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# Recurrent hepatocellular carcinoma successfully treated with radiofrequency thermal ablation

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**Abstract:** We report a patient with hepatocellular carcinoma (HCC) who was successfully treated with radiofrequency thermal ablation (RFA). A 71-year-old man was admitted to our hospital in August 1996 with recurrence of HCC. Partial hepatic resection had been performed in January 1993 for HCC that had measured 1.3 cm in segment VIII, and subsequently he had received six sessions of percutaneous ethanol injection (PEI) for treatment of recurrence. Dynamic computed tomography (CT) performed in August 1996 showed two recurrent tumors, one measuring 3.8 cm in segment VIII adjacent to the right hepatic vein, and one measuring 2.0 cm in segment V. Three sessions of percutaneous RFA were performed. After this treatment, most of the tumor in segment VIII and all the tumor in segment V showed low density on dynamic CT, and the right hepatic vein was preserved. However, a remnant of the mass appeared near the right hepatic vein 2 months after the treatment. An additional two sessions of RFA were performed. After the end of treatment, serum alpha-fetoprotein level dropped to the normal range, and no sign of recurrence has been observed until September 1998.

**Key words:** hepatocellular carcinoma, radiofrequency, thermal ablation tissue temperature, impedance

## Introduction

Various modalities have been established for the treatment of hepatocellular carcinoma (HCC), according to tumor size, location, number of tumors, hepatic function, and clinical condition. Surgical treatment has evolved as the only curative method, but, in Japan, it is not always feasible because of the high incidence of liver cirrhosis related to hepatitis B and/or C virus. Conservative therapy such as percutaneous ethanol injection (PEI) and transcathether arterial embolization (TAE) is now commonly used as regional therapy for small HCC with cirrhosis. However, the prognosis of HCC patients remains unsatisfactory[1] because of the high incidence of intrahepatic recurrences.

Thermal ablation therapy such as radiofrequency ablation (RFA),[2,3] microwave coagulation therapy (MCT),[4,5] and laser hyperthermia[6] can cause necrosis, and has yielded good results in the treatment of liver tumors. We report a patient with recurrent HCC successfully treated with RFA.

## Method

The RF delivery system (RITA Medical Systems, CA, USA) consisted of an active expandable needle electrode, an RF generator producing radiofrequency waves with a frequency of 460 kHz, a maximum output power of 50 W, and a monitor that displayed tissue temperature and impedance around the tip of the needle. The RF needle electrode was 15-gauge in diameter, and had a 15- or 25-cm insulated stainless steel shaft. This needle can be inserted through the thoracic or abdominal wall without a guide needle because of its sharp tip. Four expandable hooks with a thermometer were deployed from the tip of the needle electrode (Fig. 1a,b).

An external grounding pad was fixed to the patient's back in advance. First, biopsy with an 18-gauge needle was performed under ultrasound (US) guidance with a guide attachment, under local anesthesia. The electrode was directly inserted into the deepest part of the tumor, and then the hooks were deployed. The electrode was connected to the generator through a flexible cable. The duration of ablation was fixed at 5 min each time. RF power was adjusted to keep the temperature between 90 °C and 110 °C. After the first 5 min of ablation, the

