PERCUTANEOUS CT-GUIDED RADIOFREQUENCY ABLATION OF PRIMARY LUNG CANCER: A CASE REPORT

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ABSTRACT

Successful application of percutaneous CT-guided radiofrequency ablation (RFA) of a peripheral bronchogenic carcinoma in a 62 years old female patient was reported. RFA was the favored treatment option in this patient, who was not a candidate for surgery and presuming inoperative stage. A 14 G Leveen Needle Electrode (Radio Therapeutics, Corporate, USA) with an array diameter of 4.0 cm. connected to a 200 watt Generator (RF 3000, Radio Therapeutics Corporate, USA) was inserted into a 3.5 cm. squamous cell carcinoma of the lateral basal segment of the right lower lobe. RFA resulted in almost completely tumor necrosis replacing by thin-wall cavitation on post-ablation CT-imaging. After treatment of post procedural pneumothorax and post-ablation pneumonia the patient had a better life quality, with gaining in weight for at least 6 months of followed up period. Further clinical experience and prospective studies for a longer period are necessary to determine the long term efficacy of RFA in the treatment of lung tumors.

INTRODUCTION

Primary bronchogenic carcinoma is among the most common occurring malignancies in the world and is the leading cause of cancer death. Standard surgical resection and lymph node dissection remain the foundation for the treatment of early stage of NSCLC and isolated pulmonary metastases.[1,2] Conventional treatment strategies for treatment of patients with malignant lung tumors in advanced stages include surgery, chemotherapy, and radiation. Unfortunately many patients found are not suitable for operation due to advanced-stages of disease or having co-morbidities that preclude surgery. Conventional treatment with radiation and/or systemic chemotherapy may not significantly improve the survival in these patients.[3,4]

Percutaneous RFA under CT guidance is a minimally invasive, effective, and safe method for the treatment of some malignant and benign conditions in the lungs.[3,5,6] Radiofrequency ablation (RFA) has been used for a decade for the treatment of primary and secondary liver tumor.[7] RFA is a method of tumor destruction that works by generating radiofrequency waves that are converted into heat, thus producing coagulation necrosis of the lesion.[8] Early results are promising and indicate that substantial tumor reduction and eradication is possible.[9] The advantages of percutaneous RFA over invasive surgery include its potential for reduction of morbidity and mortality, decreasing cost, and ability to be performed on an outpatient basis.[10] Recently, RFA is

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feasible and can be performed safely in the setting of an open thoracotomy. Complete tumor cell necrosis was noted in the small tumors.[11] Improvements in technology have made it possible to treat larger lesions by RFA and this has led to a wider clinical applications.[1] Although RFA has been used for unresectable liver lesions with success,[12] to our knowledge very little experience of bronchogenic carcinoma treated by CT-guided percutaneous RFA has been reported. The surrounding lung parenchyma provides an "insulating effect" and thereby represents an optimal environment for RFA of lung tumors.[3] As a minimally invasive technique, RFA may be a complement to standard treatment methods in the palliative care situation, and hence alleviate the patient symptoms and improving life quality.

CASE REPORT

A 62 years old female with a presumptive diagnosis of lung cancer on imaging was referred to the Chest Disease Institute. The patient had no underlying disease. Initial CT scan revealed a 3.5 cm.x 3.5 cm. bronchogenic carcinoma in the lateral basal segment of the right lower lobe, without hilar/mediastinal lymph node enlargement. However there were two small nodules less than 1 cm. in the RML that assumeed to be metastatic nodules with minimal right pleural effusion. No endoluminal tumor was detected at bronchoscopy. FNAB was performed and confirmed a diagnosis of RLL non-small cell lung cancer. First, the assuming tumor staging was stage IV due to non -provable two small RML nodules with also minimal right pleural effusion. The patient refused surgery and her disease staging relatively was not suitable for surgery. The decision was made to treat the tumor with RFA followed by chemo and radiotherapy. After informed consent was obtained, CT-guided percutaneous RFA was performed under conscious sedation and analgesia, using 7 mg midazolam hydrochloride (Dormicum) and 90 mg pethidine chlorhydrate injected intravenously. Vital signs and cardiac status were monitored by pulse oxymetry and electrocardiography throughout the procedure. Spiral CT scans (Picker 5000, Philips, Eindhoven, The Netherland) with 5-mm. contiguous slice were performed to plan the intervention. The depth from the skin to the edge of the lesion was calculated from a relevant CT image. Local anaesthesia was obtained using 10 ml of 0.5% bupivacaine solution. A 15-gauge Leveen Needle Electode tines forming as umbrella-shaped array diameter of 4.0 cm and a shaft working length of 15 cm. was inserted and deployed under CT guidance into the bronchogenic carcinoma in three target points (fig. 1a). After connection of the electrode with a Radiofrequency Generator (RF 3000, Radio Therapeutics Corporate, USA), RFA was started at an energy level of 80 watts. The deployed energy was increased by 10 watts up to 180 watts until tissue-impedance rose and further current flow into the tumor volume. In this patient the impedance peak was 900 ohms after an interval of 15 min. To obtain complete necrosis, after a delay period to allow re-hydration and cooling adjacent to the array wires, second and third RFA cycles were started into the other two target points, respectively.

