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Radiofrequency ablation of hepatic metastasis: Results of treatment in forty patients

ABSTRACT

Aim: To evaluate the local control of hepatic metastasis with radiofrequency ablation treatment.

Materials and Methods: We did a retrospective analysis in 40 patients treated with radiofrequency ablation for hepatic metastasis. The tumors ablated included up to two metastatic liver lesions, with primaries in breast, gastrointestinal tract, cervix, etc. Radiofrequency ablation was performed under general anesthesia in all cases, using ultrasound guidance. Radionics Cool-Tip RF System was used to deliver the treatment.

Results: The median age of patients treated was 49 years. There were 13 female and 27 male patients. The median tumor size ablated was 1.5 cm (0.75 - 4.0 cm). A total of 52 radiofrequency ablation cycles were delivered. Successful ablation was achieved in all patients with hepatic metastasis less than 3 cm in size. Pain was the most common complication seen (75%). One patients developed skin burns. At 2-year follow-up 7.5% of patients had locally recurrent disease.

Conclusions: Radiofrequency ablation is a minimally invasive treatment modality. It can be useful in a select group of patients with solitary liver metastasis of less than 3 cm size.

KEY WORDS: Cancer, minimally invasive technique, radiofrequency ablation

INTRODUCTION

Radiofrequency ablation (RFA) is a relatively new treatment modality used for management of malignant conditions. Thermal ablation techniques such as high-intensity ultrasound, lasers, and microwave have been used to treat malignant conditions.[1] Hyperthermia has been used along with radiation in the cure of different malignant conditions. It has been seen that malignant cells are more sensitive to hyperthermic damage than normal cells.[2]

RFA uses thermal energy to produce coagulation necrosis in tumor cells. It has been used to treat hepatocellular carcinoma, liver metastases, renal tumors, and prostate, adrenal, and splenic neoplasia. It is also being studied as a treatment modality in early breast cancer.[3,4] Thermal ablation has also been used for treatment of nonmalignant conditions like osteoid osteomas, cardiac conduction abnormalities, and for managing neuralgic pain.[5]

RFA can be done percutaneously, laproscopically, or during open surgery. The procedure can be performed under general or local anesthesia and involves initial localization of the tumor under ultrasound or CT scan guidance. An ablation unit includes a radiofrequency current generator [Figure 1], which generates a low frequency alternating current. Attached to the RFA generator is the RFA electrode [Figure 2], which is introduced into tumor tissue and delivers the radiofrequency current. Grounding pads kept on the patient’s thighs help complete the circuit. As the current flows from the radiofrequency electrode tip towards the grounding pads it causes ionic agitation. This ionic agitation produces frictional heating in tissues, leading to thermal ablation of tumor tissues around the electrode.[1] In the cool-tip systems, the radiofrequency electrode tip is cooled by circulating cold sterile water through specially designed channels inside the electrode. Real-time sonographic monitoring of the procedure is done. A temperature up to 60-100ºC can be generated inside the tumor tissue. Heating of tissues to more than 50ºC usually results in cellular death.[6] At a temperature of 51ºC, effective coagulation can be achieved within 2 min. A higher temperature than this is usually generated to shorten treatment time and to ensure complete ablation. A zone of tumor ablation varying from 3 cm to 5 cm has been reported in various trials.[7] The treatment can be delivered as a single session or in multiple sessions in the same sitting. Cycle time for deposition of radiofrequency current usually varies from

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Efficacy of ablation has been judged using various techniques like CT scan, ultrasonography, and MRI. MRI-based imaging may be a better option for evaluating the ablation zone. PET scan evaluation of the ablation zone has also been studied for assessing treatment response.

MATERIALS AND METHODS

We did a retrospective analysis of 40 patients with hepatic metastasis who were treated at our center by RFA. The aim of the study was to evaluate the local control using RFA. The tumors ablated included metastatic liver lesions, with primaries in breast, gastrointestinal tract, cervix, etc. The inclusion criteria included (1) histologically proved malignancy, (2) Karnofsky performance score >60, (3) lesion size 4 cm or less, and (4) lesion well visualized on screening ultrasound and CT scan. A written consent was obtained from all patients prior to the procedure. Exclusion criteria included (1) patients with more than two metastatic lesions and (2) patients having tumor close to the skin or a major vessel. The procedure was performed under general anesthesia. All the lesions were ablated under real-time ultrasound guidance. Post-ablation imaging was done with CT scan after 48 h to evaluate the ablation zone. The patients were kept on a 2-monthly follow-up for the first 2 years following treatment. We used Radionics Cool-Tip™ RF system (Burlington, MA, USA) for delivering treatment. This system supplies 200 watts of radiofrequency power at 480 KHz. and comes with single and cluster electrodes in various sizes. It uses an internally cooled RF probe. The system also includes a peristaltic pump, which uses rotating rollers to push cold sterile water to the electrode tip to facilitate more symmetric coagulation.