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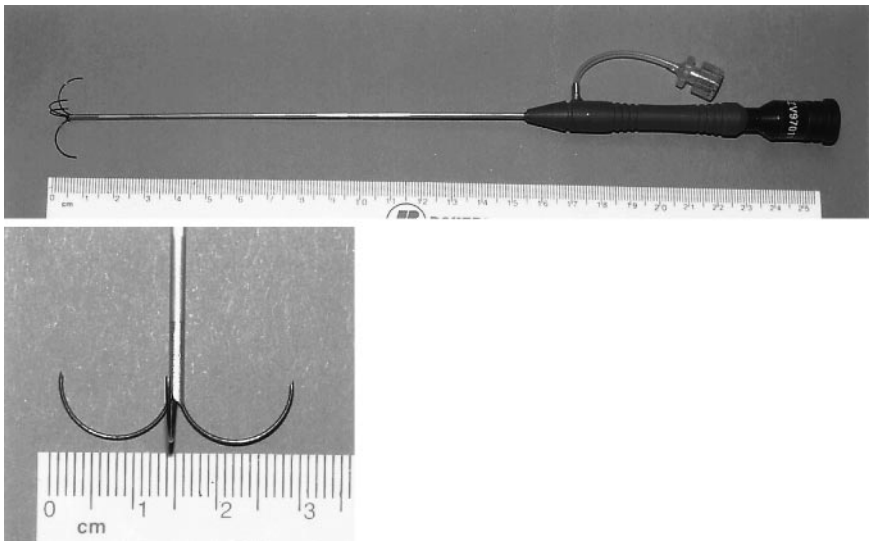


**Fig. 1a,b.** The radiofrequency needle has **a** a 15-cm insulated stainless steel shaft with **b** four 3-cm-wide expandable hooks

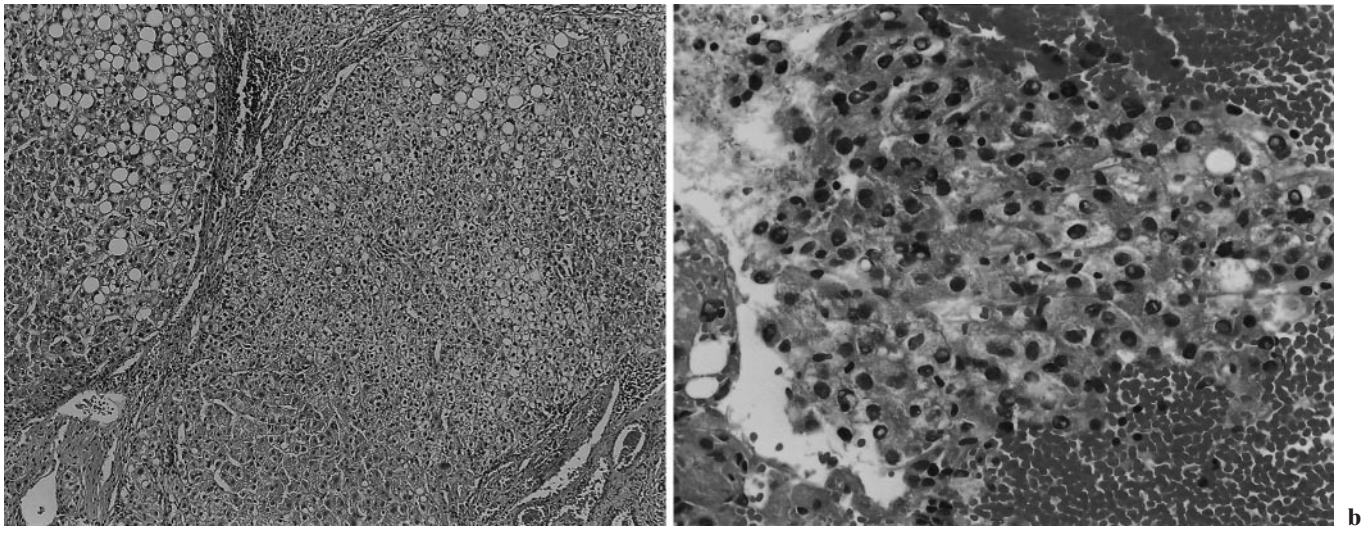


**Fig. 2a,b.** Histological findings showing well differentiated hepatocellular carcinoma with fatty change. **a** Tumor resected in 1993 and **b** specimen biopsied in 1996 before radiofrequency ablation (RFA) treatment. **a** H&E, ×40; **b** H&E, ×100

needle was pulled out 1 cm, and the second application was started. Two to eleven applications were needed until the image of the whole tumor was hyperechoic.

