



Original Research Vascular and Interventional Radiology

Microwave ablation for hepatocellular carcinoma in cirrhotic patients with diuretic-resistant ascites

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ABSTRACT

Objectives: The purpose of this study was to evaluate the feasibility, safety, and efficacy of computed tomography (CT)-guided percutaneous microwave ablation (MWA) of liver hepatocellular carcinoma (HCC) lesions in patients with pre-existing diuretic-resistant ascites. There is logical hesitation among clinicians to pursue MWA in these decompensated patients for fear of worsening an already bleak prognosis, but there is limited evidence to justify this behavior.

Material and Methods: A retrospective review of HCC treated with percutaneous MWA at a single center was performed. 18 patients who underwent CT-guided MWA with pre-existing diuretic-resistant ascites were identified. A control group of 29 patients who underwent CT-guided MWA without pre-existing diuretic-resistant ascites was identified, which was further narrowed to 18 patients after matching by Model for End-Stage Liver Disease-Sodium score and age. The effectiveness of treatment was compared between the two groups and evaluated by disease-free survival, residual disease, and overall survival over 36 months. Kaplan-Meier curves plotting the survival function were constructed to compare these variables in both groups.

Results: MWA was successfully performed in all patients. The probability of survival at 1 year for the ascites and matched control groups were 0.778 and 1.00, respectively ($P = 0.038$). The probability of survival at 3 years for the ascites and matched control groups were 0.556 and 0.630, respectively ($P = 0.237$). There were no significant differences between residual disease and disease-free survival between the two groups at 1 or 3 years.

Conclusion: CT-guided percutaneous MWA for HCC in select patients with pre-existing diuretic-resistant ascites is a feasible, safe, and effective treatment option.

Keywords: Ablation in ascites, Diuretic resistant ascites, Microwave ablation, Microwave ablation in cirrhosis, Microwave ablation of hepatocellular carcinoma

INTRODUCTION

Hepatocellular carcinoma (HCC) is the most common primary liver malignancy, accounting for over 75% of primary liver tumors worldwide.^[1] Unfortunately, this cancer is often associated with a poor prognosis averaging a 5-year survival rate of approximately 21%.^[1,2] While surgical resection and liver transplantation offer the highest long-term survival rate, many patients are ineligible for these procedures.^[3] Minimally invasive treatments such as percutaneous thermal ablation have emerged as effective alternatives, particularly for patients who are not surgical candidates.

Microwave ablation (MWA) is a percutaneous procedure that uses thermal energy to induce tumor destruction.^[4] Compared to surgical resection, MWA is less invasive with faster recovery

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times, has reduced morbidity and mortality, can be easily repeated, and has an overall lower cost. Furthermore, a recent meta-analysis has shown comparable 3-year overall survival rates between MWA and hepatic resection for early-stage HCC.^[5]

Another important application of MWA is its use as “bridging” therapy for patients awaiting liver transplantation. By preventing tumor progression, MWA can help maintain a patient’s eligibility for liver transplantation. However, there is limited clinical data on the efficacy of MWA in patients with diuretic-resistant ascites, who are often excluded from treatment due to the lack of supportive literature. These patients, with more advanced cirrhosis and poorer prognosis, require effective treatment options to improve survival, quality of life, and eligibility for other therapies such as transplantation.

To address this gap in knowledge, we conducted a single-center retrospective matched case series of patients with diuretic-resistant ascites who underwent MWA for treatment of HCC. Our goal was to demonstrate that MWA is a safe and effective treatment option for well-selected patients with diuretic-resistant ascites, making it a viable option for eligible patients.

MATERIAL AND METHODS

Patient selection and demographics

Institutional Review Board approval was obtained for this study, and a retrospective chart review was performed from a database of 1443 unique entries of patients who underwent ablative procedures from 2014 to 2020 in our institution. All study participants provided written consent. The selection of patients is outlined in Figure 1. To select patients, the inclusion criteria were unresectable HCC or those with HCC who refused surgical resection; single lesion <8 cm or ≤3 lesions with no more than 1 being larger than 5 cm; Child–Pugh score A or B liver cirrhosis; and adequate hematologic function (platelet count >40,000, international normalized ratio <2.0). Diagnosis of Liver Imaging Reporting and Data System-5 (LIRADS-5) HCC lesions was established by cross-sectional imaging or confirmed by histopathological studies of samples through percutaneous liver biopsy for lesser LIRADS lesions. The exclusion criteria were non-HCC ablation; prior liver resection; and prior chemoembolization, radioembolization, or bland liver embolization. Following the application of these criteria, 47 patients were found. Those with diuretic-resistant ascites were identified and compared to patients without diuretic-resistant ascites. Diuretic-resistant ascites were defined as a patient having persistent ascites despite appropriate diuretic therapy. 18 were found to have diuretic-resistant ascites and the remaining 29 without. The demographics of each group can be seen in Table 1.

