



## Radiofrequency Ablation of Lung Tumors

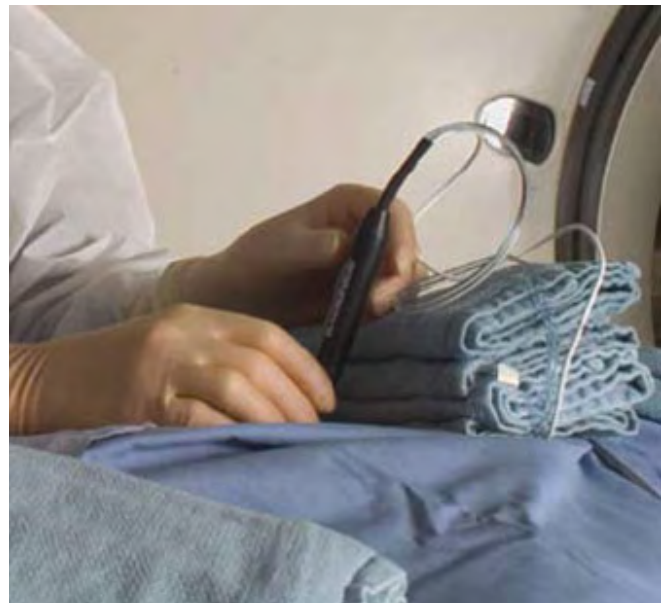
- Radiofrequency ablation (RFA) is a minimally invasive therapy for biopsy-proven lung tumors in patients who are not surgical candidates due to medical conditions
- Patient are selected for RFA after evaluation and collaboration between thoracic surgery, thoracic oncology, and thoracic radiology
- The RFA procedure is generally performed under conscious sedation and patients are admitted overnight to monitor for complications
- Imaging follow-up by radiologists familiar with post-procedural changes is recommended at 1, 3, 6, 9, 12, 18, and 24 months after RFA to assess for tumor recurrence

Radiofrequency ablation (RFA) is an image-guided technique for the destruction of tumors *in situ* that has recently been introduced for the treatment of lung tumors in selected patients who are not surgical candidates or who have refused surgery. Surgical resection remains the gold standard for the treatment of localized primary tumors and metastases from other primary cancers. Unfortunately, many patients cannot tolerate surgery because of limited pulmonary reserve or severe co-morbid states.

RFA treatment of medically inoperable early stage lung cancer may be considered for definitive treatment; however, additional data and long term follow-up are still being accumulated. RFA offers an alternative treatment that is generally well tolerated for these patients as well as a palliative treatment for those with symptomatic disease. Data on overall survival are limited but RFA appears to compare favorably with radiation therapy alone. In a recent report on 75 patients with Stage I non-small cell lung cancer (NSCLC) and 57 patients with localized lung metastases from colorectal cancer, overall survival following RFA was 78% after 1 year and 27% after 5 years in patients with NSCLC and 87% and 57%, respectively, for those with colorectal metastatic disease. The 5 year progression-free rate after RFA for small tumors <3 cm was 47%, compared to 25% for tumors  $\geq 3$  cm, a statistically significant difference.

### Patient Selection

At our institution, RFA may be considered in patients who have biopsy-proven malignancy. Localized disease is confirmed with a PET/CT and any distant abnormalities are evaluated. These patients are assessed by a thoracic surgeon and thoracic oncologist who evaluate them for consideration of conventional therapies, including surgery, radiation, and chemotherapy, as well as RFA. RFA is contraindicated in patients with tumors adjacent to the mediastinum, airways, esophagus, and large blood vessels, including the aorta. Patients with pacemakers must be evaluated

