



# High-powered microwave ablation of larger hepatocellular carcinoma: evaluation of recurrence rate and factors related to recurrence



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**AIM:** To evaluate the safety and efficacy of high-powered (80–100 W) percutaneous microwave ablation (MWA) at a frequency of  $2450 \pm 10$  MHz for treating larger hepatocellular carcinoma (HCC) and to predict the risk factors of local recurrence after high-powered MWA.

**MATERIALS AND METHODS:** The study was approved by the Institutional Review Board, and informed consent was waived because of the retrospective study design. Forty-five patients with a total of 60 lesions received high-power (80–100 W) MWA at a frequency of  $2450 \pm 10$  MHz through a percutaneous approach that was guided by ultrasound. Of the 60 lesions with a maximum tumour measuring 3–8 cm, 46 lesions were 3–5 cm and 14 were 5–8 cm. The complete ablation rates, local recurrence rates, complications, and short-term survival were analysed. Ten possible risk factors for local recurrence were analysed.

**RESULTS:** The complete ablation rates were 82.61% for the first ablation and 100% for the second ablation for 3–5 cm lesions. The complete ablation rates were 64.29% (82.61% versus 64.29%,  $p=0.037$ ) for the first ablation and 85.71% (100% versus 85.71%,  $p=0.055$ ) for the second ablation for 5–8 cm lesions. Local recurrence was observed in 11 out of the 45 (24.44%) successfully treated patients. The 1-year and 2-year survival rates were 95.56% (43/45) and 86.67% (39/45), respectively. No procedure-related mortality was observed and no major bleeding, liver rupture, or liver abscesses occurred. Univariate analysis showed that a positive correlation existed between the number of lesions ( $p=0.022$ ), proximity to the risk area ( $p=0.001$ ), pre-ablation alpha-fetoprotein (AFP) levels ( $p=0.025$ ), hepatitis B virus (HBV)-DNA replication ( $p=0.027$ ) and local recurrence. Multivariate analysis identified HBV-DNA ( $p=0.031$ ) and proximity to the risk area ( $p=0.039$ ) as the independent prognosis factors causing postoperative HCC local recurrence.

**CONCLUSION:** High-powered MWA of larger hepatocellular carcinomas appears to be a safe and effective treatment. HBV-DNA and proximity to the risk area appear to be independent predictors of local tumour recurrence.

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## Introduction

Hepatocellular carcinoma (HCC) is the fifth most frequently diagnosed cancer worldwide and is the second

most common cause of cancer-related death.<sup>1</sup> Surgical resection is recognised as a potentially curative treatment for patients with HCC. Unfortunately, the majority of primary HCCs are frequently considered to be unresectable because of the number of tumours, location of tumours, or poor hepatic functional reserve that is a result of underlying liver disease, thus making the resection of a large volume of the liver parenchyma unfeasible.<sup>2</sup> Thermal ablation, including radiofrequency ablation (RFA) and microwave ablation (MWA), are image-guided techniques that are used to treat tumours up to 3 cm in diameter.<sup>3</sup>

With improvements in devices and techniques, thermal ablation has displayed potential for treating HCC measuring >3 cm.<sup>4</sup> Meanwhile, RFA is the therapy of choice in very early and early HCC according to the Barcelona Clinic Liver Cancer (BCLC) classification when patients are not candidates for either liver resection or transplantation<sup>5</sup>; however, RFA has had limited success in treating larger tumours with high local recurrence rates.<sup>6</sup> MWA has some advantages over RFA with regard to energy delivery, such as larger ablation zones, higher treatment temperatures, and less susceptibility to heat-sink effects.<sup>7</sup> Recently, the advanced development of a cooled-shaft antenna has allowed MWA to be performed at much higher power outputs with longer ablation durations. This allows the lesion to be treated with a single application without severe skin burns or severe pain.<sup>8</sup> The present study was undertaken to evaluate the results of higher power output (80–100 W) MWA at a frequency of 2450±10 MHz in patients with larger HCC tumours measuring over 3 cm and to clarify the risk factors of recurrence after MWA.

## Materials and methods

### Patient enrolment

From January 2012 to June 2013, 45 HCC patients (38 men and seven women with a mean age of 58.41±7.67 years) with 60 lesions underwent percutaneous high-power (80–100 W) MWA at a frequency of 2450±10 MHz. All patients had chronic hepatitis B virus (HBV) infections. Of the 45 patients, 17 had tumours that were within 5 mm of risk areas (diaphragm, gall bladder, blood vessels, and gastrointestinal tract). Not all patients were amenable to surgical resection, and some declined surgical resection; treatment selections were made after a full multidisciplinary discussion. The MWA treatment procedure was explained to both the patient and his/her relatives. Final decisions were made by the patients and relatives, and consent for the ablation was signed by the patient or his/her relatives. The study was approved by the institutional review board. Because of the retrospective nature of this study, informed consent of the patients was waived.

HCC diagnosis was established based on histological evidence or typical findings with contrast-enhanced ultrasonography, contrast-enhanced computed tomography (CT), or magnetic resonance imaging (MRI). The inclusion criteria for the study were no more than three lesions, no

treatment undertaken for the lesions before MWA, tumour measuring >3 cm in diameter, and liver function Child–Pugh status score of A or B. Patients with extra-hepatic metastases or vascular invasion were excluded. The demographic characteristic data of these patients are listed in [Table 1](#).

### Ablation procedures

An ECO-100C microwave generator (ECO Microwave Electronic Institute, Nanjing, China) at a frequency of 2450±10 MHz and a power output of 0–100 W was used for MWA. The microwave antenna was a 15 cm 14 G water-cooled electrode needle. Ablation therapy was performed at 80–100 W output with one antenna. An overlapping ablative technique with antenna reinsertion was applied to treat tumours to ensure adequate coagulation necrosis. The ablation time was determined according to the ultrasound findings; the size and shape of the hyperechoic zone caused by gas microbubbles appearing in the ablation zone during the MWA procedure was monitored by ultrasound to assess the completion of therapy. Treatment was stopped when the entire target was completely hyperechoic and when the hyperechoic area overlapped the area of the tumour with a 1 cm safety margin.

### Anaesthesia

Local anaesthesia with 2% lidocaine (Hubei Tianyao Pharmaceuticals, Hubei, China) and intravenous

**Table 1**  
Demographic characteristics of hepatocellular carcinoma (HCC) patients.

Characteristic	No. of patients
Gender (male/female)	38/7
HBV e antigen	
Positive	6
Negative	39
HBV-DNA replication	
Positive	26
Negative	19
Child–Pugh classification	
Class A	31
Class B	14
Type of tumour	
Initial HCC	23
Recurrent HCC	22
Diameter of tumour (cm)	
3–5	46
5–8	14
No. of tumours	
Solitary	29
Multiple	16
Adjacent to risk area	
Diaphragm	6
Gall bladder	4
Blood vessels	5
Gastrointestinal tract	2
Serum alpha-fetoprotein level (ng/ml)	
≥400	11
<400	34

HBV, hepatitis B virus.

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