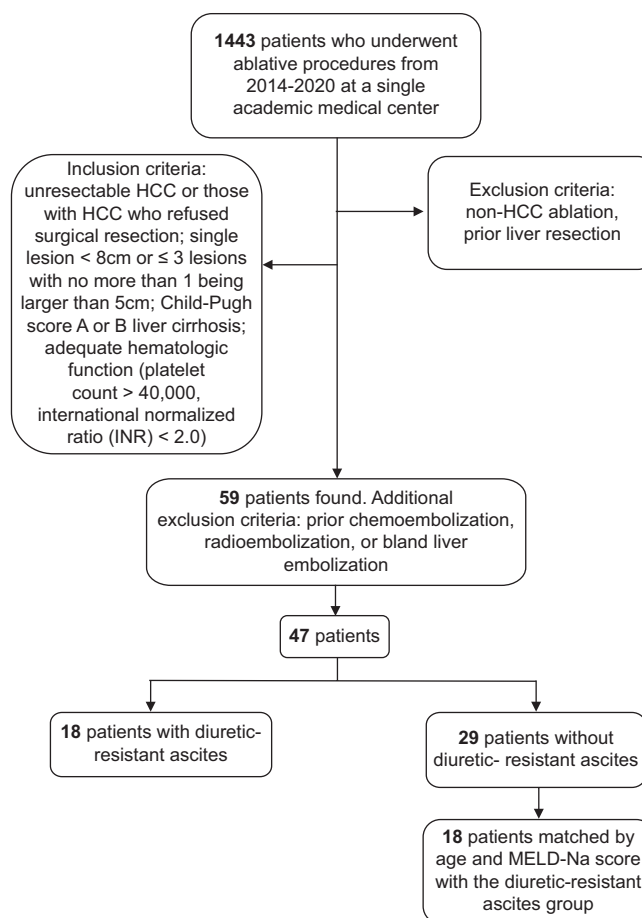


Figure 1: Flowsheet demonstrating patient selection criteria and process. (HCC: Hepatocellular carcinoma, MELD-Na: Model for end-stage liver disease-sodium.)

Given the differences in Model for End-Stage Liver Disease-Sodium (MELD-Na) score between the two groups, although insignificant, matching was performed by age and MELD-Na score to select and create a group of 18 controls to compare to the 18 patients with diuretic-resistant ascites. Independent *t*-tests were used to compare baseline characteristics such as age and MELD-Na score between the diuretic-resistant ascites group and each control group independently.

Ablation technique

MWA was performed using the Emprint™ MWA System (Covidien, Boulder, CO, USA), which consists of a generator with a frequency of 2450-MHz, a maximum power of 100W, and a 13-gauge water-cooled dipole antenna. Pre-procedural planning was done using contrast-enhanced CT or magnetic resonance imaging (MRI), interpreted by fellowship-trained abdominal radiologists. All procedures were carried out under general anesthesia, and the microwave antenna was advanced into the liver lesion under CT and/or ultrasound guidance. Ablation time and power were recorded, and

Table 1: The demographics of each study group involved in this study.

Study group	Patients	Age (years)	Tumor size (cm)	MELD-Na score
Diuretic-resistant ascites group	n=18	63.3	2.23	12.11
Unmatched control	n=29	66.4 (P=0.191)	2.11 (P=0.401)	9.66 (P=0.063)
Matched control	n=18	64.8 (P=0.604)	1.92 (P=0.089)	11 (P=0.447)

MELD-Na: Model for end-stage liver disease-sodium

immediate post-procedural CT without contrast was performed to ensure proper targeting and assessment for any obvious complications. The ablation margin was 10 mm for all procedures, which is standard at our institution. Our liver ablation protocol includes a pre-ablation “burn” of 45 watts for 1 min for initial cautery and fixation of the probe followed by the ablation itself. After the ablation, a 20 s × 45 watts cautery is performed all the way to the liver capsule to minimize bleeding and risk of tumor seeding.

