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Research Article

Can Tumor Recurrence Be Predicted by Magnetic Resonance Imaging Findings Before Microwave Ablation in Patients with Hepatocellular Carcinoma?

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Objective: Hepatocellular carcinoma (HCC) is a common cancer. The primary treatment is surgery or liver transplantation. Percutaneous ablation techniques constitute the primary treatment in patients who are not suitable for surgery. Although it gives successful results, some studies report a recurrence rate of up to 50%. This study aimed to obtain an idea about the possibility of possible recurrence by evaluating the lesion characteristics in the pre-procedural MRI images of patients with and without recurrence.

Methods: Forty-eight patients who underwent microwave ablation for HCC in our center between 2018 and 2021 were included in the study. Lesion size, presence of peripheral enhancement, arterial contrast enhancement, and T2 signal characteristics were evaluated on pre-procedural MRI. Subsequently, the relationship of these features with tumor recurrence was evaluated.

Results: The risk of recurrence was higher in patients with lesion sizes with larger than 3 cm diameter and in lesions showing peripheral contrast enhancement (p= 0.036 and p= 0.021, respectively).

Conclusion: Close follow-up will be beneficial in HCCs larger than 3 cm and showing peripheral enhancement since there is a high probability of recurrence after ablation.

Keywords: Hepatocellular carcinoma, Microwave ablation, MRI

1. INTRODUCTION

Hepatocellular carcinoma (HCC) is one of the most common cancers in our country and around the world. It is the most common subtype of primary liver cancer and accounts for 75% of all primary liver cancers. Although it ranks fifth among the most common cancers, it ranks third in cancer-related deaths.[1] Chronic liver disease is the most common cause of HCC. Hepatitis B and C viruses are the most common factors causing chronic liver disease.[2] Other etiological factors are alcohol dependency, non-alcoholic fatty liver disease (NAFLD), obesity, and smoking. Despite the increasing technological developments in diagnosis and treatment options, the desired level of reduction in HCC-related mortality has not yet been achieved. [3]

Barcelona Clinic Liver Cancer (BCLC) staging is the most common staging method used in the management of HCC patients. There are many treatment options for HCC which include surgical resection, percutaneous or laparoscopic ablation, chemoembolization, radioembolization, radiotherapy, systemic tyrosine kinase therapy, systemic immunotherapy, and liver transplantation. Treatment preference varies depending on the location, number, and size of the tumor and the stage of the patient's chronic liver disease, if any. According to the guidelines, surgery or transplantation is still the first option for tumors that are smaller than 3 cm in size and located suitable for resection. However, percutaneous tumor ablation is being used effectively in increasingly more centers as a minimally

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invasive method in patients who cannot tolerate surgery due to comorbidities or in lesions whose location is not suitable for surgery. [4,5]

Currently, radiofrequency ablation and microwave ablation are used as thermal ablation techniques. Both methods are based on creating coagulation necrosis by creating a temperature increase in a determined volume in the target tissue. In suitable patients, ablation therapy is one of the primary treatment methods and offers the chance of curative treatment.[5] However, since the risk of local recurrence is relatively high in these patients, predicting recurrence before the procedure is essential for patient selection and management.

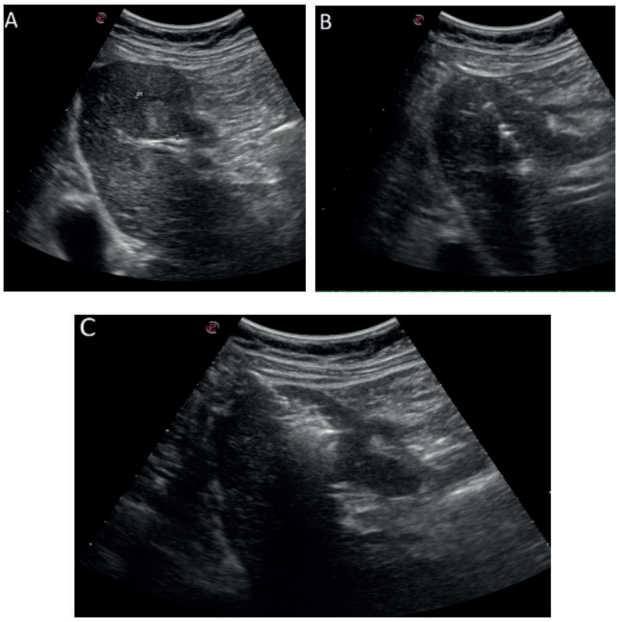
Our aim in this study is to evaluate the potential role of the lesion's pre-procedural magnetic resonance imaging (MRI) features in predicting local recurrence in HCC patients undergoing microwave ablation therapy (MWA).

