Absence of Left-Sided Predominance in Asbestos-Related Pleural Plaques*

A CT Study

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Study objectives: Differences between the number and areas of pleural plaques in every hemithorax could not be expected a priori. However, previous studies based on chest radiographs reported an unexplained left-sided predominance. In this paper, a comparison of summed surfaces and location of plaques calculated from CT studies was performed.

Patients and methods: Thoracic CT scans from 40 adults with asbestos exposure and pleural plaques were analyzed. The surface area of every plaque was calculated, and summed areas were recorded separately for every hemithorax. The statistical analysis was performed with t-tests for paired samples. Emphasis was placed on measurement differences.

Measurements and results: The results show lack of significant predominance for any hemithorax. A total of 668 plaques (352 right and 316 left) were measured, with an average area (±SD) of 47.81±47.72 cm² for the right plaques and 45.34±67.32 cm² for the left. The mean of differences (left minus right areas) was −2.56±53.68 and slightly statistically different from zero (p=0.652).

Conclusions: Left-sided predominance of asbestos-related pleural plaques is not supported by this study.

(CHEST 1998; 113:1034-36)

Key words: asbestosis; pleural diseases; x-ray computed tomography

Pleural plaques are the most common manifestation of asbestos exposure. They are discrete fibrous lesions affecting the parietal pleura, but sometimes they also involve the visceral pleura. The mode of origin of these lesions is uncertain. Although microscopic fragments of asbestos fibers have been isolated from pleural plaques, it remains unclear how fibers can reach the parietal pleura and if they are responsible for inflammation and fibrosis.\(^1\) Plaques are frequently diagnosed radiographically in asymptomatic persons and have important medicolegal significance. Some papers have pointed out their functional relevance,\(^2,3\) but this is controversial.

With the use of chest radiographs for the screening of pleural disease in asbestos-exposed workers, a considerable quantity of data has been available for studies about the prevalence of pleural plaques and their functional relevance. Some studies reported an unexplained left-sided predominance. Two are semiquantitative studies that showed a higher prevalence of left-sided pleural disease in patients with exposure to asbestos,\(^4,5\) while the others emphasized the fact that “unilateral” plaques are more often left-sided,\(^6-8\) all the papers failed to explain these intriguing findings. However, because chest radiographs can detect only about 15% of the pleural plaques that are found at autopsy,\(^9\) further studies using CT were mandatory.

Conventional and high-resolution CT showed better accuracy in the detection of pleural plaques.\(^10-13\) Unfortunately, a study based on correlation of CT and autopsy findings is not available at present. None of the previously mentioned studies had paid attention to the distribution of the lesions in both hemithoraces, except Aberle et al.,\(^12\) who recorded right or left location but did not report any data separately. Autopsy series also did not offer lateralization.\(^9,14,15\)

The aim of this study was to test the hypothesis that pleural plaques are bilateral and symmetric lesions.

Materials and Methods

CT scans of 40 patients with proved asbestos exposure and pleural plaques were reviewed in order to quantify separately the amount of pleural disease in both hemithoraces. Patients were adult men with professional asbestos exposure (shipyards workers, former or current, who had begun working at least 20 years earlier) who underwent thoracic CT for evaluation of various
benign diseases (bronchiectasis, "bulky" pleural plaques, previous to bullectomy, etc.). Ten other patients with evidence of previous pleural disease (infections effusion, pneumothorax, malignancy, etc.) were excluded. The remaining 40 had pleural plaques and their ages ranged from 42 to 80 years (mean, 64.37 years).

In all cases, CT was obtained (Somatom CR; Siemens Medical Systems; Erlanger, Germany) using 8-mm collimation at 8-mm intervals. Patients were imaged supine at full inspiration from above the lung apices to below the posterior costophrenic angles. The measurements were made at 500 window setting at a level of 50 (mediastinal window).

**Determination of Pleural Plaques**

Even though pleural plaques need not be elliptical, an oval shape was supposed for calculation, because this is the type most commonly seen.9 Maximum anteroposterior diameter of every plaque was measured either electronically on the display console or on the hard copies (using a pair of calipers). The cranio-caudal diameter was calculated on the basis of table motion during the study (intervals between slices). For the diaphragmatic plaques, transverse and anteroposterior diameters were measured directly. The area of every plaque was calculated as the area of an ellipse (where \( a \) and \( b \) were the semiaxis):

\[
S = \pi \times a \times b
\]

Number and size of plaques (sum of areas) were recorded separately for both pleurae.

**Statistical Analysis**

The data were retrospectively examined to search for unilateral predominance. Analysis of the mean of the differences between right and left areas was performed with a t test for paired samples. The hypothesis of zero difference was tested with limits of agreement of 95% (2 SD). Results of differences were plotted against the average of both areas (Fig 1). All statistical analyses were performed using SPSS software (SPSS; Chicago).

**Results**

Measurements of 668 plaques were obtained from 40 patients (right 352, left 316). Only two patients had small unilateral lesions (one right and one left, with areas of 12.25 cm\(^2\) and 25.08 cm\(^2\), respectively).

The mean value of the summed areas (±SD) for the right plaques was 47.81±47.72 cm\(^2\), and for the left plaques it was 45.34±67.32 cm\(^2\). The difference between right and left means was not statistically significant. The mean of the differences was -2.56±53.68 cm\(^2\) and its difference from zero was statistically poor (\(p=0.652\)) (Fig 1). These data were consistent with the absence of left-sided predominance.

**Discussion**

No significant differences between right and left pleural plaques could be expected a priori, because the extent of both pleural surfaces is similar and there is no evidence that airway length in humans differs in the right and left lungs.

The appearance of left-sided predominance in chest radiographs remains unexplained. This finding was found in studies based on the International Labour Office interpretations5-8 and also in others that did not use that method of scoring4 and may be observer-dependent. “Unilateral” disease reported in the previously cited studies6-8 is also inexplicable. Probably, in the early stage of disease, unilateral plaques can exist but are undetectable with chest radiographs. The autopsy study by Karjalainen et al15 states that when

![Figure 1. Differences of left minus right areas of pleural plaques (cm\(^2\)) plotted against the averages of both side areas (cm\(^2\)). The 95% confidence interval is indicated by the lines marked -2 SD and +2 SD.](http://publications.chestnet.org/pdfaccess.ashx?url=/data/journals/chest/21763/)
unilateral plaques are present, their extent is moderate; widespread, radiographically visible disease always involves bilateral plaques.

In this study, comparison of the summed surface areas of pleural plaques lends support to that hypothesis, showing no significant predominance in either hemithorax, and moderate surface areas for the unilateral plaques. The method used in this study, however, has some inaccuracies. The shape of the plaques may be discordant with a "perfect" ellipse. The measurement of the anteroposterior diameter is underestimated because of the thoracic wall curvature. Also, the measurement of the craniocaudal diameter may be modified by respiratory movements and partial volume effect. Nevertheless, it can be useful for detecting asymmetry. Perhaps spiral CT, with its planar and curved multiplanar reformations, can display the complete plaque to allow a direct measurement of area. A perfect quantitative scoring of pleural disease may, then, be possible.

Cost and radiation dose make CT impractical for screening cohorts of asbestos-exposed workers; therefore, the chest radiograph remains the imaging tool available for that purpose. Nevertheless, because pleural plaques are markers of asbestos exposure, their detection can be useful in the clinical diagnosis of pulmonary asbestosis.6

In summary, this paper supports that symmetry is the rule in the extent of pleural plaque formation. The small number of patients studied, however, may be insufficient to detect asymmetry that occurs with a low prevalence.

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Clinical Investigations