While no pre-procedural paracentesis was performed, a post-ablation paracentesis was undertaken immediately after the procedure to decrease bleeding risk in all patients with significant intraprocedural ascites fluid.

Patient follow-up

All selected patients returned to clinic within 4–6-week post-ablation. CT with contrast or MRI of the abdomen was performed to assess the efficacy of ablation using the modified Response Evaluation Criteria in Solid Tumors (mRECIST) criteria. After the initial post-ablation encounter, follow-up imaging was scheduled at 3-month intervals in the 1st year and then at 6-month intervals afterward. Residual tumor and new lesions were subjected to further treatment.

Analysis of outcomes

The outcomes of disease-free survival, residual disease, and overall survival were analyzed using log-rank tests and Kaplan–Meier curves through the Statistical Package for the Social Sciences (SPSS) Statistics software (V. 29.0, SPSS Inc., Chicago, IL, USA). Disease-free survival was defined as survival without recurrence of HCC in any location on follow-up imaging, either local or distant. Residual disease was defined as no evidence of residual disease at the ablation site on follow-up imaging. As part of our analysis, patients were counted as recurrences at the time point at which they recurred and all time points thereafter. Overall survival was defined as survival regardless of disease status.

Parameters of interest and potential confounders included age, sex, history of cirrhosis and underlying etiology, MELD score, procedural adverse events, treatment modalities before ablation, tumor location (liver segment), tumor size, total follow-up time, overall survival, and presence of residual

or recurrent disease post-ablation. The inclusion criteria attempted to address confounding variables including history of prior embolization. Additional statistical analysis was performed on matched study groups that accounted for initial variable disparities. The procedures were performed by two board-certified interventional radiologists with over 5 years’ experience in percutaneous liver ablation using the same device during the study period.

RESULTS

All MWA procedures reported in this study were a technical success defined as complete ablation of the targeted lesion without evidence of residual tumor on imaging performed 4–6 weeks after ablation using mRECIST criteria. Images are provided showing an example of one patient with pre-ablation, intra-ablation, and post-ablation images [Figures 2-4].

Kaplan–Meier curves: Unmatched groups

Kaplan–Meier survival curves evaluating overall survival, disease-free survival, and residual disease between the diuretic-resistant ascites group and the original control group with results of log-rank tests up to 3-year follow-up are shown in Figures 5-7. Outcomes at 1 year and 3 years are additionally expressed in the Table 2 and Table 3, respectively.

The probability of survival at 1 year for the ascites and control groups was 0.778 and 0.931, respectively ($P = 0.183$). The probability of survival at 3 years for the ascites and control groups was 0.556 and 0.718, respectively ($P = 0.242$). These differences were not significant given the $P > 0.05$, although there was a trend toward lower survival in the ascites group.

The probability of disease-free survival at 1 year for the ascites and control groups was 0.657 and 0.448, respectively ($P = 0.536$). The probability of disease-free survival at 3 years for the ascites and control groups was 0.517 and 0.408, respectively ($P = 0.374$). The probability of local tumor control at 1 year for the ascites and control groups was 0.882 and 0.690, respectively ($P = 0.175$). The probability of local tumor control at 3 years for the ascites and control groups was 0.728 and 0.563, respectively ($P = 0.263$). There were no significant differences between the two groups in disease-free survival and local tumor control per the log-rank test.



Figure 2: A 62-year-old man with cirrhosis complicated by diuretic-resistant ascites, found to have hepatocellular carcinoma during workup for a transjugular intrahepatic portosystemic shunt. Computed tomography of abdomen liver protocol arterial phase showing 37 mm × 26 mm arterial enhancing lesion (red arrow) in the liver consistent with consistent with hepatocellular carcinoma.

