ASBESTOSIS AND THE SERRATUS ANTERIOR MUSCLE

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Twenty-seven patients with a history of asbestos exposure were reviewed at the UCLA Medical Center in December 1981. All patients were referred by the United States Department of Labor. The patients were told they had asbestosis on the basis of their history of exposure and chest radiographs taken at a local asbestos screening program and initially interpreted by a "B" reader. None of the 27 patients reviewed were found to have evidence of asbestosis either clinically or radiographically. The false-positive radiographic interpretations were due to the extrathoracic musculature (serratus anterior) mimicking intrathoracic disease. Since the study described here was done, an additional 330 patients have had their radiographs reviewed.

Patients with assumed exposure to asbestos were referred from the United States Department of Labor for respiratory evaluation. All patients arrived with a diagnosis of asbestosis on the basis of their exposure to the asbestos material and chest radiographs which had been taken by a regional screening center and interpreted by a "B" reader. Often the radiographs that accompanied these patients for interpretation had grease pencil markings on the posteroanterior chest film laterally corresponding to the density of the serratus anterior muscle.[1]

The authors became interested when radiographs from the referring centers continued to have markings outlining the normal muscular anatomy of the chest. Many of the radiographs consistently depicted the serratus muscle as pleural disease. This information was relayed to the Occupational Medical Service and forwarded to the Department of Labor.

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The purpose of this paper is to inform radiologists and other clinicians that a variation does exist in the chest wall anatomical contour and that false-positive reporting may be avoided by using other modalities in diagnostic radiology.

METHODS

Procedurally, patient radiographs are reviewed in the Department of Radiology and the reports are sent directly to the Chest Service in the Department of Medicine. PA, lateral, and both oblique radiographs are reviewed. Attention is directed to the contour of the lateral chest wall and a comparison is made with the outside referral radiographs from various private physicians and medical centers. In this study, the outside radiographs were interpreted by a radiologist and/or a nonradiologist unaffiliated with the referral centers. The physicians reading the films are designated as "B" readers. The interpretation by the "B" readers did not accompany the patient's radiographs and were not available for our review.

In most cases, the "B" reader reviewed a single PA chest radiograph. Occasionally, a lateral and oblique radiograph was sent along from another institution for comparison (Table 1). The institution taking the films have fully qualified radiologists who do not interpret the films but refer them to an outside reader. Three hundred fifty-seven of these patients were studied by conventional radiographs. Five of these had additional computerized tomograms at UCLA.

RESULTS

Figures 1 through 8 represent various PA and oblique radiographs of patients with suspected asbestosis. The computerized tomogram (Figure 9) demonstrates a fractured rib with pleural reaction corresponding to the PA radiographs in Figure 8.

Four other computerized tomograms of the chest wall were obtained on different patients

TABLE 1. SUMMARY OF CHEST RADIOGRAPHS OF PATIENTS WITH SUSPECTED DIAGNOSIS OF ASBESTOSIS (n = 357)

Findings	
Serratus anterior muscle prominence	243 (81%)
Biconcave chest (lower 1/3), all males	252 (72%)
Granulomatous disease	56 (15.68%)
No disease	293
Diseases (cause undetermined)	8
Tumors	2
Bullous lung disease	2
Calcification of diaphragm	2
Bilateral pleural thickening	2
No. years patients followed with chest radiographs	1.7 (3.7 av)
No. of outside radiographs for comparison	143 (40%)

along with conventional PA, lateral, and both oblique views. The findings in these patients presented questions of pleural thickening vs prominence of the serratus musculature. The tomograms were obtained to rule out pleural disease.

The results are summarized in Table 1. The patients varied in age from 25 to 84 years, with an average age of 56.5 years and included 350 men and 7 women. The patients had been followed with chest radiographs from one to seven years (average 3.7 years). Fifty-six had previous granulomatous disease. Two had bilateral pleural thickening of undetermined cause. Two other patients had calcification of the diaphragm, one with a 0.6-cm linear calcification over the right and the other with a 0.8-cm linear calcification on the left. The lungs were otherwise entirely clear.

