Resection of organizing pneumonia with leftover adjacent cystic squamous lung carcinoma: A case report and literature review

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Abstract. The aim of the present case report was to investigate the clinical manifestations, imaging features and changes of tumor markers of organizing pneumonia (OP) complicated by squamous lung carcinoma with cystic air space (LC-CAS). A patient with OP resection and leftover adjacent LC-CAS complicated by pneumothorax was evaluated. Relevant reports of OP cases complicated by LC-CAS before February 2022 were searched in the PubMed, EMBASE, Web of Science, China Biomedical Literature Service System, Wanfang Data, China Journal Network full-text database and China HowNet databases using 'lung cancer' OR 'lung cancer with cystic air space' AND 'organizing pneumonia' as retrieval terms. After screening relevant reports, no Chinese articles and only one English article (case report) were obtained. The patient in the literature showed signs of dry cough, tachypnea and fever during the early stage of the disease. Chest computed tomography (CT) revealed an irregular consolidation around the lower lobe of the right lung accompanied by a sign of bronchial inflation (usually indicated by a clear bronchial shadow seen in the diseased lung tissue area). A positron emission tomography-CT (PET-CT) scan and examination for tumor markers were not performed. OP secondary to LC-CAS was confirmed by bronchoscopy, and the patient was in a generally good condition 6 months after right lobotomy. The patient in the present case had no obvious discomfort during the early stage of the disease. Chest high-resolution CT showed that the LC-CAS had an irregular shape, uneven wall thickness and feeding vessels during the early stage, and cystic cavity consolidation during the later stage of the disease. PET-CT revealed that the OP exhibited increased ^{18}F-fluorodeoxyglucose (^{18}F-FDG) uptake, whereas the LC-CAS did not exhibit a high ^{18}F-FDG uptake at the early stage, and that the level of tumor markers (such as neuron-specific enolase, cytokeratin 19 fragment and squamous cell carcinoma antigen) gradually increased. OP was diagnosed through histopathological examination. A total of 32 months after pulmonary lobectomy, bronchoscopy revealed endobronchial neoplasm, and LC-CAS was diagnosed through biopsy. In conclusion, the present case demonstrates that OP with LC-CAS is rare, and thus, prone to missed or delayed diagnosis. Therefore, good clinical judgment and continuous learning can help reduce misdiagnosis.

Introduction

Organizing pneumonia (OP), a type of chronic fibrotic disease after lung tissue injury, has several etiologies, including those related to infection and age (1-3), and it can accompany lung cancer (4). The histomorphological features of OP include granulation tissue composed of fibroblasts, myofibroblasts, collagen and fibrotic exudate within respiratory bronchioles, alveolar ducts and alveoli (5). OP has a relatively low incidence, and patients typically present with atypical symptoms, such as a mild cough or even no symptoms, making early detection challenging (6). Due to the lack of specific clinical signs, OP is frequently misdiagnosed and is often only confirmed through lung biopsy (7). Notably, OP has been reported to be associated with lung cancer (8). Squamous lung carcinoma with cystic air space (LC-CAS), is a rare type of cystic lesion in lung cancer that has a prevalence of ~3.6% worldwide (9-12). According to Fintelmann *et al* (13), the cystic cavity in LC-CAS represents a pathological expansion of the native airspace within the lung, often presenting as an isolated, thin-walled cavity containing air sacs in the lung parenchyma. The pathogenesis of LC-CAS has been proposed to involve several mechanisms (14): i) Tumor cells proliferate along the alveolar wall, leading to fusion of the damaged alveolar wall and formation