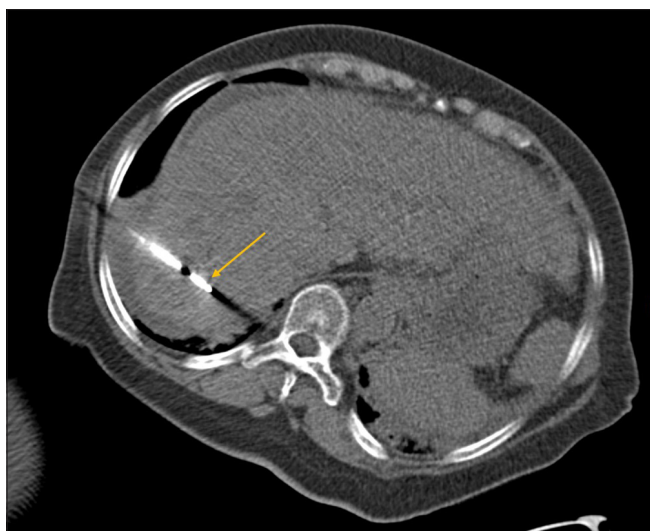


Figure 3: The same 62-year-old man with cirrhosis complicated by diuretic-resistant ascites, found to have hepatocellular carcinoma during workup for transjugular intrahepatic portosystemic shunt. Computed tomography fluoroscopy spot image showing microwave ablation probe placement in the liver (orange arrow) before ablation through the ascites plane obviating the need for transpulmonary approach.

Kaplan–Meier curves: matched groups

Kaplan–Meier survival curves evaluating overall survival, disease-free survival, and residual disease between the diuretic-resistant ascites group and the matched control group with results of log-rank tests up to 3-year follow-up are shown in Figures 8-10. Outcomes at 1 year and 3 years are additionally expressed in Table 2 and Table 3, respectively.

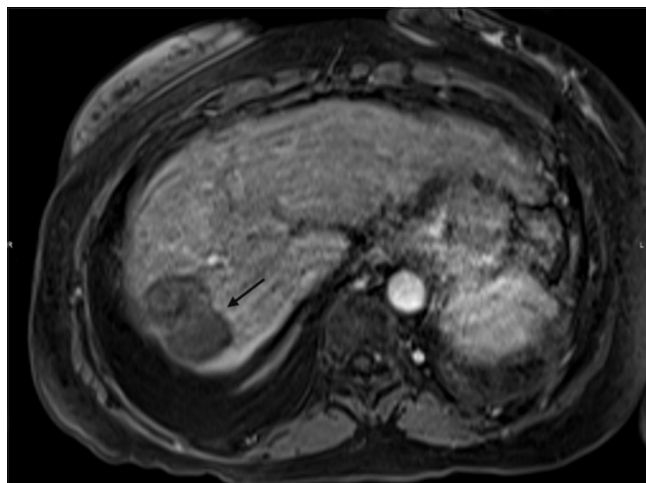


Figure 4: A 62-year-old man with cirrhosis complicated by diuretic-resistant ascites, found to have hepatocellular carcinoma during workup for transjugular intrahepatic portosystemic shunt. Magnetic resonance imaging of the liver T1 post-contrast arterial phase image 8 weeks after ablation showing 45 mm × 33 mm ablation cavity (black arrow) without any arterial enhancement.

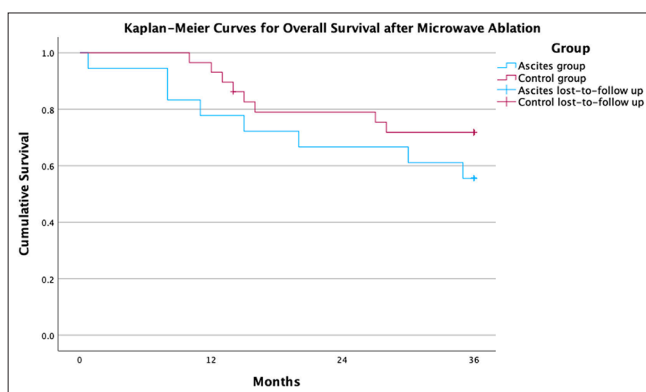


Figure 5: Kaplan–Meier curve comparing overall survival between the ascites group and unmatched control group.

The probability of survival at 1 year for the ascites and matched control groups were 0.778 and 1.00, respectively, which were significantly different per the log-rank test ($P = 0.038$). The probability of survival at 3 years for the ascites and matched control groups was 0.556 and 0.630, respectively ($P = 0.237$).

