparative assessment of technical performance, procedural outcome, and safety of microwave ablation, radiofrequency ablation, and cryoablation. J Vasc Interv Radiol JVIR 2018;29(7):943–51.
[11] Filippiadis DK, Gkizas C, Chrysofos M, Siatelis A, Velonakis G, Alexopoulou E, et al. Percutaneous microwave ablation of renal cell carcinoma using a high power microwave system: focus upon safety and efficacy. Int J Hyperth Off J Eur Soc Hyperthermic Oncol North Am Hyperth Group 2018;34(7):1077–81.
[12] Andreano A, Brace CL. A comparison of direct heating during radiofrequency and microwave ablation in ex vivo liver. Cardiovasc Intervent Radiol 2013;36(2):505–11.
[13] Li J, Li Z, Jiao DC, Si G, Zhou X, Li Y, et al. Clinical outcomes after selective renal artery embolization combined With DynaCT-guided microwave ablation for T1a renal-cell carcinoma: case series. Clin Genitourin Cancer 2021;19(1):e1–5.