Microwave Ablation for Lung Cancer

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Lung cancer is the leading cause of cancer-related death in the US surpassing the annual mortality rates from breast, colon and prostate cancer combined. This year 222,520 people will be diagnosed and 157,300 patients will die in the US from lung cancer.[1] Surgery remains the gold standard in treating patients with early stage lung cancer with five-year survival rates of 70%. However, due to medical co-morbidities, only about one third of patients diagnosed with early stage lung cancer are surgical candidates. Traditional therapy with external beam radiotherapy results in five-year survival ranging between zero and 42%. Therefore, alternative therapeutic options are being researched and used clinically in this patient population.

Thermal ablation using either radiofrequency or microwave energy can be performed with image guidance as an outpatient procedure. The underlying principle of thermal ablation is that coagulative necrosis and cell death occurs immediately at temperatures above 60 degrees Celsius. While **radiofrequency ablation (RFA)** creates heat using a high frequency alternating current (460-480kHz), **microwave ablation (MWA)** uses a much higher frequency (900-2450MHZ) creating frictional heat from rapidly oscillating water molecules.[2] Experimental data from a swine model demonstrated MWA to have larger and more circular ablation zone compared to RFA.[3] Initial clinical data suggests MWA to be safe, effective and may offer better survival rates and

Figure 1. 1.3 cm right upper lobe adenocarcinoma.

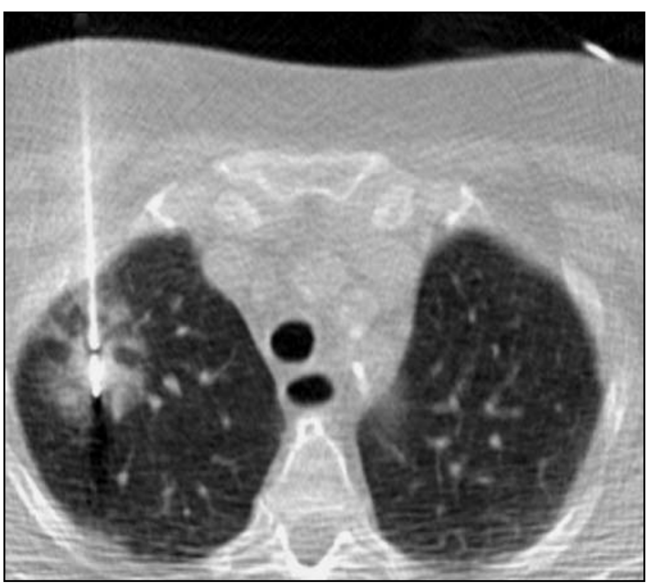
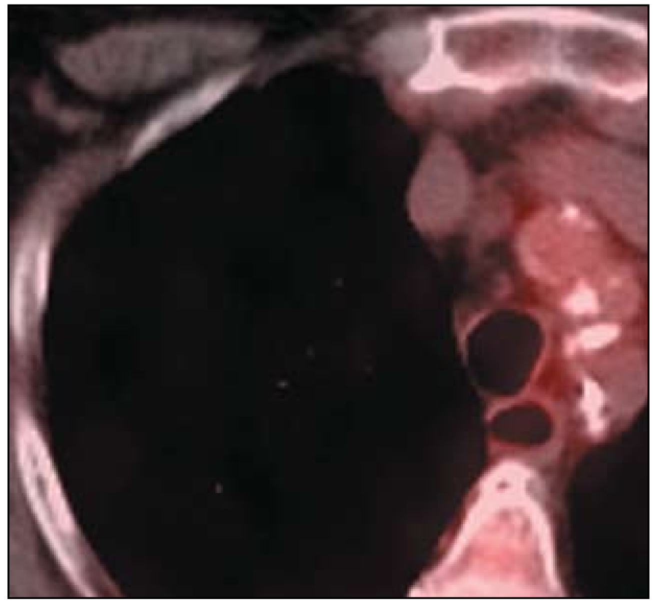


Figure 2. Microwave applicator within the tumor surrounded by ground glass opacity following a ten minute treatment.



Figures 3a (above) and 3b (below). Fused PET-CT and CT lung windows shows no evidence of local tumor progression three years following MWA. (a) Axial fused PET-CT. (b) Axial CT in lung windows.

