Ultrasonic Examination of Pleural Thickenings and Calcifications in Occupational Asbestosis

M. Viikari, M.D., J. Jääskeläinen, M.D. and E. Tähti, M.D.

The roentgenologic diagnosis of occupational asbestosis is based upon typical pulmonary fibrosis and anteriorly detected pleural calcifications, which appear much later than parenchymal changes. Therefore, a definite diagnosis usually demands a long observation period. We used ultrasonic A- and B-mode methods to examine pleural changes in nine occupational asbestosis patients and five normal persons. In normal persons the parietal pleura was shown as a thin, sharp line when the B-mode method of examination was used. Roentgenographically observed calcifications were easily detected and distinguished from the normal pleura by this examination. It is noteworthy that similar echo peaks were seen in A-mode examinations in lateral and posterior pleura, where roentgenograms did not reveal pleural calcifications, and their size could be traced well with the B-mode examination. Thus it is possible to find early pleural changes, which, in our opinion, are connected with occupational asbestosis. Diagnosis could be made earlier without a long observation time.

Pleural thickenings and calcifications can be caused either by pulmonary and pleural diseases or by hemothorax. In occupational asbestosis, pulmonary fibrosis and pleural calcifications are determined radiologically, but the latter have been studied very little. According to the literature, results of investigations of the two are not similar. Jacob and Bohlig were the first to consider that pleural calcifications were sometimes caused by asbestosis. Then in 1960, Kiviluoto created a new concept, that of nonoccupational endemic asbestosis, paying attention to the high incidence of cases with pleural calcification without an adequate history of pulmonary or pleural disease or injury. In addition in 1965, Kiviluoto found similar calcifications in 77 patients. Hurwitz stated that calcified pleural plaques are typical in mild cases of asbestosis and that they are more frequent in asbestosis than roentgenologically discernible fibrotic changes of the lungs. Caravaglia found calcifications in 21.5 per cent of the occupational asbestosis patients he examined radiographically. Meurman stated that a discrepancy existed between the roentgenographic and autopsy findings of pleural calcifications in his study concerning asbestosis bodies and pleural plaques. Calcified plaques, especially those situated in the posterior parietal pleura, were seldom observed in roentgenograms. He also pointed out that dust and asbestos bodies do not seem to be the sole cause of plaque formation.

In asbestosis patients, pleural calcifications are situated radiologically always toward the anterior section of the body and occur only after a long exposure to asbestos. However, the quality and quantity of pulmonary fibrosis differ very much even in early cases and are by no means always proportional to the length of exposure. Thus, a definite diagnosis of asbestosis often demands a long observation period. However, if it were possible to observe earlier, by other means, pleural changes or thickenings before they become calcified, the diagnosis of occupational asbestosis could be made in many cases without delay.

In this investigation we, therefore, have examined occupational asbestosis patients with ultrasound to resolve: (a) if it is possible to recognize the parietal pleura when using this investigation method, (b) if it is possible to distinguish pleural calcification plaques that have already been found with roentgenographic techniques, and (c) if it is possible to find pleural calcification plaques and thickenings in areas where they are not visible roentgenographically.

*From the Radiodiagnostic Department, Meilahti Hospital, University Central Hospital and Institute of Occupational Health, Helsinki, Finland.
Table 1.—Results of Roentgenographic and Ultrasonic Examinations of Nine Asbestosis Patients

<table>
<thead>
<tr>
<th>Case No.</th>
<th>Sex</th>
<th>Age, Yr.</th>
<th>Exposure to Asbestos Dust, Yr.</th>
<th>Roentgenographically Detected Diagnosis</th>
<th>Fibrosis Only</th>
<th>Ultrasonically Detected Pleural Thickenings</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>M</td>
<td>55</td>
<td>35</td>
<td>Asbestosis</td>
<td>+</td>
<td>+</td>
</tr>
<tr>
<td>2</td>
<td>M</td>
<td>61</td>
<td>31</td>
<td>Asbestosis</td>
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<td>+</td>
</tr>
<tr>
<td>3</td>
<td>M</td>
<td>48</td>
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<td>Asbestosis</td>
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<td>+</td>
</tr>
<tr>
<td>4</td>
<td>F</td>
<td>67</td>
<td>16</td>
<td>Asbestosis</td>
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<td>+</td>
</tr>
<tr>
<td>5</td>
<td>F</td>
<td>49</td>
<td>16</td>
<td>Susp. asbestosis</td>
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<td>+</td>
</tr>
<tr>
<td>6</td>
<td>F</td>
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<td>Asbestosis</td>
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<td>+</td>
</tr>
<tr>
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<td>F</td>
<td>54</td>
<td>11</td>
<td>Susp. asbestosis</td>
<td>-</td>
<td>-</td>
</tr>
</tbody>
</table>

METHODS AND SUBJECTS

The examinations were made with an ultrasound laminograph (Picker Model MDU - 061 BU Portascan) which operates with a 2 megacycles/second frequency. Both A- and B-mode examinations were used.