Two patients presented with primary tumors of the lung. One had Pancoast's tumor with postradiation changes. The second patient presented with a left hilar mass, the cause of which as yet is not determined. Two others presented with apical bullous disease. Outside films of one confirmed a previous pneumothorax on the right side. Four other patients presented with rib fractures and pleural reaction at the fracture sites. No other changes were present in the remaining lung fields.

Two hundred fifty-two (72 percent) had biconcave lateral lower third chest wall configurations that accentuated the overlying serratus musculature. None of the seven women had radiographic evidence of concavity. One hundred forty-three had outside x-ray films (40 percent).

The serratus muscles were observed to be most prominent at the level of the anterior fourth rib superiorly and the anterior seventh rib inferiorly on the PA views.

DISCUSSION

Two hundred ninety-three patients had no disease, either radiographically or clinically (Table 1). Two hundred fifty-two patients had biconcave lateral chest walls which were believed to contribute to the pseudoasbestosis interpretations from the outside radiographs by the "B" readers.

The serratus muscle can mimic intrathoracic disease and/or mass lesions.[1] Needle biopsies of the chest wall were obtained by the senior author before this was recognized. Oblique radiographs, coupled with the PA and lateral views, have aided in correcting the misinterpretations. The added use of fluoroscopy with spot filming has also contributed by recording the soft tissue density of the serratus muscle as being the suspected pleural disease.

Oblique filming and fluoroscopic examinations do not rotate pleural disease off the chest wall as demonstrated in Figure 7. Many of the oblique radiographs from outside sources were suboptimal because of inadequate rotation. When oblique films were questioned, fluoroscopic examination was obtained with the patient rotated to separate the musculature away from the chest wall. The lateral chest musculature cannot be displaced with only a single PA chest radiograph, which is perhaps one of the reasons why patients were given a false asbestosis interpretation. Five patients required computerized tomography of the chest to confirm a normal pleural surface. Their results confirmed that the serratus musculature was mimicking pleural disease.

Since a regional screening center takes the radiographs of the patient and the "B" reader interprets these films, the screening center loses control over monitoring the additional films unless the "B" reader requests further radiographs.[2-5] It is believed that the interpretation of the radio-

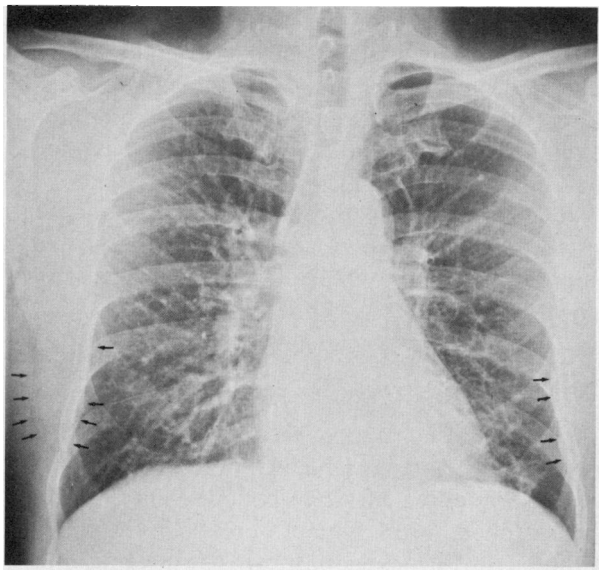

Figure 1. PA chest shows that the serratus anterior muscle on the right and left of the lateral chest wall (arrows) contributes to the density overlying the 6th, 7th, and 8th ribs bilaterally

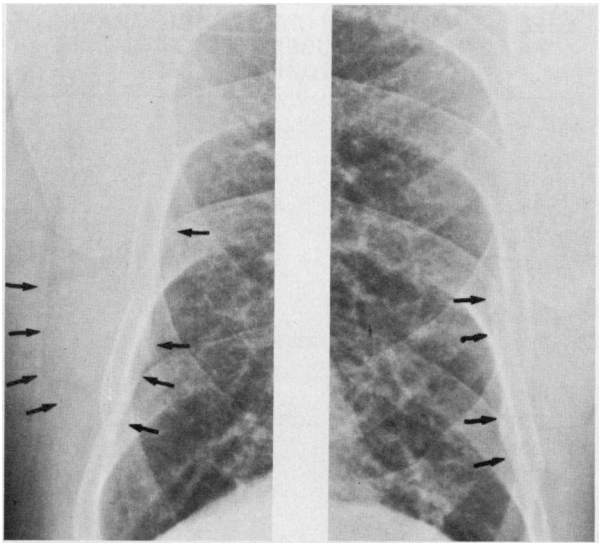

Figure 2. An enlarged composite PA view demonstrating the serratus anterior muscle outlined by the arrows tapering superiorly on the inner aspect of the thoracic cage. The arrows on the right outline the serratus muscle outside the chest wall