The probability of disease-free survival at 1 year for the ascites and matched control groups was 0.657 and 0.471, respectively ($P = 0.314$). The probability of disease-free survival at 3 years for the ascites and matched control groups was 0.517 and 0.471, respectively ($P = 0.605$). All recurrences noted in the control group occurred before 1 year of follow-up. The probability of local tumor control at 1 year for the ascites and matched control groups was 0.882 and 0.647,

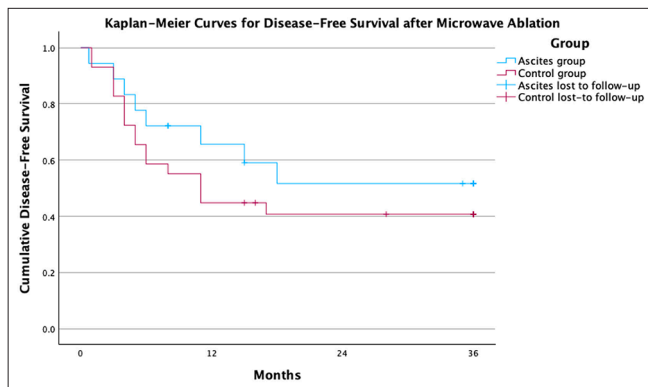


Figure 6: Kaplan–Meier curve comparing disease-free survival between the ascites group and unmatched control group.

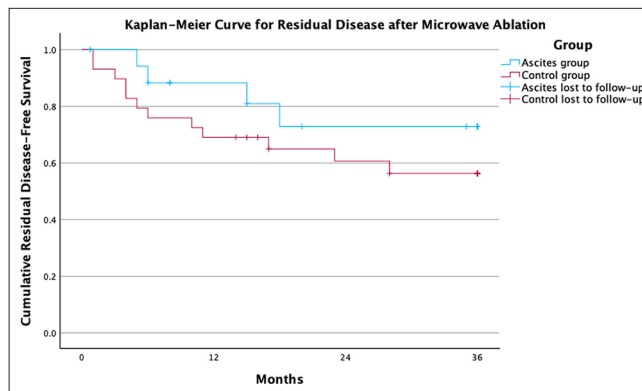


Figure 7: Kaplan–Meier curve comparing residual disease between the ascites group and unmatched control group.

Table 2: Outcomes of residual disease, overall survival, and disease-free survival at 1 year of follow-up assessed through the survival function with both matched and unmatched control groups compared independently to the ascites group through the log-rank test.

Study group	Residual disease	Overall survival	Disease-free survival
Ascites Group: 1 year	0.882	0.778	0.657
Unmatched Group: 1 year	0.690 (<i>P</i> =0.175)	0.931 (<i>P</i> =0.183)	0.448 (<i>P</i> =0.536)
Matched Group: 1 year	0.647 (<i>P</i> =0.129)	1.00 (<i>P</i> =0.038)	0.471 (<i>P</i> =0.314)

Table 3: Outcomes of residual disease, overall survival, and disease-free survival at 3 years of follow-up assessed through the survival function with both matched and unmatched control groups compared independently to the ascites group through the log-rank test.

Study group	Residual disease	Overall survival	Disease-free survival
Ascites Group: 3 years	0.728	0.556	0.517
Unmatched Group: 3 years	0.563 (<i>P</i> =0.263)	0.718 (<i>P</i> =0.242)	0.408 (<i>P</i> =0.374)
Matched Group: 3 years	0.566 (<i>P</i> =0.294)	0.630 (<i>P</i> =0.237)	0.471 (<i>P</i> =0.605)

respectively (*P* = 0.129). The probability of local tumor control at 3 years for the ascites and matched control groups was 0.728 and 0.566, respectively (*P* = 0.294).

A summary comparative table displaying the outcomes at both 1 year and 3 years of follow-up for each group in the study is provided [Table 4].

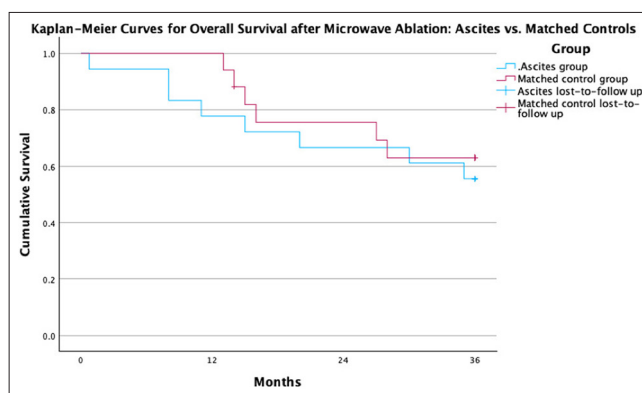


Figure 8: Kaplan–Meier curve comparing overall survival between the ascites group and matched control group.