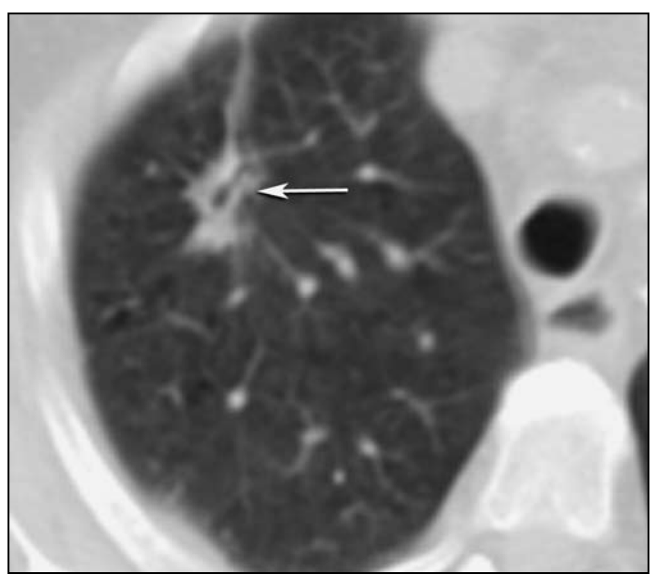


Figure 4. CT lung windows shows a stable ablation scar five years following MWA.

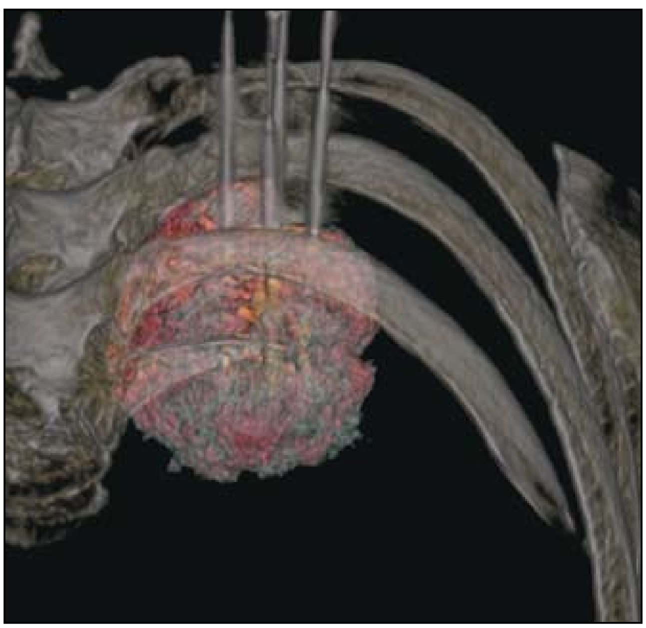


Figure 5. 3-D volume rendering from a different patient shows four applicators placed within a 7 cm adenocarcinoma.

local tumor control compared to RFA in non-surgical patients.[4] We present one patient who was treated with MWA.

A 64 year-old female presented to her primary care physician complaining of a sore throat and a sense of "fullness." On direct inspection a mass on the epiglottis was seen and biopsy confirmed squamous cell carcinoma of the epiglottis. The patient was treated with chemotherapy and radiation therapy for a T2N0M0 primary head and neck cancer. On subsequent CT follow-up a 1.3 x 1.3 x 1.2 cm nodule in the left upper lobe was discovered (Figure 1; white arrow). Biopsy confirmed the diagnosis of a primary bronchogenic adenocarcinoma T1N0M0. No distant metastatic lesions were discovered and the patient was declared a non-surgical candidate due to a cadre of coexisting medical problems including COPD, diabetes, hypertension, and coronary artery disease with prior myocardial infarction. The patient was seen by the tumor ablation service at Rhode Island Hospital and after discussing the treatment options, risks and benefits, the patient chose to proceed with percutaneous thermal ablation. Using local anesthesia and conscious sedation, a single 14-gauge 3.7 cm active tip applicator was placed under direct CT-guidance and a ten minute treatment was performed. Peripheral ground glass opacity surrounding the tumor indicated an adequate ablation margin and the applicator was removed (Figure 2). After being observed in the radiology recovery room for two hours and a chest radiograph confirmed the absence of complication, the patient was discharged home. Close follow-up imaging with CT and PET-CT are used to monitor for tumor progression. A PET-CT at three years following the MWA demonstrated no FDG uptake within the ablation scar (Figure 3; white arrow). A CT five years following MWA demonstrates further involution of the scar without evidence of local tumor progression (Figure 4; white arrow). MWA has not only been applied to small tumors, as the ability to use multiple applicators simultaneously has allowed successful treatment of larger tumors. For example four applicators were used to treat this seven cm adenocarcinoma (Figure 5).

While the treatment of choice for patients with non-small cell lung cancer remains surgery, many alternate therapies have been shown to be safe and effective in non-surgical candidates. Early experience with MWA is very promising and long-term data will be necessary to prove its survival benefit and cost-effectiveness.

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Disclosure of Financial Interests

The authors and/or significant others have no financial interests to disclose.

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