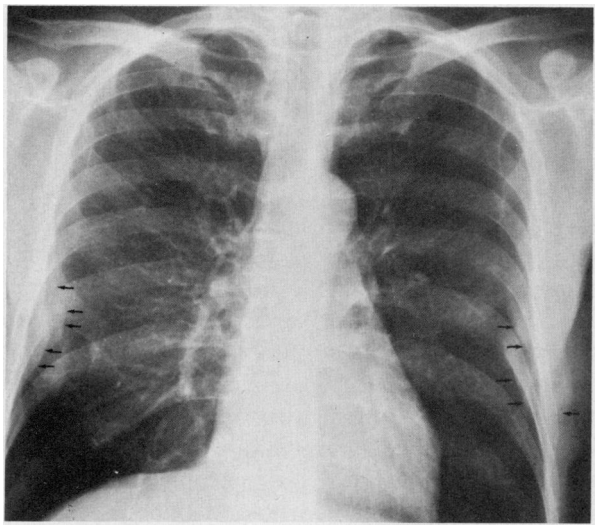

Figure 3. Patient with large serratus muscle bundle coursing medially over the lateral chest wall (arrows)

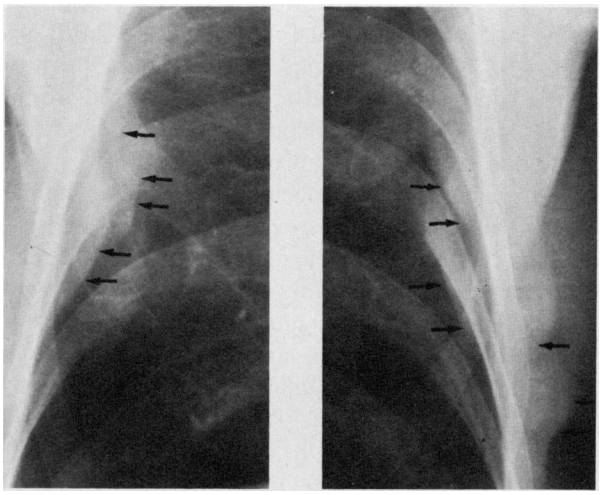

Figure 4. Enlarged composite PA demonstrating the prominent serratus muscles as they project over the lateral chest walls (arrows)

graphs taken by the regional screening center could be best controlled by having a "B" reader and the screening center located at the same institution where the films are taken. Until the radiographs and interpretations are brought together, the problem of inaccuracy will continue. Therefore, the serratus anterior musculature will continue to be interpreted as an abnormality until it is recognized as a normal variant.[1]

Because extrathoracic musculature mimics intrathoracic disease, the addition of fluoroscopic examination of the chest can aid in solving the problem of false-positive interpretations. Fluoroscopic examination with spot radiographs will en-