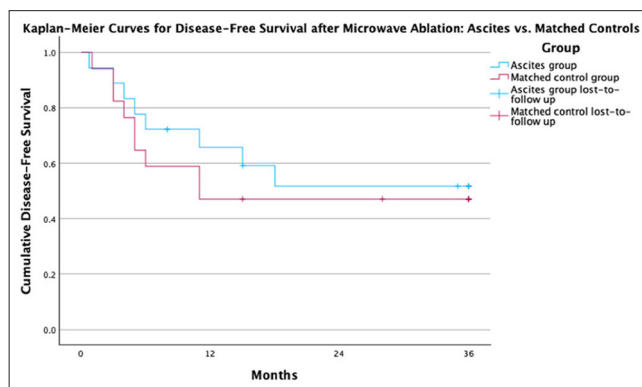


Figure 9: Kaplan–Meier curve comparing disease-free survival between the ascites group and matched control group.

Post-procedural adverse events

Adverse events were defined by the Society of Interventional Radiology Adverse Event Severity Scale.^[6] In the ascites group, 2/18 (11%) patients experienced post-procedural adverse events, including an overnight admission for post-

Table 4: Summary of 1-year and 3-year outcomes for overall survival, disease-free survival, and residual disease across the ascites group, unmatched control group, and matched control group. Outcome probabilities are from Kaplan–Meier survival curves using log-rank tests. Residual disease is interpreted from local tumor control rates (i.e., absence of residual disease).

Outcome	Time point	Ascites group	Unmatched control	Matched control
Overall survival	1 year	0.778	0.931 ($P=0.183$)	1.00 ($P=0.038$)
	3 years	0.556	0.718 ($P=0.242$)	0.630 ($P=0.237$)
Disease-free survival	1 year	0.657	0.448 ($P=0.536$)	0.471 ($P=0.314$)
	3 years	0.517	0.408 ($P=0.374$)	0.471 ($P=0.605$)
Residual disease	1 year	0.882	0.690 ($P=0.175$)	0.647 ($P=0.129$)
	3 years	0.728	0.563 ($P=0.263$)	0.566 ($P=0.294$)

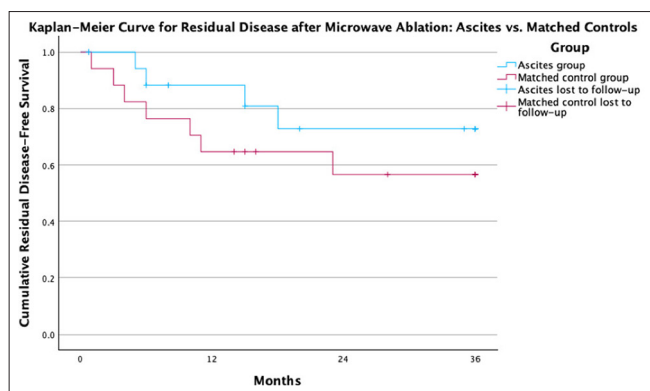


Figure 10: Kaplan–Meier curve comparing residual disease between the ascites group and matched control group.

procedural lethargy following concurrent intraprocedural drainage of hepatic hydrothorax (moderate adverse event, but unlikely related to the MWA procedure), and an asymptomatic iatrogenic pneumothorax (mild adverse event). In the control group, 1/29 (3%) patients experienced adverse events, with the only one being a small asymptomatic pneumothorax (mild adverse event).

