Organizing Pneumonia Complicated by Cyst and Pneumothorax Formation

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Abstract

We present a case of organizing pneumonia complicated by pneumothorax in association with cyst formation that developed during corticosteroid treatment. Although it has been reported that the check-valve mechanism is a plausible cause of cyst and pneumothorax formation in patients with organizing pneumonia, the details of the corresponding pathological changes that occur in air-trapping have not been elucidated. A pathological examination of lung specimens obtained with video-assisted thoracoscopic surgery suggested that granulation tissues plugging the bronchiole lumens might be a potential cause of the check-valve mechanism in this case. In this report, we also reviewed eight other cases of organizing pneumonia with pneumothorax or cyst formation.

Key words: organizing pneumonia, cyst, pneumothorax, check-valve mechanism

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Introduction

Organizing pneumonia (OP) complicated by pneumothorax formation concomitantly with cyst formation is rare. Eight cases of OP complicated by cyst or pneumothorax formation have been previously reported; however, the causal mechanisms of the development of cyst and pneumothorax formation related to OP have not been clarified (1-8). Although air-trapping caused by the check-valve mechanism is thought to be a plausible mechanism of cyst and pneumothorax formation, the details of the corresponding pathological changes that occur in air-trapping have not been elucidated. We herein report a case of OP complicated by cyst and pneumothorax formation in which the pathological examination of lung specimens obtained with video-assisted thoracoscopic surgery (VATS) suggested that granulation tissues plugging the bronchiole lumens might be a potential cause of the check-valve mechanism. We also reviewed eight other reported cases of organizing pneumonia with pneumothorax or cyst formation.

Case Report

A 37-year-old Japanese man was referred from another hospital and was admitted to our hospital due to pneumonia that was refractory to conventional antibiotic treatment. Four weeks prior to admission, the patient presented with fever, a dry cough and respiratory distress. Chest X-rays performed at that time showed multiple areas of consolidation in the right lung field, and a diagnosis of pneumonia was thus suspected. The patient had been treated unsuccessfully with several antibiotics (clarithromycin at a dose of 400 mg/day for three days, then levofloxacin at a dose of 500 mg/day for three days followed by meropenem at a dose of 1 g/day for 14 days, garenoxacin at a dose of 400 mg/day for five days and minocycline at a dose of 200 mg/day for nine days). The patient also presented with arthralgia of multiple joints; however, he denied morning stiffness or Raynaud’s phenomenon. He had no medical history of allergies or previous medications and had smoked a half-pack of cigarettes daily for 15 years.

A physical examination revealed hypoxemia with an oxygen saturation of 95% (nasal O₂ at 1 L/min). Auscultation of...
the lungs revealed decreased respiratory sounds in the right lower lobe. The patient complained of joint pain in the left cubital joint, right shoulder joint and bilateral knee joints on exertion; however, no swelling or tenderness were demonstrated. The laboratory findings showed elevated levels of C-reactive protein (CRP) (9.75 mg/dL), a white blood cell count of 8,600/μL with 74% neutrophils, a rheumatoid factor level of 309.1 IU/mL and an anti-CCP antibody level of 1,070.0 U/mL. The pleural effusion was exudative with a white blood cell count of 8,100/μL (neutrophils: 74.8%, eosinophils: 1.5%), a rheumatoid factor level of 386.0 IU/mL, a glucose level of 46 mg/dL and low levels of complement. The results of bacteriological examinations for blood, urine and sputum were all negative.

Chest X-rays showed multiple areas of consolidation in the right lower and left middle lung fields and a right-sided pleural effusion (Fig. 1a). A computed tomography scan showed extensive dense infiltration on right S4, S8, S9 and S10 and consolidation with an air bronchogram accompanied by ground glass opacity in the bilateral lower lobes (Fig. 1b). Bronchoalveolar lavage fluid (BALF) obtained from the rt.Ba demonstrated an increased total cell count (3.28×10⁶ cells/mL) with a marked increase in the proportion of lymphocytes (66.2%) and a normal CD4/CD8 ratio of 1.52. These findings were compatible with a diagnosis of secondary OP suspected to be undifferentiated connective tissue disease, particularly rheumatoid arthritis.

Treatment with corticosteroid therapy (1 mg/kg/day, total of 55 mg/day) was started, after which the patient’s symptoms and X-ray findings gradually improved. However, on the 7th day of steroid therapy, a right-sided pneumothorax and small cysts (right S8) were found on chest X-ray and chest CT (Fig. 1c). Hence, a chest drainage tube was inserted on the same day. The air leak persisted for more than five days and a complicated hemothorax developed. Therefore, we considered the option of surgical resection to treat the refractory pneumothorax. Video-assisted thoracoscopic bullectomy was performed on the 15th day of steroid therapy. A thoracoscopic examination demonstrated that the air leak point was located near the cyst, which was confirmed by clamping the cyst. The pathological findings of the specimens obtained with VATS revealed a cystic lesion with lung tissue laceration and fresh bleeding (Fig. 2a), granulation tissue plugging the bronchiole lumens in close proximity to the cystic changes (Fig. 2b) and granulation tissue in the alveoli and alveolar ducts (Figs. 2c, 2d). The results of the pathological examination were compatible with a diagnosis of OP. Following the VATS, the prednisolone dose was...
Figure 2. Photomicrographs of the following specimens: (a) A cystic lesion with laceration of the lung tissue and fresh bleeding, Masson’s trichrome stain; (b) granulation tissue plugging in the lumen of bronchiole, Masson’s trichrome stain, ×100; (c) granulation tissue in the alveoli and alveolar duct, Hematoxylin and Eosin staining, ×100; and (d) granulation tissue in the alveoli and alveolar duct, Masson’s trichrome stain, ×100.

gradually tapered by 5 mg every two weeks. The patient’s symptoms and X-ray consolidation improved remarkably. He was free of relapse and exacerbation during the reduction of the corticosteroid treatment (Fig. 1d).