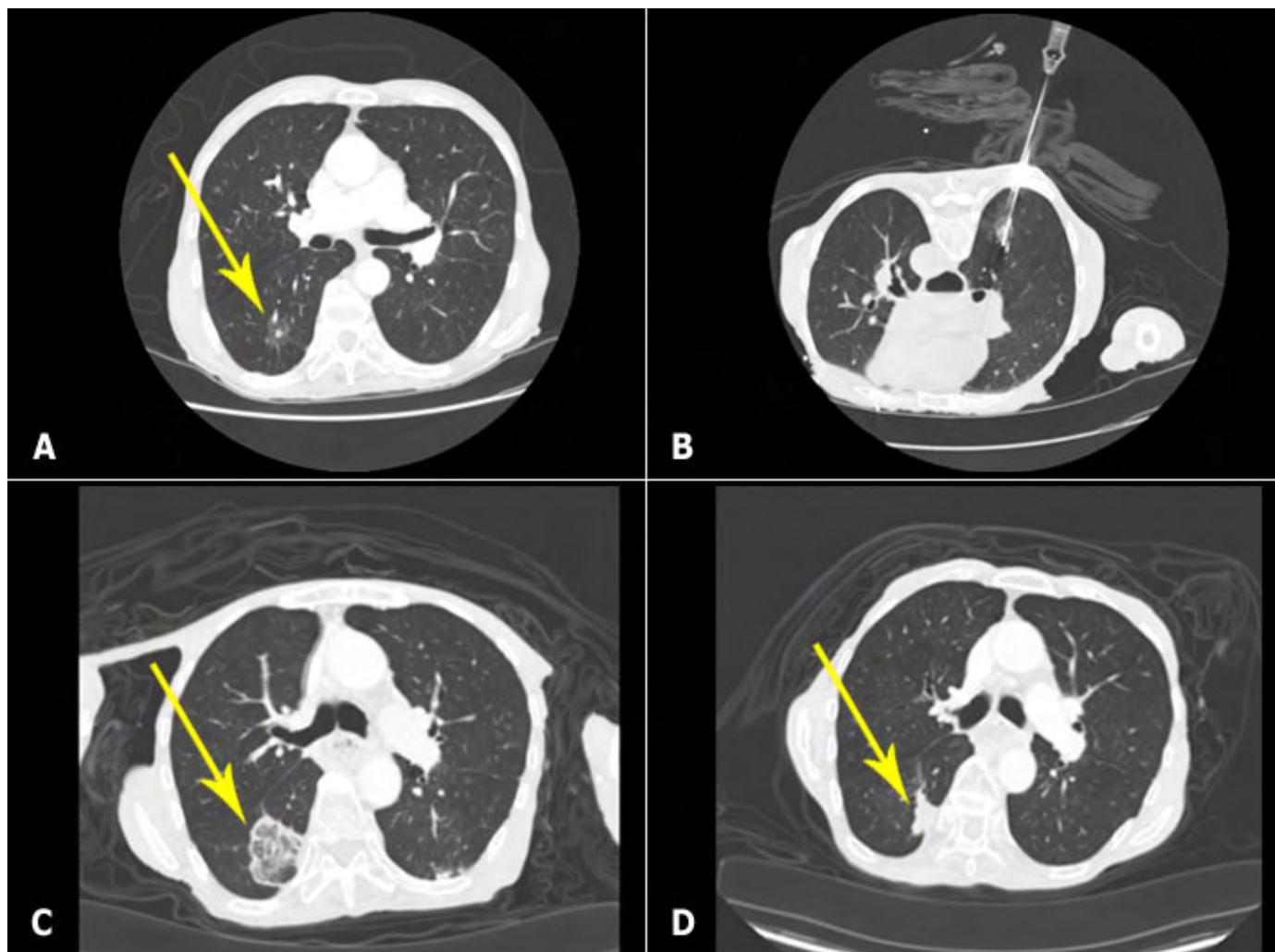


**Figures 1.** Radiofrequency ablation (RFA) of a lung cancer performed with CT guidance.

by their cardiologist because the RF current may cause the device to malfunction and the patient must be able to tolerate temporary deactivation. Patients on positive airway pressure masks (BIPAP or CPAP) at night for sleep apnea are considered high risk for complications and should be carefully evaluated. If selected for RFA, patients will also meet with a thoracic radiologist and an interventional radiology nurse, who will discuss the RFA procedure, possible complications, and follow-up.

### RFA Procedure

In most cases, conscious sedation and local anesthesia are sufficient to ensure that patients remain immobile during the RFA procedure, breathing steadily with no sudden inspirations or expirations, and to prevent discomfort during the procedure. However, conscious sedation is contraindicated in patients with severe



**Figure 2.** (A) CT scan showing a bronchioloalveolar carcinoma (arrow) of the right lower lobe; (B) an image taken during the procedure, showing the RFA electrode in position; (C) image 1 month after treatment shows zone of reaction (arrow); and (D) Follow-up image 1 year after treatment shows a scar (arrow).

cardiac and pulmonary co-morbidities. These patients, as well as those in whom severe chest pain can be anticipated, are given general anesthesia.