## Case report

A 71-year-old man was admitted to Chiba University Hospital in August 1996 with recurrence of HCC and liver cirrhosis related to hepatitis C. He had had a partial hepatic resection in January 1993 for HCC in segment VIII which measured 1.3 cm. The histological appearance of the resected tumor was well differentiated HCC, trabecular type (Fig. 2a). Subsequently six sessions of PEI were performed to treat two recurrent lesions in segment VIII. However, the patient did not wish to undergo further PEI treatment because of the nausea and vomiting he experienced.

Dynamic computed tomography (CT) examination, performed on August 21, 1996, showed two tumors, one that was 3.8-cm diameter in segment VIII adjacent to the right hepatic vein (Fig. 3a), and one that was 2.0-cm diameter in segment V (Fig. 4a). Ascites was not observed. Laboratory data on admission revealed liver dysfunction, with an indocyanine green retention (ICG R15) test result of 48%. The disease was clinical stage 2, based on the Liver Cancer Study Group of Japan *General rules for the clinical and pathological study of*

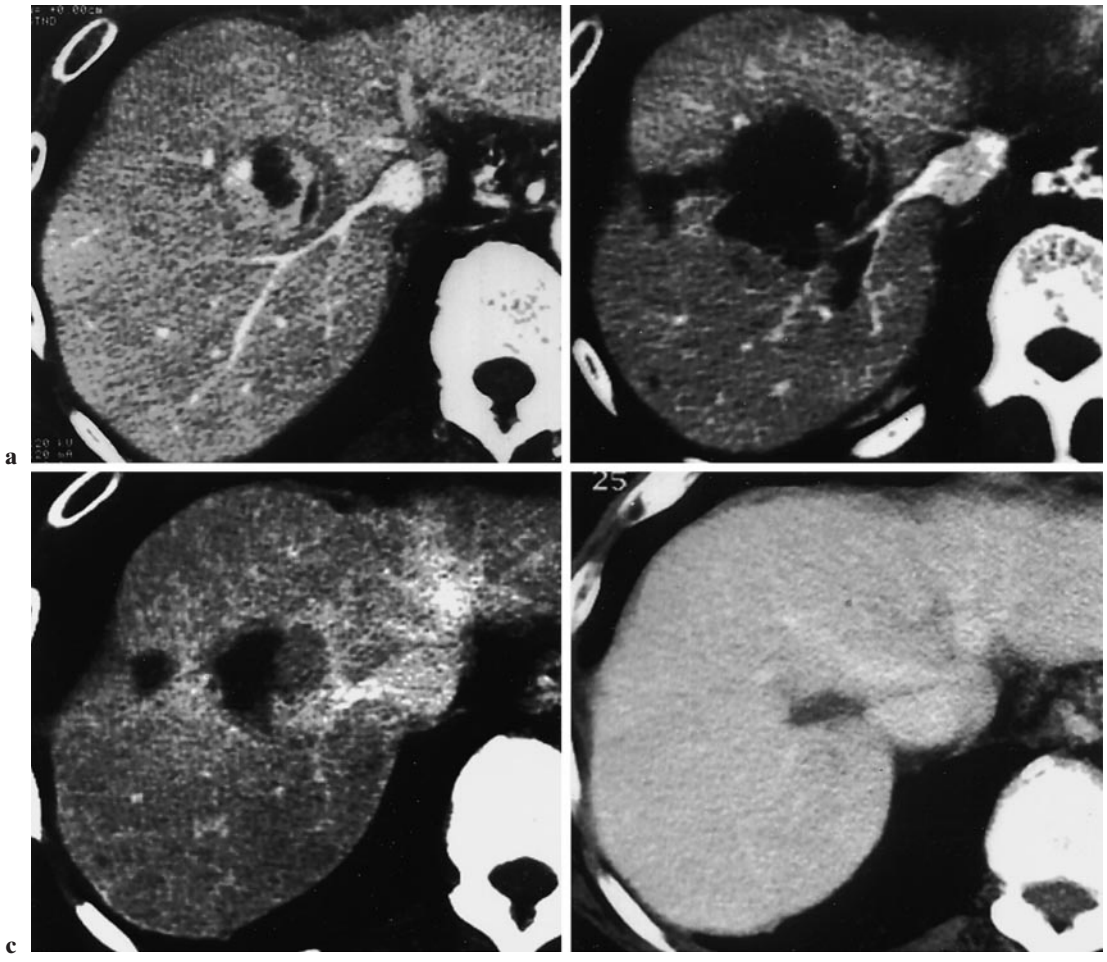


**Fig. 3a–d.** Computed tomography (CT) scans. **a** Showing a 3.8-cm hepatocellular carcinoma (HCC) in segment VIII, adjacent to the right hepatic vein. **b** After RFA treatment, most of the tumor showed low density, without injury of the right hepatic vein. **c** Local recurrence 2 months after treatment. **d** No residual tumor is observed following additional RFA treatment

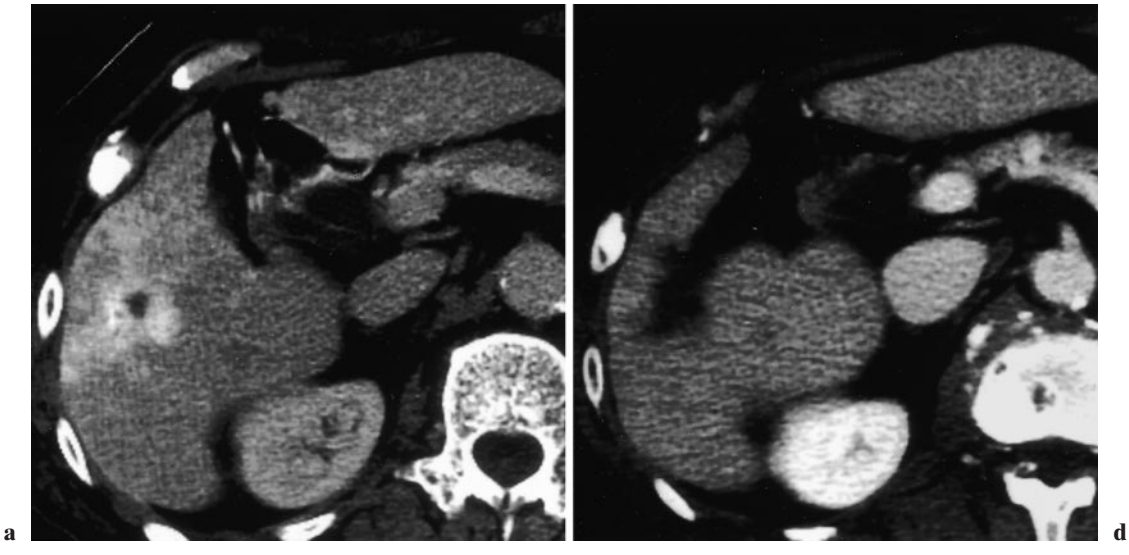


**Fig. 4a,b.** CT scans showing a 2.0-cm HCC in segment V **a** before and **b** after treatment

**Table 1.** Laboratory data during first RFA treatment

| | Pre | Day 1 | Day 3 | Day 8 |
|---|---|---|---|---|
| WBC (/mm$^3$) | 4900 | 4400 | 5800 | 4700 |
| Hb (g/dl) | 13.7 | 14.1 | 13.8 | 13.4 |
| Plt ($\times 10^4$/mm$^3$) | 10.6 | 7.8 | 7.8 | 8.9 |
| GOT (IU/l) | 78 | 296 | 204 | 77 |
| GPT (IU/l) | 68 | 153 | 175 | 84 |
| ALP (IU/l) | 237 | 221 | 241 | 276 |
| T-Bil (mg/dl) | 0.9 | 1.6 | 2.1 | 0.7 |
| ALB (g/dl) | 3.3 | 3.2 | 3.2 | 3.4 |
| PT (s) | 11.3 | 11.9 | | |
| CRP (mg/dl) | <0.2 | <0.2 | 1.7 | <0.2 |
| ICGR15 (%) | 48 | | | |
| AFP (ng/ml) | 925 | | | 789 |

