Tumor location does not limit percutaneous treatment of small renal masses with microwave ablation

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The global incidence of renal cell carcinoma (RCC) has steady increased over the past two decades and accounts for 5% of all cancers in men and 3% of all cancers in women (1). This rising incidence is likely due to increased detection of small renal masses (SRMs), characterized as ≤4 cm in size, on cross-sectional imaging for other conditions (2). This increase in detection has historically led to more surgical treatment, yet a corresponding improvement in mortality rates for RCC has not happened, especially in elder patients (2,3). With better understanding of the biology and natural history of SRMs, there has been a shift in management patterns in the last decade from radical treatment towards more localized treatment with partial nephrectomy (PN), ablative surgery and surveillance (4).

Both the AUA and EAU (5,6) recommend nephron sparing approaches for patients with clinical T1a RCC given similar oncologic safety between PN and radical nephrectomy (RN), improved preservation of kidney function and possible long term cardiovascular benefits (7-9). Compared to PN, thermal ablation (TA) has similar metastasis-free survival and cancer-specific survival, similar renal function preservation and potentially lower peri-procedural morbidity and shorter hospital stay (10-12). Systematic reviews have demonstrated that patients undergoing TA tend to be older and have more comorbidities than patients undergoing PN (13,14). These studies also identified a higher local tumor recurrence rate in the patients treated with TA compared to PN but no difference in cancer-specific mortality or distant metastasis rate (13,14).

The majority of current comparative studies have been performed using either cryoablation or radiofrequency ablation (RFA) as the thermal source, with microwave ablation (MWA) considered investigational by both the EAU and AUA (5,6). However, MWA has the potential to overcome some of the size and efficacy limitations seen with cryoablation or RFA (15). Unlike RFA, which relies on ion flow to heat tissue, microwaves cause oscillation of molecules which produce frictional heat, especially in tissues with a high percentage of water. This characteristic of microwaves allows for propagation through tissue even with low electrical conductivity, low thermal conductivity or high impedance (16). Microwaves are able to penetrate through the desiccated and charred tissue that develops around the probe, leading to larger ablation zones and faster temperature increases compared to RFA in *ex-vivo* and preclinical animal models (17). The ability to heat tissues faster helps MWA better overcome the cooling effects of blood flow in the highly vascular kidney (16).

Recent trials comparing MWA, RFA and cryoablation have demonstrated significantly decreased ablation and procedure times in favor of MWA with similar complication rates and renal function changes post-procedure (18). Hao *et al.* demonstrated low rates of local tumor progression after MWA treatment of 171 RCC nodules in 162 patients, with only a 3% rate of recurrence per patient over a median follow-up of 45.5 months (19). The authors reported that tumors in dangerous locations (defined as distance between tumor margin and bowel or renal pelvis <5 mm on ultrasound) were significantly associated with higher local tumor progression, with 8% *vs.* 0.8% recurrence for dangerous location tumors (19).

This was the question that Maciolek *et al*. strived to answer in their paper published in European Radiology in April 2019 (20). This was a single center retrospective study examining the oncologic outcomes, complication rates and procedure duration for 151 biopsy-proven clinical T1a RCC in 148 consecutive patients who were treated with percutaneous MWA. Their primary aim was to examine the oncologic efficacy of anteriorly located tumors as TA of these tumors were considered to have higher perceived risk of injury to the small bowel, pancreas, and colon (21). Sixty-six patients in the cohort had anterior tumors, 59 had posterior tumors and 23 had midline tumors. Baseline characteristics among the groups were similar with respect to age, body mass index (BMI), gender or the Eastern Cooperative Oncology Group (ECOG) performance status although patients with anterior tumors had a statistically higher Charlson comorbidity index (CCI). Median tumor diameter was 2.4 cm, median RENAL score was 6, pre-dominant RCC subtype was clear cell (67%) and the majority were grade 2 (61%). There were no significant differences in tumor characteristics between anterior and posterior tumors. To help create distance between the tumors and critical surrounding structures, hydrodisplacement was used in a third of ablations, with 40% in anterior tumors and 28% in posterior tumors. An interesting clinical point is that all patients underwent immediate post-procedural contrast enhanced computed tomography (CT) and if residual enhancing tumor or suboptimal margin was identified, repeat MWA was performed in the same setting. The authors of the study attribute this factor to their 100% primary efficacy in a single session compared to other published series reporting primary efficacy rates of 95.5% to 98.0% (22,23).

