Unilateral Non-Functioning Lung

B. SLUTZKER, M.D.,* W. R. SHAW, M.D.** AND J. TOMASHEFSKI, M.D. F.C.C.P.†

Dayton, Ohio  Columbus, Ohio

In July, 1959, Margolin, Rosenberg, Felson, and Baum† reported four cases of a new entity which they called “idiopathic unilateral hyperlucent lung.” These cases had radiologic evidence of unilateral emphysema, a radiologically distinctive type of bronchiectasis with normal large bronchi and abnormal smaller bronchi, and a microscopically decreased vascular pattern in the affected areas. In September of the same year, Katz and Wagner‡ reported a similar case which they called “unilateral pulmonary ‘emphysema.’” More recently, Francis§ recorded an additional case, the first in a woman. The case reported in detail here is the second in the original series of four reported by Margolin et al. In view of the physiologic and histologic abnormalities, it is likely that this represents a clinical, as well as a radiologic entity.

CASE REPORT

D.P., a 28-year-old white machinist, was admitted to the Dayton Veterans Hospital on July 26, 1957, with a nine-year history of chronic cough, a one-year history of change from whitish to brownish sputum, a sensation of tightness in the chest, and inability to breathe deeply. There had been a single episode of left chest pain four months prior to admission, and three separate occasions of expectoration of small blood clots, all within the three months preceding admission. He had had pertussis in childhood and at the age of eight years had aspirated and immediately expectorated a carpet tack without known complications. There was a history of sinus trouble of ten years’ duration and a single bout of pneumonia in 1951. He had had a fractured skull, age 12, a right herniorrhaphy in 1947, and pilonidal cyst excision in 1952.

‡Formerly Chief, Medical Chest Section, Veterans Administration Hospital (Dayton), and Clinical Assistant Professor of Medicine, Ohio State University.

§Formerly Chief, Thoracic Surgical Section, Veterans Administration Hospital (Dayton); Presently at Wausau, Wisconsin.

†Chief of Research, Ohio Tuberculosis Hospital and Assistant Professor of Medicine, Ohio State University.

Physical Examination. Respiratory excursions were equal bilaterally and, though the percussion note over both lung fields was slightly hyperresonant, there was no localized change in sound. A very slight decrease in breath sounds and scattered expiratory wheezes was heard in the area of the lower lobe of the right lung; the latter changed and disappeared on cough. An occasional crepitant rale was heard over the right posterior mid-lung field which also cleared on coughing. Except for the presence of the surgical scar from the old herniorrhaphy the rest of the physical examination was completely unremarkable. He was afebrile and appeared in good health.

Extensive laboratory studies including tests for fungi and tuberculosis were negative, as well as a G.I. series and bronchoscopy.

Routine inspiratory PA chest x-ray film (Fig. 1) showed increased radiolucency in the lower half of the right lung field. The expiratory PA chest film (Fig. 1) showed shift of the mediastinal structures to the left, the entire left lung field and upper half of the right lung field becoming normally cloudy, but the lower half of the right lung field remaining radiolucent and apparently noncompressible. Bronchography showed the right middle and lower lung bronchi to fill and have normal distribution, but to have irregular fusiform dilatation with some cystic changes at the termination of the bronchi in many areas. Non-filling areas, cysts, or bullae were not seen. There was no area of obstruction. There was practically no alveolar filling in the areas of bronchial abnormality and the bronchi in the upper right and entire left lung field appeared normal.

