



The changes underwent by free fat pads used for pulmonary air leakage repair

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Abstract

The use of free fat pads is effective for repairing pulmonary air leakage clinically. It has been reported that the free pericardial fat pad (FPFP) used to repair the lung remained at the transplanted site in many cases according to images. However, no information is available regarding what type of actual changes these free fat pads with no blood supply undergo. We examined changes in an FPFP that was used to repair pulmonary air leakage in a patient who underwent a surgery for lung cancer 1 year ago. Although the FPFP transplanted to the pleural defect remained without deforming morphologically in this patient 1 year after the first surgery, pathological findings suggested fat necrosis surrounded by fibrous tissue. Our findings suggest that while free fat pads used for pulmonary air leakage repair presumably are not engrafted, they should remain on the lung surface in a thoracolithiasis-like condition.

Keywords Pulmonary resection · Air leakage · Free fat pad · Fat pad · Change

Introduction

The most frequent complication of post-pulmonary resection is air leakage from lung parenchyma. Prolonged air leakage results in hindering early postoperative removal of chest tubes, early recovery, and early discharge. We previously reported the usefulness of intraoperative pleural defect closure using a free pericardial fat pad (FPFP) to prevent intraoperative and postoperative pulmonary air leakage [1]. Recently, Shintani et al. [2] reported that using a free subcutaneous fat pad during thoracoscopic pulmonary resection is effective for repairing pulmonary air leakage.

FPFPs are used to repair the lung as described above and to reinforce a bronchial stump; it has been reported that the FPFP remained at the transplanted site for a

period of 6–12 months in more than half of the cases according to computed tomography (CT) images [3, 4]. However, no information is available regarding what type of actual changes these free fat pads with no blood supply undergo since the opportunity to evaluate the changes undergone by an FPFP in a human body is very rare. This is the first report of changes in a free fat pad that was used to repair pulmonary air leakage in a patient with lung cancer.

Case

The patient was a 66-year-old man who underwent video-assisted left lower lobectomy and partial resection of the upper lobe and lymph node dissection for treatment of lung cancer 1 year ago. During surgery, air leakage from the residual pulmonary upper lobe was repaired using an FPFP by a previously described method [1]. All stitches were passed through the pleura on the surface of the FPFP. Pathological examination of lung cancer showed that the pleomorphic carcinoma was 2.7 cm in diameter, p13, d0, pm0, pT2aN1M0, and stage IIB. He received adjuvant chemotherapy with carboplatin and gemcitabine as an outpatient. 1 year after the first surgery, chest CT showed a newly found 1.5-cm lesion

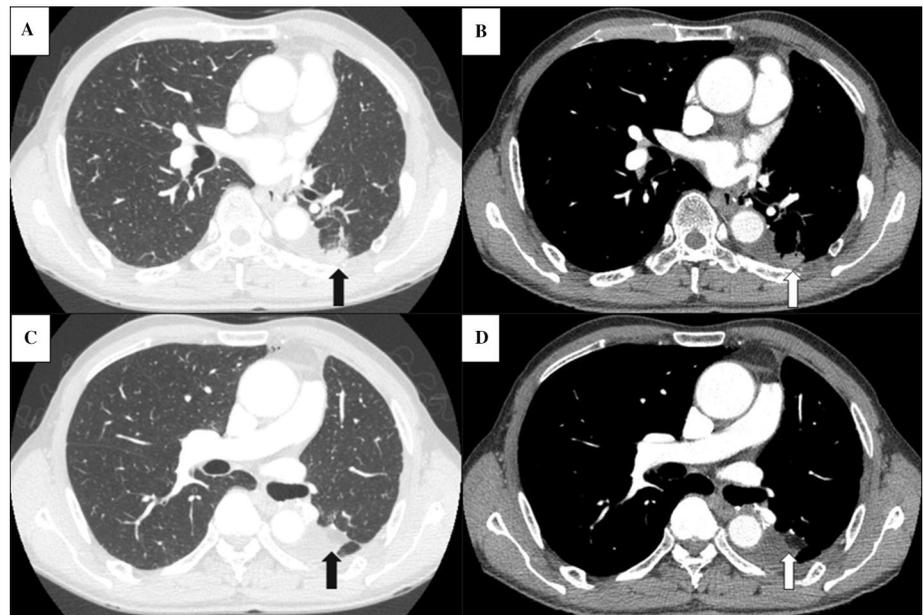
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Fig. 1 Chest computed tomography findings before the second surgery. **a** New lesion (arrow) in pulmonary window. **b** New lesion (arrow) in mediastinal window. **c** Transplanted free pericardial fat pad (arrow) in pulmonary window. **d** Transplanted free pericardial fat pad (arrow) in mediastinal window



