

Ureteral protection during microwave ablation of renal cell carcinoma: combined use of pyeloperfusion and hydrodissection

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ABSTRACT

A 56-year-old female with past medical history of thrombotic microangiopathy presented to her physician with nonspecific abdominal pain. A magnetic resonance imaging scan was obtained, which revealed a 3.1 cm mass arising from medial lower pole of the left kidney that was subsequently shown to be renal cell carcinoma by percutaneous biopsy. Because of her history of thrombotic microangiopathy and other comorbidities, she was deemed a nonsurgical candidate and was therefore referred to interventional radiology for thermal ablation. Computed tomography (CT)-guided microwave ablation was performed with the combined use of pyeloperfusion and hydrodissection for maximal ureteral protection. Follow-up unenhanced CT scan obtained one month after ablation showed a normal collecting system without evidence of hydronephrosis or urinoma.

Percutaneous image-guided thermal ablation is a widely accepted treatment option for renal tumors (1). Of the thermal ablation methods currently available, including microwave ablation (MWA), cryoablation, and radiofrequency ablation (RFA), MWA has potential advantages of shortest treatment time and higher thermal efficacy, and it is less affected by heat sink phenomenon compared with RFA and cryoablation (2).

Nontarget organ injury is one of the most dreaded complications of any thermal ablation procedure. Given the anatomical location of kidneys, structures at risk of nontarget thermal injury can include the duodenum, colon, small bowel, pancreas, adrenal gland, psoas muscle, and ureter (3). To help lessen the risk of injury to these structures during renal ablations, several adjunctive maneuvers including gas insufflation, electrode torquing, hydrodissection, and ureteral pyeloperfusion have been described (4, 5). Hydrodissection describes the process of physically displacing structures away from renal tumors, while pyeloperfusion is used to cool or maintain body temperature within the ipsilateral ureter during thermal ablations of tumors that arise from the medial lower pole and keep ureter from untargeted thermal injury.

In this report, we present a case of CT-guided MWA of a renal cell carcinoma for which the combined use retrograde pyeloperfusion for ureteral cooling and hydrodissection for displacement of the ureter from the tumor was performed to minimize the risk of thermal injury.

Technique

Our hospital does not require Institutional Review Board approval for retrospective case reports. A 56-year-old female with a complex medical history of thrombotic microangiopathy which required chronic anticoagulation, anemia, and chronic renal failure presented with nonspecific abdominal pain. An informed consent was obtained from the patient. MRI revealed left renal lower pole 3.1 cm tumor abutting the proximal left ureter (Fig. 1). Subsequent CT-guided biopsy confirmed clear cell renal cell carcinoma. She was not considered a suitable surgical candidate due to her medical comorbidities and was therefore referred to Interventional Radiology for percutaneous thermal ablation.

Percutaneous MWA was chosen over RFA and cryoablation due to the potentially relatively short treatment time and exposure of the left ureter to thermal energy compared with

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the other modalities. Immediately prior to the procedure, a urologist cystoscopically placed a 5 F stent (Pollack Open-End Flexi-Tip® Ureteral Catheter, Cook Urological) into the ipsilateral ureter. Following stent placement, it was clear that the left ureter was in direct contact with the left renal tumor (Fig. 2). Therefore, hydrodissection was also performed by injecting 500 mL dilute contrast (20 mL Ultravist in 1000 mL normal saline) between the left ureter and tumor using a 19G needle (CHIBA Biopsy needle, Cook Medical) (Fig. 3). Subsequently, two overlapping MWAs were performed using 60 watts of energy for 5 minutes for each ablation (AMICA™, HS Medical), (Fig. 4). An immediate postprocedure CT scan showed no acute complication. An unenhanced CT obtained one month after treatment showed no evidence of hydronephrosis or perirenal fluid (Fig. 5).

Discussion

Thermal ablation is now widely used for management of selected cases of renal cell carcinoma. Recent studies have shown that survival rates after RFA and cryoablation for renal cell carcinoma are comparable to nephrectomy and are associated with less morbidity than traditional surgical methods (6, 7). Among all minimally invasive methods, MWA offers the potential of shorter treatment time, higher thermal efficacy when compared to RFA or cryoablation with an acceptable safety profile (2, 8). Recent studies suggest that MWA is also associated with high technical and clinical effectiveness (8, 9).

Location of the tumors plays an important role in treatment success. Ablation of the tumors located in a proximity to the ureter is associated with higher risk of direct ureter thermal injury (10). Gervais et al. (11) showed that 25% of RFAs of the tumors located less than 1 cm from the ureter resulted in ureteral stricture while no stricture