Discussion

We herein present a case of OP complicated by cystic lesions and a pneumothorax that developed after steroid treatment. Although there are a few cases of OP complicated by either cyst or pneumothorax formation, the concomitant complication of cyst and pneumothorax formation underlying OP has never been reported. The characteristic features of the eight previously published case reports and the present case are summarized in Table 1-8. These cases were classified on the basis of a pathological diagnosis of OP, its diagnostic method, the presence of cysts or a pneumothorax, suspected mechanisms and steroid use. This classification revealed interesting characteristics. First, the patients in all cases were men. Second, seven of nine patients were diagnosed with cryptogenic OP. However, we speculate that the present case include antecedent pulmonary involvement of rheumatoid arthritis. Although the present patient did not fulfill the classification criteria for rheumatoid arthritis, the articular symptoms, positivity for anti-CCP and rheumatoid factor and high rheumatoid factor level in the exudative pleural effusion observed in the case support that possibility. Third, only the present case was complicated by both cyst and pneumothorax formation. Moreover, some cases (1, 4, 6) were complicated by either cyst or pneumothorax formation after the initiation of corticosteroid therapy, whereas in the other cases (2, 7), the cysts disappeared after the initiation of corticosteroid therapy. Therefore, we surmise that corticosteroid therapy administration could be one risk factor for pneumothorax formation by making the tissue fragile, as with dissolving OP tissue. Pneumothorax formation might be associated in some ways with a delayed wound healing process caused by corticosteroid therapy. The exact mechanism underlying the development of both a cyst and a pneumothorax in our case remains uncertain. One plausible explanation might be the check-valve mechanism, in which obstruction of the bronchioles increases alveolar pressure during exhalation, resulting in initial overinflation, the formation of a cyst with pulmonary tissue laceration and, finally, rupture of the pleural tissue. Air from the ruptured alveolus continues to move through the mediastinal parietal pleura into the pleural space, leading to pneumothorax formation (9). Previous reports (2, 5, 7) have already discussed the role of the check-valve mechanism in the development of cysts and pneumothoraces due to OP. The authors concluded that the bronchiolar lesions of polypoid granulation observed in these cases had resolved in response
Table. Case Reports of Organizing Pneumonia with Pneumothorax or Cyst

<table>
<thead>
<tr>
<th>Lead author</th>
<th>Year</th>
<th>Age (yrs), sex</th>
<th>Diagnosis</th>
<th>Diagnosed by</th>
<th>Cyst</th>
<th>Pneumothorax</th>
<th>Mechanism</th>
<th>Steroid therapy (yrs, packs/day)</th>
<th>Smoking</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mukae H</td>
<td>1991</td>
<td>69, M</td>
<td>COP</td>
<td>Open lung biopsy</td>
<td>×</td>
<td>–</td>
<td>–</td>
<td>–</td>
<td>–</td>
</tr>
<tr>
<td>Kofteridis DP</td>
<td>1999</td>
<td>74, M</td>
<td>OP (L. pneumophila)</td>
<td>Open lung biopsy</td>
<td>×</td>
<td>–</td>
<td>–</td>
<td>× Exsmoker (unknown)</td>
<td></td>
</tr>
<tr>
<td>Oguri T</td>
<td>1999</td>
<td>75, M</td>
<td>COP</td>
<td>TBLB</td>
<td>×</td>
<td>–</td>
<td>–</td>
<td>–</td>
<td></td>
</tr>
<tr>
<td>Iwanaga T</td>
<td>2000</td>
<td>46, M</td>
<td>COP</td>
<td>Open lung biopsy</td>
<td>×</td>
<td>–</td>
<td>Check-valve mechanism, cough, strain</td>
<td>×</td>
<td></td>
</tr>
<tr>
<td>Lee PC</td>
<td>2005</td>
<td>41, M</td>
<td>COP</td>
<td>TBLB</td>
<td>×</td>
<td>–</td>
<td>–</td>
<td>Cough, strain (–)</td>
<td>×</td>
</tr>
<tr>
<td>Chakravorty I</td>
<td>2008</td>
<td>17, M</td>
<td>COP</td>
<td>Open lung biopsy</td>
<td>×</td>
<td>–</td>
<td>–</td>
<td>×</td>
<td></td>
</tr>
<tr>
<td>Nakayama T</td>
<td>1999</td>
<td>21, M</td>
<td>COP</td>
<td>TBLB</td>
<td>–</td>
<td>×</td>
<td>Check-valve mechanism (–)</td>
<td>×–</td>
<td></td>
</tr>
<tr>
<td>Inoue T</td>
<td>2006</td>
<td>66, M</td>
<td>COP</td>
<td>TBLB</td>
<td>–</td>
<td>×</td>
<td>Check-valve mechanism (–)</td>
<td>×</td>
<td></td>
</tr>
<tr>
<td>Present case</td>
<td>2011</td>
<td>37, M</td>
<td>OP (RA)</td>
<td>VATS</td>
<td>–</td>
<td>–</td>
<td>Check-valve mechanism (–)</td>
<td>Exsmoker (15,0.5)</td>
<td></td>
</tr>
</tbody>
</table>


We herein presented a case of OP complicated by the secondary development of pneumothorax and cyst formation. Notably, the presence of granulation tissue plugging the bronchiole lumens in close proximity to the cystic changes during the pathological examination supports the notion that the check-valve mechanism may be a leading cause of pneumothorax and cyst formation in patients with OP.

The authors state that they have no Conflict of Interest (COI).

References