at the staple line of the residual left pulmonary upper lobe that was located 1.5 cm away from the transplanted FPF (Fig. 1a, b). A positron emission tomography-CT examination showed that only the newly found lesion had a fluorodeoxyglucose hot spot. There was no metastasis in brain magnetic resonance imaging. Therefore, the patient underwent partial resection of the left upper lobe of the lung including the FPF to examine whether the nodule was malignant.

Pathological findings of the newly developed lesion showed an epithelioid granuloma accompanied by infiltration of histiocytes and lymphocytes and small areas of necrosis. The lesion was not connected to the FPF. The results of the tissue culture, acid-fast stain, Periodic acid–Schiff stain, and Grocott stain of the lesion were negative. It was diagnosed as pneumonia with necrotizing granuloma that had developed at the staple line, which was unrelated to the FPF. The FPF was 1.5 × 1.3 × 1.0 cm, adipose tissue-like, and a yellowish nodule surrounded by fibrous tissue. When we prepared histological sections, we observed that the FPF was separated from lung parenchyma (Fig. 2a). Histological analysis showed that the mature adipose tissue was surrounded by cicatricial fibrosis. The elastic layer of the pleura on the surface of the FPF had disappeared (Fig. 2b). Although adipocyte cell morphology was maintained, a nucleus was not found (Fig. 2c). Peripheral

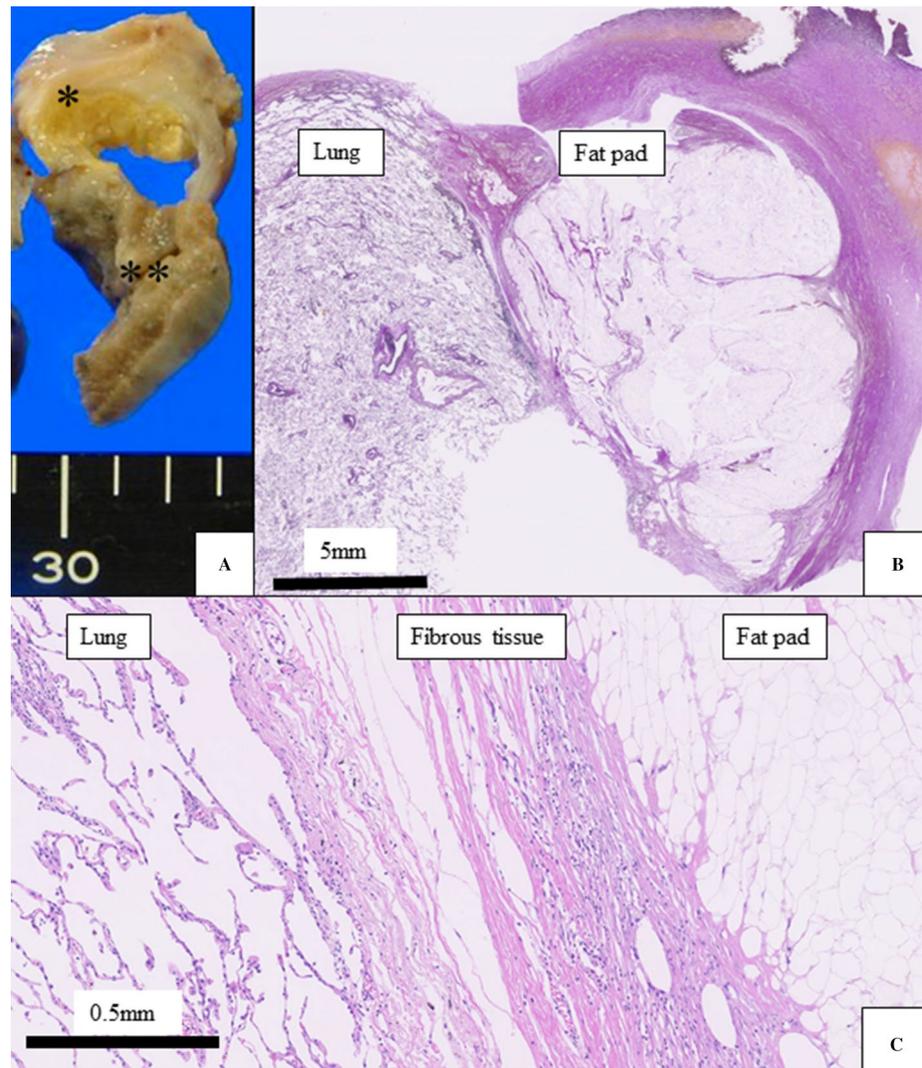
areas of the tissue had inflammatory cell infiltration and foam cells. These findings suggested fat necrosis. The damaged area of the pulmonary visceral pleura was covered with hyalinized fat and fibrous tissue (Fig. 3a, b). No new blood vessels or abscess had formed between the FPF and the lungs.

