Electrocardiographic Studies in Pulmonary Disease

II. Establishment of Criteria for the Electrocardiographic Inference of Diffuse Lung Disease

By David H. Spodick, M.D.

Criteria based on changes in P waves are proposed for the electrocardiographic detection of diffuse lung disease. In a "blind" evaluation of 100 consecutively admitted patients these proved highly accurate.

The results of analysis of the electrocardiographic records in part I of these studies suggested that it might be possible to infer the presence of diffuse lung disease from the electrocardiogram alone with considerable accuracy. It is apparent that the significance and applicability of such a procedure would be enhanced if a minimum of criteria were necessary. Accordingly, a deliberately simple basis was adopted: the axis of the frontal plane P waves.

The following criteria were chosen for a positive or possible inference of pulmonary disease; all tracings lacking any of these were considered to be negative for this inference.

Positive Diagnosis ("Consistent with Diffuse Lung Disease")

Any of the following were considered diagnostic, regardless of other abnormalities on the tracings: 1. Presence of P pulmonar or unmistakable "Gothic" P in II, III, and AVF. 2. Frontal $\alpha$P = +70° or more and $-P$ waves to V2 or beyond, or, precordial S wave of 2 mm. or more to V6 (or both). 3. Frontal $\alpha$P = +60° and all 3 of the following: vertical or "axis illusion" $\alpha$QRS, precordial S wave of 2 mm. or more to V6, and prominent $+P$ waves to or beyond V2.

Possible Diagnosis

Any of the following were considered suggestive, but not conclusive evidence of pulmonary disease. 1. Frontal $\alpha$P = +60° and any 2 of the following: vertical or "axis illusion" $\alpha$QRS, precordial S wave of 2 mm. or more to V6, and prominent $+P$ waves to or beyond V2.

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Table 1.—Electrocardiographic Analysis for Evidence of Diffuse Lung Disease in 100 Consecutive Adult Patients

<table>
<thead>
<tr>
<th>Electrocardiographic Interpretation</th>
<th>Total Patients</th>
<th>Correct</th>
<th>Incorrect</th>
<th>Per cent correct</th>
</tr>
</thead>
<tbody>
<tr>
<td>Consistent with diffuse lung disease</td>
<td>14</td>
<td>13</td>
<td>1</td>
<td>93</td>
</tr>
<tr>
<td>Possibly consistent with diffuse lung disease</td>
<td>10</td>
<td>6</td>
<td>4</td>
<td>60</td>
</tr>
<tr>
<td>No evidence of diffuse lung disease</td>
<td>76</td>
<td>73</td>
<td>3</td>
<td>96</td>
</tr>
<tr>
<td>Totals</td>
<td>100</td>
<td>92</td>
<td>8</td>
<td></td>
</tr>
</tbody>
</table>
nite diagnosis or exclusion of lung disease. The over-all error for the criteria per se was only 8 per cent (8 of 100 incorrect). However, this appears somewhat optimistic when the influence of the 10 cases in the "possible" group is taken into account.

If only the positively diagnostic criteria were employed, the cases in the "possible" group would have to be shifted to the "negative" group. Under these conditions 77 of a total of 86 cases without diffuse lung lesions (90 per cent) would have been correctly excluded. However, 6 patients of a total of 22 with diffuse lung disease would have been missed. If, conversely, the "possible" cases were induced with the "positive" group (which is more logical), 19 of 22 cases with diffuse lung disease would have been correctly identified—a positive accuracy of 86 per cent; only 5 patients of 78 without lung disease (6 per cent) would have been falsely labeled.

**Analysis of Errors**

Some light may be cast on the validity of these criteria by an analysis of those cases which were misinterpreted (table 2).

From these data, the following facts are especially noteworthy: 1. Two of the 3 "false negatives" had hypertensive disease and the third had a mediastinal shift. 2. One (no. 7) of the 4 cases which did not have diffuse lung disease, but were considered "possible," had bilateral pleural effusion and another (no. 6) had upward displacement of the right diaphragm by an aberrant loop of colon. 3. Six of the 8 cases had $\overrightarrow{AP} = +60^\circ$, again emphasizing the conclusion drawn in part I of these studies—this P axis, in itself, is a "borderline" finding.

**Summary**

The following statements may be made with regard to the criteria described for the electrocardiographic inference of diffuse lung disease: 1. Frontal P wave axis and configuration are effective bases for this interpretation. 2. The criteria described appear to be highly accurate in positively identifying (93 per cent) or excluding (96 per cent) cases of diffuse lung disease with the exception of a small "possible" group (10 per cent of patients in this series) in whom the accuracy was only 60 per cent. Nevertheless, if the "possible" group is included with the "positive" group, fully 86 per cent of cases were correctly diagnosed and only 6 per cent of cases without lung lesions were falsely labeled. 3. Some of the errors of diagnosis were associated with the presence of other diseases and mechanical abnormalities of the chest. (This matched the findings in the atypical cases in part I of these studies.) 4. It is proposed that the criteria employed in this study are adequate for a new standard electrocardiographic interpretation: "consistent with diffuse lung disease."
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