The electrode was then removed. CT scan immediately after the procedure revealed ground glass opacities representing presumably small areas of haemorrhage into the surrounding lung parenchyma as well as pleural effusion and thickening. The occurring pneumothorax during the procedure was aspirated after the third cycle completely without the need for ICD tube drainage (figure 1b). After experiencing mild pain overnight at the puncture site, the patient had pain free. She also suffered from nausea and vomiting due to analgesic drug adverse reaction for a day. Following RFA her temperature was elevated for three days possibly due to the effected of tumor lysis. She refused the complementary chemo and radiotherapy and was discharged from the hospital seven days after the procedure, pain free without analgesia. One month after RFA the patient developed pneumonia and was admitted into the hospital in her province. After completing treatment of infection, the tumor was almost completely lysis after two months later, which showed on CT imaging replacing the tumor with thin-wall

cavities. There was no tumor mass that could be taken for tissue analysis by FNAB (figure 2). The patient's condition was clinically favorable with good appetite and gaining weight. On 3-months followed up by CT imaging, a recurrence is suggested at the anterior wall of the cavity as thickening of soft tissue shadow. FNAB was performed and cytologically proved to be a recurrence (figure 3). A second treatment was given by RFA. She still had a good quality of life at the 6 months follow up.

FNAB = Fenestration Aspiration Biopsy **RFA** = Radio Frequency Ablation

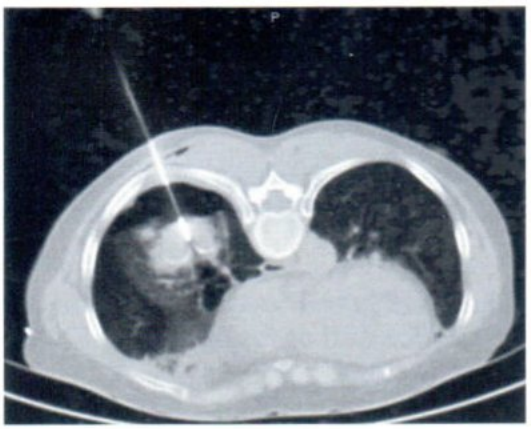
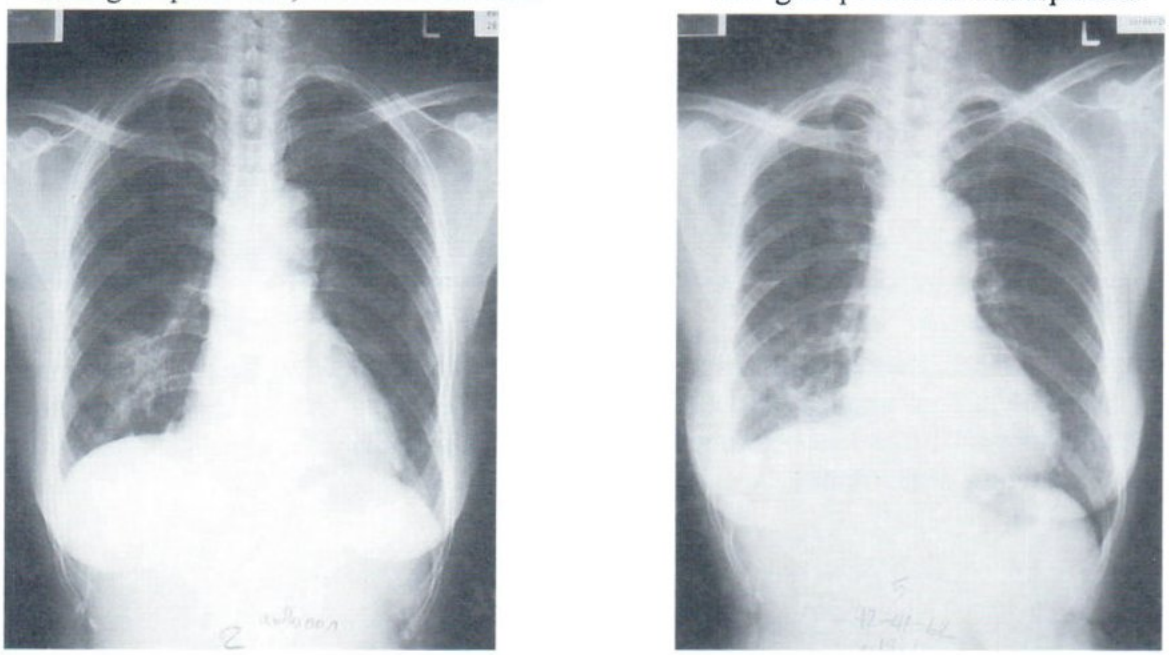