Follow-up was obtained in 137/148 (93%) of the cohort with median clinical follow-up of 32 months and median imaging follow-up of 26 months. Six patients experienced local tumor progression (4%) at a median follow-up of 27 months. Of the 6 patients with local progression, 1 elected for active surveillance, 4 underwent salvage ablation and 1 under nephrectomy. No progression to metastatic disease or RCC-related deaths were seen in the cohort, although 6 patients died from other causes with a median of 2.2 years after ablation. Importantly, the location of the tumor did not impact local control or local tumor progression. Overall, there was a 13.5% complication rate with 2.7% major complication rate (Clavien-Dindo III–IV). The two procedure related grade III complications were due to post-procedure hematuria requiring bladder irrigation. Importantly, there were no non-target organ injuries noted to the pancreas, small bowel, colon, body/chest wall, ureter or lumbar plexus nerves in the study attributed to tumor location.

This excellent study by Maciolek *et al*. demonstrates that tumor location should not prevent appropriately selected patients from undergoing MWA, as patient positioning and judicious use of hydrodisplacement to increase distances between the ablation area and critical surrounding structures can prevent injury with good oncologic outcomes. The authors also correctly highlight that their outcomes are from a high-volume center and their results need to be interpreted with this in mind. Lack of hydrodisplacement or improper placement of the fluid for hydrodisplacement in the hands of a less experienced practitioner may very well result in more significant intra-abdominal complications which needs further consideration and study. The authors do not report the number of patients that needed repeat MWA after contrast-enhanced CT and did not evaluate the effect of this contrast load after MWA on downstream renal function. If the number of patients needing re-treatment in the same setting is small, then the post-treatment CT could potentially be avoided given the marginal improvement in primary efficacy rate.

Overall, the majority of published outcomes using TA of SRMs have good oncologic outcomes and low complication rates (7,14). Given the potential advantages of MWA for treatment of larger tumors compared to RFA or cryoablation, it would be of interest if the authors could examine the oncologic outcomes with treatment of tumors over 3 cm with MWA. While MWA may have incremental improvements in complication and recurrence rates compared to RFA for SRMs (14), if this technology is able to treat 4 or even 5 cm tumors successfully, it may open up additional avenues for treatment for patients with larger tumors that may have too many co-morbidities to undergo PN. In conclusion, this excellent paper by Maciolek *et al*. in European Radiology further elucidates the role of TA for the treatment of SRMs, demonstrating good oncologic efficacy and low complication rates regardless of tumor location.

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None.

Footnote

Conflicts of Interest: The authors have no conflicts of interest to declare.

Ethical Statement: The authors are accountable for all aspects of the work in ensuring that questions related to the accuracy or integrity of any part of the work are appropriately investigated and resolved.