2. MATERIAL AND METHODS

Ethical approval was obtained from the Local Ethics Committee of the Faculty of Medicine, with the approval number 21457-214. Forty-eight patients who underwent microwave ablation for HCC in our center between 2018 and 2021 were included in the study. The diagnosis of HCC was made by radiographic appearance and high AFP level in cross-sectional imaging using LI-RADS criteria.[6] All procedures were performed under sedoanalgesia and ultrasonography (US) guidance. After the patient was positioned appropriately, antennas of appropriate diameter and length were placed in the center of the lesion under US guidance. As microwave antenna diameter, 14-16-17 Gauge antennas were used, taking into account the location and size of the lesion. Again, ablation was performed at appropriate electrical power (watts) and duration depending on the size and location of the lesion (Figure 1). In cases where a sufficient and homogeneous ablation zone could not be obtained, the antenna was repositioned, and the procedure was continued. The ablation area was visualized simultaneously with the US, and all lesions remained within the ablation zone. Afterward, tract ablation was performed, the antennas were removed, and the procedure was terminated. Twenty-four hours after the procedure, the ablation zone was evaluated with triphasic contrast-enhanced CT, and it was confirmed that the ablation zone covered the tumoral lesion and did not show significant contrast enhancement in all patients.

Figure 1.

A) A mass in the right lobe of the liver (HCC). B-C) The lesion was placed with an antenna, and ablation was performed to cover the entire lesion.



Dynamic contrast-enhanced MRI images and serum AFP values of all patients at least one month before the procedure, in the 1st month, in the 3rd month, and in the 6th month were obtained from the hospital data system. Lesion size, presence of corona enhancement, arterial enhancement, and T2 signal characteristics were evaluated on

pre-procedural MRI, and the differences between recurrent and non-recurrent lesions were evaluated. What is meant by peripheral contrast enhancement? Regardless of its shape, it was defined as parenchymal enhancement observed outside the tumor border in the arterial phase. It became isointense with the background liver parenchyma in subsequent dynamic phase images. Lesion dimensions were measured in three planes in T2 ve contrast-enhanced series, and the most extensive length was defined as the lesion diameter. The MRI sequence that best showed the ablation border was used for border measurements.

MedCalc (version 12, Ostend, Belgium) was used for statistical analysis. Descriptive statistics are given as means. The independent sample test was used to compare continuous variables with normal distribution, and the Mann-Whitney U test was used for data that did not comply with the normal distribution, according to the Kolmogorov-Smirnov test. Kaplan-Meier analysis was used to evaluate primary patency. A value of $P<0.05$ was considered statistically significant.

3. RESULTS

Forty-eight patients were included in the study. All patients had a single lesion. The average age of the patients was 61.1± 10.8 years. Thirty patients were male (62.5%), and 18 were female (37.5%). The majority (83.3%) of the patients were cirrhotic. The most common etiology was viral hepatitis (hepatitis B 62.5%, hepatitis C 12.5%, both hepatitis B and C 4.2%). The patients were mostly Child-Pugh class A (62.5%). The average AFP of the patients was 211.7 ± 101.5. 16G antennas were used in 23 patients, 17G in 18 patients, and 14G in 7 patients, and total ablation times varied according to lesion size and antenna diameter.

Technical success rate was 100%. The most common complication after the procedure was abdominal pain which developed in 29 patients (60.4%). It was ultimately resolved within 24 hours with analgesic support. In 1 patient, a 2-unit hemoglobin drop occurred after the procedure. After erythrocyte suspension and fluid support, hemoglobin levels were stabilized.

In follow-up MRI images, there was local recurrence in 18 patients (37.5%). The ablation zone and its adjacent foci showing contrast enhancement in the arterial phase and wash-out in the venous phase were evaluated in favor of relapse in 3rd-month control MRI (Figure 2). There was no recurrence in 30 patients (62.5%) (Table 1). There was a statistically significant difference between the two groups in terms of tumor size (≥ 3cm) and peripheral contrast enhancement (p 0.036 and p 0.021, respectively). Notably, lesions with recurrence were larger and showed significant peripheral contrast enhancement in the pre-procedural MRI. When arterial contrast enhancement and T2 signal characteristics were evaluated, no statistically significant difference was observed between the groups (p 0.744 and p 0.149, respectively).

Figure 2.

In the pre-ablation MRI examination, a 35 mm diameter peripheral contrast-enhancing lesion in the liver in the arterial phase (A) shows washout in the venous phase (B). In the post-ablation control MRI images, nodular contrast enhancement in the ablation zone in the arterial phase (C) and washout in the venous phase (D) were interpreted in favor of recurrence.

