Commentary

CT for Asbestosis: Value and Limitations

David A. Lynch[1]

The diagnosis of asbestosis is important. It means that the worker must be removed from asbestos exposure and may be entitled to compensation for a work-related injury. Because asbestosis is diagnosed by the presence of peribronchiolar fibrosis with asbestos bodies in lung tissue [1], definitive documentation of asbestosis usually requires open-lung biopsy, which is difficult to justify because there is no accepted treatment for asbestosis. Asbestosis thus differs from most other interstitial lung diseases because it usually is diagnosed by clinical criteria.

The clinical diagnosis of asbestosis [1] involves a reliable history of exposure and an appropriate time interval between exposure and detection (the latency period for the development of asbestosis is usually longer than 15 years). The presence of small irregular opacities (profusion greater than or equal to either 1/0 or 1/1, according to the International Labor Office [ILO] system) on the chest radiograph is the next most important criterion. Considerable caution is recommended if this criterion is not met [1]. Other features of recognized diagnostic value include a restrictive pattern of physiologic impairment, diminished diffusing capacity, and bilateral basal crackles on physical examination.

Asbestosis may be present and may cause physiologic impairment when the lung parenchyma appears normal on the chest radiograph [2, 3]. Because the standard radiographic criteria may lead to diagnoses of asbestosis being missed [4], interest in other diagnostic techniques, including examination of exercise physiology [5], scintigraphic evaluation of the lungs with gallium-67, and bronchoalveolar lavage [6], has been increasing. However, none of these tests provides a specific diagnosis of asbestosis.

Correlation Between CT-Determined Abnormalities and Pathologic Asbestosis

Because of its ability to depict relatively fine morphologic changes in the lungs and to document pleural plaques, high-resolution chest CT has been embraced as an objective method for confirming the presence of asbestos-related lung fibrosis. The CT criteria for the diagnosis of asbestosis [7] are subpleural curvilinear lines, thickened septal and core lines, subpleural density, parenchymal bands of fibrosis, and honeycombing. These abnormalities usually are seen best in the posterior subpleural area of the lung, at the lung bases, in the prone position. Gamsu et al. [8] have discarded subpleural density, presumably because of its lack of specificity, and added subpleural nodules and the useful sign of architectural distortion.

The general lack of a pathologic gold standard in the published CT studies of asbestosis has led to considerable concern about the accuracy of CT diagnosis of this condition. Akira et al. [9], with meticulous radiologic–pathologic correlation for seven postmortem lungs, confirmed that core structure thickening, intralobular lines, subpleural curvilinear lines, and honeycombing correlate with pathologic evidence of fibrosis. However, interlobular septal thickening and ground-glass opacity could be attributable either to fibrosis or to edema [9]. The study by Gamsu et al. [8], which evaluated

This article is a commentary on the preceding article by Gamsu et al.

[1]Department of Radiology, Box A030, University of Colorado Health Sciences Center, 4200 E. Ninth Ave., Denver, CO 80262. Address correspondence to D. A. Lynch.

AJR 1995;164:69–71 0361–803X/95/1641–69

the relationship between CT-determined abnormalities and pathologic evidence of asbestosis in 30 asbestos-exposed subjects, is a timely and thought-provoking contribution to our knowledge of the pathologic correlates of CT findings in asbestosis.

To interpret the study of Gamsu et al. [8], one must realize that the study population is unique. The authors deserve great credit for accumulating a large series of asbestos-exposed subjects from whom adequate lung tissue was available to make the histologic diagnosis of asbestosis. Because lung biopsy samples were available from only six patients, the remainder of the pathologic material was obtained at autopsy ($n = 16$) or at lobectomy (presumably for malignancy) ($n = 8$). In all, 16 patients had malignancy at the time of death, lobectomy, or biopsy. For many of these patients, asbestosis must have been an incidental finding at lobectomy or autopsy. Indeed, in a study of asbestos insulation workers with lung cancer [3], asbestosis was present in all 138 workers from whom sufficient nonmalignant tissue was available for analysis, suggesting that asbestosis is an almost invariable companion to lung cancer in asbestos-exposed workers [10]. Thus, the patients in the current study range from those in whom symptomatic asbestosis was sufficient to cause death or to warrant open-lung biopsy to those who had no asbestosis or for whom asbestosis was an incidental finding at lobectomy or autopsy. Because of the inevitable selection bias, it is unlikely that this study population is representative of the general population of asbestos-exposed workers. One should not use the current study to draw general conclusions regarding the accuracy of CT for the diagnosis of asbestosis.