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of a cystic air cavity; ii) liquefaction necrosis causes the lesion to discharge, creating a cystic air cavity; iii) elastic retraction of surrounding lung tissue pulls and thins the cavity wall; and iv) a 'valve effect' may occur when tumor cells originating from the bronchiolar epithelium obstruct the bronchioles, resulting in distal alveolar dilation and rupture. This partial bronchiolar obstruction contributes to the formation of valves, explaining why LC-CAS often arises in peripheral lung regions. Pneumothorax is a rare complication of LC-CAS, with only a small number of clinical cases reported in the literature (15). Cases of OP with late LC-CAS complicated by pneumothorax have been rarely reported. Therefore, such patients are prone to missed diagnosis, misdiagnosis or inappropriate treatment. The current report describes the case of a patient who developed LC-CAS in the early stage after OP resection and pneumothorax complication in the later stage. To improve the understanding of the condition and avoid missed or delayed diagnosis, the literature on the clinical features of the patient, as well as the pathogenesis of the disease, was reviewed and the causes of misdiagnosis were analyzed.

Case report

Case presentation. A 66-year-old man was admitted to the Department of Respiratory and Critical Care Medicine of Daping Hospital, Third Military Medical University (Chongqing, China) in December 2021 due to a right lung mass that was discovered 2 years before and right chest and abdominal pain persisting for 3 months. The patient had a smoking history of 45 pack-years but quit in December 2019. They consumed alcohol (20-100 g/day) for 40 years but quit in 2011. The patient denied a history of lung disease. In March 2019, chest high-resolution computed tomography (HRCT; Fig. 1A, E, D and H) examined in Chongqing Cancer Hospital (Chongqing, China) revealed a mass shadow in the basal segment of the right lower lobe measuring 4.3x2.9x2.6 cm (black arrow in Fig. 1E). In April 2019, positron emission tomography-CT (PET-CT) was performed in the Department of Radiology, Daping Hospital, which revealed a soft tissue mass shadow in the right lower lobe. The shape of the lesion was irregular, with lobulation and spiculation signs, and the boundary between the lesion and the adjacent pleura, oblique fissure and diaphragm was unclear (Fig. S1). Furthermore, ^{18}F-fluorodeoxyglucose (^{18}F-FDG) PET-CT revealed a mass with a maximum standardized uptake value (SUV_{max}) of 7.25 and average standardized uptake value (SUV_{avg}) of 3.97. The maximum diameter of the mass was ~4.5 cm; thus, the possibility of peripheral lung cancer was considered. The peripheral blood carcinoembryonic antigen (CEA) and carbohydrate antigen 125 levels were both elevated (5.41 ng/ml and 64.68 U/ml, respectively, compared to their normal ranges of 0.00-5.00 ng/ml and 0.00-35.00 U/ml). After 1 day, wedge resection of the right lower lung lesion was performed in the Department of Thoracic Surgery, Daping Hospital, and pathology analysis revealed OP of the right lower lung (Fig. 2A). For pathology analysis, the tissue was fixed in 4% neutral formaldehyde at room temperature for 6 h, followed by paraffin embedding for 72 h. The tissue was cut into 4-μm sections, which were stained with hematoxylin and eosin for 10 min at room temperature. The sections were observed under a light microscope (BX43; Olympus Corporation). The patient was discharged 5 days later. During health examination at the same teaching hospital in November 2020, the patient was found to have pulmonary cysts in the right lower lung (details unknown), but neither the doctor nor the patient gave it serious attention due to a lack of any clinical symptoms. However, the patient gradually experienced pain and discomfort on the right side of the chest and abdomen, and in September 2021, the thoracoabdominal pain was accompanied by cough, expectoration with bloody sputum, and tachypnea and malaise when walking fast and climbing stairs, which could be relieved after rest. The patient was hospitalized in a local hospital (Chongqing Shapingba People's Hospital, Chongqing, China), but the symptoms were not markedly alleviated by anti-infection (moxifloxacin hydrochloride sodium chloride injection 400 mg once a day) and analgesic (oxycodone hydrochloride extended-release tablet 10 mg twice a day) treatments; thus, the patient was transferred and admitted to the Department of Radiology of Daping Hospital, Third Military Medical University in October 2021. Outpatient chest HRCT revealed a right pneumothorax, with 40-50% right lung compression, as indicated by the red arrow in Fig. 1B and F. After 3 days, the patient was admitted again to the current hospital, and laboratory tests revealed the following: Neuron-specific enolase (NSE), 17.1 ng/ml (normal range <16.3 ng/ml); cytokeratin 19 fragment (CyFRA21-1), 0.1 ng/ml (normal range <3.3 ng/ml); and squamous cell carcinoma antigen (SCCA), 21.0 ng/ml (normal range <2.7 ng/ml). The thoracic surgeon diagnosed space-occupying lesions of the right lower lung and right pneumothorax. Following conservative treatment (nasal cannula), the patient was discharged after 5 days. The thoracoabdominal pain gradually aggravated, and the patient was admitted to the Emergency Department of Daping Hospital ~1.5 months later. Chest HRCT indicated right liquid pneumothorax (Fig. 1C and G) and 60-70% right lung compression. Closed thoracic drainage was performed, and the patient was admitted to the Department of Respiratory and Critical Care Medicine of the present hospital for further treatment. The patient was placed in a high semireclining position. Breath sounds were lower in the right lung than in the left lung, with no obvious rales observed on either side of the chest. There was right upper abdominal tenderness, with no signs of rebound pain or muscle tension. There was no edema observed in either lower limb. The preliminary differential diagnoses included pneumonia of the right lung or a tumor of the right lung.