The subjects were nine asbestosis patients. In addition, five normal persons of the same age range were examined.

The chest wall was examined with a movable probe which was connected to the angle computer of the instrument. The back, the front, and both sides were examined. When ultrasonic echoes referring to pleural changes were recognized, a model picture was drawn of the area in question. Thus, the pleural changes were registered with the help of ultrasonic examinations of the complete chest area, the upper limit being the topmost ribs. With this instrument, it was even possible to examine the posterior part of the right diaphragm as far as the middle of it. The interesting and diagnostically significant areas were photographed from the memory tube of an oscilloscope with a Polaroid camera.

![Figure 1. Case 6, woman, age 48; 22 years exposure to asbestos dust. A) (above) Posteroanterior view, bilateral calcifications. B) (right) Lateral view shows calcifications anteriorly.](http://journal.publications.chestnet.org/pdfaccess.ashx?url=/data/journals/chest/21460/ on 04/04/2017)
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RESULTS

The changes that had been determined through roentgenography in all of the asbestosis patients and the pleural calcifications recognizable in the roentgenograms are shown in Table 1, columns 6 through 8. The pleural calcifications were all in the anterior area or located laterally very near the anterior area or in the diaphragm (Fig 1A and B, Case 6).

In the normal persons, the parietal pleura was shown as a thin, sharp line when using the B-mode examination (Fig 2). In all places where pleural calcification could be recognized in the roentgenograms, high echo peaks were seen in the A-mode examinations (Fig 3, Case 5). In the B-mode examinations, a dense echo of equal size was seen in areal calcifications (Fig 4 and 5, Case 6). This was distinct from the echo originating in the pleura elsewhere, which was considered normal. The ultrasonic examination, however, produced loud echoes in the posterior area and elsewhere, and these echoes referred to pleural thickenings in seven patients (Table 1, column 9) and differed clearly from the echo caused by the normal pleura.

It is noteworthy that in Case 5, in whom roentgenograms showed only fibrosis, ultrasound revealed echoes suggesting pleural thickenings.

DISCUSSION

With ultrasonic examinations, different parts of tissues can be recognized according to the changes of acoustic impedance. Pleural thickening and calcification are on the surface of normal parietal pleura and are distinctly confined by the surrounding healthy pleura (Meurman). A clear border is recognizable on both sides of the plaque. According to Meurman’s observations, the thickness of the plaques varies from 0.2 to 7 mm, the average being 2 mm. In A-mode investigations, these plaques appear as sharp peaks, and the width of the display reveals their thickness. With B-mode examinations, the location of the plaques can be mapped exactly by using the memory tube of the oscilloscope, and when needed, the observations of the different parts of the thorax can be marked graphically. It should be noted that the sensitivity of the ultrasonic apparatus must be controlled for different patients because the thickness of the thoracic cage and of

FIGURE 2. Man, age 47; no occupational exposure to asbestos dust. Posterolateral projection. Pleura is seen as a thin, sharp line in B-mode examination.

FIGURE 3. Case 5, woman, age 49. In the A-mode examination, a high echo peak is observed posteriorly, suggesting pleural thickening.

FIGURE 4. Case 6, woman, age 48 (same case as Fig 1). The B-mode examination indicates dense echo drawn posteriorly.
the fat tissue under the skin varies. In the rib area, the sound is greatly absorbed, and the part of the pleura located under it is not properly defined in the B-picture. Because of this, the compensation level of the apparatus must be turned to optimal so that the parietal pleura can be seen as distinctly as possible and even the smallest changes in it can be observed. Therefore, skill and experience are needed to make ultrasonic examinations and interpretations.

CONCLUSION

Only A-mode lung ultrasonic examinations have been used for the investigation of fibrosis in asbestosis and silicosis patients (Tronzano et al.,7 and Rolfo and Baima-Ballone,8) In the present study, both A- and B-mode ultrasonic examinations were used for the first time to detect the parietal pleura, pleural thickening, and pleural calcifications. According to our pilot studies, pleural thickening and calcifications are discernible from the normal pleura. Changes in the ultrasonic examinations are distinct for the pleural calcifications. Ultrasound offers the possibility of defining pleural thickening in the posterior area and elsewhere, where they are not recognizable by roentgenographic techniques. Thus ultrasonic examinations complement the roentgenographic ones in cases of occupational asbestosis by distinguishing pleural changes and by making, in our opinion, an early diagnosis possible in many cases. To confirm the value of these observations, we are continuing our work.

REFERENCES


Reprint requests: Dr. Viikeri, Institute of Occupational Health, Haartmanink 1, Helsinki, Finland