VISCERAL PLEURAL THICKENING IN ASBESTOS EXPOSURE: THE OCCURRENCE AND IMPLICATIONS OF THICKENED INTERLOBAR FISSURES

S. DAVID ROCKOFF,* M.D., F.A.C.R. • Arnold Schwartz,* M.D. • William Hix,*M.D. • Prashant Rohatgi,* M.D. • Elliot Kagan,† M.B., BCh, MRCPath • David Kriebel,‡ Sc.D.

*The George Washington University Medical Center (GWUMC), Washington, DC, USA
†Georgetown University Medical School, USA
‡School of Public Health, Harvard Medical School, USA

INTRODUCTION

The interlobar fissures are lined by visceral pleura. We have noticed, radiographically, the frequent occurrence of thickened interlobar fissures in asbestos exposed individuals, even when the lungs have been normal otherwise. Visceral pleural thickening in asbestos exposure has not received much attention in the diagnosis of asbestos-related thoracic disease, having been considered mainly to be an extension of a more diffuse pleural reaction to asbestos dust.[1] However, in the 1980 revision of the I.L.O. classification, provision was made to indicate fissural thickening as being present or absent. We studied the significance of such thickening[2] and describe the potential practical application of fissural thickening on radiographs as an early sign of asbestos exposure. The peripheral deposition of inhaled asbestos fibers in the lung[3-5] and the fact that visceral pleural thickening is the usual finding histologically in asbestosis,[6] provides a reasonable expectation for a relationship between asbestos exposure and visceral pleural thickening radiographically.

METHODS

A *control group* of 100 adult male patients with no known asbestos exposure, with good quality posterior-anterior (PA) and lateral chest radiographs read as "no active disease" and admitted for non-thoracic problems were selected from 257 consecutive admissions, after 157 were excluded for inadequate radiographs and/or radiographic evidence of obvious cardiopulmonary disease. The radiographs were classified as to the presence and degree of fissural thickening. All had otherwise normal appearing lungs.

The *study group* was comprised of 220 asbestos-exposed workers drawn from 241 consecutively encountered individuals participating in an occupational screening program, with 21 being eliminated for absence of adequate radiographs or the presence of cardiopulmonary disease which could interfere with the interpretation. The number of years since first occupational contact was recorded as a measure of asbestos exposure. The radiographs of the study group subjects were analyzed for the following factors:

1. *Parietal pleural plaque formation* was noted to be present, absent or questionable.
2. *Interstitial pulmonary fibrosis* was noted as the presence or absence of accentuation of the nonvascular, fine linear lung markings of the type generally referred to as "small irregular opacities," without an attempt to grade the degree of profusion.
3. *Fissural thickening* was graded as 0 = Normal fissures, being <0.5 mm throughout; +/- = Questionable thickening, with areas of apparent thickening (>0.5 mm), which could represent either localized fissural thickening or superimposed fissures; 1 + = Minimal fissural thickening with definite, localized thickening of >0.5 and <1.0 mm; 2 + = Moderate fissural thickening with definite, diffuse fissural thickening >0.5 and <1.0 mm, involving the equivalent of a large portion of the length of a major or minor fissure, with or without localized plaques; 3 + = Marked fissural thickening was extensive, diffuse involvement of the fissure(s) as evidenced by thickening of virtually all of the major and/or minor fissures and/or thickening predominantly >1.0 mm.

In addition to the control and study groups, a series of individuals with *clinically and/or histologically diagnosed asbestosis* were studied to see whether asbestos-induced fissural thickening occurs in the absence of pulmonary fibrosis and, regardless of the presence of radiographically-evident pulmonary fibrosis, to analyze the plain film and computed tomographic appearances of visceral pleural thickening in interlobar fissures.

STATISTICAL METHODS

Group means were examined with Student's "t" test and the relationship between years since first exposure to asbestos and the occurrence of pleural abnormalities was investigated by fitting logistic models, as described in our earlier paper.[2] These models corrected for the effect of the person's age on the data.

