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LETTER /*Interventional imaging*

Reversible phrenic nerve injury after radiofrequency ablation of lung tumor

Keywords Lung cancer; Radiofrequency ablation (RFA); Phrenic nerve injury

Dear Editor,

One major complication of radiofrequency ablation (RFA) of lung tumor is injury to a peripheral nerve (such as brachial or phrenic nerve) when the target is located near these structures [1,2]. We report a reversible phrenic nerve injury in a patient with lung tumor who was treated with percutaneous RFA.

A 79-year-old woman was referred for RFA of histopathologically proven lung cancer recurrence. The tumor was a 0.8-cm nodule located in the left upper lobe of the lung, near the mediastinum (Fig. 1). Her pulmonary function before RFA was slightly impaired [vital capacity (VC), 1.81 L; forced expiratory volume in 1 s (FEV_1), 1.04 L]. Lung RFA was performed under computed tomography (CT) fluoroscopy guidance with conscious sedation and local anesthesia with lidocaine. A 17-Gauge single internally cooled electrode with a 2-cm non-insulated tip (Cool-tip; Covidien, Mansfield, MA) was advanced into the tumor and radiofrequency energy was applied for 17 minutes with infusion of iced saline into the cooling lumen of the electrode. The maximal power and temperature of the electrode tips were 50 W and 82 °C, respectively. During the procedure, the patient did not complain of any symptoms suggesting phrenic nerve injury such as pain of the shoulder, teeth, or mandible. However, CT images obtained immediately after the procedure showed a left elevated diaphragm, indicating phrenic nerve injury. Two days later, the patient was discharged without oxygen supplementation or sequelae except for slight shortness of breath. Her pulmonary function one month after RFA was markedly decreased (VC, 1.37 L; FEV_1, 0.72 L). She continued the breathing exercises using an incentive spirometer at home. Her shortness of breath improved rapidly. Thereafter, CT images showed no recurrence and gradual improvement of the elevated diaphragm. Her pulmonary function also gradually improved: her VC and FEV_1 at 3, 15, and 27 months were 1.50 L and 0.79 L, 1.69 L and 1.02 L, and 1.82 L and 1.07 L, respectively.

RFA of the lung is very effective and usually safe [3] and, recently, various new tools to assist its planning and guidance have been developed [4]. Lencioni et al. reported that lung RFA had no significant effect on pulmonary function [5]. In contrast, Tada et al. reported that pulmonary function decreased significantly 1 month after RFA but increased after 3 months and mentioned that severe pleuritis and an ablated parenchymal volume $\geq 20\,cm^3$ were independent risk factors for impaired pulmonary function [6]. Phrenic nerve injury is also a risk factor for decreased pulmonary function after lung RFA because it causes diaphragmatic paralysis [1,2]. The incidence of phrenic nerve injury after RFA is approximately 1.3%, and most reported cases were irreversible [1]. The proximity of the phrenic nerve to the RFA site is a significant risk factor [3]. After lung RFA the mean VC and FEV_1 decreases by a mean of 18.2% ($P = 0.02$) and 19.1% ($P < 0.01$), respectively [1]. Phrenic nerve injury can also be observed after cardiac RFA in patients with atrial fibrillation, with complete recovery of diaphragm function in 12/18 patients (67%), partial recovery in 3/18 (17%) and persistent diaphragm paralysis in 3/18 (17%) [7]. The radiofrequency energy used to treat a lung tumor is much stronger than that used for cardiac RFA. Matsui et al. reported that there were no radiographic evidences of improvement of the elevated diaphragm in 10 patients after lung RFA [1], although they did not describe whether the patients had breathing exercises after RFA. In our patient, although the phrenic nerve injury might have recovered naturally, breathing exercises might also have contributed to a favorable outcome.