References

1. Siegel RL, Miller KD, Jemal A. Cancer statistics, 2015. CA Cancer J Clin 2015;65:5-29.
2. Hollingsworth JM, Miller DC, Daignault S, Hollenbeck BK. Rising incidence of small renal masses: a need to reassess treatment effect. J Natl Cancer Inst 2006;98:1331-4.
3. Lane BR, Abouassaly R, Gao T, et al. Active treatment of localized renal tumors may not impact overall survival in patients aged 75 years or older. Cancer 2010;116:3119-26.
4. Drangsholt S, Huang WC. Current trends in renal surgery and observation for small renal masses. Urol Clin North Am 2017;44:169-78.
5. Ljungberg B, Albiges L, Abu-Ghanem Y, et al. European Association of Urology guidelines on renal cell carcinoma: the 2019 update. Eur Urol 2019;75:799-810.
6. Campbell S, Uzzo RG, Allaf ME, et al. Renal mass and localized renal cancer: AUA guideline. J Urol 2017;198:520-9.
7. Pierorazio PM, Johnson MH, Patel HD, et al. Management of renal masses and localized renal cancer: systematic review and meta-analysis. J Urol 2016;196:989-99.
8. Huang WC, Elkin EB, Levey AS, et al. Partial nephrectomy versus radical nephrectomy in patients with small renal tumors--is there a difference in mortality and cardiovascular outcomes? J Urol 2009;181:55-61; discussion 61-2.
9. Miller DC, Schonlau M, Litwin MS, et al. Renal and cardiovascular morbidity after partial or radical nephrectomy. Cancer 2008;112:511-20.
10. Thompson RH, Atwell T, Schmit G, et al. Comparison of partial nephrectomy and percutaneous ablation for cT1 renal masses. Eur Urol 2015;67:252-9.
11. Pierorazio PM, Johnson MH, Patel HD, et al. Management of renal masses and localized renal cancer. Rockville: Agency Healthc Res Qual, 2016:167.
12. Goyal J, Verma P, Sidana A, et al. Single-center comparative oncologic outcomes of surgical and percutaneous cryoablation for treatment of renal tumors. J Endourol 2012;26:1413-9.
13. Pan XW, Cui XM, Huang H, et al. Radiofrequency ablation versus partial nephrectomy for treatment of renal masses: a systematic review and meta-analysis. Kaohsiung J Med Sci 2015;31:649-58.
14. Uhlig J, Strauss A, Rücker G, et al. Partial nephrectomy versus ablative techniques for small renal masses: a systematic review and network meta-analysis. Eur Radiol 2019;29:1293-307.
15. Seror O. Ablative therapies: advantages and disadvantages of radiofrequency, cryotherapy, microwave and electroporation methods, or how to choose the right method for an individual patient? Diagn Interv Imaging 2015;96:617-24.
16. Lubner MG, Brace CL, Hinshaw JL, et al. Microwave tumor ablation: mechanism of action, clinical results, and devices. J Vasc Interv Radiol 2010;21:S192-203.
17. Yu J, Liang P, Yu X, et al. A comparison of microwave ablation and bipolar radiofrequency ablation both with an internally cooled probe: results in ex vivo and in vivo porcine livers. Eur J Radiol 2011;79:124-30.
18. 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 2018;29:943-51.
19. Hao G, Hao Y, Cheng Z, et al. Local tumor progression after ultrasound-guided percutaneous microwave ablation of stage T1a renal cell carcinoma: risk factors analysis of 171 tumors. Int J Hyperthermia 2018;35:62-70.
20. Maciolek KA, Abel EJ, Posielski NM, et al. Tumor location does not impact oncologic outcomes for percutaneous microwave ablation of clinical T1a renal cell carcinoma. Eur Radiol 2019. [Epub ahead of print].
21. Haddad RL, Patel MI, Vladica P, et al. Percutaneous radiofrequency ablation of small renal tumors using CT-guidance: a review and its current role. Urol J 2012;9:629-38.
22. Breen DJ, King AJ, Patel N, et al. Image-guided

cryoablation for sporadic renal cell carcinoma: three- and 5-year outcomes in 220 patients with biopsy-proven renal cell carcinoma. Radiology 2018;289:554-61.
23. Atwell TD, Schmit GD, Boorjian SA, et al. Percutaneous ablation of renal masses measuring 3.0 cm and smaller: comparative local control and complications after radiofrequency ablation and cryoablation. AJR Am J Roentgenol 2013;200:461-6.

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