Diagnosis and treatment. Arterial blood gas analysis was completed on the day of admission (nasal catheter oxygen inhalation; oxygen concentration, 29%) with the following results: pH, 7.47 (normal range: 7.35-7.45); partial pressure of CO_2, 30 mmHg (normal range: 35-45 mmHg); arterial oxygen pressure, 76 mmHg (normal range: 60-100 mmHg); oxygen saturation, 96% (normal range: 95-100%); CEA, 30.7 ng/ml (normal range: 0.0-5.0 ng/ml); pro-gastrin-releasing-peptide, 53.5 pg/ml (normal range: 28.3-65.7 pg/ml); CyFRA21-1, 30.1 ng/ml (normal range: 0.0-3.3 ng/ml); NSE, 19.5 ng/ml (normal range: 0.0-16.3 ng/ml); and SCCA, 48.5 ng/ml (normal range: 0.0-2.7 ng/ml). The pleural fluid CEA level was 1,577 ng/ml (normal range <5.0 ng/ml), and cytology examinations showed suspected cancer cells. For cytology, the samples

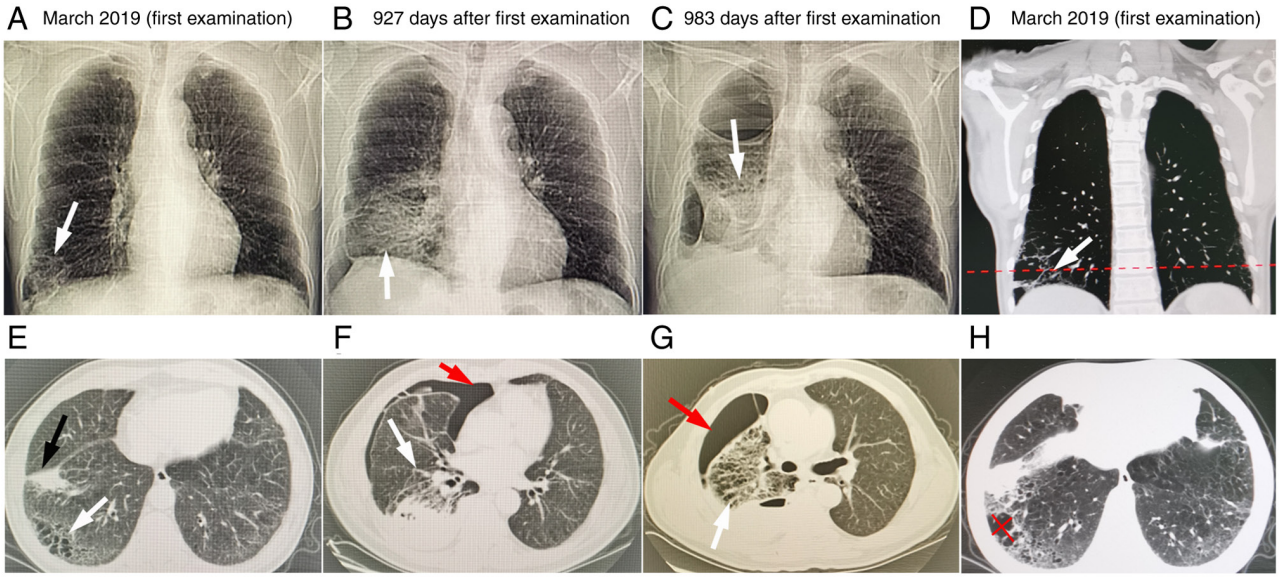

Figure 1. Chest HRCT (localization phase) of pulmonary cystic lesions (white arrow) in (A) March 2019, (B) October 2021 and (C) December 2021. (D) HRCT (coronal reconstruction) showing tumor angiogenesis (white arrow). (E) HRCT (transverse section) showing right lung mass lesion (black arrow) and cystic lesion (white arrow) in March 2019. HRCT (transverse section) showing cystic lesion (white arrow) and right pneumothorax (red arrow) in (F) October 2021 and (G) December 2021. (H) HRCT (transverse section) showing tumor angiogenesis, with a measured length of 40.1 mm and width of 24.9 mm (dimensions of the tumor as indicated by the red lines). HRCT, high-resolution computed tomography.

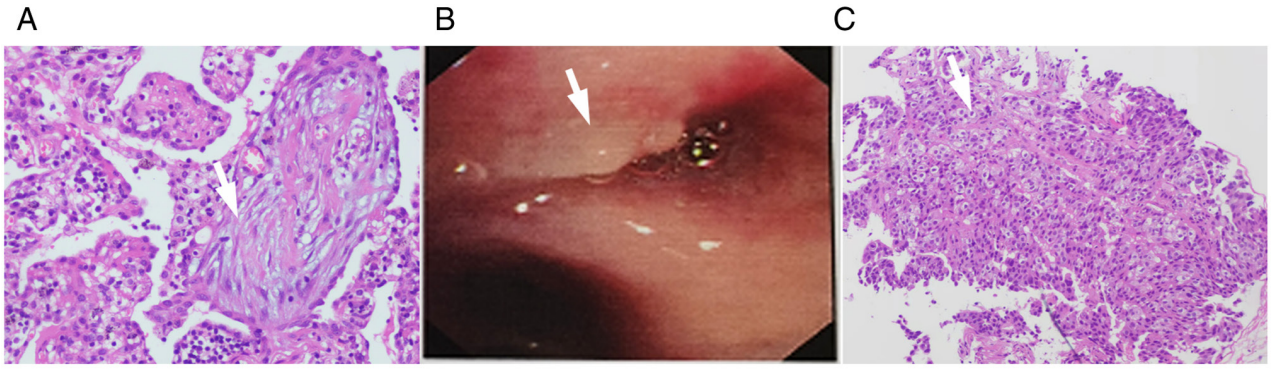

Figure 2. (A) Pathology of the right lower lung nodules (hematoxylin and eosin; magnification, x200), showing non-tissue fibrous hyperplasia accompanied by a large number of inflammatory cell infiltration and local microabscess formation (white arrow), consistent with the changes in organizing pneumonia. (B) Bronchoscopy (right lower dorsal segment) where a neoplasm can be seen in the lumen (white arrow). (C) Pathology in the dorsal bronchus of the right lower lung (hematoxylin and eosin; magnification, x200), which was consistent with squamous cell carcinoma (white arrow).