RESULTS

A. *Control Group:* Combining fissural thickening of 0 and

+/- degrees as "normal" and 1+ to 3+ as abnormal, 84% had "normal" fissures while 16% had fissural thickening. Of those with fissural thickening, none was marked (i.e., 3+) with an equal distribution between "slight" and "moderate" thickening.

B. *Study Group:* Definite fissural thickening was observed in 54.5% while 45.5% had radiographically "normal" fissures. The relationship between fissural thickening and years from first exposure is shown in Figure 1 where it is seen that the 50% probability of having fissural thickening occurs at 21 years after first exposure. With regard to parietal pleural plaques, 38.2% had definite plaque formation while 61.8% had none. As shown in Figure 2, the 50% probability of having pleural plaques occurs 31 years after first exposure. Both the pleural plaques and the fissural thickening were associated with the length of time since first exposure. These data show not only that fissural thickening occurs some 10 years earlier than pleural plaque formation, but also that it is a more common lesion (i.e., 54.5% vs. 38.2%). However, the two types of pleural changes generally occurred together with 85% of those with parietal pleural plaques also having fissural thickening. Further, it was relatively uncommon to see radiographic evidence of pulmonary fibrosis in the absence of fissural thickening.

C. *Fissural Thickening in Clinical Asbestosis:* In studying our series of asbestosis patients, the radiographic finding of fissural thickening was uniformly found even in the *absence* of diffuse chest wall pleural thickening. Pulmonary asbestosis was found histologically in the absence of radiographic changes in the lungs. (Figure 3) The uncalcified fissural thickening as seen on plain chest radiographs and on computed tomograms is demonstrated in Figure 4. In one of our cases, the fissure was calcified on CT only.[7]

DISCUSSION AND CONCLUSIONS

The data presented suggest some interesting possibilities with regard to the earlier radiographic diagnosis of pulmonary asbestosis. While the relationship between radiographically visualized fissural thickening and underlying asbestos-induced pulmonary fibrosis has yet to be clarified definitively, the visceral pleura is part of the lung (unlike parietal pleural plaques) and thickening of it has been shown to be related to the concentration of asbestos fibers and bodies.[8]

A few comments are in order about radiographic techniques. The I.L.O. method[9] uses only the frontal view, on which only the minor fissure of the right lung is routinely visualized. To achieve the results presented in our work, the lateral as well as the frontal view is required in order to visualize the major as well as the minor fissures.

Based upon the observations we have made using frontal (PA) and lateral chest radiographs, we conclude the following:

1. Fissural thickening is common in asbestos exposed individuals (54.5%) although it is not specific, being also seen in 16.0% of an unexposed control group.
2. Fissural thickening was found to be more common than pleural plaque formation in the asbestos-exposed population (i.e., 54.5% vs. 38.2%).
3. An age adjusted analysis using logistic models showed that fissural thickening occurs, on an average, 10 years earlier after asbestos exposure than does pleural plaque formation (i.e., 21 years vs. 31 years). This means that fissural thickening can serve as an earlier, if not more specific, sign of asbestos-related disease of the thorax.
4. The severity of the fissural thickening, when adjusted for age, increases with length of time since first exposed to asbestos, suggesting its direct relationship to the asbestos exposure.
5. The plain film and computed tomographic appearances of the fissural thickening ranges from isolated visceral pleural plaques to thickening involving entire fissures. Our cases rarely showed any relationship to diffuse, generalized pleural thickening.

There are two potential practical clinical applications of the finding of fissural thickening on radiographs. First, if a person is known to have been exposed to asbestos, it could be a marker of early involvement of the lungs as the result of the exposed and lead to appropriate inquiries. In individuals without known occupational exposure, the finding of unexplained fissural thickening could lead to inquiries which might indicate unusual spousal or environmental contact with asbestos dust, bearing in mind that isolated fissural thickening is a non-specific finding.