The authors' recognition that the CT findings of asbestosis are not perfectly sensitive or specific led them to evaluate two grading systems for determining the likelihood of asbestosis. One system was a cumulative measure of the number of different types of abnormalities present on CT scans. Not surprisingly, the likelihood of asbestosis rose as the variety of signs of asbestosis on CT scans increased. The other grading system was essentially a subjective measure of the profusion and severity of abnormalities on CT scans. Despite the subjectivity of this scoring system, it correlated significantly ($r = .78$, $p = .0001$) with the severity of fibrosis measured by histopathology. It is reassuring that all 16 subjects with grade 2 or grade 3 asbestosis (changes that were bilateral or occurred at multiple levels) had pathologic evidence of asbestosis. However, four of five subjects with grade 1 CT scan abnormalities (unlikely to represent diffuse lung fibrosis) had pathologic evidence of asbestosis, suggesting that even small abnormalities should be regarded as indicating possible asbestosis. In practice, it is often difficult to distinguish such small parenchymal abnormalities from the linear densities (crow's feet) commonly seen in subjects with asbestos-related pleural disease [11] or the minor septal thickening or subpleural lines sometimes seen in normal subjects.

Normal CT Scans in Subjects with Asbestosis

Five of nine subjects with normal (grade 0) CT findings in the study by Gamsu et al. [8] had histologic evidence of asbestosis. All of these subjects had normal chest radiographs. Some of these patients may have come from the group in which asbestosis was discovered incidentally at lobectomy or autopsy. It is not known whether any of them had physiologically significant disease. It is clear that there exists a phase in the development of any interstitial lung disease during which the disease is too focal or too mild to cause a recognizable morphologic change on CT scans [12]. In the future, image analysis techniques may aid in the detection of changes in CT density or texture before a morphologic change is apparent [13].

Is CT more sensitive than chest radiography for the detection of asbestosis? Friedman et al. [14] concluded that CT rarely depicted asbestosis (two of 60 cases) unless this condition was suspected on the basis of the chest radiograph findings. However, Aberle et al. [7] demonstrated that eight of 38 subjects for whom asbestosis was found highly likely by CT had normal chest radiographs. In a study by Staples et al. [2] of 169 asbestos-exposed subjects with normal chest radiographs, 57 had CT findings suggesting a high probability of asbestosis. The vital capacity and diffusing capacity were significantly lower in these 57 subjects than in 76 subjects with normal or nearly normal CT findings. In the study by Gamsu et al. [8], with its unique population, 11 of 21 subjects with asbestosis (52%) had abnormal chest radiographs (ILO profusion, ≥1/0), whereas 16 of 25 subjects with asbestosis (64%) had abnormal CT findings. On balance, CT seems considerably more sensitive than chest radiography for the detection of asbestosis.

Pleural Plaques in Asbestosis

Pleural plaques are an important and clinically useful marker of asbestos exposure. However, plaques were absent on the chest radiographs of 32% of subjects with lung cancer and pathologic evidence of asbestosis [3]. Conversely, plaques may be present on chest radiographs in the absence of histologically determined asbestosis. In the study by Friedman et al. [14], two of 21 subjects with CT findings of asbestosis had no plaques on CT scans. Gamsu et al. [8] confirmed that the absence of plaques on CT scans does not exclude asbestosis. A more frequent CT sampling interval may increase the likelihood of the detection of plaques.