(from the dorsal opening of the right lower lobe) were fixed in 10% neutral formalin at room temperature for 12 h, and were stained with hematoxylin and eosin for 10 min at room temperature, before being visualized under an Olympus BX43 light microscope (Olympus Corporation). The right pleura pathology report revealed squamous cell carcinoma. Bronchoscopy revealed infiltration of new organisms in the dorsal opening of the right lower lobe, narrowing of the lumen and white foam-like secretions in a part of the lumen (Fig. 2B). The pathology revealed squamous cell carcinoma (Fig. 2C). For pathology analysis, the samples (wedge resection of the right lower lung lesion) were fixed in 10% neutral formalin at room temperature for 12 h, and 4-μm paraffin-embedded sections were stained with hematoxylin and eosin for 10 min at room temperature, and were observed under a light microscope (BX43; Olympus Corporation). Finally, the patient was diagnosed as having a right LC-CAS with pleural metastasis and right pulmonary fluid pneumothorax, and underwent resection for OP (right lower lung; pathological section diagnosis in April 2019). The findings were discussed with the patient's family, who then agreed to genetic testing. The PD-L1 (22C3) test was positive (tumor cells, >15%; Fig. S2) through immunohistochemical detection. The samples from the dorsal opening of the right lower lobe were fixed with 10% neutral formalin at 20-25˚C for 6 h, were embedded in paraffin at room temperature for 72 h, and then cut into 4-μm sections. Subsequently, antigen retrieval was performed in EDTA (pH 9.0) at 97˚C for 50 min, followed by blocking with 3% H_2O_2 at 20-25˚C for 5 min. The sections were then incubated with a monoclonal mouse anti-PD-L1 antibody (dilution 1:50; cat. no. SK006; Agilent Technologies, Inc.) at 4˚C for 175 min, and with a secondary antibody (dilution 1:20) conjugated to horseradish peroxidase at 4˚C for 40 min (cat. no. SK006; Agilent Technologies, Inc.). DAB staining was carried out for 5 min, and counterstaining

Table I. Key diagnostic characteristics of the patient.

Diagnostic characteristic	Description
Age, years	66
Sex	Male
Past medical history	No history of lung disease
Smoking history	Yes
CT imaging features	Chest HRCT (March 2019) showed LC-CAS with irregular shape, uneven wall thickness and nourishing blood vessels, and subsequent HRCTs (October 2021 and December 2021) revealed that the lesions gradually expanded and the cystic cavity became solid.
Tumor markers (CEA and CA-125)	Early elevation (April 2019)
Clinical presentation	There was no obvious discomfort in the early stage (March 2019). Late-stage clinical (October 2021 and December 2021) manifestations included chest and abdominal pain, cough, sputum with blood, and shortness of breath after activity.

CT, computed tomography; HRCT, high-resolution CT; LC-CAS, lung carcinoma with cystic air space; CEA, carcinoembryonic antigen; CA-125, carbohydrate antigen 125.

with hematoxylin was performed for 1 min (using the PD-L1 IHC 22C3 pharmDx detection kit; cat. no. SK006; Agilent Technologies, Inc.), and then observed under a light microscope (BX43; Olympus Corporation). Genetic tests of lung cancer (amplification refractory mutation system-PCR method) indicated PIK3CA gene mutation in paraffin-embedded tissue samples, and no mutations in other genes or loci were found. DNA was extracted from tissue samples using the column extraction method, with DNA polymerase and a Five Mutation Gene Detection Kit used according to the manufacturer's protocol (cat. no. CSX1800164; Amoy Diagnostics Co., Ltd.) used. The forward and reverse primers were included in the kit. The amplification procedure used was as follows: First stage (reverse transcription reaction, inactivation of reverse transcriptase), one cycle: 42˚C for 5 min and 95˚C for 5 min; second stage (specific amplification), 10 cycles: 95˚C for 25 sec, 64˚C for 20 sec and 72˚C for 20 sec; stage 3 (specific amplification, fluorescence acquisition), 36 cycles: 93˚C for 25 sec, 60˚C for 35 sec and 72˚C for 20 sec. The method of detection of the mutations was fluorescence PCR. As the symptoms of chest and abdominal pain were relieved, the patient was discharged in December 2021. After a telephone follow-up (January 2022), the general condition of the patient was poor, and despite not receiving immunosuppressive therapy, they were hospitalized in a local hospital for symptomatic treatment. The patient did not undergo CT follow-up or other tests, and died at home in June 2022. The key diagnostic characteristics of the patient are summarized in Table I.

