Pneumomediastinum in Pulmonary Fibrosis*

Detection by Computed Tomography

Takuya Fujiwara, M.D.

Pneumomediastinum was found in 5 of 34 patients (14.7 percent) with pulmonary fibrosis on computed tomographic (CT) scan of the chest. Small collection of air was seen in the retrosternal space in two patients, preaortic space in one patient, pretracheal space in two, subcarinal space in three, at the hilum in one, and perivertebral space in three patients. Concomitant pneumothorax was noted in two patients, both on the left side. Patients showed either honeycombing on CT (four patients) or presented with violent cough (four patients). Pneumomediastinum seen in these patients was thought to be the result of rupture of alveoli or honeycomb cysts due to raised intrapulmonary pressure on coughing, and subsequent tracking of air along the vascular sheath and accumulation in the mediastinum.

(Poesth 1993; 104:44-46)

\[ PF = \text{pulmonary fibrosis}; \text{UIP} = \text{usual interstitial pneumonia} \]

Pneumothorax as a complication of acute idiopathic pulmonary fibrosis or Hamman-Rich syndrome was first described by Beyer and colleagues in 1961. McLoud and colleagues have reported 7.4 percent incidence among 95 cases of usual interstitial pneumonia (UIP). However, we could not find any radiologic report dealing with pneumomediastinum seen in patients with pulmonary fibrosis. We wish to describe computed tomographic (CT) findings of five patients and discuss its etiology.

**Materials and Methods**

We reviewed the CT scans and clinical records of 34 consecutive patients with interstitial pneumonitis or pulmonary fibrosis (PF). The patients ranged from 42 to 88 years of age (mean, 69 years old); there were 19 men and 15 women. Their diagnoses were UIP in 28 patients, PF associated with collagen disease in 4 (3 rheumatoid arthritis, 1 progressive systemic sclerosis), and so-called end-stage lung in 2. The latter two entities were included since they are usually indistinguishable from UIP either radiologically or pathologically. The diagnosis was substantiated by transbronchial lung biopsy specimens in 13 cases and by autopsy in 1 case. In the remaining 20 cases, the diagnosis was based on characteristic clinical, radiologic, and respiratory function test findings, i.e., exertional dyspnea of insidious onset, progressive loss of lung volume, and restrictive respiratory dysfunction. Computed tomographic scanning was performed on a scanner (TCT-900S, Toshiba Medical Co, Tokyo, Japan). Fifty-five CT scans were performed on 34 patients; examinations were repeated two to seven times as initial and follow-up study in nine patients. Contiguous 10-mm collimation scans or 2-mm collimation scans at 15-mm intervals were performed without contrast enhancement.

We have reviewed CT images of these patients and sought abnormal air collection outside the tracheobronchial tree or the esophagus in the mediastinum. All CT scans were reviewed on the hard copy with two window settings: one optimized for the mediastinal soft tissues and one for the lung parenchyma. If present, the amount and location of the air were recorded. A radiologist assessed CT visual score of pulmonary fibrosis using the method described by Staples and colleagues. The CT score represented the percentage of lung parenchyma that showed evidence of interstitial disease and was estimated to the nearest 10 percent of parenchymal involvement. Presence or absence of concomitant pneumothorax was also recorded. Clinical records of the patients were reviewed, with special attention to the degree of cough and dyspnea at the time of examination. The results of pulmonary function tests that were performed shortly before or after CT were also recorded. The differences of the CT visual score between the patients with and without pneumom mediastinum were assessed using Wilcoxon's test. Differences in the pulmonary function test results were compared by Student's t test.

**Results**

Clinical data of patients who showed pneumomediastinum are presented as Table 1. All patients presented with moderate to severe cough at the time of CT scan. Four patients died subsequently of respiratory failure one week to six months after CT. Pneumomediastinum was found in 5 of 34 patients (14.7 percent) with PF. This high incidence was in striking contrast to the overall incidence of pneumomediastinum seen in patients without fibrosis during the same period (4 of 436 cases or 0.92 percent). Although these data suggest higher prevalence of pneumomediastinum in PF than in the general pop-

<table>
<thead>
<tr>
<th>Case No./Sex</th>
<th>Age, yr</th>
<th>Diagnosis</th>
<th>Observation Period: Outcome</th>
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</thead>
<tbody>
<tr>
<td>1/79/F</td>
<td>69</td>
<td>PF</td>
<td>1 wk: died of pneumonia</td>
</tr>
<tr>
<td>2/77/F</td>
<td>77</td>
<td>PF</td>
<td>6 mo: alive and well</td>
</tr>
<tr>
<td>3/83/M</td>
<td>83</td>
<td>End-stage lung</td>
<td>2 mo: died of respiratory failure</td>
</tr>
<tr>
<td>4/74/F</td>
<td>74</td>
<td>UIP</td>
<td>6 mo: died of respiratory failure</td>
</tr>
<tr>
<td>5/80/F</td>
<td>80</td>
<td>PF</td>
<td>1 mo: died of pneumonia</td>
</tr>
</tbody>
</table>

*PF = clinically diagnosed as having pulmonary fibrosis; UIP = usual interstitial pneumonitis diagnosed by transbronchial lung biopsy specimen.