Pulmonary ventilatory studies showed a significantly decreased vital capacity, but the timed vital capacity (3-second) showed no obstruction. The maximum breathing capacity was reduced to the same degree as the vital capacity. Walking ventilation was essentially normal. These results were interpreted as representing restrictive interference with ventilation. Arterial gas studies showed normal CO₂ content and resting oxygen saturation. However, the oxygen saturation did not increase on oxygen breathing, and dropped slightly on exercise, suggesting physiologic shunting. Differential bronchospirometry (Table 1) was done before and after surgical removal of the right lower lobe. Prior to surgery there was...
UNILATERAL NON-FUNCTIONING LUNG

BRONCHOSPIROMETRIC DATA

<table>
<thead>
<tr>
<th>CARLEN'S CATHETER</th>
<th>RIGHT</th>
<th>LEFT</th>
<th>TOTAL</th>
</tr>
</thead>
<tbody>
<tr>
<td>8-7</td>
<td>9-25</td>
<td>8-7</td>
<td>9-25</td>
</tr>
<tr>
<td>RATE/MIN.</td>
<td>17</td>
<td>13</td>
<td>17</td>
</tr>
<tr>
<td>TIDAL AIR (C.C.)</td>
<td>250</td>
<td>125</td>
<td>300</td>
</tr>
<tr>
<td>M.V. (C.C.)</td>
<td>4250</td>
<td>1825</td>
<td>5000</td>
</tr>
<tr>
<td>O2 C.C./MIN.</td>
<td>67</td>
<td>67</td>
<td>200</td>
</tr>
<tr>
<td>% O2 CONSUMPTION</td>
<td>24</td>
<td>27</td>
<td>76</td>
</tr>
<tr>
<td>O2 UPTAKE CC/L</td>
<td>15.8</td>
<td>41</td>
<td>39</td>
</tr>
<tr>
<td>V.C. (C.C.)</td>
<td>1400</td>
<td>450</td>
<td>1900</td>
</tr>
<tr>
<td>% V.C. (C.C.)</td>
<td>43</td>
<td>23</td>
<td>57</td>
</tr>
<tr>
<td>% VENTILATION</td>
<td>45</td>
<td>30</td>
<td>55</td>
</tr>
</tbody>
</table>

**Table 1:** Bronchspirometric data showing marked decrease in oxygen uptake on the right side despite normal ventilation prior to surgery with increase in the oxygen uptake by the right side following removal of the right lower lung (see text).

essentially normal ventilation of the right side, but this normally ventilating right side was responsible for only 24 per cent of the total oxygen consumption while participating in 43 per cent of the total ventilation. Twenty-six days after lobectomy, this was repeated and, although the right lung now participated in only 23 per cent of the ventilation, oxygen consumption had increased to 27 per cent, indicating that the remaining lung tissue on that side was functioning more efficiently than when it had been embarrassed by the presence of the noncollapsing right lower lobe. This suggested that the right lower lobe itself had been participating little, if at all, in oxygen consumption. Attempts at retrograde aortography and angiography were technically unsatisfactory.

Thoracotomy was performed, and pleural adhesions were found over the right hemithorax, most marked at the lower portions and, although the right lower lobe felt crepitant, no bullae, cysts, or blebs were found. The vasculature of

**Figure 1:** Inspiration and expiration PA chest films showing radiologically emphysematous right lower lung field with shift of the mediastinum to the left and continued radiolucency in the right lower lung field on expiration.
the right lung was grossly normal in both the pulmonary artery and its branches and there was no anomalous vessel or pulmonary circulation (i.e., from aorta). Slight crepitation was also felt in the middle lobe. Gross and cut sections of the lung appeared normal.

Microscopic examination of the tissue (Fig. 2A and B) suggested some decrease in the total number of bronchi of the third and fourth order. The walls of the bronchioles were thickened with excessive smooth muscle and there were areas of calcification of the bronchiolar cartilages. The associated blood vessels, whose lumens were somewhat large in comparison with the size of the bronchus, also had increased muscular tissue in walls which were thicker than normally found in pulmonary tissue. Alveolar ducts and respiratory bronchioles were decreased in number and there was hyalinization of the basement membranes of the bronchioles. Microscopic areas of emphysema were present. These slides were reviewed by several pathologists and the predominant opinion was that this represented a malformation of the lung (probably congenital) in which all the normal components were present, but with somewhat peculiar distribution.