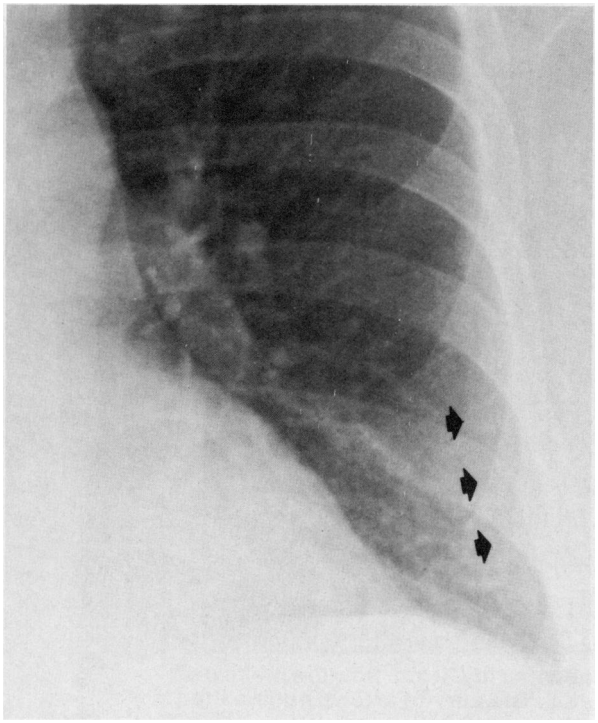

Figure 5. The serratus anterior muscle, demonstrating the hazy appearance that the muscle causes on the PA chest radiograph (arrows)

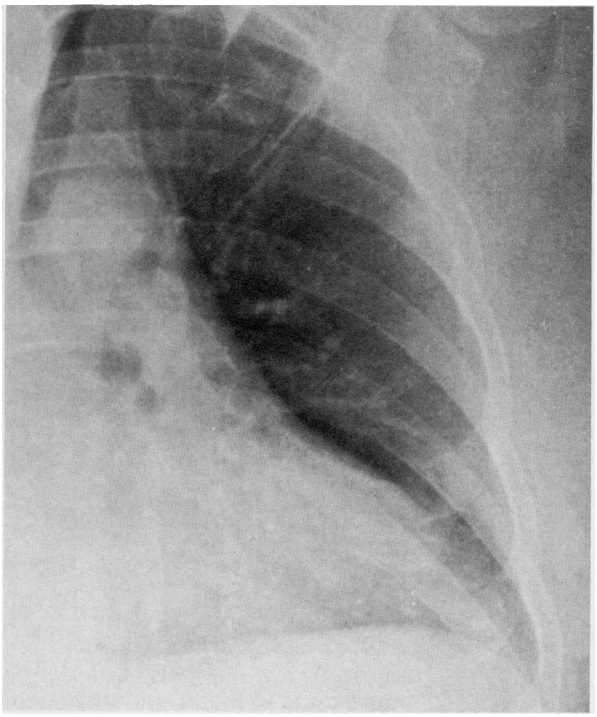

Figure 6. Oblique view of the patient in Figure 3. The haziness of the serratus anterior muscle is no longer identifiable—the muscle bundles lie projected over the lateral chest wall

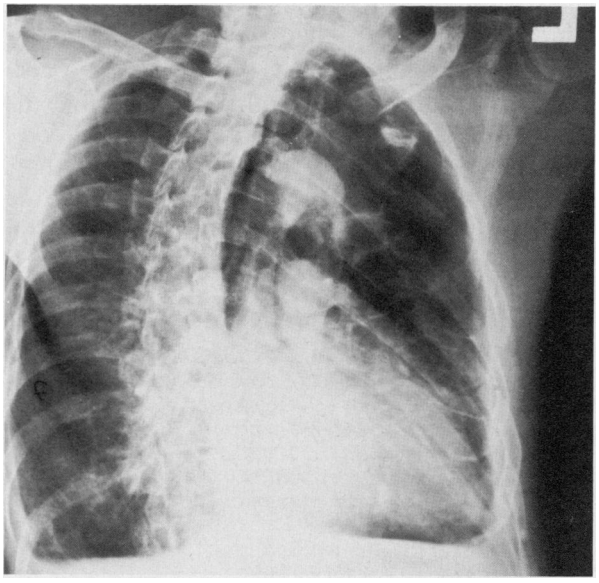

Figure 7. Oblique chest film of a patient with bilateral pleural thickening. Rotation of the chest does not rotate the pleural thickening off the chest wall

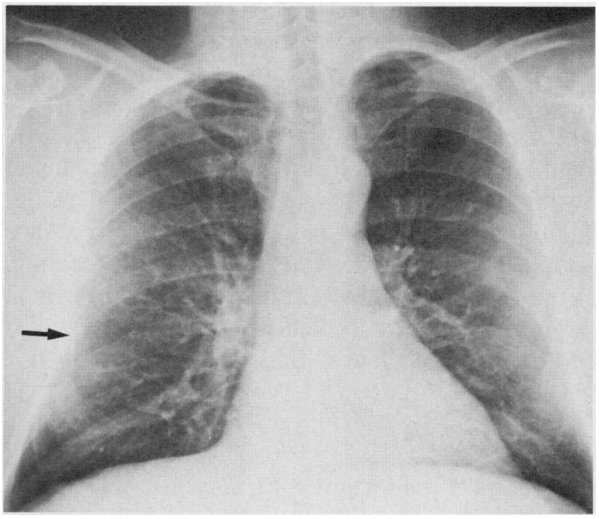

Figure 8. PA chest of a patient with irregularity on right lateral chest which could represent mild pleural thickening. The arrow indicates site of suspected abnormality

