Clinical Case Report

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Radiofrequency ablation for lung squamous cell carcinoma in a single-lung patient

A case report and literature review

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Abstract

Rationale: High morbidity and high mortality are the main features of non-small cell lung cancer (NSCLC). Radiofrequency ablation, which produces a large amount of heat to kill tumor cells, is one effective way to treat this disease.

Patient concerns: We report the case of a 74-year-old man who presented with a 1-month history of right chest pain. His left lung was removed 12 years prior. Chest computed tomography (CT) revealed a mass in the right lower lobe.

Diagnoses: An excision biopsy of the mass showed lung squamous cell carcinoma.

Interventions: We performed radiofrequency ablation.

Outcomes: The patient underwent 3.5 and 10 months of follow-up, with a partial response and complete remission, respectively.

Lessons: CT-guided radiofrequency ablation is a safe and an effective minimally invasive treatment option. Radiofrequency appears to be a valuable alternative to surgery for inoperable patients presenting with a single-lung NSCLC.

Abbreviation:

Keywords: case report, non-small cell lung cancer, pulmonary mass, single-lung, radiofrequency ablation

1. Introduction

Non-small cell lung cancer (NSCLC) accounts for most cases of lung cancer, with squamous cell carcinoma being the most prevalent.[1] Early surgery is still the gold standard for its treatment.[2] However, most lung cancer that is found at the advanced stage or combined with unresectable disease or cardiorespiratory comorbidities cannot be treated with surgical resection.[3] Radiotherapy and chemotherapy also have many restrictions. Tyrosine kinase inhibitors have made good progress for the treatment of NSCLC, particularly in patients with adenocarcinoma and epidermal growth factor receptor (EGFR) gene mutations.[4] However, little progress has been made for the treatment of squamous cell carcinoma.

Radiofrequency ablation (RFA), thermal ablation, and microwave ablation have been used for the clinical treatment of cancer for approximately 20 years, and is safe, effective, and minimally invasive, particularly for the treatment of advanced lung cancer.[5–7] RFA generates thermal energy to create heat and destroy cancer cells.[6] It is a new interventional radiological technique used to treat lung tumors in patients who are unsuitable for, or reluctant to undergo traditional treatment. RFA for patients with a single lung has rarely been performed because of the risk of causing pneumothorax in the single lung.[8–11] Here, we report the case of a patient who underwent RFA to treat squamous cell lung carcinoma and had undergone previous pneumonectomy for contralateral squamous cell carcinoma.

2. Case presentation

A 74-year-old male patient visited our hospital with a 1-month history of right chest pain in December 2015. He reported no fever, cough, hemoptysis, chills, night sweats, or dyspnea. His medical history included left lung cancer resection 12 years prior (Fig. 1A). Postoperative pathology indicated squamous cell carcinoma, and the patient received chemotherapy twice (gemcitabine + cisplatin). He had hypertension for 10 years, which was treated with Felodipine (sustained release tablets; 5 mg qd), and untreated coronary heart disease but no diabetes mellitus.

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GS and GL have contributed equally to this work and should be considered co-first authors.

Informed Consent: Written informed consent was obtained from the patient's daughter for publication of this case report and any accompanying images.

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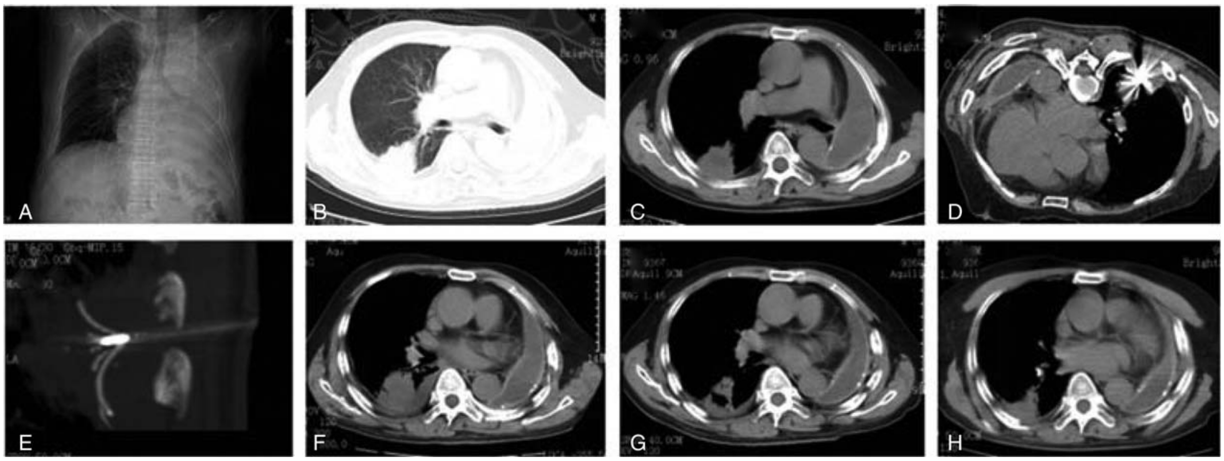