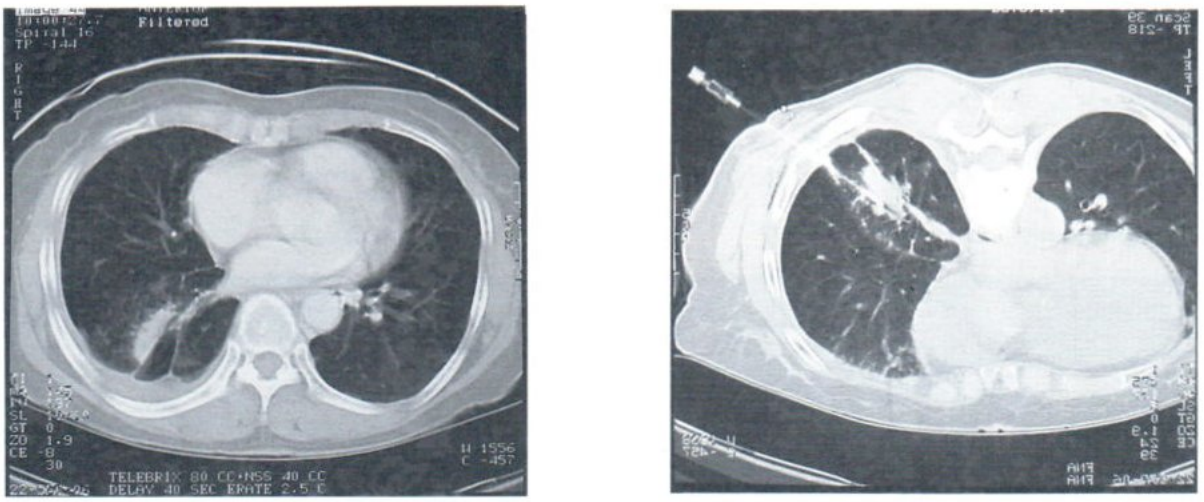
Fig. 1a CT scan during RFA demonstrates LeVeen needle electrode with umbrella-shaped electrode tines placed into a 3.5 cm tumor mass at the lateral basal segment of RLL. Pleural effusion, thickening and pneumothorax during the procedure, were demonstrated.

Fig. 1b Control CT scan immediately after RFA reveals ground glass opacities representing hemorrhage into the surrounding lung parenchyma as well as minimal pleural effusion and thickening. The occurring pneumothorax during the procedure was aspirated.



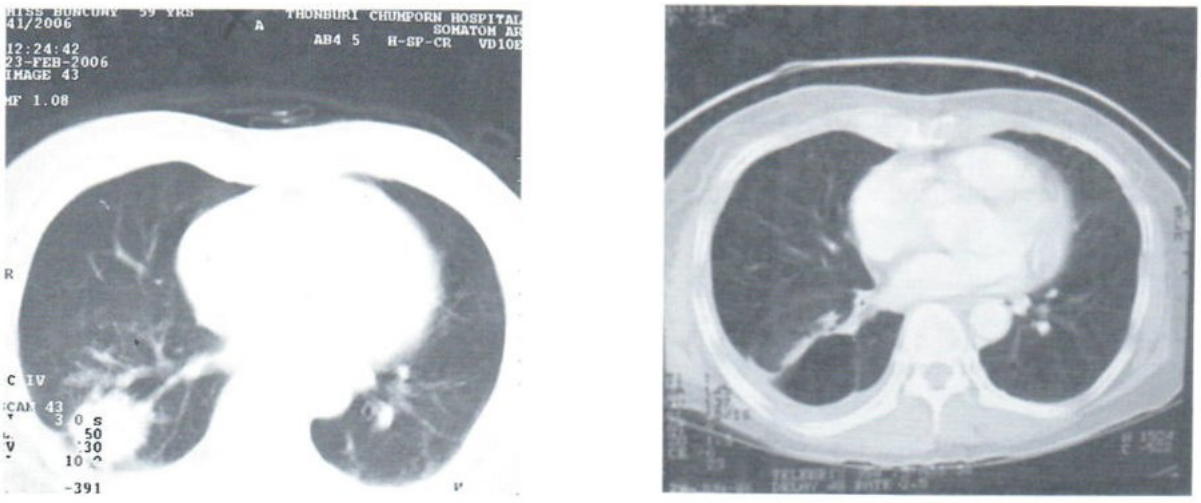
a b

Fig.2 a,b Comparison of prior and post radiofrequency ablation on plain chest films (a,b)



a b

Fig.3 a,b CT scan after 3 month post ablation shows decreased in size of thin wall cavity with pleural thickening. There was a progressive tissue thickening at the anterior wall of the cavity (a). FNAB was performed (b) and tissue analysis proved to be a recurrent tumor.



c d

Fig.3 c,d CT scans (c,d). The treated mass were demonstrated as a thin wall cavity (d) replacing the tumor mass at the lateral basal segment of RLL (c) after 2 month followed up. Only soft tissue thickening at the anterior wall that had not been obtained for tissue analysis. Same degree of pleural effusion and thickening is demonstrated.

