CT-guided percutaneous microwave ablation for non small cell lung cancer: single center experience

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Aims and objectives

To retrospectively evaluate the effectiveness, safety and follow up imaging features of microwave ablation in 42 patients with non small cell lung cancer (NSCLC).

Percutaneous thermal microwave ablation (MWA) under computed tomography (CT) guidance is a cost-effective, minimally invasive modality in treating tumors in different solid organs like liver or lungs (1,2). Clinical experience with microwave ablation for lung tumors is limited, but is rapidly growing. Recently microwave ablation has been used to treat primary and metastatic lung tumors with promising results. The gold standard therapy for stage I lung tumors (Stage IA: T1, N0, M0 - Stage IB: T2, N0, M0) is surgical resection, this being the only approach with any prospect of cure or long-term survival. Unfortunately, only about a third of patients are eligible for surgery, and some patients have widespread disease at the time of diagnosis. Microwave ablation seems to be an alternative to surgery or radiation therapy for the elimination of tumors in patients with primary NSCLC lung cancer. In patients with stage IA disease, microwave ablation may potentially be curative, although surgery remains the method of choice (3).
Methods and materials

At our institution, patients were referred for minimally invasive thermal ablation by their physicians, surgeons, or oncologists. In our department, from February 2008 to January 2011 (an interval of 35 months), 42 patients (27 men, 15 women; age range 47-82 years; mean age 65.8 years) were submitted and 51 percutaneous microwave ablation sessions were performed. The median nodule size was 4.31 cm, ranging from 3 to 8 cm. Nineteen patients (45.2%) underwent a single ablative session, ten patients (23.8%) underwent two sessions, and four patients (9.52%) underwent three sessions. Seventeen patients had non resectable lesions. Fifteen patients had potentially resectable lesions, but they refused to undergo surgery and ten patients did not undergo surgery due to anatomic or technical contraindications (tumor location or coexistent morbidities). Prior to therapy all patients had undergone laboratory examinations (hematocrite, white blood cell count, blood coagulation tests): a platelet (PLT) count <50,000/ml or international normalized ratio (INR) >1.3 was considered a contraindication for MWA and was therefore corrected. Coumadin and aspirin had been ceased at least for 3 days. Patients received Bromazepam 3 mg per os and zideron 75mg (intramuscular injection), 45 minutes before each session to decrease anxiety prior to the procedure. The procedure was performed under local anesthesia with injection of 2% Bromazepam. A single type of microwave probe was used for this study: the microwave percutaneous antenna, which is 17 cm in length, 14-gauge, with a 3.7-cm radiating active tip. The microwave probe was placed directly into the tumor which sent an energetic field into the tissue for 3 to 12 min, depending on the size of the lesion, its location and its vascularity. Post-treatment follow-up imaging (CT), was routinely performed first at 1-, 3-, and 6-month intervals for a minimum of 1 year following the initial ablation procedure.
Results

Non-contrast CT imaging of the tumor immediately after MWA presented the ablative zone appearing as an area of low density (measured in Hounsfield units [HU]), and tumor tissue was surrounded by a ground glass attenuation area. In our study, contrast-enhanced CT imaging of the tumor in the immediate post-MWA setting has demonstrated an ablation zone with a non-enhancing central area, decreased density, intralesional bubbles, and ground-glass opacity in 30 patients (71.42%) (figures 1,2).