DISCUSSION

Our results found no significant difference between the diuretic-resistant ascites group and the original control group in overall survival, disease-free survival, and residual disease over the course of 3-year follow-up. When the control group was matched to the ascites group, the only significant difference in outcomes found was overall survival at 1 year, with survival higher in the control group. At 3 years, there was no longer a significant difference. Patients with diuretic-resistant ascites pose a unique challenge as they often have more advanced cirrhosis and carry a worse prognosis. Ascites itself is a sequela of end-stage liver disease; mortality can be as high as 50% within 2 years for those with ascites.^[7] When ascites become refractory to initial therapy of diuretics and sodium restriction, the prognosis is even worse, with mortality at 50% within 1 year.^[8]

Limited data exist regarding the outcomes of MWA in patients with diuretic-resistant ascites. Our study aimed to

address this gap by evaluating the safety and efficacy of MWA in treating HCC in a subset of patients with diuretic-resistant ascites. The results from our study suggest that MWA can be an effective option in this high-risk population, with outcomes comparable to a matched HCC population without underlying diuretic-resistant ascites. At 12 months, there was a significantly higher rate of overall survival in the matched control group than in the ascites group ($P = 0.038$). This is unsurprising given the inherently lower survival rates of cirrhotic patients with diuretic-resistant ascites.^[9] However, this significance did not persist throughout follow-up, and there was no significant difference at 36 months between overall survival, disease-free survival, and local tumor control between the two groups.

Importantly, there was no significance found toward increased recurrence rates in the ascites group, suggesting that MWA remains an effective treatment option in patients with diuretic-resistant ascites. In fact, while there were no statistically significant differences between the two groups, recurrence rates were consistently lower in the ascites group when compared to the control group, in both the matched and unmatched comparisons. Of course, a more powered study would be more helpful in determining whether this trend is significant or is just a byproduct of under-sampling.

Certain locations in close proximity to critical structures such as the heart, diaphragm, gallbladder, or colon carry a risk of undertreatment.^[10] However, the presence of ascites may allow for safer ablation of these high-risk tumors by acting as an insulator, akin to the well-known advantage of hydro-displacement.^[11,12] Alternatively, excessive ascites can make ablation more technically difficult, with the fluid creating a longer needle path. In these cases, it might be necessary to perform concurrent paracentesis to improve access. In our study, none of the 18 patients with diuretic-resistant ascites received a pre-procedural paracentesis with their ablation; however, we do perform post-ablation paracenteses in patients with significant ascites fluid to decrease the risk of bleeding from liver puncture. Our study did not differentiate high-risk from low-risk ablation, which is consistent with the reported literature on percutaneous

liver ablation. The majority of tumors treated in this cohort were HCCs located in the right hepatic lobe, with most measuring ≤ 3 cm in maximum diameter. While tumor size and segmental location are important considerations in procedural planning, they did not consistently influence inclusion in this series. Rather, patient selection was driven by overall feasibility, technical access, and clinical need.

In patients with ascites such as our study population, there is a theoretically increased risk of introducing peritoneal metastasis due to the continuity of the ablation tract with overlying free fluid. While the literature is limited, a study comparing the rates of peritoneal seeding in patients who had undergone radiofrequency ablation with or without artificial ascites found no significant difference in occurrence between the two groups.^[11] In our own study, there was no peritoneal seeding noted in either group. However, our ablation protocol does introduce an additional layer of protection by performing an initial 1 min 45 watts “controlled burn” along the needle tract before proceeding with the ablation itself.

While our results suggest MWA as an effective therapy for select patients with HCC and diuretic-resistant ascites, there are limitations to the study. This study was performed at a single academic center in a busy liver ablation practice; however, only a small sample size met the inclusion criteria, and only one of the many available ablation devices was used. The study was retrospective in nature and grouped all MWA procedures together, irrespective of their varying device settings. Our study does not compare MWA to other alternative methods of treatment, such as other locoregional therapies or systemic therapy. There is sparse literature evaluating locoregional therapies in patients with diuretic-resistant ascites, with most existing studies excluding this population due to presumed elevated risk. Our study adds to the limited data by specifically evaluating the safety outcomes of MWA in this cohort.

In addition, this study is underpowered to undoubtedly conclude that MWA is as effective in patients with diuretic-resistant ascites as it is in those without. Nonetheless, our results are encouraging as they suggest that MWA may be a relatively safe option in patients with often limited options. It should be noted that patients were counted as recurrences at the time point at which they recurred and all time points thereafter. Hence, this analysis does not include patients who had repeat ablation procedures with subsequent control of disease, and therefore, this may overestimate residual disease rates and underestimate disease-free survival at specific time intervals, especially at longer interval points. Furthermore, the discrepancy of 1-year versus 3-year overall survival may be secondary to the already mentioned limitation of underpowered study, in this case, specifically underpowered to assess long-term survival. The current study rather aimed at highlighting the safety, feasibility, and short-term

efficacy of MWA in cirrhotic patients with diuretic-resistant ascites; given that this patient population has more than one competing risk factor for death with cirrhosis sitting at the top, a much larger study would be needed to investigate this point.