Literature review

Literature search. A literature search using the retrieval terms 'lung cancer' OR 'lung cancer with cystic air space' AND 'organizing pneumonia' was performed using the PubMed (https://pubmed.ncbi.nlm.nih.gov/), EMBASE (https://www.embase.com), Web of Science (https://www.webofknowledge.com), and China Biomedical Literature Service System (https://www.sinomed.ac.cn), Wanfang Data (http://www.wanfangdata.com), China Journal Network full-text database (http://www.cnkie.net) and China HowNet databases (https://www.cnki.net) to identify the clinical, pathological and imaging features of LC-CAS based on studies before February 2022. The screening inclusion and exclusion criteria were as follows: i) Lung cancer confirmed by histopathological or cytological results; ii) reporting of CT imaging features of lung cancer at single or multiple time points; iii) LC-CAS identified on CT; and iv) co-occurrence with OP. Ultimately, only one study was identified (8), and along with the patient in the present case report, there are 2 patients in total. The clinical data of the 2 patients were analyzed.

General conditions and clinical manifestations. Both patients were elderly adult men (65 years old in the literature and 66 years old in the present case) with a history of heavy smoking. The early clinical manifestations of the case from the literature included dry cough and fever, and the later manifestations were chest pain and dyspnea. In the present case, the patient showed no obvious discomfort at the early stage, but later clinical manifestations included chest and abdominal pain, cough, expectoration, bloody sputum, and shortness of breath after activity.

Imaging features. Chest CT of the patient in the literature showed irregular consolidation around the right lower lobe with bronchial air sign, which was connected with the lower lung hilum. In the present case, early chest HRCT (March 2019, Fig. 1A, D, E and H) showed that the LC-CAS had an irregular shape, uneven wall thickness and feeding vessels, whereas later HRCT (October 2021, Fig. 1B and F; December 2021, Fig. 1C and G) showed gradual lesion enlargement and cystic cavity consolidation. The patient in the literature did not undergo PET-CT examination, whereas the patient in the present case underwent PET-CT examination, and the results showed that the ^{18}F-FDG value in OP in October, 2021 was increased compared with that in March, 2019.

Tumor markers. The patient in the literature did not undergo tumor marker tests. In the present case, early peripheral blood

CEA levels were already elevated, and the level of tumor markers (CEA, NSE, CyFRA21-1 and SCCA) in both the serum and pleural effusion gradually increased in the late stage.

Treatment and prognosis. The patient in the literature underwent bronchoscopy examination and was diagnosed with OP secondary to LC-CAS. They were in a generally good condition 6 months postoperatively. In the present case, OP was pathologically confirmed in the right lung tissue, and wedge resection was performed on the right lung. Bronchoscopy was performed 32 months postoperatively to monitor the tumor, and a biopsy was performed to confirm the diagnosis of LC-CAS. After a telephone follow-up (January 2022), the general condition of the patient was poor, and despite not receiving immunosuppressive therapy, they were hospitalized in a local hospital for symptomatic treatment.

