A case of postoperative pyopneumothorax following CT-guided radiofrequency ablation for lung cancer with interstitial pneumonia

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Abstract
We report a case of serious complications following computed tomography (CT)-guided radiofrequency ablation (RFA) performed for the treatment of lung cancer with interstitial pneumonia. The patient developed delayed-onset pyopneumothorax, which required 6 months of antibiotic treatment, drainage, and video-assisted thoracoscopic debridement. Although CT-guided RFA is a promising, effective procedure for difficult-to-treat lung cancer, the present case suggests a risk of complications for patients complicated with interstitial pneumonia and warrants caution.

Keywords: Lung, ablation procedures, complications

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In lung cancer patients with interstitial pneumonia, life-threatening acute exacerbation of pneumonia may occur following surgery, radiotherapy, or chemotherapy, and no consensus has been reached regarding the choice of treatment or treatment indications (1, 2). Many reports have described the effectiveness of radiofrequency ablation (RFA) as a local treatment for lung tumors for which surgery is difficult and chemotherapeutic and radiotherapy are not indicated due to poor pulmonary function (3–6). However, only a few reports have been documented on the use of RFA for lung cancer with interstitial pneumonia (6–8), and the indication for the procedure remains to be determined. The objective of this article is to present a case of intractable pyopneumothorax due to the placement of the chest tube for the pneumothorax that developed after RFA in a lung cancer patient complicated with interstitial pneumonia and to raise awareness of the risks associated with RFA in such patients.

Case report
The patient was a 67-year-old man with cT1bN0M0 non-small-cell lung cancer complicated with mild interstitial pneumonia. Prior to referral to our hospital, he had been under observation at the referring hospital for idiopathic pulmonary fibrosis/usual interstitial pneumonia for 1 year, during which a nodule of 2 cm was detected in the superior segment of the right lower lobe (S6) by chest computer tomography (CT) in May 2010 but remained undiagnosed even after additional bronchoscopy. At our center, pulmonary rehabilitation and oxygen inhalation at 3 l/min on exertion were started on an inpatient basis. Despite another diagnostic bronchoscopy, diagnosis was not made until September 2010 when CT-guided biopsy was performed. Non-small-cell lung carcinoma was diagnosed based on the biopsy results and staged as cT1bN0M0, as no metastasis was detected by contrast-enhanced CT and fluorodeoxyglucose positron emission tomography. Because the patient was considered at high risk for surgery, chemotherapy, and radiotherapy due to the complication with usual interstitial pneumonia and did not wish to undergo high-risk treatment, RFA was considered as an option.

After review and approval by the institutional review board of Osaka City University Graduate School of Medicine and obtaining informed consent from the patient and his family, CT-guided lung RFA was performed in October 2010 (Fig. 1). Arterial blood gas measurements
were: pH 7.41; PCO₂ 44; PO₂ 59.7; HCO₃⁻ 27.9; and SaO₂ 90.7 in room air. Pulmonary function test results were as follows: total lung capacity 6.15 l (percentage predicted total lung capacity 89.6%), total vital capacity 5.37 l (percentage predicted total vital capacity 87.3%); vital capacity 2.99 l (percentage predicted vital capacity 89.5%); forced expiratory volume in 1 s (FEV₁) 2.71 l (percentage predicted FEV₁ 90.6%) and diffusion capacity for carbon monoxide 7.09 mL/min/mmHg (percentage predicted diffusion capacity for carbon monoxide; 43.8%). After subcutaneous and subpleural local anesthesia, the 2-cm lesion in the right S6 was punctured with a 17-gauge LeVeen Needle Electrode (array diameter of 3 cm, Boston Scientific, Natick, MA, USA) under CT guidance. 0.2 mg of fentanyl and 7 mg of midazolam were used in combination for analgesia and sedation, respectively. Electric current was applied to the tumor four times, starting at 30 W and then increasing by 5 W every 2 min. When the maximum resistance was reached, the current automatically stopped (“roll off”) indicating the completion of treatment. Ablation was applied for a total of 59 min and 37 s. The tumor was contained within the ablation range of the electrode, and a safety margin was considered achieved. Postoperatively, a prophylactic antibiotic was administered intravenously (Cefamezin, 1 g BID for 3 days). Only a small amount of hemoptysis was observed, and postoperative fever did not develop. Minor pneumothorax was indicated by CT after 2 days, but the patient did not exhibit dyspnea nor require oxygen administration at rest. The patient was discharged 3 days after RFA.