Summary

CT is more sensitive than clinical evaluation for the detection of asbestosis but is inevitably less sensitive and less specific than pathologic evaluation. For the asbestos-exposed individual, CT is useful for the evaluation of suspected lung masses, particularly rounded atelectasis [15], for identifying pleural plaques, and for confirming unequivocal asbestosis (grade 2 or grade 3 [8]). CT also will identify and quantify emphysema as a cause of physiologic impairment. Because clinicians commonly use CT to resolve clinical uncertainties, radiologists often feel pressured to categorize disease as unequivocally present or absent. Gamsu et a show that the borderline between normal and abnorma not always sharply defined. In the absence of pathologic proof, the diagnosis of asbestosis must be based on a

thoughtful evaluation of the likelihood of asbestosis by use of all available clinical, physiologic, and radiologic information. The scoring systems used by Gamsu et al. [8] offer a practical approach to defining the likelihood of asbestosis based on CT appearances.

ACKNOWLEDGMENT

The author wishes to express appreciation for the very helpful comments made by Dr. Newman and the expert assistance of Mary Ann Hamm.

REFERENCES

1. Murphy RL, Beckdake MR, Gaensler EA, et al. The diagnosis of nonmalignant diseases related to asbestos. *Am Rev Respir Dis* 1986;134:363–368
2. Staples CA, Gamsu G, Ray CS, Webb WR. High resolution computed tomography and lung function in asbestos-exposed workers with normal chest radiographs. *Am Rev Respir Dis* 1989;139:1502–1508
3. Kipen HM, Lilis R, Suzuki Y, Valciukas JA, Selikoff IJ. Pulmonary fibrosis in asbestos insulation workers with lung cancer: a radiological and histopathological evaluation. *Br J Ind Med* 1987;44:96–100
4. Rockoff SD, Schwartz A. Roentgenographic underestimation of early asbestosis by international labor organization classification. *Chest* 1988; 93:1088–1091
5. Smith D, Agostoni P. The discriminatory value of the P(A-a)O2 during exercise in the detection of asbestosis in asbestos exposed workers. *Chest* 1989;95:52–55
6. Begin R, Ostiguy G, Filion R, Groleau S. Recent advances in the early diagnosis of asbestosis. *Semin Roentgenol* 1992;27:121–139
7. Aberle DR, Gamsu G, Ray CS. High-resolution CT of benign asbestos-related diseases: clinical and radiographic correlation. *AJR* 1988;151:883–891
8. Gamsu G, Salmon CJ, Warnock ML, Blanc PD. CT quantification of interstitial fibrosis in patients with asbestosis: a comparison of two methods. *AJR* 1995;164:63–68
9. Akira M, Yamamoto S, Yokoyama K, et al. Asbestosis: high-resolution CT-pathologic correlation. *Radiology* 1990;176:389–394
10. Churg A. Asbestos-related disease in the workplace and the environment: controversial issues. *Monogr Pathol* 1993;36:54–77
11. Hillerdal G. Non-malignant asbestos-pleural disease. *Thorax* 1981;36: 669–675
12. Lynch DA, Rose CS, Way D, King TJ. Hypersensitivity pneumonitis: sensitivity of high-resolution CT in a population-based study. *AJR* 1992;159:469–472
13. Wollmer P, Jakobsson K, Albin M, et al. Measurement of lung density by X-ray computed tomography: relation to lung mechanics in workers exposed to asbestos cement. *Chest* 1987;91:865–869
14. Friedman AC, Fiel SB, Fisher MS, Radecki PD, Lev-Toaff AS, Caroline DF. Asbestos-related pleural disease and asbestosis: a comparison of CT and chest radiography. *AJR* 1988;150:269–275
15. Lynch DA, Gamsu G, Ray CS, Aberle DR. Asbestos-related focal lung masses: manifestations on conventional and high-resolution CT scans. *Radiology* 1988;169:603–607