JACOBS PUBLISHERS

OPEN ACCESS

Jacobs Journal of Pulmonology

Research Article

Axillary Crackles are more Prevalent than Basal Crackles in Asbestos Exposed Workers with Asbestosis

Henry J. Steer[*1], Bruce W.S. Robinson[2,3]

[1]*Research Fellow, University of Western Australia, Sir Charles Gairdner Hospital*

[2]*Consultant Respiratory Physician, SCGH, Perth,, Sir Charles Gairdner Hospital*

[3]*Director, National Centre for Asbestos Related Diseases, Sir Charles Gairdner Hospital*

**Corresponding author: Dr. Henry J. Steer, Research Fellow, University of Western Australia, Sir Charles Gairdner Hospital, Perth, 6008, Australia, Tel: +61893463494; E-mail : henrysteer@hotmail.com*

Received: 04-30-2015

Accepted: 06-15-2015

Published: 06-23-2015

Abstract

Background The presence of basal crackles is an important indicator of asbestosis, along with high resolution CT (HRCT) scan and pulmonary gas transfer abnormalities. In areas where neither HRCT scanning nor gas transfer measurements are readily available, the presence of basal crackles is commonly relied upon as an indicator of asbestosis in asbestos-exposed individuals. However, because crackles can sometimes be heard in the axillae we set out to determine the prevalence of both axillary and posterior basal crackles in patients with asbestosis.

Methods Examination findings and other radiological and physiological parameters were assessed in 70 asbestos exposed workers with bilateral crackles who were seen in a specialist asbestos clinic.

Results Biaxillary crackles (61/70) were more common than bibasal crackles (46/70). Bibasal crackles were present in 32/46 (70%) and biaxillary crackles in 41/46 (89%) of those with asbestosis on CT. 24 patients did not have fibrosis on CT despite the presence of fine, late inspiratory crackles characteristic of asbestosis.

Conclusions Over a quarter of cases of CT evident asbestosis presented with axillary rather than bibasal crackles. Crackles characteristic of asbestosis can also be heard in asbestos exposed workers in the absence of CT changes. This data suggests that clinical screening for asbestosis should include careful auscultation of the axillary areas in addition to the posterior lung bases.

Keywords: Asbestosis; Auscultation; Axilla; Crackles; Occupational Exposure

Introduction

Asbestos exposure can cause progressive fibrosis, known as asbestosis. It is essential to be able to detect the earliest changes of asbestosis in any worker exposed to asbestos to ensure that no further asbestos inhalation occurs. The World Health Organization says that 125 million workers are still exposed to asbestos. Each year, over 2 million metric tonnes of asbestos are mined, much of it used in developing countries, particularly in Asia [1,2]. As cost and availability limit the availability of sophisticated imaging and functional testing, clinical screening remains and important tool for local physicians as they screen workers for early asbestosis. Careful clinical examination for the presence of crackles ('crepitations', 'rales') may be the primary screening tool for many asbestos exposed workers.

The presence of bilateral, basal, posterior crackles has been used as a useful indication of the presence of asbestosis in virtually all medical definitions and published diagnostic criteria. American Thoracic Society guidelines for the diagnosis of asbestosis have recommended that the clinical finding of bilateral crackles at the posterior lung bases is of value in the assessment of asbestos exposed workers [3,4]. This is supported by a recent consensus statement from the American College of Chest Physicians [5].

Fine, end-inspiratory crackles are common in patients exposed to asbestos [6-9] and many of these patients will have evidence of asbestosis on Xray or high resolution CT scan with associated reductions in lung function. Before the era of CT it was well recognised that crackles often occurred before changes in radiology and it was reported that crackles may be the earliest detectable sign of asbestos-induced alveolitis [7,10]. In addition, the degree of alveolitis, as determined by the numbers of inflammatory cells seen on bronchoalveolar lavage, was found to be no different between asbestos exposed workers with crackles and a normal chest xray and those with chest xray confirmed asbestosis, suggesting that radiology may not reflect the severity of the alveolitis [11]. However, few studies have looked at how crackles compare to HRCT findings of asbestosis and the clinical significance of crackles in persons with significant asbestos exposure but without asbestosis evident on CT is unknown.