RFA, Radiofrequency ablation

*primary liver cancer.*[7] Serum alpha-fetoprotein (AFP) level was 925 ng/ml. The tumors were deemed unresectable because of the patient's limited hepatic reserve, age, and history of hepatectomy. On September 10, 20, and 24, RFA was carried out for treatment of the tumors. The number of RF applications for the tumor in segment VIII was 7, 11, and 8, respectively. Two applications were made for the tumor in segment V. The histological finding of the biopsy specimen from segment VIII was also well differentiated HCC (Fig. 2b).

After three sessions of RFA treatment, dynamic CT showed that most of the tumor in segment VIII (Fig. 3b) and all of the tumor in segment V (Fig. 4b) had low density. Although the ablated area in segment VIII extended over the right hepatic vein, the vein was preserved (Fig. 3b). Part of the rim in the ablated area was slightly enhanced. Serum AFP level had dropped to 33 ng/ml. The hepatic functional data did not change markedly throughout the course of the treatment (Table 1).

Two months after the treatment, the area that had been slightly enhanced on CT scan showed a mass (Fig. 3c), and serum AFP was elevated to 48 ng/ml. Two additional sessions of RFA were performed, on January 23 and February 7, 1997, with five RF applications each time. No serious complications occurred throughout the treatment. After the end of treatment, serum AFP level dropped to 7 ng/ml, and no sign of recurrence has been observed until September 1998 (Fig. 3d).

## Discussion

Radiofrequency interstitial thermal ablation, a new technique for the destruction of tumors,[8] is similar to microwave coagulation therapy (MCT).[9] In conventional MCT, it has been said that thermal ablation should not be performed close to vessels, to avoid complications such as portal thrombosis and liver infarction. This RF system has the advantage over MCT in that adjustment of output power can be done while tissue temperature and impedance is monitored. In our experience, even when the tumor is adjacent to Glisson's sheath and the hepatic vein, RFA can be performed safely by keeping the tip temperature below 90 °C. The heat effect in RFA depends on the strength of the electric current. The effect would be low around large vessels which have higher conduction than parenchyma. Moreover, the blood flow in vessels of more than medium size acts as a heat sink to protect the vessel wall from thermal damage.[10] For the above reason, Glisson's sheath and the hepatic vein can be preserved. In the present patient, although the tumor was adjacent to the right hepatic vein, treatment was applied repeatedly, and no complications occurred. With the results from this patient, we consider that RFA is a useful modality which can be safely used for the treatment of HCC.

This advantage of the RFA method may be possible to limit the extent of ablation, while destroying tumor cells near vessels. In the present patient, the recurrence after the first three sessions of RFA could have arisen from the regrowth of residual tumor cells that escaped the fatal heat effects. Solbiati et al.[11] reported that tumor regrowth was observed in an area adjacent to a large vessel. As for MCT, the extent of heat ablation during the procedure was roughly estimated as a hyperechoic region formed by microbubbles. However, this region was not uniform in size and shape each time, and obscured the position of the needle. The procedure was stopped when the tumor could not be detected by US and was replaced by a hyperechoic region. Thus, identification of the precise ablation area was not easy. Furthermore, even on CT, it is difficult to evaluate whether or not viable cells remain in the area adjacent to a vessel, because the rim of the ablated area is enhanced, reflecting inflammation or fibrotic change.[12] The low-density area after enhancement does not always represent complete necrosis microscopically.[13] Therefore, it is very important to follow the patient carefully, and if an area of recurrence is observed, additional treatment, including RFA, should be administered.

RFA is a minimally invasive procedure, and can be performed repeatedly. In our experience, most patients can take food 2 h after treatment, and a few had a temperature above 38 °C. This minimal invasiveness indicates that RFA has the potential to be performed on an outpatient basis. We believe that RFA will play an important role in the treatment of HCC.

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