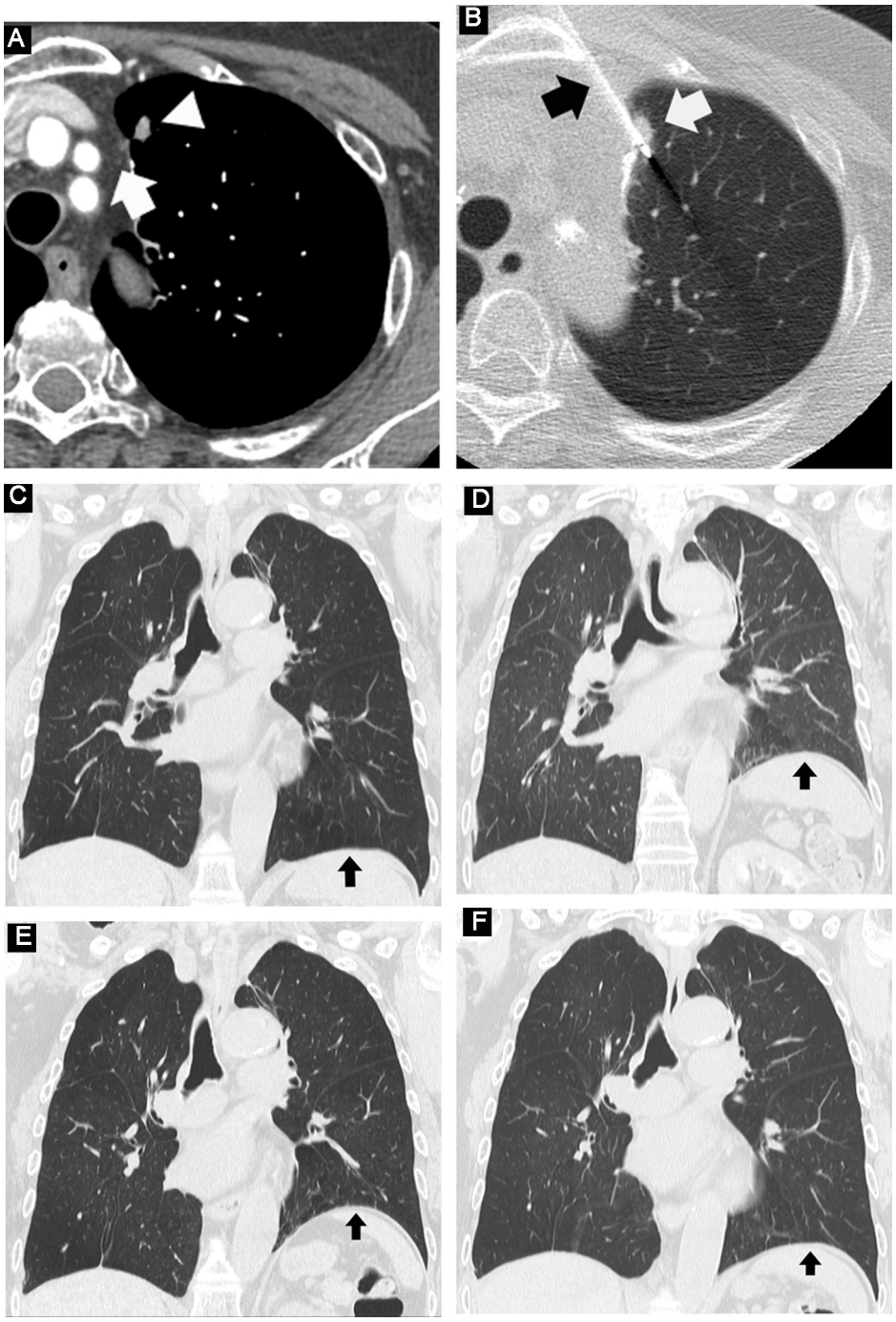

Figure 1. 79-year-old woman with lung cancer recurrence in the upper left lobe; A: Computed tomography (CT) image in the axial plane shows the target tumor (arrowhead) and the phrenic nerve (arrow), which was 9 mm away from the target; B: CT fluoroscopic image during radiofrequency ablation shows that the electrode (black arrow) has penetrated the target tumor (white arrow); C-F: CT images in the coronal plane show elevated left diaphragm (arrow) that gradually decreases over time (C: before ablation; D: immediately after ablation; E: 15 months later; F: 27 months later).

Disclosure of interest

The authors declare that they have no competing interest.

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