Discussion

LC-CAS, a special type of lung cancer, is a relatively rare manifestation (16), while OP with LC-CAS is even rarer. At present, the pathogenesis of LC-CAS is still unclear (17), and the cystic components of LC-CAS may increase, stabilize or decrease over time (14). Obtaining cystic pathological tissues of LC-CAS is difficult due to a high risk for injury; therefore, it is challenging to diagnose this disease (18). The patient in the present case had no obvious discomfort in the early stage, but they developed major clinical symptoms, such as chest and abdominal pain, cough, expectoration, bloody sputum and shortness of breath after activity in the later stage. Cysts associated with LC-CAS are usually multilocular, polycystic or thick-walled, while thin-walled cysts are less common (17). The present report highlights the presence of uneven cyst walls and irregular, non-spherical edges, which are characteristics not documented in previous reports. Early HRCT of LC-CAS revealed an irregular shape, uneven wall thickness and feeding vessels that gradually expanded; gradual cystic cavity consolidation occurred later, and finally, pneumothorax occurred. The chest HRCT imaging features of LC-CAS, which showed gradual enlargement over time, are consistent with those reported in previous studies (14,17).

Based on the aforementioned reasons, dynamic evaluation and comprehensive judgment should be performed for patients with suspected LC-CAS based on chest HRCT combined with risk factors, tumor markers and other data (such as bronchoscopy). The chest HRCT data of the patient in the current case prior to OP resection in March 2019 showed the aforementioned abnormal changes in LC-CAS. Given the slightly elevated CEA levels and other lung cancer markers (CYFRA21-1, NSE and SCCA), as well as a history of heavy smoking, regular follow-up should include monitoring cystic lesions in the right lower lung through chest HRCT and cancer marker assessments. Because the doctor did not consider or inform the patient about the possibility of LC-CAS, neither the patient nor the doctor paid attention to the enlargement of the right lower lung cyst until November 2020, which ultimately delayed the best treatment opportunity.

It is generally considered that PET-CT can provide metabolic information on tumors. Furthermore, the ^{18}F-FDG value of lesions is closely related to different malignant degrees, including the change indices of SUV_{avg} and SUV_{max} (19,20). OP has a high PET-CT metabolism, which is consistent with the increased ^{18}F-FDG uptake during the early PET-CT examination of the patient in the present case (21). However, the thin air cavity wall and irregular shape of LC-CAS lesions reduce the total density of metabolic cells, resulting in no or poor uptake of ^{18}F-FDG, measurement difficulties and false-negative imaging results, which affect the judgment of radiologists (16,22-24). In the present case, the PET-CT examination performed during an earlier stage showed that LC-CAS had a low ^{18}F-FDG uptake value, which was also an important reason for the missed diagnosis of LC-CAS during the early stage.

A previous study (22) demonstrated that the check-valve mechanism of LC-CAS (the infiltration of tumor cells into the bronchiolar lumen leading to elastic retraction) is the cause of pneumothorax as a complication, particularly in cases of liquid pneumothorax that may persist despite active treatment. Further examination, including bronchoscopy, is required if the liquid is bloody. The liquid amount in the present case was moderate (lung compression, 30-70%). A pneumothorax complicated by LC-CAS was revealed in the later stage of the present case, and despite active treatment and drainage of bloody hydrothorax, achieving re-expansion of the lung was challenging, with drainage exceeding moderate levels. Furthermore, bronchoscopy revealed a neoplasm. The check valve was caused by the tumor in the patient's right lower lung, which may lead to the formation of refractory pneumothorax and bronchial obstruction during the early stage, resulting in OP.