Discussion

Although it was observed both in the images and the resected specimen that the FPF remained without deforming morphologically in our patient, its pathological findings suggested fat necrosis. This finding is compatible with a finding in our previous study on dogs [1]. In this previous study, the FPF remained on the lung surface; a histological examination showed that the fat structure was maintained, although there was no feeding vessel to the FPF.

Why the necrotic fat does not dissolve remains to be understood. Nevertheless, pathological findings of the removed FPF highly resembled those of thoracolithiasis [5, 6] or intraperitoneal loose bodies [7] macroscopically and histologically. In many reports of thoracolithiasis cases [5, 6], the outer wall of the intrapleural loose body was fibrous tissue with or without hyalinization. Furthermore, the central cores varied, but fatty tissue with

Fig. 2 **a** Macroscopic findings. *Transplanted free pericardial fat pad. **Lung. **b** Microscopic findings (Elastica van Gieson stain). The mature adipose tissue was surrounded by cicatricial fibrosis. The elastic layer of the pleura on the surface of the FFPF had disappeared. **c** Microscopic findings (Hematoxylin and eosin stain). Although adipocyte cell morphology was maintained, a nucleus was not found



or without necrosis was the most common histological finding. As it is argued that intrapleural loose bodies are formed by necrotic fat originating from pericardial and other intrapleural fats, free fat does not appear to dissolve inside the body [5, 6]. Donald et al. [7] successfully generated intraperitoneal loose bodies by placing pieces of excised parauterine fat free in the peritoneal cavity in an experiment using mice.

In our case, the FFPF that was transplanted to the pleural defect developed into a thoracolithiasis-like condition and did not appear to be engrafted. The structure of the pleura on the surface of the FFPF also disappeared in this case. Nevertheless, the changes transplanted free fat

pads undergo may be affected by whether the free fat pads include the pleura.

Conclusions

Our findings suggest that while free fat pads that are used to repair pulmonary air leakage presumably are not engrafted, they should remain on the lung surface in a thoracolithiasis-like condition.

Compliance with ethical standards

Conflict of interest The author(s) declare that they have no conflict of interest.

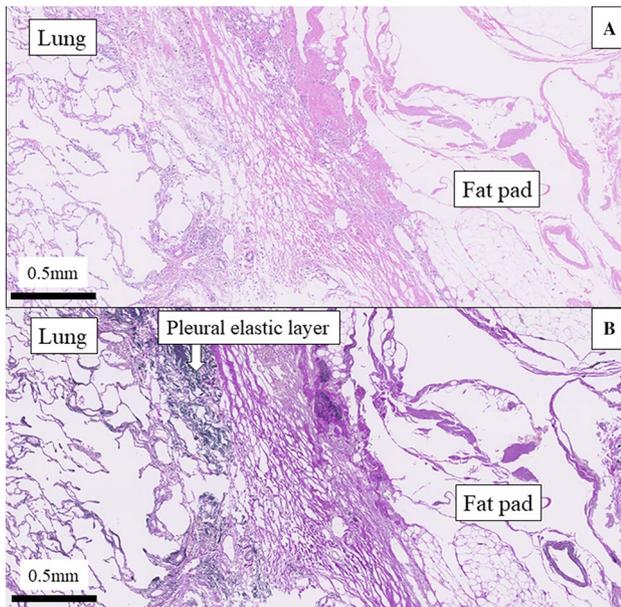


Fig. 3 The damaged area of the pulmonary visceral pleura is covered with hyalinized fat and fibrous tissue. **a** Hematoxylin and eosin stain. **b** Elastica van Gieson stain

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