Although the posterior basal regions are traditionally examined for crackles, in our experience crackles due to asbestosis are often heard in the axillae, an area which can be overlooked during routine chest examination. We therefore set out to determine, in a population of asbestos-exposed individuals with bilateral crackles whether axillary or basal crackles were more prevalent and how they correlated with CT and other physiological parameters. Our study shows that examination of axillary regions for the presence of crackles is an essential component of screening examinations.

Methods

Subjects were identified prospectively from patients referred to a specialist asbestos clinic. All patients had significant occupational asbestos exposure. The presence of crackles was assessed in both lung bases posteriorly and in both axillae in the anterior and posterior axillary line. Patients were included in the study if fine, late inspiratory crackles were present at one or more of these sites on both sides of the chest. Auscultation was performed on inspiration from functional residual capacity with the patient standing. Two deep breaths were taken prior to auscultation to clear any transient crackles due to atelectasis. All patients were examined by one physician experienced in the assessment and management of asbestos related lung disease and blinded to the results of the patients' HRCT or physiological findings (BWSR). Subjects were excluded if they had any evidence of alternative causes for the crackles, in particular cardiac failure, bronchiectasis, bronchiolitis, emphysema or any other non-asbestosis diffuse interstitial lung disease. Lung function was assessed by body plethysmography and measurement of carbon monoxide diffusing capacity. For total lung capacity (TLC), carbon monoxide diffusing capacity (TLCO) and carbon monoxide diffusing capacity corrected for alveolar volume (KCO), a value of less than 80% of the predicted value was defined as abnormal. Airway obstruction was defined as a forced expiratory volume to forced vital capacity ratio (FEV1/FVC) of less than 70%. High resolution CT scan was interpreted in accordance with published descriptions of asbestosis, including subpleural lines, parenchymal bands, interlobular septal thickening and honeycombing [12,13]. Ethics approval and signed informed consent was not obtained as all observations made were recorded as part of usual clinical care. Categorical data was analysed by Fishers exact test or a Chi squared test and parametric data was analysed by a Students t test.

Results

70 subjects fulfilled inclusion criteria for the study. The mean age of subjects was 71 (range 54 – 78), all of whom were male and had been exposed to asbestos. 19 had never smoked, 2 were current smokers and 49 were ex-smokers with a mean time since quitting of 24 years.

All 70 patients had crackles bilaterally on examination, in either the axillae or the lung bases. Of these, 46 (66%) patients had bibasal crackles, 61(87%) patients had biaxillary crackles and 3(4%) patients had unilateral basal crackles with contralateral axillary crackles. Thus, if only basal crackles had been considered 34% of patients with truly bilateral crackles would have been missed.

CT findings

All patients apart from one had pleural plaques and these were

bilateral in all but two. 46 of 70 patients had evidence of asbestosis on HRCT. Smoking history in pack years was significantly associated with asbestosis on CT. There was no association between the distribution of crackles and the presence or absence of asbestosis on CT (Table 1). Bibasal crackles were present in 32 of 46 patients with asbestosis on CT whereas biaxillary crackles were present in 41 of 46. Thus, failure to look for axillary crackles would have missed 14 out of 46 (30%) cases of CT evident asbestosis in this series.

Table 1. Summary of clinical and physiological findings in patients with and without asbestosis on CT.

