# CT-guided microwave ablation of renal cell carcinoma in a horseshoe kidney – a case report

## CT-navigovaná mikrovlnná ablace renálního karcinomu v podkovovité ledvině – kazuistika

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### Summary

***Background:*** Horseshoe kidney (HSK) is the most common congenital renal fusion anomaly. While the incidence of renal cell carcinoma (RCC) in HSK is not higher than in anatomically normal kidneys, altered renal anatomy makes surgical management technically challenging. Minimally invasive, image-guided therapies such as microwave ablation (MWA) have emerged as promising alternatives. ***Observation:*** We present the case of a 65-year-old male with HSK and a 2.0 cm RCC in the right renal moiety who underwent CT-guided MWA with no complications. Hydrodissection was used to protect the psoas muscle and lumbosacral nerves. Follow-up imaging confirmed local tumor control with no signs of remnant or recurrence. Only a limited number of similar cases have been reported. ***Conclusion:*** This case highlights the feasibility and safety of percutaneous MWA for RCC in HSK. It adds to the growing evidence supporting MWA as a minimally invasive option in anatomically complex renal tumors.

### Key words

horseshoe kidney – renal cell carcinoma – microwave ablation – image-guided therapy – hydrodissection

### Souhrn

***Východiska:*** Podkovovitá ledvina (horseshoe kidney – HSK) je nejčastější vrozená anomálie ledvin. Ačkoli incidence renálního karcinomu (renal cell carcinoma – RCC) u HSK není vyšší než u anatomicky normálních ledvin, změněná anatomie ledvin činí chirurgickou léčbu technicky náročnou. Jako slibná alternativa se objevily minimálně invazivní, obrazem řízené terapie, jako je mikrovlnná ablace (microwave abblation – MWA). ***Pozorování:*** Představujeme případ 65letého muže s HSK a 2,0 cm RCC v pravé ledvině, který podstoupil CT-navigovanou MWA bez komplikací. K ochraně psoasu a lumbosakrálních nervů byla použita hydrodisekce. Následné zobrazovací vyšetření potvrdilo lokální kontrolu nádoru bez známek zbytků nebo recidivy. Bylo hlášeno pouze omezené množství podobných případů. ***Závěr:*** Tento případ zdůrazňuje proveditelnost a bezpečnost perkutánní MWA u pacientů s RCC v HSK. Přispívá k rostoucímu množství důkazů podporujících MWA jako minimálně invazivní možnost u anatomicky složitých renálních nádorů.

### Klíčová slova

podkovovitá ledvina – renální karcinom – mikrovlnná ablace – obrazem řízená terapie – hydrodisekce

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## Introduction

Horseshoe kidney (HSK) is a congenital renal fusion anomaly characterized by fusion of the lower poles during early embryogenesis, affecting approximately 1 in 400–1,000 individuals [1]. While the overall risk of renal malignancy is not increased in HSK, the abnormal anatomy poses technical challenges in surgical management [2–4].

According to the most recent international, multidisciplinary guidelines (NCCN 2024), partial nephrectomy or percutaneous ablation can be proposed for the management of T1a RCC [5]. However, in the case of HSK, surgical options are associated with increased blood loss, prolonged operative times, and a higher risk of complications due to the altered anatomy [2–4]. Recognizing these challenges, recent case reports have demonstrated the feasibility of percutaneous ablation techniques, including microwave ablation (MWA) in HSK [2–8]. Unlike cryoablation or radiofrequency ablation, MWA offers advantages such as shorter procedural time, reduced sensitivity to heat-sink effects, and the ability to create larger and more predictable ablation zones with a single probe [9].

Despite these advantages, reports of percutaneous MWA in HSK remain extremely limited, with only a few published cases in the literature [6–8]. These studies have highlighted the technical modifications required to ensure adequate tumor coverage while avoiding injury to adjacent structures. In this report, we present the case of a patient with a right moiety renal lesion in an HSK, successfully treated with percutaneous MWA. We discuss the technical considerations, procedural adaptations, and clinical outcomes, contributing to the growing evidence supporting MWA as a viable alternative for renal tumors in HSK.