The enhancement pattern and change in size of the ablated lesion are the most important CT findings in order to determine whether a complete ablation has been achieved (figures 3,4). At the 6-month follow-up, 6 patients (14.28%), all with an initial tumor diameter greater than 3 cm, presented recurrent disease at the ablation site and 4 patients (9.52%) who had a tumor bigger than 4.5 cm presented distant recurrence. All patients with local recurrence underwent a second ablative procedure and four of them had a third session. Minor complications occurred in few patients; in thirteen sessions (25.49%), productive cough occurred which lasted between 48 and 72 hours and sixteen patients (38.9%) complained of mild thoracic pain which was treated with non-steroidal anti-inflammatory medication. Dyspnea was observed in four cases (9.52%) and minimal, asymptomatic, pleural effusion occurred in six patients (14.28%) which resolved spontaneously. Moderate-grade fever (<38.5°C), occurred in nine patients (21.42%) and usually resolved within a few days by administration of antipyretic medication. Post-ablation syndrome was reported in 9 patients (21.42%). Small pneumothorax occurred in 4 patients (approximately 9.52%) all of which were self-limited. No significant worsening in pulmonary function occurred. No major complications such as acute pulmonary bleeding, large pneumothorax, pulmonary embolism, excessive necrosis, bronchopulmonary fistulas or arteriovenous fistulas or death were seen.
Fig. 1: Lung CT scan mediastinal window: right, lower lobe lung lesion. Needle within lesion during MWA session.

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Fig. 2: Lung CT scan, pulmonary window: Contrast-enhanced CT imaging of the tumor in the 3 month post-MWA follow-up has demonstrated an ablation zone with a non-enhancing central area, decreased density, intralesional bubbles, and ground-glass opacity. Considerable volume reduction of malignancy was observed!

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Fig. 3: Lung CT scan, mediastinal window: peripheral right upper lobe lung lesion (primary lung cancer-NSCLC), needle within lesion during MWA session. The microwave percutaneous antenna, is 17 cm in length, 14-gauge, with a 3.7-cm radiating active tip. The microwave probe was placed directly into the tumor and produced an energetic field into the tissue for 6 min.

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**Fig. 4:** Follow up. Lung CT scan, mediastinal window: peripheral right upper lobe lung lesion at six month follow-up control. Considerable volume reduction of malignancy is observed.

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Conclusion

Microwave ablation is being considered as a new option, either alone or as an adjuvant to chemotherapy, radiotherapy, and limited pulmonary resection. (4)

However, the long-term clinical benefits of MWA for the treatment of malignant tumors are still to be proven. MWA can be performed on an outpatient basis (or with overnight hospitalization), and presents a low rate of complications when performed by an experienced interventional radiologist. (5,6,7)

Elliot Wasser and Damian Dupui (6,8) reported that MWA offers many of the benefits of radiofrequency ablation (RFA) with some more theoretical advantages. In RFA the zone of active heating extends only for a few millimeters from the electrode, whereas microwave probes allow for a larger zone of active heating, up to 2 cm surrounding the antenna, thus allowing a more uniform tumor ablation, especially for lesions abutting major vessels. Radiofrequency ablation energy is subject to the insulating effects of water vapor, tissue charring and resulting carbonization. Microwave energy is not as subject to this limitation allowing higher temperatures to be reached in a shorter period of time. These effects allow for more rapid treatment and larger ablation zones. As reviewed by Carrafiello et al (9), we also observed that increased incidence of pneumothorax is associated with central location of the tumor and chronic obstructive airway disease/emphysema. If possible, therefore, the needle path should minimize the amount of lung that must be traversed to avoid crossing large bullae or interlobar fissures. Multiple paracenteses must be avoided, in order to reduce the risk of pneumothorax, choosing the shortest route, avoiding crossing lung parenchyma as much as possible. In addition, we always perform the MWA sessions under sedation using the antidepressant and analgesic medication thus the patient can follow instructions and cooperate in order to achieve optimal results.

Although the feasibility and safety of MWA in lung tumors have been assessed, the efficacy of this ablative technique still remains to be determined. Treatment response to MWA is practically determined only with radiological follow-up, in contradiction to surgical resection, in which the tumor is removed. In conclusion, we believe that MWA of lung tumors is a very promising minimally invasive technique that gives patients who are not candidates for surgery the opportunity and the potential to achieve a better quality of life. But, well designed clinical trials with a long-term follow-up are required to confirm any short-term results, before MWA can enter into clinical practice.
References