He was last seen one year following surgery at which time he was without complaints. There had been no recurrence of cough or hemoptysis, and the only abnormal physical finding was somewhat distant breath sounds in the right lower lung field compatible with the fibrous reaction expected following thoracotomy.

**FIGURE 2A**

**FIGURE 2B**

**FIGURE 2:** Photomicrographs of resected specimen showing hypertrophy of the muscular walls of the arterioles and bronchioles (left [A]) and minor emphysematous changes in the alveoli (right [B]). There was also calcification of the bronchiolar cartilages seen in many sections.

**DISCUSSION**

This young man presented somewhat nondescript complaints. When the inspiratory and expiratory chest films were seen, the symptoms were attributed to a localized area of emphysema with attendant interference with the normal physiology of respiration. After the arterial gas studies were done and a probable physiologic shunt found and, later, when the bronchospirometric studies showed lack of normal oxygen uptake on the affected side, it was decided to explore the patient. The abnormalities seen on bronchography were the same as those described by Margolin et al. The lungs appeared grossly normal, but microscopic sections showing ossification of some of the bronchiolar cartilages and increased smooth muscle in both the bronchioles and the arterioles, as well as localized emphysema, were not characteristic of the ordinarily recognized histopathologic entities. The marked improvement of the patient and his sustained improvement over a one-year period suggests that there had been physiologic shunting as well as the interference with normal ventilation and
oxygen exchange as discussed above. The roentgen findings as described by Margolin, et al., as well as the rest of the clinical picture, seemed to make this fit the descriptive term of "unilateral nonfunctioning lung" and this has since been referred to in the radiologic literature as "idiopathic unilateral hyperlucent lung" and "unilateral pulmonary emphysema." Although it is possible that the abnormalities in this case were residual effects of remote pneumonia or transient foreign body aspiration, it is far more likely that they were of congenital origin.

ACKNOWLEDGMENT: Our thanks to P. C. Pratt, M.D.; B. Felson, M.D.; and E. A. Gall, M.D. for their kind assistance.

REFERENCES

PATCH GRAFTS FOR SACCIFORM AORTIC ANEURYSMS

Simple excision of sacciform aneurysms distal to the occluding clamp and closure of the aortic opening by suture, as employed in lesions involving a small part of the aortic circumference and attached by a narrow neck, is not applicable to aneurysms with relatively large necks whose sacs roll over to incorporate much of the aortic wall. It is difficult, if not impossible, to apply an occluding clamp across the base of such aneurysms without causing severe constriction or complete occlusion of the aortic lumen. Moreover, repair of these aneurysms may cause severe encroachment on the normal aortic lumen. Therefore, complete excision of the involved aortic segment with graft replacement may be necessary, a procedure of considerable magnitude. It has proved possible to eradicate such lesions by a much simpler procedure, consisting of excision of the aneurysmal sac and closure of the aortic opening with a patch graft. This has the advantage of being relatively simple, as evidenced by the great reduction in the amount of blood lost and in the duration of the operation in the five cases herein reported.


CLINICOVENTGENOLOGIC FEATURES OF EMBOLIC PULMONARY INFARCTS

Thrombophlebitis of peripheral veins is the most frequent cause of pulmonary embolism and infarcts. The peculiarity of clinicoroentgenologic manifestations of embolic infarcts to a considerable extent is due to the state of the cardiovascular system and the patient's age. Embolic infarcts occurring against the background of insufficiency of the cardiovascular system run a course with clinical and roentgenologic signs characteristic for cardiogenic pulmonary infarcts. In young persons, in the absence of marked circulatory disturbances prior to the formation of embolism, the clinicoroentgenologic manifestations of the infarcts are analogous with those seen in septic embolic abscesses of the lungs. Embolic infarcts, occurring against the background of age peculiarities of the cardiovascular system, by their clinicoroentgenologic manifestations resemble cardiogenic infarcts; however, they run a benign course and the patient recovers within a shorter period of time.