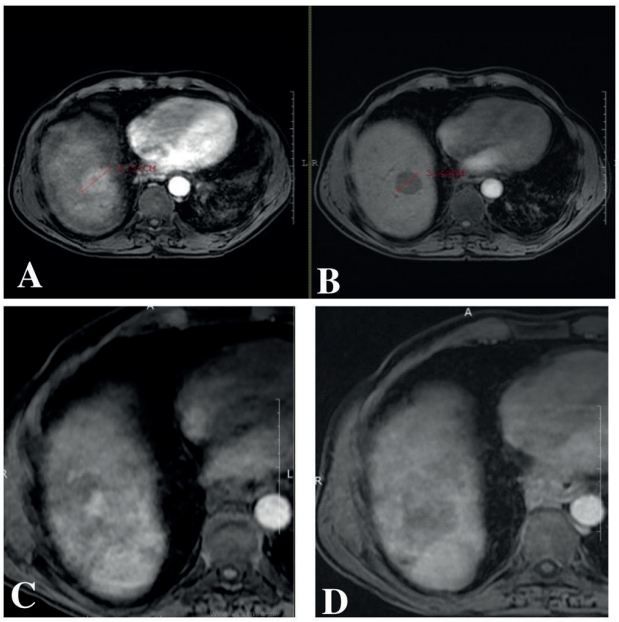


Table 1.

Comparison of parameters on pre-procedural MRI in the groups with and without local recurrences

	With Local Tumor Recurrence n=18 (%37,5)	**Without Local Tumor Recurrence n=30 (%62,5)**	**P**
Age(mean)	63.5±10	59.8±13.4	0.292
Gender(F/M)	6/12	12/18	0.422
Tumor size (≥ 3 cm)	%50	%25	**0.036**
Periferal Enhancement	%83.3	%30	**0.021**
Contrast Enhancement in Arterial Phase	%83.3	%80	0.744
T2 Hyperintensity	%66.6	%60	0.149

4. DISCUSSION

Our study has shown that the probability of recurrence is higher if the ablated lesion is larger than three centimeters and shows peripheral contrast enhancement on preoperative MRI images.

Percutaneous ablation is an effective method used to keep the disease under control until the disease is suitable for surgical resection or liver transplantation or until transplant preparations are made.[7] The most commonly used techniques nowadays are radiofrequency ablation (RFA) and (MWA.) Both methods have their strengths and weaknesses. Microwave ablation offers technical advantages over RFA, including predictable ablation zones, faster ablation times, and insensitivity to current and thermal heat sinks within the ablation area.[8] We included only cases treated with MWA in our study to eliminate technique-related differences.

MRI provides better contrast between soft tissues and higher spatial resolution with higher sensitivity than CT. Recent advances in MRI have made it possible to image the liver with a high spatial resolution during a single breath-hold. In addition, the fact that the patient is not exposed to X-rays is the basis for its increased use. However, CT, with its fast acquisition feature, still constitutes a good alternative in the follow-up of patients who cannot hold their breath and cannot comply with commands.[9,10]

30-55% recurrence rates have been reported in patients treated with thermal ablation.[9,11] When comparing hepatic lesions, it is noteworthy that the recurrence rate is higher in HCCs than in metastases and other lesions.[11] Our study aimed to determine whether pre-procedural MR imaging features of the lesions could effectively predict recurrence.

The study by Chu et al. showed that the probability of recurrence was higher in tumors larger than 2 cm.[12] In a recent study, Dong et al. also showed that the likelihood of recurrence increases as tumor size increases.[13] When the MRI images were evaluated in our study, the tumor was larger than 3cm in 9 (50%) relapsed patients. It was observed that this rate remained at 20% in patients without recurrence (p 0.036). Similar to the literature, it has been shown that the likelihood of recurrence increases as tumor size increases.

Another parameter we examined in our study was peripheral contrast enhancement. Peripheral contrast enhancement was observed in 15 (83.3%) of 18 patients with recurrence. In patients without recurrence, this rate was determined to be 30%, and it was shown that there was a statistically significant difference (p:0.021). It was noted that the findings were compatible with the literature. [14,15]

Arterial enhancement is a common finding in HCCs. Rapid washout in the early venous phase is characteristic of the diagnosis of HCC. Arterial contrast enhancement assessed in the T1 phase of MRI was detected in more than 80% of the patients in both groups. It was not statistically significant in predicting recurrence (p 0.744). When peripheral enhancement and arterial enhancement were compared, it can be speculated that peripheral-enhancing lesions may be more invasive in spreading to the adjacent parenchyma, which may increase the risk of recurrence.

When patient age, gender, and T2 hyperintensity were evaluated, no statistically significant difference was found in predicting the development of recurrence between the two groups.

Our study has many limitations. First of all, it is a single-center study and sample size. Another limitation is that patients were not grouped according to HCC subgroups.

5. CONCLUSION

In conclusion, tumor size and peripheral enhancement on pre-procedural MRI can be used as easily accessible and helpful parameters to predict the local recurrence risk of HCCs before MWA ablation.

Ethical Approval

The study was approved by the Ethics Committee of the Sakarya University Faculty of Medicine, (Number:21457-214 Date: 30.03.2021), and performed by Helsinki Declaration.

Conflict of Interest

The authors declare that they have no conflict of interest.

Informed Consent

Informed consent was obtained from all patients before the procedure.

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Author Contribution Statement

Concept/Design/Analysis/Writing: MÖ

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