	Asbestosis on CT (n=46)	No Asbestosis (n=24)	
Unibasal + C/L axillary	1	2	
Biaxillary crackles only	13	8	
Bibasal crackles only	4	2	
Bibasal + biaxillary	28	12	NS[1]
TLC (% predicted; 95% C.I)	84.5 (78.9-90.0)	87.8 (81.5 - 93.9)	NS[2]
FVC (% predicted; 95% C.I.)	86.4(80.4-92.4)	92.0(84.3-99.6)	NS[2]
FEV1 (% predicted; 95% C.I)	82.7(76.4-88.9)	91.3(82.3-100.2)	NS[2]
FEV1/FVC Ratio (%; 95% C.I)	74.3 (70.8 -77.8)	76.5 (71.7 - 81.35)	NS[2]
TLCO (% predicted; 95% C.I.)	78.3 (72.4 - 84.3)	93.45 (83.3 - 103.6)	p=0.007[2]
KCO (% predicted; 95% C.I)	99.7(92.5-106.7)	110.3(107.8-119.8)	NS[2]
Breathlessness	45 of 46	18 of 24	P=0.006[1]
Smoking hx (Pack yrs; 95% C.I)	25.1 (18.9 - 31.4)	13 (7.6 - 18.4)	p=0.01[2]

[1]Chi squared test, [2] Student T test.

Functional impairment

Subjects with asbestosis on CT scan had a significant reduction in carbon monoxide diffusing capacity (TLCO) compared to those without asbestosis, however there were no significant differences in other lung function parameters (Table 1). Breathlessness was significantly correlated with the presence of asbestosis on CT (Table 1). However, the distribution or extent of crackles did not correlate with breathlessness or carbon monoxide diffusing capacity.

Patients with crackles but without asbestosis on CT

There were 24 patients with bilateral crackles but without asbestosis on CT. However, only 6 of these had a diffusing capacity (TLCO) less than 80% predicted. 4 of these patients had reductions in both TLCO and TLC and in only 1 of 6 was the diffusing capacity abnormal when corrected for alveolar volume. It is possible therefore that the reduction in TLCO may, at least in part, have been due to restriction from asbestos related pleural disease. In addition 1 of the 6 with low diffusing capacity had both a significant smoking history and an FEV1/FVC ratio less than 70%, implying smoking related lung damage may also have contributed. In only 1 of 24 patients with bilateral crackles but without asbestosis on CT did we find impaired lung function which could not be attributed to either smoking or restriction from pleural disease.

Discussion

The majority of asbestos usage today occurs in areas where CT scanning and lung function testing may not be readily available, particularly Asia. As a result, clinical examination plays an important role in screening for asbestosis in asbestos exposed workers, and the presence of posterior basal crackles has long been regarded as the most useful clinical finding. The presence of fine, late inspiratory crackles in asbestos workers has previously been reported in 18 – 32% of asbestos workers [6-9].

Axillary v posterior basal crackles

In our group of asbestos exposed workers with crackles, axillary crackles were more common than basal crackles. Examining the bases without examining the axillae would have missed 30% of cases of CT evident asbestosis in this group. This is at odds with most published definitions of asbestosis which suggest that posterior basal crackles are the most characteristic clinical feature [3,4]. This finding highlights the importance of including axillary auscultation in respiratory examinations and has significance for those involved in the clinical or medico-legal assessment of asbestos exposed workers. It would be important to document the presence or absence of both posterior basal and axillary crackles in such patients.

Crackles v imaging

Over a third of patients with persistent fine, late inspiratory crackles did not have CT evidence of asbestosis. The presence of crackles in the absence of changes in radiology or lung function has been noted previously in 22% of asbestos workers [7], although this was before the use of HRCT. HRCT is more sensitive than chest xray at detecting early asbestosis [13], however no studies have looked at the clinical significance of crackles in those exposed to asbestos but without CT changes. Al Jarad found bibasal posterior crackles on auscultation in 19% and 10% of asbestos workers without evidence of asbestosis on CXR and HRCT respectively [6]. These were of similar character on time expanded wave form analysis to those seen in asbestosis and therefore were felt to represent early asbestosis.

