

## Real-Time MRI-guided Microwave Surgery of Hepatocellular carcinoma

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**Synopsis:** From January 2000 to December 2002, 57 nodules of hepatocellular carcinoma (HCC) in 45 patients were treated by real-time MRI-guided microwave surgery. The microwave surgery for HCC was performed under real-time MR image guidance with a vertically oriented open MRI system (0.5T SIGNA SP/i system : GE Medical Systems). The microwave electrode and tumor were clearly visualized in the liver during MRI-guided microwave surgery. There were no significant complications and adverse effects. The recurrence lesions at treated site appeared in only 7 cases. Our results suggest the real-time MRI-guided microwave surgery is a safe and effective treatment for HCC.

**Introduction:** Microwave surgery has emerged as a less invasive therapeutic option in a treatment for HCC. To this date, microwave ablation is mostly offered through a percutaneous approach with ultrasonic guidance. However, tumors may become invisible with an ultrasonic image because of micro bubbles during microwave ablation. On the contrary, with the guidance of open configuration MRI system, we can monitor appearances as well as temperature of treated site at all the time. In this study, we demonstrate that the real-time MRI-guided microwave surgery is a feasible, safe and effective procedure in the treatment for HCC.

**Patients and Methods:** *Patient:* From January 2000 to December 2002, 57 nodules in 45 patients with HCC were treated by real-time MRI-guided microwave surgery at Department of Surgery, Shiga University of Medical Science. There were 33 men and 12 women. The mean age of patients was 66.0 years. *MRI Guidance:* All MR data were collected on a 0.5T vertically oriented MRI system (SIGNA SP/i, GE Medical Systems, Milwaukee, WI) (Fig. 1). Real-time MR images sampled by a matrix of 256 x 128 pixels with a SPGR protocol (TR/TE 14/3.4 ms at a refresh rate of 2 sec/image). The image plane can be controlled by a surgeon with the scan plane pointer (1, 2). *Microwave Ablation:* Microwave coagulator (Microtaze, Model HSD-20M, Azwell, Osaka, Japan) was used as the thermo-ablation device. The procedure was carried out under general anesthesia. An MR compatible needle-type electrode (250 mm long, 1.6 mm in diameter) was introduced into the liver through an MR-compatible 14G needle (Daum Corporation, Chicago, IL) via a percutaneous puncture (Fig. 2). Microwave ablations at 60 W for 60 seconds were repeated several times depending on the tumor size. The extent of tumor coagulation were evaluated with contrast enhanced MRI or CT.



Fig. 1 Vertically oriented MRI system(SIGNA SP/i)

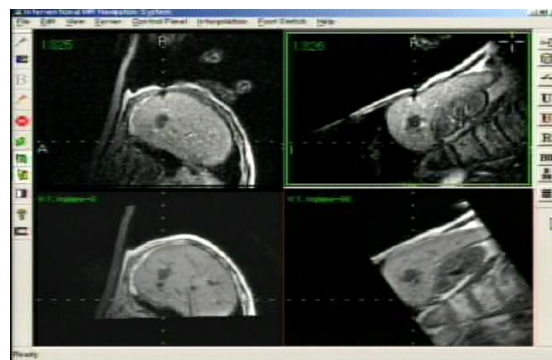


Fig. 2 MRI-guided microwave surgery(inbore monitor)

**Results and Discussion:** The liver tumors were located in all segments of liver except S1. The mean diameter of the tumors was 25.0 mm (range; 15 - 62 mm, median; 22 mm). In 25 cases among them, the tumors were located just below the diaphragm (S4, S7 and S8). These cases were selected for thoracoscope-assisted microwave thermoablation under MRI-guidance across the diaphragm (3). In 4 cases (S3), MR-guided microwave thermoablation therapy in combination with laparoscope-assistance was undergone. In another case, the procedure was undergone without video-assistance. MRI-guided microwave surgery of HCCs was performed successfully without significant complication. In two cases, the recurrent neoplastic lesions appeared in the treated site on follow-up contrast enhanced images. The recurrence lesions at treated site appeared in only 7 cases. Safety margin is most important to obtain a good therapeutic value on the microwave ablation therapy of HCC. With the real-time MRI-guidance, the accurate tumor localization and tissue temperature can be shown on the inbore-monitor even during microwave ablation. Therefore, MRI-guided microwave surgery could be performed safely and sufficient safety margin could be obtained.

**Conclusions:** Real-time MR imaging may be employed as a reliable guide for percutaneous puncture. Moreover, sufficient safety margin could be obtained for hepatic tumor ablation. Our results suggest MRI-guided microwave surgery is a feasible method of treatment for HCC.

### References:

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