Chest X-ray and clinical follow-up after discharge, 2 weeks after RFA, revealed no pneumothorax requiring evacuation, dyspnea on exertion or other respiratory symptoms. Pulmonary rehabilitation was restarted on an outpatient basis. Progression of pneumothorax was evident on CT performed at 4 weeks after RFA. The patient was rehospitalized for aspiration via a 4 Fr chest tube. Pneumothorax improved, but the patient complained of back pain, and the tube was removed 5 weeks after RFA and continued administration of the antibiotic. Symptoms improved for 4 weeks, but the fever and back pain reappeared and elevated C-reactive protein and white blood cell count were observed. CT showed pleural effusion with an air-fluid level 12 weeks after RFA. Therefore, video-assisted thoroscopic debridement of empyema and drainage were performed 13 weeks after RFA (Fig. 2). Necrosis of the S6 tumor was confirmed during the procedure. 24Fr conventional double lumen drain and 19Fr silastic flexible drain (BLAKE silicone drain; Ethicon, Somerville, NJ, USA) were inserted. Exudative pleural effusion cytology and cell culture tests were both negative. Because the control of air leak was poor even with debridement and drainage, 4 mL of a tissue adhesive (Bolheal, Kaketsuken, Kumamoto, Japan) and two times of autologous blood were administered. The air leak and fever finally subsided 24 weeks after RFA, and the drain was removed. Even though evidence of pleural effusion and pneumothorax was still detectable on CT, the patient did not present associated symptoms and was discharged 7 months after RFA.

Discussion

The treatment of lung cancer with interstitial pneumonia remains a challenge. The presence of interstitial pneumonia is a risk factor for development of drug-induced pneumonia, which is most notably associated with the anticancer agents used in chemotherapy. Surgery also poses a risk of acute postoperative exacerbation of interstitial pneumonia, as the level of cytokines increases after invasive surgery (1, 2). Radiotherapy also carries a risk of radiation pneumonitis and is contraindicated in patients with interstitial pneumonia. When acute exacerbation occurs, the patient is likely to become refractory to any kind of treatment, including massive doses of steroids, and the prognosis is very poor.

Many reports have described RFA for lung cancers that are difficult to treat by surgery, chemotherapy, or radiotherapy (3–6). In a report of 1000 cases of lung RFA, the 5-year survival rate was 40.4%, which is comparable to that with stereotactic radiotherapy (4). To the best of our knowledge,
data on pulmonary RFA for lung cancer with interstitial pneumonia are limited to several cases: a patient with pulmonary fibrosis and lung cancer reported by Simon et al. (6); a patient with good local control reported by Takao et al. (7); and three patients with pneumothorax and acute exacerbation reported by Okuma et al. (8). The current criteria for lung RFA does not include tumor size or number, results of pre-RFA pulmonary function test, or the presence or absence of concurrent lung conditions such as interstitial pneumonia or emphysema, leaving many issues unresolved. Nonetheless, the optimal ablation size for lung tumor is considered to be a 3-cm radius around the expandable electrode, and within this range the respiratory function is not likely affected (6). In the present case, complete ablation was possible, because the tumor size was smaller than this optimal ablation size.

The most commonly reported complication of lung RFA is puncture-associated pneumothorax, which occurs in 9–52% of cases (typically reported as around 30%) (8). Among these cases, pneumothorax requiring pleurodesis accounts for 1.6% (4). Factors associated with a high risk of pneumothorax are the absence of a history of surgery, the presence of emphysema, and a long puncture route (5). A report by Yoshimatsu et al. (9) reported delayed-onset pneumothorax that was not detected by CT scan obtained immediately after RFA but was found on follow-up imaging in 10% of cases following RFA, and development of subpleural ground-glass opacity on CT was considered to be a risk factor. Sakurai et al. (10) reported cases of intractable pneumothorax in which bronchopleural fistula formation occurred following RFA. The frequency was 0.6%, and lack of pleural adhesions from surgery, complications of emphysema and excessive ablation were suggested as causes. Whether RFA treatment of lung cancer with interstitial pneumonia represents a risk factor for the occurrence of pneumothorax, delayed-onset pneumothorax or bronchopleural fistula is unclear because of the limited data available to date.

In conclusion, lung RFA is thought to be a minimally invasive treatment method that can be performed during a short hospitalization period. However, in a patient with pre-existing interstitial pneumonia, postoperative management may become difficult if pneumothorax develops as a result of electrode puncture during RFA or an empyema due to the placement of the chest tube for the pneumothorax treatment. One should bear in mind that RFA for lung cancer with interstitial pneumonia may carry a certain degree of risk and that treatment options should be considered carefully.

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