Crackles and early asbestosis

We excluded patients with alternative causes for crackles,

such as cardiac failure or other respiratory diseases. Although many of our group were smokers, the crackles heard in COPD are qualitatively different from those of interstitial lung disease and are usually heard early in the respiratory cycle [14]. In the absence of alternative causes, it is plausible that the characteristic crackles we heard in asbestos exposed subjects without fibrotic changes on CT reflect a mild asbestos induced alveolitis. However it is not proven whether this might represent an early, pre-clinical phase of a progressive process, or whether some patients exposed to asbestos develop a mild subclinical alveolitis which does not progress to fibrosis. Epler found that of 22 asbestos exposed workers with fine bilateral crackles who did not meet diagnostic criteria for asbestosis, 6 developed asbestosis within 6 years, suggesting that crackles in this circumstance may reflect early, progressive disease in a significant proportion of patients [10] However, this study was before the era of CT, which has a greater sensitivity than chest xray in detecting early asbestosis.

In this study, we did not find evidence that crackles in the absence of CT changes reflected functionally significant lung damage, as only 1 out of 24 of these workers had impaired lung function which could not be explained by restriction from pleural disease or by smoking related lung damage. Further follow up of this cohort is planned to determine whether they are at risk of developing progressive interstitial disease over time.

In summary we found that axillary crackles were more common than basal crackles in asbestos exposed workers. Failure to examine for axillary crackles would have missed around a third of cases of CT proven asbestosis in this series. In addition, in asbestos exposed persons, crackles suggestive of asbestosis can be heard in the absence of HRCT changes. The clinical significance of crackles in this situation is still to be determined but we would support the removal of such workers from further exposure to asbestos.

Acknowledgement

BWSR conceived the study and collected the clinical data.

HS performed data analysis. HS and BWSR wrote the manuscript.

Conflict of Interest

No competing interests to declare

References

1. World Health Organisation. International program on Chemical Safety. Asbestos.

2. The Centre for Public Integrity. Public Health: Asbestos: Dangers in the dust.

3. American Thoracic Society. Medical Section of the American Lung Association: The diagnosis of nonmalignant diseases related to asbestos. Am Rev Respir Dis. 1986; 134(2): 363-368.

4. American Thoracic Society. Diagnosis and initial management of nonmalignant diseases related to asbestos. Am J Respir Crit Care Med. 2004, 170(6): 691-715.

5. Banks DE, Shi R, McLarty J, Cowl CT, Smith D et al. American College of Chest Physicians consensus statement on the respiratory health effects of asbestos. Results of a Delphi study. Chest. 2009, 135(6): 1619-1627.

6. al Jarad N, Strickland B, Bothamley G, Lock S, Logan-Sinclair R et al. Diagnosis of asbestosis by a time expanded wave form analysis, auscultation and high resolution computed tomography: a comparative study. Thorax. 1993, 48(4): 347-353.

7. Murphy RL, Jr., Gaensler EA, Holford SK, Del Bono EA, Epler G. Crackles in the early detection of asbestosis. American Review of Respiratory Disease. 1984, 129(3): 375-379.

8. Shirai F, Kudoh S, Shibuya A, Sada K, Mikami R. Crackles in asbestos workers: auscultation and lung sound analysis. British Journal of Diseases of the Chest. 1981, 75(4): 386-396.

9. Workum P, DelBono EA, Holford SK, Murphy RL Jr. Observer agreement, chest auscultation, and crackles in asbestos-exposed workers. Chest. 1986, 89(1): 27-29.

10. Epler GR, Carrington CB, Gaensler EA. Crackles (rales) in the interstitial pulmonary diseases. Chest. 1978, 73(3): 333-339.

11. Robinson BW, Rose AH, James A, Whitaker D, Musk AW. Alveolitis of pulmonary asbestosis. Bronchoalveolar lavage studies in crocidolite- and chrysotile-exposed individuals. Chest. 1986, 90(3): 396-402.

12. Aberle DR, Gamsu G, Ray CS. High-resolution CT of benign asbestos-related diseases: clinical and radiographic correlation. American Journal of Roentgenology. 1988, 151(5): 883-891.

13. 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(6): 1502-1508.

14. Piirila P, Lehtola H, Zitting A, Kivisaari L, Koskinen H, et al. Lung sounds in asbestos induced pulmonary disorders. Eur Respir J. 2000, 16(5): 901-908.