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ulation, direct comparison may not be appropriate since the mean age of patients with both pneumomediastinum and PF was quite high. Air was noted in the retrosternal space in two cases, preaortic space in one, pretracheal in two, subcarinal in two, at the hilum in one, and perivertebral (anterior or lateral to the vertebral body) in three cases (Table 2). In one case, air can be followed from the right hilum and along the right pulmonary artery as far as the pretracheal space (Fig 1). Two cases showed concomitant pneumothorax, both on the left side. Figure 2 shows a CT scan of a 74-year-old woman with histologically proved UIP.

The CT visual score of the patients with pneumomediastinum tended to be higher than that of patients without pneumomediastinum (mean: 56 percent and 35 percent, respectively); their difference was statistically significant (p<0.05). The mean percentage predicted for vital capacity (percent VC) of patients with pneumomediastinum was lower than that of patients without pneumomediastinum (65.2 percent and 76.4 percent), but it was not statistically significant. Other pulmonary function test results showed no significant differences either.

DISCUSSION

Since exhaustive review of the subject by Macklin and Macklin,9 many articles have appeared reporting the causes of pneumomediastinum.10-14 The association between pneumomediastinum and PF has sometimes been mentioned in the discussion of several articles;3,9,10,15 however, to our knowledge, there seems to be no report that paid special attention to this association or showed actual images. This lack of attention seems rather peculiar when one overviews the frequent association between diseases characterized by interstitial fibrosis, such as silicosis, radiation pneumonitis, or sarcoidosis and pneumomediastinum.9,10,15-17 A small amount of mediastinal air as seen in our patients was difficult to detect by chest radiography, concealed by overlying disease process of the lungs. Computed tomography, with its superior con-

Table 2—Location of Mediastinal Air

<table>
<thead>
<tr>
<th>Case No.</th>
<th>Anterior Mediastinum</th>
<th>Middle Mediastinum</th>
<th>Posterior Mediastinum, Perivertebral</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Retrosternal</td>
<td>Preaortic</td>
<td>Pretracheal</td>
</tr>
<tr>
<td>1</td>
<td>+</td>
<td></td>
<td></td>
</tr>
<tr>
<td>2</td>
<td>+</td>
<td></td>
<td></td>
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<tr>
<td>3</td>
<td>+</td>
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<tr>
<td>4</td>
<td>+</td>
<td></td>
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<tr>
<td>5</td>
<td>+</td>
<td></td>
<td></td>
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</tbody>
</table>

FIGURE 1. A 79-year-old woman with idiopathic pulmonary fibrosis; (a, upper), CT scan at the level of the tracheal carina shows irregular-shaped collection of air (arrow) in the pretracheal space. Small air bubbles (arrows) can be traced along the posterior border of the right pulmonary artery (b, lower) as far as the right hilum.

FIGURE 2. A 74-year-old woman with histologically proven usual interstitial pneumonitis (UIP). CT scan through the lower chest shows several air bubbles in the retrosternal space (arrows). Fibrosis and traction bronchiectasis of the lower lobes are evident.
trast resolution and capability of axial image display, is ideally suited for the detection of small pneumomediastinum. As Macklin and Macklin⁷ have stated, alveolar rupture and subsequent air leak into the perivascular interstitium eventually leads to pneumomediastinum under various conditions. Our case 1 showed the presence of air both at the right hilum and the middle mediastinum in contiguous slices. This contiguity of hilar and mediastinal emphysema strongly suggests the above-mentioned mechanism. In four of five patients, the presence of subpleural honeycomb cyst was evident on CT. The remaining patient did not show honeycombing on CT, but the patient had suffered from violent cough, which is a common symptom of the disease,⁶ and this may have facilitated alveolar rupture by raising the intrapulmonary pressure.⁹,¹⁰ In fact, four of the five patients presented with severe cough and dyspnea at the time of CT scan, and this severity is thought to be reflected in the high CT score of these patients.⁷ Patchy distribution of fibrotic process³,⁴,¹⁰ may also play a role, producing focal emphysema and overdistention. Our patients showed fairly even distribution of air in three mediastinal compartments; three cases each for the anterior, middle, and posterior mediastinum.

In conclusion, rupture of the alveoli or honeycomb cysts and subsequent air leakage into the surrounding interstitium could be regarded as the cause of pneumomediastinum in patients with PF. Honeycombing and violent cough were considered to be predisposing factors to the rupture.

REFERENCES
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10. Evans JA, Smalldon TR. Mediastinal emphysema. AJR 1950; 64:375-90