Figure 1. (A, B, and C: December 17, 2015; D and E: December 25, 2015; F: December 30, 2015; G: April 11, 2016; H: April 11, 2016).

On physical examination, his heart rate was 80 beats per minute, his blood pressure was 136/72 mmHg, his respiratory rate was 20 breaths per minute, and his oxygen saturation level was 99% while breathing ambient air. There was no lymphadenopathy in the neck. The patient's left thoracic region showed atrophy, his trachea was at the left side, his left lung breath sounds had disappeared, and his right lung breath sounds were clear. The patient's white blood cell count was 6570 mL^{-1}, with 71.6% neutrophils, 20.1% lymphocytes, and 7.3% monocytes. In addition, his hemoglobin level was 130 g/L, his hematocrit level was 40.60%, and his platelet count was 181,000 mL^{-1}. The patient's C-reactive protein, procalcitonin, sodium, potassium chloride, blood urea nitrogen, creatinine, aspartate aminotransferase, alanine aminotransferase, international normalized ratio, partial thromboplastin time, and D-dimer levels were normal. Tumor marker tests revealed that his carcinoembryonic antigen level was normal at 3.12 ng/mL (normal range: 0–5.0 ng/mL), his cytokeratin 19 level was 6.67 μg/L (normal range: 0–3.3 μg/L), and his squamous cell carcinoma antigen level was 2.70 ng/mL (normal range: 0–2.5 ng/mL). His electrocardiogram results indicated a sinus rhythm with frequent ventricular premature contraction. On December 17, 2015, chest computed tomography (CT) revealed postoperative changes in the left lung and a mass in the right lower lobe (Fig. 1B, C), suggesting the recurrence of lung cancer. There was no chance of surgical resection of the lesion, and the patient refused radiotherapy or chemotherapy.

We permitted the patient to perform prone-position breathing exercise, for a duration of 30 minutes each time as appropriate, twice per day for 7 days. RFA of the right lung lesions under CT guidance was performed on December 25, 2015 (Fig. 1D, E) after informed consent was obtained (RFA of lung cancer and percutaneous lung biopsy). With the patient in the prone position, chest CT revealed the location of the lesion, marked it, disinfected the skin, laid towels, and used local anesthesia by 2% lidocaine 5 mL (withdrawal without blood and gas). Next, using an appropriate WHK-3A RFA puncture needle (Beijing Weierfu Company, China), chest CT was used to adjust and place the ablation needle at the appropriate lesion site. Then the needle was expanded to ensure that the lesion was within the effective radiofrequency range, after which the RFA instrument was connected, and energy was transferred to the tumor using a 14-gauge needle with 9 electrodes, the temperature was slowly raised, controlling it at 75 to 90 °C for 10 minutes. Closed the needle, withdrawal 2 cm and the ablation procedure was repeated to ensure that all of the lesions were completely ablated. After RFA, the needle was pulled out, and 3 pieces of tissue were obtained using a biopsy needle. After the surgery, CT was performed immediately to determine whether pneumothorax and other complications occurred, and then the wound was covered with a dressing. Histopathological (Fig. 2A) and immunohistochemical examinations indicated squamous cell carcinoma (Fig. 2B–J), and the EGFR mutation was negative. Pathological study revealed stage IIA (pT2N0M0) disease.

On December 30, 2015, chest CT (Fig. 1F) displayed larger lesions than those observed previously, and pleural effusion emerged. On January 18, 2016, chest CT (Fig. 1G) showed lesions smaller than that in the former range, and they did not undergo liquefactive necrosis. On April 11, 2016 a second CT review revealed a narrowed lesion (Fig. 1H), and efficacy evaluation indicated a partial response (PR). A biopsy of the same puncture site was performed using the same procedure as above, revealing a large amount of degenerated and necrosis tissue under the microscope (Fig. 2K). The patient died of myocardial infarction on October 16, 2016 with an overall survival of 10 months.