The patient is placed on a CT scanner table in a prone or supine position, depending on the location of the tumor. Grounding pads are applied to the thighs. Preliminary CT scans are performed under conscious sedation to determine the best access route to the tumor, avoiding structures such as ribs, fissures, central bronchi, large blood vessels, and the brachial plexus. A small incision is made in the skin to ease the placement of the RFA electrode through the skin into the chest wall. Then the electrode (Figure 1) is advanced incrementally through the chest with a confirmatory CT scan (Figure 2A) to confirm the accuracy of the trajectory before it is swiftly passed through the pleura into the lung and advanced into the tumor (Figure 2B). Once in place, a 12 minute RFA treatment is initiated, during which the patient is closely monitored for adequate pain control, respiration, and oxygenation. After this time, the temperature within the lesion is measured and if it exceeds 60° C, the ablation is considered adequate. Before the electrode is removed a CT scan is performed

to assess for adequate treatment response, which is seen as a ground glass opacity surrounding the tumor, and to detect any immediate complications such as hemothorax, pneumothorax, or pulmonary hemorrhage. If necessary, the electrode is repositioned and an additional treatment performed.

When the treatment is complete, the electrode is removed and the patient rolled into a dependent position, lying on the puncture site. Patients must remain in that position and not talk, move, or cough for three hours following the procedure, breathing low flow nasal oxygen. Chest x-rays are obtained at 1 and 3 hours after the procedure to assess for pneumothorax or hemothorax. Patients are admitted overnight for observation and are prescribed oral analgesic narcotics to treat pleuritic pain following the procedure. In addition, prophylactic antibiotics are administered to patients with prosthetic cardiac valves, mitral valve prolapse, or joint prostheses. Patients are instructed to watch for the development of fever or sputum production that could signal the development of pneumonia.

## Complications

The most common procedural complication is pneumothorax, which occurs in about 30% of patients and is more likely to occur in patients with emphysema. This rate is approximately the same as that associated with lung biopsy. Chest tube placement may be necessary in up to 58% of these patients. Pleural effusions are also common but are generally small and self-limiting. Limited hemoptysis has been reported to occur in 2-11%, although life threatening pulmonary hemorrhage is rare. The few deaths that have been reported with this procedure have occurred due to pulmonary hemorrhage and acute respiratory failure. There is also a risk of developing pneumonia, especially in those with chronic obstructive pulmonary disease.

## Follow-up

Imaging follow-up is recommended to assess for the effectiveness of the RFA procedure and recurrence of disease. PET/CT with diagnostic quality CT is recommended after 1, 6, 12, and 24 months. Additional CT scans are recommended at 3, 9, and 18 months. If there is evidence of disease progression or recurrence, RFA can be repeated.

It is important that radiology follow-up be conducted by physicians who are familiar with the post-procedural changes that develop after RFA. The ablated lesion may grow over the first few days after treatment due to continuing coagulation necrosis (Figure 2C). After 3-6

months the lesion decreases in size and changes in shape from a sphere to a wedge shape, which contracts to a lesion consistent with a scar (Figure 2D). Any increase in size after this time should be regarded as suspicious. Ablated tumor should have minimal or no enhancement with contrast agents but enhancement may be greater at 3 months than after 1 month due to reactive changes. However, focal or eccentric enhancement may be signs of recurrent disease. FDG-PET scans typically show increased rim FDG uptake after RFA due to reactive effects. This uptake should decline after 6 months and failure to do so indicates that there is recurrent disease.

## Scheduling

RFA is performed on the main campus only. It may be scheduled by calling 617-724-4254.

## Further Information

For further questions on RFA or patient eligibility, please contact [Amita Sharma, M.D.](#), at 617-724-4254 or [Jo-Anne O. Shepard, M.D.](#), at 617-724-4256, radiologists in the Thoracic Division, MGH Department of Radiology, and [Michael Lanuti, M.D.](#), MGH Thoracic Surgery, at 617-726-6751.

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