Additional limitations include heterogeneity of patient follow-up and lack of complete data, especially in older records, which led to additional exclusions in patients that met initial inclusion criteria. Further analysis is needed to determine the effect of tumor size and volume ablated on outcomes following MWA.

CONCLUSION

Our study demonstrates that diuretic-resistant ascites should not be considered an absolute contraindication to MWA in patients with HCC and these patients should be considered for ablative locoregional therapies. Despite being a high-risk population with worse underlying liver disease, well-selected patients with diuretic-resistant ascites can benefit from percutaneous liver ablation as a safe and effective treatment option with either curative, bridging to transplant, or downstaging intent.

Our findings highlight the need for more treatment and bridging options for HCC patients with diuretic-resistant ascites while providing some evidence supporting the use of MWA in an often-excluded cohort of patients. However, more studies with a bigger sample size are needed to investigate whether our findings are reproducible. Given the grim prognosis and limited treatment options for patients with diuretic-resistant ascites, a prospective clinical trial could be a feasible option to obtain a higher level of evidence.

Ethical approval: The research/study was approved by the Institutional Review Board at the University of Kentucky IRB, number 42415, dated 14 September 2017.

Declaration of patient consent: The authors certify that they have obtained all appropriate patient consent.

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Conflicts of interest: There are no conflicts of interest.

Use of artificial intelligence (AI)-assisted technology for manuscript preparation: The authors confirm that there was no use of artificial intelligence (AI)-assisted technology for assisting in the writing or editing of the manuscript and no images were manipulated using AI.

REFERENCES

1. McGlynn KA, Petrick JL, El-Serag HB. Epidemiology of hepatocellular carcinoma. *Hepatology* 2021;73 Suppl 1:4-13.
2. Siegel RL, Miller KD, Wagle NS, Jemal A. Cancer statistics, 2023. *CA Cancer J Clin* 2023;73:17-48.
3. Poggi G, Tosoratti N, Montagna B, Picchi C. Microwave ablation of hepatocellular carcinoma. *World J Hepatol*

- 2015;7:2578-89.
4. Gala KB, Shetty NS, Patel P, Kulkarni SS. Microwave ablation: How we do it? *Indian J Radiol Imaging* 2020;30:206-13.
 5. Cui R, Yu J, Kuang M, Duan F, Liang P. Microwave ablation versus other interventions for hepatocellular carcinoma: A systematic review and meta-analysis. *J Cancer Res Ther* 2020;16:379-86.
 6. Baerlocher MO, Nikolic B, Sze DY. Adverse event classification: Clarification and validation of the society of interventional radiology specialty-specific system. *J Vasc Interv Radiol* 2023;34:1-3.
 7. Mansour D, McPherson S. Management of decompensated cirrhosis. *Clin Med (Lond)* 2018;18:s60-5.
 8. Perri GA. Ascites in patients with cirrhosis. *Can Fam Physician* 2013;59:1297-9.
 9. Yatsuhashi H, Sano H, Hirano T, Shibasaki Y. Real-world hospital mortality of liver cirrhosis inpatients in Japan: A large-scale cohort study using a medical claims database: Prognosis of liver cirrhosis. *Hepatol Res* 2021;51:682-93.
 10. Kapoor H, Nisiewicz MJ, Jayavarapu R, Gedaly R, Raissi D. Early outcomes with single-antenna high-powered percutaneous microwave ablation for primary and secondary hepatic malignancies: Safety, effectiveness, and predictors of ablative failure. *J Clin Imaging Sci* 2020;10:10.
 11. Kang TW, Lim HK, Lee MW, Kim YS, Choi D, Rhim H. First-line radiofrequency ablation with or without artificial ascites for hepatocellular carcinomas in a subcapsular location: Local control rate and risk of peritoneal seeding at long-term follow-up. *Clin Radiol* 2013;68:e641-51.
 12. Wang CC, Kao JH. Artificial ascites is feasible and effective for difficult-to-ablate hepatocellular carcinoma. *Hepatol Int* 2015;9:514-9.

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