3. Discussion

Lung cancer remains the leading cause of cancer-related death in both men and women in China.[12] Many patients with early stage NSCLC are unfit for standard surgery due to cardiopulmonary dysfunction and/or other comorbidity, especially with single lung patient.[8,13]

RFA converts electrical energy into radiofrequency energy, producing heat to destroy cancer cells in solid tumors; additionally, tumor cells can easily produce more necrosis than normal cells during the heat treatment.[5] Furthermore, a significant increase in T-cell proliferation was detected in T-cell assays after RFA in cancer.[14] Shaobin et al[15] found that, in late-stage lung cancer patients, the helper T lymphocyte (Th) 1 cell level declined, and the level of Th1 cells and Th1/Th2 ratio were increased after RFA, manifested as an improvement in the anti-tumor immunity capability. Dupuy et al[16] first used this method for the treatment of lung cancer in 2000. RFA has become an

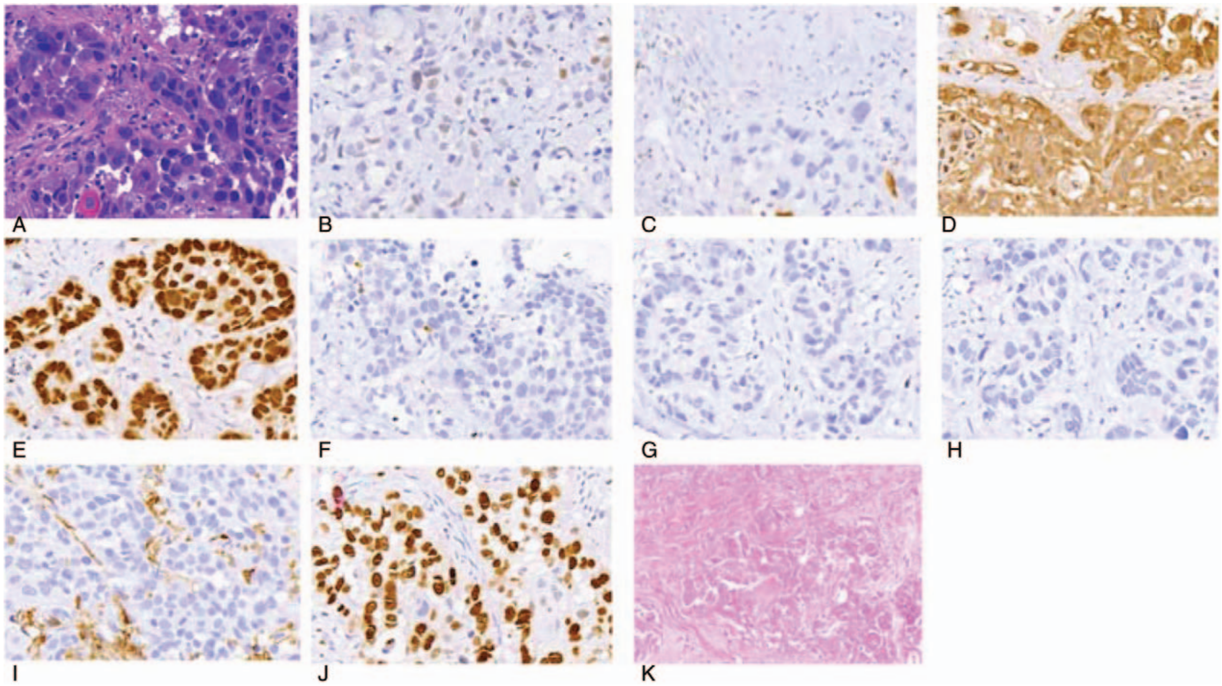

Figure 2. A: H&E staining; B: TTF-1 (–); C: CK-7 (–); D: CK5/6 (+); E: P63 (+); F: Cg-A (–); G: syn (–); H: CD 56 (–); I: LCA (–); J: Ki-67 (+++); K: H&E staining showed a large amount of degenerated and necrotic tissue (April 11, 2016).