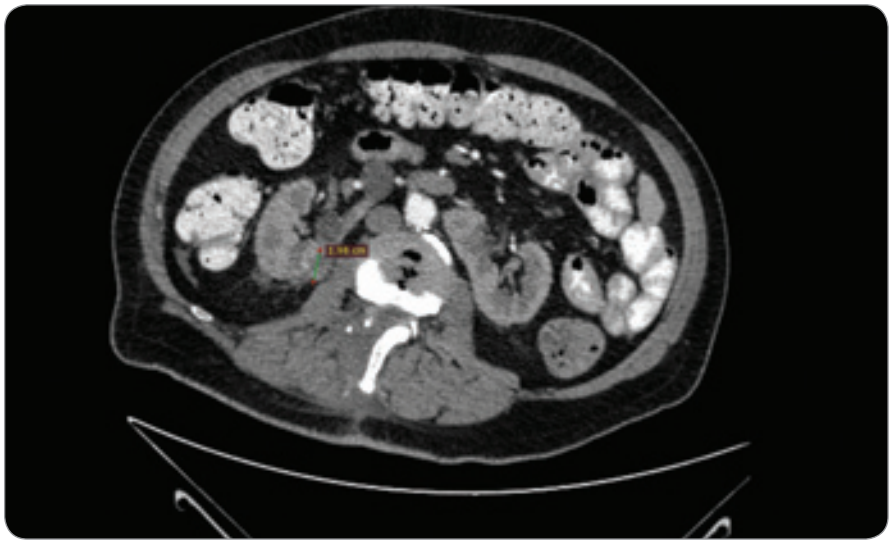

**Fig. 1. CT axial scan (arterial phase post IV contrast medium injection) showing partly exophytic lesion in the posterior side of the right moiety of the horseshoe kidney.**

## Case report

A 65-year-old male patient with a horseshoe kidney (HSK) and a solid, partly exophytic mass in the right moiety measuring 2 cm in diameter (biopsy proven as clear cell Fuhrmann grade 2 renal carcinoma) (Fig. 1), was referred to the interventional radiology (IR) department by a multidisciplinary tumour board for percutaneous ablation. After evaluating the anatomical complexity and procedural considerations, microwave ablation (MWA) was selected as the preferred ablative therapy, mainly due to its ability to create a controlled ablation zone with a single probe.

Microwave ablation was performed in an inpatient setting. Pre-procedural intravenous antibiotics (cefuroxime 1.5 g) were given prior to the ablation session. CT guidance with sequential scanning (120 Kv peak, 240 mAs wavelength and 2 mm slice thickness) was used for planning, targeting and intra-procedural modification during the ablation session. A combination of local anaesthesia (lidocaine hydrochloric 2%) and intravenous analgesia (paracetamol 1g mixed with tramadol 100 mg in 100 $cm^3$ normal saline) was used to treat intraprocedural pain. Post the initial CT scan, skin entry points were selected. To minimize thermal injury to adjacent structures, particularly the lumbosacral nerves and the psoas muscle, a trocar with a spring-loaded blunt tip stylet (15G/12.7cm Gangi Hydroguard, AprioMed AB, Uppsala, Sweden) was first inserted under CT guidance between the lesion and the dorsal musculature, allowing for hydrodissection (Fig. 2A). A mixture (10 : 1) of 5% dextrose and iodinated contrast medium was injected to displace surrounding tissues, creating a protective buffer


**Fig. 2. CT axial scan showing the coaxial needle advancement into the retroperitoneal space, between the right psoas muscle and the right moiety of the kidney, followed by hydrodissection with diluted contrast medium (A); non-contrast axial CT scan showing the percutaneous access of the microwave probe into the renal cell carcinoma mass (B, C).**