DISCUSSION

Primary lung cancer is the most common and frequent malignancy worldwide. Often, it occurs in patients who are not candidates for surgery due to co-morbid conditions (heart disease, emphysema) or having late stages of the disease.[7] In such patients, the usual treatment options are radiation or chemotherapy, or a combination of the two. Radio-frequency ablation is being considered as a new option, either alone or as an adjuvant to chemotherapy, radiation therapy, and limited pulmonary resection.[13, 14]

Since 1990, RFA is an alternative method for the treatment of liver tumors (primary and metastatic) under US or CT guidance.[7] RFA is a promising minimally invasive technique and has proved to be an effective and safe procedure for the treatment of benign and malignant tumor in several organs. There is increasing interest in its uses in the treatment of malignant lung lesions, such as bronchogenic carcinoma and occasionally lung metastases.[14] RFA can be performed under conscious sedation and local anaesthesia and offers the possibility of treating patients who are not suitable for surgery or other treatment modalities due to age, co-morbidity, or extent of disease.[5] RFA of malignant lung lesions may have a lesser morbidity than radiation therapy by preserving surrounding healthy lung tissue. The risks of thoracotomy and resection may outweigh the potential benefits of surgery.

Potential complications using RFA in the treatment of lung tumors are bleeding, infection, pleural effusion and pneumothorax.[15]

Dupuy et al.[14] first reported three patients with unresectable lung tumors treated with RF ablation. Jonathan et al.[10] described the CT appearance of thoracic neoplasm after treatment with radiofrequency ablation. RFA was the favored treatment option in our patient due to advanced staging and the affected part was rishes in blood vessels. After treatment pneumonia occurred with favored resulting. Oral prophylactic antibiotic drug which was not given in this patient was recommended to prevent post-ablation pneumonia. Pneumothorax during the procedure was monitored and completely got rid of, by aspiration during and after the procedure. No pneumothorax was shown in post-ablation CT scan, so the intercostal chest drainage tube was not necessary. Interestingly solid mass had disappeared replacing with thin-wall cavitation on 2-months follow up. CT scan showed the lesion to be suggestive of almost complete tumor necrosis. The patient's temperature was elevated for three days after RFA and decreased without antibiotic drug, likely to have been due to tumor lysis and this occurrence should not be misinterpreted as infection, that the blood count may be helpful.

In our experience, the role of CT imaging, not only provide us with accuracy in the localization planning before the procedure to be undertaken, but also helping us to assess the successfulness of the tumor lysis as the zones of consolidation surrounding the treated tumor in shape of ground glass opacities immediately after the procedure.[9] On follow up CT scan post-ablation, cavitation within the treated tumor was a common finding that often contracted over time.[10] In this case we found thin-wall cavitation representing almost representing the entire tumor necrosis, that was also decreased in size over time, on follow up. The recurrence found at the anterior wall that was lack of ground glass opacification on immediately post-ablation CT scan and thicker on 2-month follow up CT scan, was treated by a second RFA and a satisfactory result was attained. CT scan was also useful for guidance to determine for the tissue diagnosis and the tumor recurrence.[16] The chosen 4.0 Leveen Needle electrode was able to produce a spherical thermal necrosis up to 4 cm. in diameter. Dupuy and Goldberg[3] postulate that neoadjuvant cytoreduction by RFA could make radiation and systemic chemotherapy more effective. Unfortunately the patient refused other treatments. Guidelines for determining which patients are suitable candidates for

RFA of malignant lung tumors have not been developed, and therefore a careful selections of the treatment options that best serve for the individual patient is necessary. Tacke et al[2] reported that all percutaneous therapies have a significantly shorter hospitalization and recovery time compared with surgery.

In conclusion, percutaneous RFA was performed successfully in our patient. CT image was useful for determination of tumor lysis and recurrence. RFA of malignant lung tumors may reduce tumor burden and may be a complement to surgery, systemic chemotherapy or radiation therapy. The value of CT-guided percutaneous RFA in the treatment of malignant lung tumors is the subject of and ongoing prospective, interdisciplinary study conducted by our institution.

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