



ORIGINAL ARTICLE

Long-term outcomes of microwave versus radiofrequency ablation for hepatocellular carcinoma by surgical approach: A retrospective comparative study



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Summary *Background:* Both microwave ablation (MWA) and radiofrequency ablation (RFA) are commonly employed local ablation techniques for malignant liver tumors. However, comparative data on long-term results between these two techniques is scarce in the literature.

Methods: This is a retrospective comparative study between MWA and RFA for hepatocellular carcinoma (HCC) using surgical approach.

Results: The MWA group consisted of 26 patients while the RFA group consisted of 47 case-matched patients. The two groups were comparable, except patients were older and their platelet count was lower in the MWA group. The median follow-up period was 47.5 months in MWA group and 52.9 months in RFA group ($p = 0.322$). There was no difference in 5-year overall survival (MWA 73.1%, RFA 46.3%, $p = 0.082$) and 5-year disease free survival (MWA 13.8%, RFA 14.6%, $p = 0.736$). When a subgroup analysis of tumors ≥ 3.5 cm was performed, there were 16 patients in the MWA group and 21 patients in the RFA group, the 5-year overall and disease-free survival were MWA 75.0%, RFA 28.6% ($p = 0.022$) and MWA 25.0%, RFA 4.8% ($p = 0.207$), respectively.

Conflicts of interest: All authors have no conflicts of interest to declare.

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Conclusion: MWA is comparable to RFA for HCC in terms of long-term outcomes. For tumors ≥ 3.5 cm, MWA is associated with a better overall 5-year survival.

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1. Introduction

Local ablation therapy is now recognized as a form of curative treatment for hepatocellular carcinoma (HCC).^{1–3} Amongst others, two commonly used local ablation therapies are radiofrequency ablation (RFA) and microwave ablation (MWA).^{4–7} Initial studies on RFA or MWA for liver tumors mostly reported on short-term treatment efficacy such as complete tumor ablation rate and short-term local recurrence rate while the results of long-term outcomes are lacking. Furthermore, comparative data on long-term results between these two techniques are scarce in the literature. Here we would like to report our experience on the use of RFA and MWA for HCC by surgical approach (by laparoscopy or laparotomy) and perform a retrospective comparative study between them.

2. Methods

RFA has been used for ablation of malignant liver tumors in our institute since 2003. The RFA needle used was either the cool-tip radiofrequency ablation needle (Covidien, Fridley, MN, USA) or the LeVein needle (Boston Scientific, Natick, MA, USA). The needle was inserted into the tumor either percutaneously, laparoscopically, or by open laparotomy. In general, the laparoscopic or open approach was only adopted when the percutaneous approach was not feasible due to close proximity of the tumor to hollow viscera or the diaphragm. The laparoscopic approach again was considered before the open approach unless the tumor was difficult for laparoscopic ablations such as tumors located in the superoposterior segments of the liver or patients not suitable for laparoscopic procedure. In some cases, open RFA was done for patients presenting for liver resection who were found to be unresectable on the operating table. The initial results of RFA for malignant liver tumors has been reported previously.⁸

In 2009, we started a program of MWA for HCC with funding from a local charity organization. The model of MWA used was a 2.45-GHz microwave machine (Microsulis Medical Ltd, Waterlooville, Hants, UK). Because the microwave antenna supplied at that period was 5 mm in size, we only applied MWA by laparoscopy or by open laparotomy. Again, the laparoscopic approach would always be considered before the open approach, except in cases when patients were opened up with the intention for liver resection but were found to be inoperable on the operating table.

Between March 2009 and January 2011, 26 consecutive patients with a diagnosis of HCC were recruited for MWA. The diagnosis was based on histology or the typical imaging

appearance and raised α -fetal protein (AFP) according to the criteria of the European Association for the Study of Liver: cirrhotic patients with two images showing focal lesion > 2 cm with arterial hypervascularization or one image showing focal lesion > 2 cm with arterial hypervascularization together with AFP > 400 mg/mL. The indications for MWA were: unresectable tumor; resectable tumor but patient preferred local ablation treatment to hepatectomy; tumor not feasible for percutaneous RFA; and no macroscopic vascular or bile duct invasion by the tumor. We limited the use of MWA to patients with a maximum of two tumors and size of tumor up to 6 cm. Recurrent tumor after previous treatment was not considered a contraindication for MWA. The short-term treatment outcomes of this group of patients have been reported previously.⁹

Between May 2003 and January 2011, a total of 219 patients underwent RFA treatment for malignant liver tumors in our institute. To match the patient characteristics of the MWA group, we only selected patients who underwent RFA treatment for HCC using surgical approach, with tumors larger than 2 cm but smaller than 6 cm, and excluded patients with more than two tumor nodules. Patients with concomitant hepatectomy were also excluded. Finally, there were 47 patients in the RFA arm for analysis. [Figure 1](#) shows how the cohort of RFA was generated.

2.1. Ablation techniques

For MWA, the procedure was done in the operating theatre under general anesthesia. Prophylactic antibiotics were given as a routine. Any coagulopathy if present was corrected before procedure. If tumor location was favorable, the tumor would be ablated via the laparoscopic route, otherwise open laparotomy via a right subcostal incision with possible upper midline extension was necessary. A thorough inspection of the peritoneal cavity was performed to exclude extrahepatic disease. Operative ultrasound (Aloka, Tokyo, Japan) was used to exclude preoperatively undetected lesions and to guide insertion of the microwave applicator. Insertion of the applicator and the whole ablation process was monitored using operative ultrasound. Surrounding organs were cooled by constant irrigation of ice-cold saline to prevent thermal injury. The ablation was carried out according to the standard protocol. The aim was to create a 1-cm ablation margin around the tumor nodule. After ablation, the track was burnt and in some cases packed with a piece of gel-foam to prevent bleeding. With a single application, MWA could create a maximum ablation zone of 5 cm \times 7 cm in 8 minutes.

For RFA using the cool-tip needle, a single needle was used for small lesions with cluster needles for larger

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