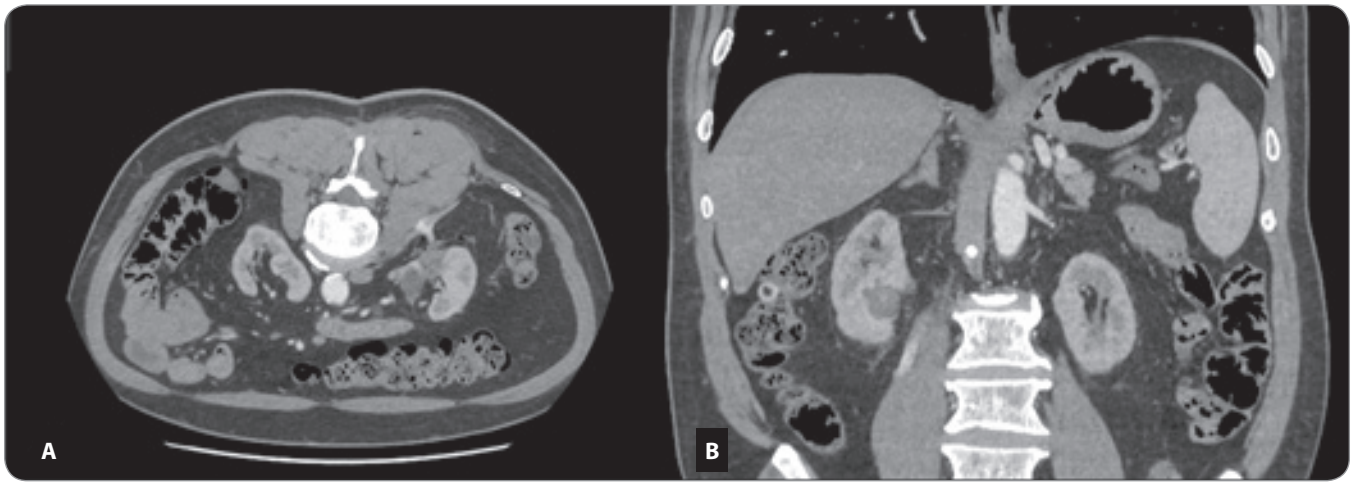


**Fig. 3. CT axial scan (A) and coronal reconstruction (B) in arterial phase showing complete tumor necrosis without any signs of tumor remnants or immediate complications.**

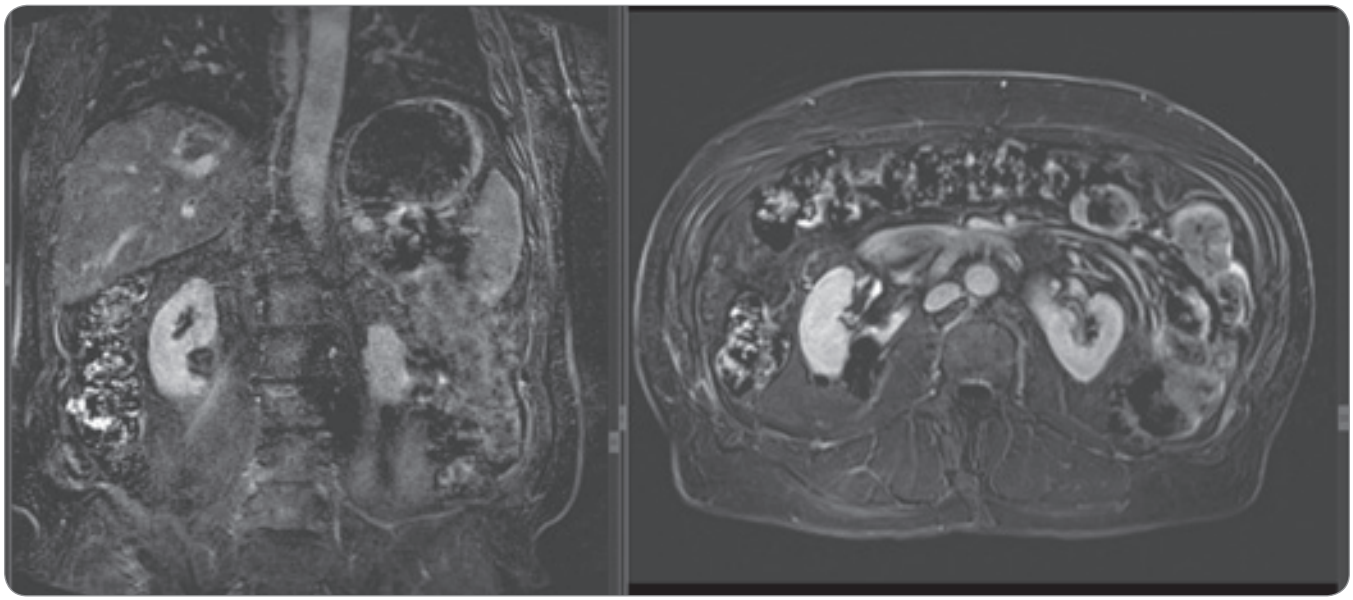

**Fig. 4. MRI (post intra-venous gadolinium injection) in coronal and axial sequences at 6 months follow-up showing complete tumor necrosis without any signs of tumor remnants.**