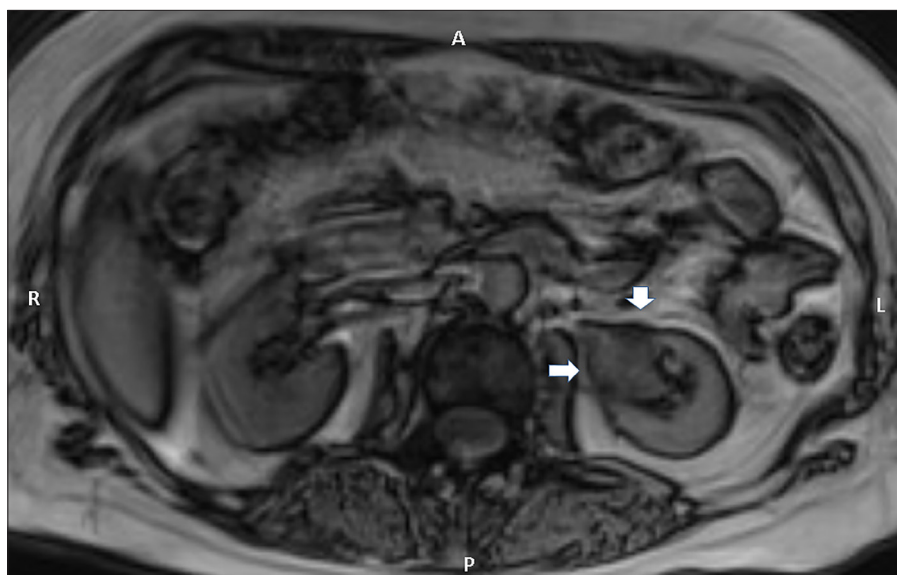


Figure 1. MRI study prior to treatment demonstrating tumor (arrows) centrally located in left kidney.



Figure 2. Preprocedure CT after placing ureteral stent (arrow) demonstrating proximity of ureter to the tumor (dashed circle).

was detected when the ureter was greater than 2 cm away from the tumor. Ruize et al. (5) demonstrated that with every 1 mm increase in distance between the tumor and the ureter, the success rate increases by 18%. While MWA is associated with shorter treatment time, since it produces higher temperature compared with RFA, it is more probable to produce thermal injury to adjacent structures.

Hydrodissection has been described as a method to displace structures away from renal tumors in order to minimize the risk of thermal and mechanical injury during

ablation (12). While the colon, duodenum, and pancreas are the most commonly displaced organ, ureteral displacement by hydrodissection is less often performed (13, 14). In our case, hydrodissection was necessary following stent placement because the ureter was in direct contact with the tumor.

In addition to hydrodissection, ureteral perfusion during ablation is another strategy to protect the ureter during thermal ablation. Although cold saline may lower the temperature near the collecting system and sacrifice ablation zone (15), Mar-

Main points

- Hydrodissection is a useful adjunctive technique for microwave ablation of renal cell carcinomas to keep adjacent structures from untargeted thermal injury.
- Pyeloperfusion is a technique to protect ureter from thermal injury during microwave ablation of lower renal pole tumors.
- Microwave ablation is a safe and effective treatment for renal cell carcinoma.

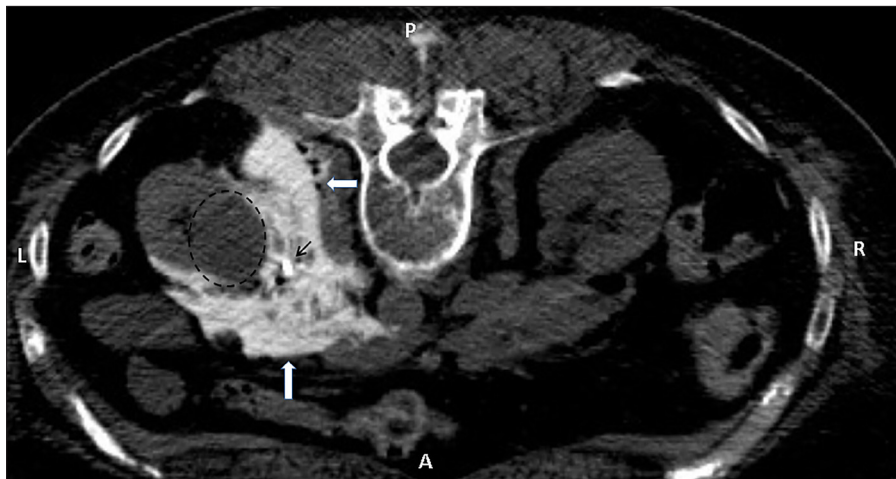


Figure 3. Ureter (black arrow) is displaced from surface of the tumor (dashed circle) by instillation of diluted contrast (white arrows).



Figure 4. Microwave ablation of the tumor after pyeloperfusion (blue arrowhead) and hydrodissection (arrows) of the ureter; curved arrow shows ablation antenna.



Figure 5. Coronal view of postprocedure CT, which shows no urologic complication such as hydronephrosis. Dashed circle demonstrates ablation zone.

gulis et al. (16) showed in an animal study that pyeloperfusion did not significantly affect the ablation size when using RFA. Similarly, Cantwell et al. (17) demonstrated 100% effectiveness of pyeloperfusion with RFA for renal tumors within 1.5 cm to ureter without any urologic complications. While several studies have assessed the efficacy of pyeloperfusion with RFA, studies investigating pyeloperfusion in MWA are lacking.

Because the primary mechanism of action of MWA is agitation of water molecules within tissue, the presence of a fluid-filled ureter adjacent to tumors treated with MWA would theoretically be at higher risk of thermal injury. However, the patient discussed in this report was treated successfully with pyeloperfusion, hydrodissection, and MWA.

In conclusion, this case demonstrates the combined value of hydrodissection with pyeloperfusion to successfully perform CT-guided MWA for a renal cell carcinoma arising from the medial lower pole. By physically displacing the ureter away from the tumor and active ureteral cooling with pyeloperfusion, MWA could be completed without acute or delayed complication of the collecting system. Larger series with longer follow-up are necessary to assess the efficacy of this technique.

Conflict of interest disclosure

The authors declared no conflicts of interest.

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