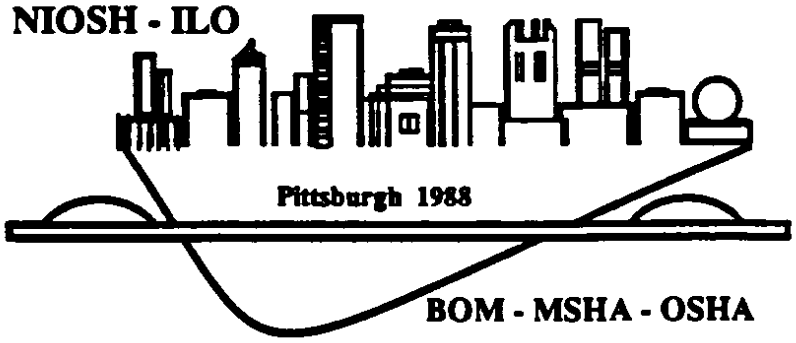
REFERENCES

1. McLoud, T.C., Woods, B.O., Carrington, C.B., Epler, G.R., Gaensler, E.A.: Diffuse pleural thickening in an asbestos-exposed population: Prevalence and cause. *Amer. J. Roentgenol.* 144:9-18 (1985).
2. Rockoff, S.D., Kagan, E., Schwartz, A., Kriebel, D., Hix, W., Rohatgi, P.: Visceral pleural thickening in asbestos exposure: The occurrence and implications of thickened interlobar fissures. *J. Thorac. Imag.* 2(4):58-66 (1987).
3. Churg, A., Wright, J.L.: Small airways disease and mineral dust exposure. *Pathol. Ann.* 18:233-252 (1983).
4. Hillerdal, G.: The pathogenesis of pleural plaques and pulmonary asbestosis: Possibilities and impossibilities. *Eur. J. Respir. Dis.* 61:129-138 (1980).
5. *Deposition and clearance of inhaled fibrous minerals in the rat. Studies using radioactive tracer techniques.* Walton WH Ed., pp 259-274. Inhaled Particles IV Proc. Int. Symp., Pergamon Press (1975).
6. Parkes, W.R.: Asbestos-related disorders. *Br. J. Dis. Chest* 67:261-300 (1973).
7. Rockoff, S.D.: CT Demonstration of Interlobar Fissure Calcification Due to Asbestos Exposure. *J. Compu. Assist. Tomogr.* 11 (6):1066-1068 (1987).
8. Warnock, M.L., Kuwahara, T.J., Wolery, G.: The relation of asbestos burden to asbestosis and lung cancer. *Pathol. Ann.* 18:109-146 (1983).
9. *Guidelines for the Use of ILO International Classification of Radiographs of Pneumoconioses.* Occupational Safety and Health Series No. 22 (rev). Geneva, International Labour Office (1980).

Note: Consult with author for figures.

Proceedings of the VIIth International Pneumoconioses Conference *Part*
Transactions de la VIIe Conférence Internationale sur les Pneumoconioses *Tome*
Transaciones de la VIIa Conferencia Internacional sobre las Neumoconiosis *Parte*

II



Pittsburgh, Pennsylvania, USA—August 23–26, 1988
Pittsburgh, Pennsylvanie, Etats-Unis—23–26 aout 1988
Pittsburgh, Pennsylvania EE. UU—23–26 de agosto de 1988

U.S. DEPARTMENT OF HEALTH AND HUMAN SERVICES
Public Health Service
Centers for Disease Control
National Institute for Occupational Safety and Health

CDC
CENTERS FOR DISEASE CONTROL

Sponsors

International Labour Office (ILO)
National Institute for Occupational Safety and Health (NIOSH)
Mine Safety and Health Administration (MSHA)
Occupational Safety and Health Administration (OSHA)
Bureau of Mines (BOM)

November 1990

DISCLAIMER

Sponsorship of this conference and these proceedings by the sponsoring organizations does not constitute endorsement of the views expressed or recommendation for the use of any commercial product, commodity, or service mentioned.

The opinions and conclusions expressed herein are those of the authors and not the sponsoring organizations.

DHHS (NIOSH) Publication No. 90-108 Part II