zone. This step was crucial in preventing nerve damage and unintended thermal spread to the psoas muscle, which could result in post-procedural pain or functional impairment. Once hydrodissection was successfully performed, the microwave probe (16G/15cm HS AMICA, HS Hospital Service S.P.A., Rome, Italy) was inserted to the centre of the tumor and its position was evaluated with sequential CT scans (Fig. 2B, C). Once in the correct location, ablation session was performed according to the provided guidelines from the manufacturer concerning energy amount (watt), duration (minutes) and resultant ablation volume (centimeters). In the current case MWA was performed using a single cycle protocol of 40 watts × 5 minutes, delivering controlled thermal energy to ensure complete tumor ablation with 5 mm safety margins.

Contrast enhanced CT immediately at the end of the ablation treatment assessed zone of necrosis and potential immediate complications (Fig. 3). The patient remained in the hospital overnight and then was discharged. The patient was monitored postoperatively, remaining hemodynamically stable and was discharged the next morning. Follow-up consisted of clinical visits and imaging follow-up. Follow-up imaging with MRI was scheduled 6 months post-procedure to assess treatment efficacy and confirm complete lesion ablation illustrating local tumor control with no signs of tumor remnant or recurrence (Fig. 4).

## Discussion

Renal fusion anomalies, such as horseshoe kidney (HSK), create unique challenges in the treatment of renal tumors [1]. While surgical resection remains an option, these anatomical com-

plexities often increase the risk of complications, prolonged operative times, and higher morbidity; in such cases, percutaneous thermal ablation constitutes a minimally invasive alternative, providing effective local tumor control while preserving renal function [2–4].

Percutaneous ablative therapies including microwave ablation (MWA) are included in the most recent international multidisciplinary as an effective option for renal tumors [2–4, 6–8].

Unlike radiofrequency ablation, which requires grounding pads and is more affected by tissue conductivity, MWA allows for more predictable, larger ablation zones with single or fewer probes [6–9]. Compared to cryoablation, which requires multiple probes and longer freezing cycles, MWA reduces procedural complexity while maintaining efficacy [6–9].

One of the primary concerns in ablating renal tumors in HSK is the risk of thermal injury to adjacent structures, particularly the psoas muscle and lumbosacral nerves [10–12]. In this case, hydrodissection was performed using a mixture of normal saline and iodinated contrast medium to create a protective buffer, displacing these structures away from the ablation zone. This technique is well-documented in percutaneous interventions and plays a crucial role in reducing collateral damage when tumors are located near vital anatomical landmarks [10–12].

MWA was selected in this case due to its ability to generate a larger, more uniform ablation zone with a single probe, reducing the need for multiple punctures. Given renal fusion anomaly, minimizing the number of probe insertions was essential to reduce procedural risks. Additionally, the ability of MWA to achieve rapid and controlled thermal destruction of tumor tissue further enhances its safety profile in anatomically complex cases.

Despite the increasing use of percutaneous thermal ablation in renal tumors, reports on MWA specifically in HSK remain scarce, with limited up to our knowledge previously documented cases [6–8]. This case further supports the feasibility of MWA as an effective alternative to surgery or other ablation techniques in HSK, particularly when combined with hydrodissection to enhance procedural safety.

The successful outcome reinforces the role of MWA in complex renal anatomies, emphasizing the need for continued investigation into its long-term benefits and clinical applications.

## Conclusion

Microwave ablation offers a safe and effective treatment option for RCC in horseshoe kidney, especially when anatomical complexity limits surgical approaches. The success of this case underscores the value of MWA combined with adjunctive techniques like hydrodissection. Further clinical experience and long-term follow-up will help define its role more clearly.

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