accepted alternative to treat intrathoracic malignancies. However, the incidence and characteristics of post-procedural complications are not well described at the early stage.[17] With the increased clinical use of RFA for the treatment of lung cancer, its common disadvantages such as pneumothorax, hemoptysis are being reported.[18] The most frequent complication of RFA is pneumothorax, requiring chest tube insertion in 5% of cases.[19] However, although typically safe, RFA still can result in pulmonary hemorrhage ranging from mild to life-threatening.[20] Another study showed that the application of RFA for tumors located in or near functional structures appears feasible without severe complications.[21] Yoshimatsu et al[22] reported that pneumothorax after RFA occurred in 82 of 194 ablation sessions (42.3%), 33 of 82 sessions had either delayed pneumothorax (n=20) or recurrent pneumothorax (n=13), and the other 49 sessions had nonprogressive pneumothorax.

Although RFA is a safe and effective minimally invasive procedure for the treatment of lung cancer, postoperative pneumothorax complications, as well as the view that single-lung patients are relatively contraindicated, have limited the clinical use of the procedure, there was only 2 cases and 2 retrospective studies have described, the OS is between 14 months and 37 months, which are listed in the Table 1.[8–11] The probability of lung puncture pneumothorax and lesions from the chest wall is inversely proportional to the distance.[23] This patient's lesion was close to the chest wall, and the probability of pneumothorax caused by puncture was low. Radiofrequency treatment changes the tumor tissue and surrounding lung tissue into coagulation necrosis, thus reducing the blood supply of lesions, occurrence of bleeding by follow-up biopsy, and probability of pneumothorax. There was little influence in the pathological evaluation of the cells after RFA.[24]

Table 1

Patient clinic characteristics of the literatures.

Reference	Patient number	Age, y	Gender	Tumor number	Location	Tumor type	TNM stage	Size	Fellow up	OS
Ambrogi et al [8]	1	62	M	1	Right	NSCLC	IIIB (T4N1)	25 mm	NA	NA
Hess et al[9]	16	64 (42–82)	9M/6F	21	Right 15/ Left 6	Primary 12 and metastatic 4	NA	4–37 mm (15.5 mm ± 8)	2 y	71.4% (95% CI: 36%, 92%) at 2 y
Modesto et al[10]	12	44–81 (mean, 64; median, 65)	8M/4F	16	NA	Primary 9 and metastatic 4	NA	2 cm (range, 1.2–4 cm)	37 mos	21 mos (95% CI, 18–53 mos
Sofocleous et al[11]	1	69	M	1	Right	Squamous-cell carcinoma	T3N2M0	16 mm	14 mos	NA

F=female, M=man, NSCLC=no-small cell lung cancer, NA=not applicable, OS=overall survival.

RFA of early tumor tissue transforms it into liquefaction, necrosis, and vaporization.[25] Chest CT showed low-density areas and vacuoles, increased diameter of the lesions, and decreased CT value. We have found that the diameter of the lesions was increasing even after 1 to 3 months of RFA, consistent with Fig. 1F and G in this paper. Three months after treatment, the lesion size was gradually reduced, showing a low-density change. During this time, a CT was performed to examine and to evaluate the efficacy.[26] Whereas positron emission tomography-computed tomography was more accurate than CT. The efficacy of RFA was evaluated for a time period of 3 successive months.[27]

This case was a review of CT 3.5 months after RFA, in which the tumor was significantly smaller than before, and good results were achieved. The case was reviewed 3.5 months after RFA by performing a CT. During which, the tumor size was observed to be significantly smaller than it was earlier. Thus, it was perceived that good results were achieved.

CT-guided radiofrequency ablation is a minimally invasive treatment option. There was little influence of the pathologic evaluation of the tumor cells after RFA. In addition, after repeated biopsy, microscopic analysis revealed a large amount of degeneration and necrosis of the one tumor, providing solid pathologic evidence for the efficacy of CT review after radiofrequency ablation. There was no needle puncture-relative implantation during the follow-up period in this case. RFA appears to be a valuable alternative to traditional treatment for inoperable patients presenting with single-lung NSCLC.

CT-guided radiofrequency ablation is a minimally invasive treatment option. There was little influence of the pathologic evaluation of the tumor cells after RFA. RFA appears to be a valuable alternative to traditional treatment for inoperable patients presenting with single-lung NSCLC.

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