In the present case, the confirmation of LC-CAS was delayed for 32 months, which warrants reconsideration. There are at least two factors that can justify the long-term missed diagnosis and misdiagnosis of LC-CAS by clinicians and radiologists. The first is the insufficient knowledge about LC-CAS. The chest HRCT in March 2019 showed a cystic structure (diameter, 4.0x2.5 cm) behind the right lower lung mass, with neovascular presence and multiple enlarged feeding vessels on the coronal plane <1 cm away from the pleura. The characteristic of the HRCT image is not consistent with the narrowing of pulmonary arterial vascular structures in the pulmonary bullae and non-vascular structures in lung cyst lesions. The cystic changes of lymphatic vessels, such as lymphocytic interstitial pneumonia, are usually in the periphery of the cystic cavity, while the cystic changes in this patient are also not characteristic of previously described cases. The aforementioned abnormal changes were neither mentioned in the radiology report nor was the LC-CAS in the right lower lung mentioned in the preoperative discussion and postoperative review by thoracic surgeons, indicating that there is limited knowledge of this type of imaging. Second, incomplete judgment existed in clinical and radiological diagnosis. A previous study (25) demonstrated that 80% of misdiagnoses stemmed from incomplete thinking and resulting thinking biases and that one-third of serious medical errors resulted from thinking biases. When assessing the imaging data, the radiologist potentially only found the first right lung-occupying lesion by 'pattern recognition' or 'sample recognition' in order to achieve a quick diagnosis. However, the relaxed vigilance to the aforementioned abnormal changes in the right lower lung reduced the accuracy of diagnosis. Despite the reported increase in peripheral blood CEA levels, the doctors did not

change the primary diagnosis or monitor changes in tumor markers and the cystic lesion in the right lower lobe of the patient. They also did not investigate other potential reasons for the elevated CEA levels. The patient visited the hospital only when LC-CAS complicated by pneumothorax had been present for 32 months postoperatively. Furthermore, the value of tumor markers, such as peripheral blood CEA levels, was markedly increased during the second admission of the patient to the Department of Thoracic Surgery, Daping Hospital. However, the possibility of cancer was still not fully considered. Clinicians and radiologists should pay close attention to the aforementioned misjudgments in order to improve clinical data evaluation during the initial diagnosis. This includes utilizing chest HRCT, monitoring CEA levels and other tumor markers, performing fiberoptic bronchoscopy, and integrating these findings closely with the medical history of the patient. Following the initial detection of abnormalities, clinicians should systematically review clinical data, images and reports to identify any potential counter-evidence. If the clinical manifestations or other evidence are inconclusive, a peer or superior doctor should be consulted, and if necessary, a second evaluation for potential lesions should be conducted to ensure a comprehensive differential diagnosis, thereby reducing the risk of missed diagnoses and misdiagnosis. The diagnosis of LC-CAS in the present case took 32 months from the initial detection on CT to confirmation, which warrants reflection. This prolonged interval was partly attributed to reviewing previous imaging studies rather than deliberate long-term imaging follow-up. Additionally, annual follow-up for a simple parenchymal cyst is not part of routine lung cancer screening (26). Therefore, cases of pulmonary cystic disease with wall thickening or nodules should raise suspicion of lung cancer, necessitating long-term follow-up to ensure stability and exclusion, thereby preventing misdiagnosis. After discharge, the patient did not undergo CT follow-up or other tests, and died at home in June 2022. Therefore, it is not possible to analyze and discuss the psychological and physiological effects on patients following misdiagnosis.

In conclusion, OP with LC-CAS is a rare clinical entity that is prone to missed and delayed diagnosis. Cultivating good clinical judgment skills and continuous learning are the keys to reducing misdiagnosis and inappropriate treatment.

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Availability of data and materials

The data generated in the present study may be requested from the corresponding author.

Authors' contributions

JF and HC wrote the original draft and were involved in analyzing patient data. FS and QM were involved in analyzing patient data. SZ wrote, reviewed and edited the manuscript, and was involved in analyzing patient data. WD designed the study and was involved in analyzing patient data. GC designed the study, wrote, reviewed and edited the manuscript, and supervised the work. JF and GC confirm the authenticity of all the raw data. All authors read and approved the final manuscript.

Ethics approval and consent to participate

Not applicable.

Patient consent for publication

Written informed consent for publication was obtained from the patient.

Competing interests

The authors declare that they have no competing interests.

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