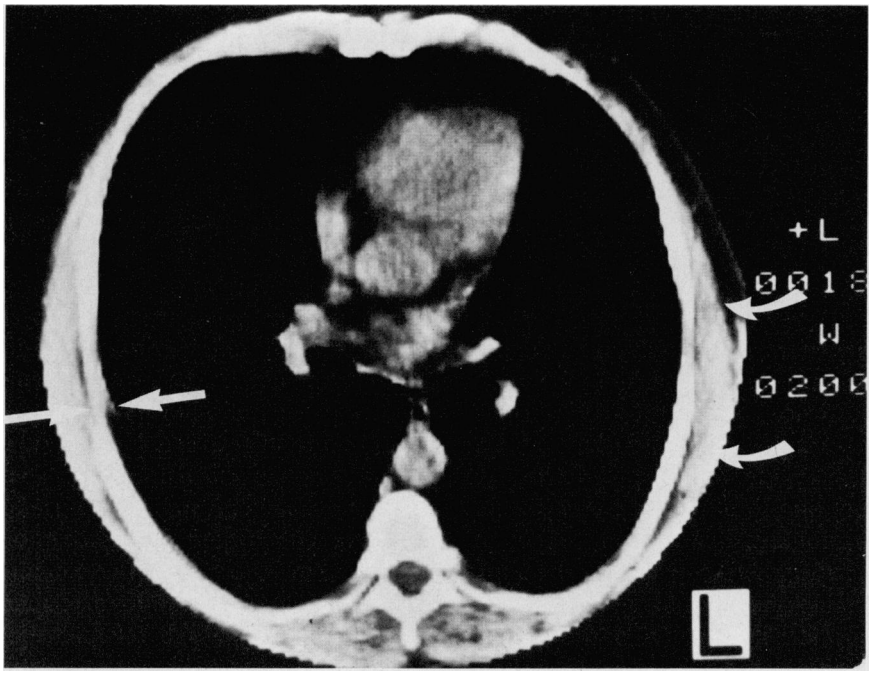

Figure 9. A computerized tomogram demonstrating a rib fracture. Arrows correspond to the irregularity seen in Figure 8. The curved arrows outline the serratus muscle

able the radiologist to give an accurate interpretation of most pathologic conditions involving the pleura, as oblique radiographs may not be taken at the right angle for clear interpretation of the overlying serratus muscle separating it from the chest wall. Therefore, we advocate that fluoroscopy be used because it is best able to evaluate the chest and obtain sufficient radiographs confirming the findings of fluoroscopy. Computerized axial tomography (CAT) of the chest is another means by which the accuracy of the chest pathology can be evaluated, although it is expensive and believed by the authors as being unnecessary when adequate radiographs and spot fluoroscopy views are obtained. In medicolegal instances, CAT scanning of the chest may be an additional means by which the problem can be solved when there is a continued question of pleural disease.

CONCLUSION

The most important information gained from this study is that "B" reader interpretation of the limited radiographs has led to a false-positive finding of changes described to be consistent with asbestosis.[2-5] The serratus anterior muscle is believed to be the extrathoracic musculature that contributed to the diagnosis of pleural disease consistent with asbestosis. The only problem existing at present is to inform radiologists and pulmonary physicians that it is imperative that the anatomy of the serratus anterior muscle be considered in the interpretation of chest radiographs when the patients have the history of exposure to asbestos material. In fact, the serratus anterior musculature should always be considered in patients with known disease that may involve the chest or any other disease that is to be ruled out, as patients may be given medical treatment when actually no disease exists. This is particularly true in patients with exposure to agents which may result in one of the pneumoconioses.

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