RESULTS

The median age of patients treated was 49 years (38-57 years). There were 13 female and 27 male patients. The median tumor size ablated was 1.5 cm (0.75-4.0 cm) [Table 1]. Six patients had two lesions and both the lesions were ablated at the same sitting. A total of 52 RFA cycles were delivered and analyzed. The mean time for ablation was 12 minutes. The end temperature achieved ranged from 62 to 92ºC, with a median of 82ºC. The total time taken to execute the RFA procedure varied from 30 min to 45 min.

Successful ablation was seen radiologically in all hepatic lesions in the follow-up scan done after 48 hours. On longer follow-up, complete radiological resolution of the ablated area could be seen [Figure 3] At 2-year follow-up, three (7.5%)
patients showed an increase in size of the ablation zone on CT scan, indicating local tumor recurrence. All these recurrent cases had two metastatic lesions at the time of the procedure and two of these patients had tumors greater than 3 cm in size. Asymptomatic pleural effusion was seen in six patients who had undergone ablation for liver lesions at 4-months follow-up. However, the effusion was not associated with any apparent diaphragmatic injury. Thirty (75%) patients complained of moderate pain in the post-ablation period, which was controlled using analgesics. One patient experienced skin burns on the thigh at the site of the grounding pads. No other procedure-related complication was observed. The procedure was well tolerated.

DISCUSSION

Radiofrequency ablation offers exciting possibilities in the management of small-sized tumors. It works on the principal of thermal ablation caused by frictional heating due to ionic agitation in tissues and ablates the tumor-bearing area with an adequate surrounding margin.[8]

RFA has proved to be an effective modality in dealing with metastatic liver lesions. Curley et al.[9] have reported a 1.8% recurrence rate with a median follow-up of 15 months in primary and metastatic hepatic lesions. Metastatic liver lesions in our study had a 7.5% recurrence rate at 2-year follow-up. Hepatic recurrences are usually reported at the periphery of the ablation zone. Perfusion-mediated tissue cooling or the heat sink effect has also been described to cause sparing of tumor cells close to major blood vessels, with subsequent tumor recurrences. Seeding of tumor cells along the RFA tract can be another area of concern.

Lencioni et al.[10] have compared RFA with percutaneous ethanol injection in the treatment of small hepatocellular carcinomas. The 1-year and 2-year local recurrence-free survival rates were 98% and 96% in the RFA group compared to 83% and 62% in the percutaneous ethanol arm (P = 0.002). Shibata et al.[11] have compared RFA with percutaneous microwave coagulation therapy in 94 hepatocellular carcinoma nodules. Complete ablation was achieved in 96% of tumors undergoing RFA and in 89% tumors undergoing microwave coagulation (P = 0.26). During follow-up residual foci of untreated disease were seen in four patients in the RFA arm and in eight patients in the microwave coagulation therapy arm (P = 0.20). They concluded that both techniques had equivalent efficacy; however, RFA was achieved in fewer treatment sessions. A complication rate of RFA in liver lesions of less than 3% is reported.[9] Izzo et al.[12] have reported good results for ablation of early breast cancer lesions less than 2 cm in size under ultrasound guidance. The time required to reach the target temperature varied from 2.9-13 min. Histological evaluation of resected breast specimens showed the ablated zone in 17 patients to be 2.3-4.5 cm in size. RFA with radiotherapy is also being explored as a definitive modality of treatment in inoperable lung cancer.[13] Assessment of ablation is usually done using ultrasound or CT scan. However, these modalities cannot detect microscopic residual disease. FDG-PET has been studied to evaluate the efficacy of hepatic RFA and has been found to detect incomplete ablation not detected on CT scan.[14] Portal thrombosis has been reported in hepatic RFA. Skin burns and thermal necrosis have been reported as procedure-related complications, but their incidence is low.

The advantages of RFA lie in it being minimally invasive in nature. Moreover, the RFA procedure can be safely repeated if required, and it is associated with low morbidity and mortality.

CONCLUSIONS

RFA appears to be a promising modality due to production of adequate ablation and minimal complications. Effective local control can be achieved in patients having solitary hepatic metastasis less than 3 cm in size. Patients with multiple hepatic metastases are likely to have a poor local control.

REFERENCES


