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Attached is an addendum to the talk given by H. C. Lewinsohn at the GOHC/GSC meeting held in Danbury, February 7-9, 1983.

R. R. Rankin

RRR/pob
Attachment

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Criteria for the Diagnosis of Asbestosis and Considerations in the Attribution of Lung Cancer and Mesothelioma to Asbestos Exposure

Prepared by the Medical Advisory Panel* to the Asbestos International Association

Section 1 — Asbestosis

Definition

Asbestosis is a diffuse fibrosis of the parenchyma of the lung caused by exposure to respirable airborne asbestos fibres. The fibrosis is irreversible and in some persons progresses even after exposure has ceased.

Criteria for Diagnosis

1.1. History. There should be evidence of substantial occupational exposure (or substantial para-occupational exposure) to asbestos fibres.

1.2. Clinical Signs and Symptoms. Persistent basal inspiratory crepitations characteristic of interstitial pulmonary fibrosis may be heard but are not invariably present. Breathlessness and finger clubbing occur but are not specific signs in themselves.

1.2.1. Crepitations (Crackles). These are fine basal inspiratory crepitations, usually bilateral which occur late in inspiration and persist after coughing or hyperpnoea. They are characteristically heard with each inspiration and on each occasion present very much the same pattern of sound. They are not essential to the diagnosis any more than they are pathognomonic of the disease. However, when not accounted for by another cause and when heard on at least two occasions a few months apart, given a history of exposure and radiological evidence of dust disease, they do provide valuable confirmation of the diagnosis. In the presence of

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equivocal radiological change, basal crepitations as here defined are a strong indication for the diagnosis of asbestosis.

1.2.2. Abnormal Breathlessness. This, occurring initially on exertion, is a symptom of asbestosis. There are, of course, many other causes of breathlessness and these must be excluded. In those under routine medical surveillance a provisional diagnosis would probably have been made before disabling dyspnoea occurs.

1.2.3. Clubbing. This is a sign seen in many lung and other diseases including asbestosis where it may be of late occurrence. It develops slowly but the rapid development of finger clubbing, particularly if painful, in a person with asbestosis suggests lung cancer.

1.2.4. Dry Cough and Ill-defined Chest Pain or Discomfort. These can occur in asbestosis, but infrequently, and then only late in the progression of the disease. They are not specific and of little diagnostic significance.

1.3. Radiological Aspects. Radiographic evidence of predominantly basal diffuse interstitial fibrosis is the characteristic change seen.

1.3.1. So that films are comparable they must be of good technical quality and of full size (approximately 350 mm × 430 mm and to include both costo-phrenic angles). Ideally, inspiration should be such as to have brought the diaphragm below the fifth rib anteriorly and the tenth rib posteriorly.

1.3.2. The recording of pulmonary changes on the radiograph follows the system used in the ILO Classification[1]. This system describes irregular or linear opacities as follows:

i) Small (s) — width up to about 1.5 mm.
ii) Medium (t) — width over 1.5 mm and under 3 mm.
iii) Large (u) — width over 3 mm and up to 10 mm.

The changes may be of such profusion as to obscure the normally clear margins of the bronchovascular structures. Small (p), medium (q), or rarely, large (r) rounded opacities may also be present. In advanced disease the sharpness of the cardiac and diaphragmatic borders are sometimes obscured.

1.3.3. Pleural changes are commonly present and are often the first radiological indicator of exposure to asbestos. Diffuse or localised pleural thickening or circumscribed pleural plaques, with or without calcification, may occur and need not be associated with parenchymal fibrosis. Transient pleural effusions have been reported. The pleural abnormalities can be sufficiently extensive to obscure the lung fields and may, in rare cases, lead to impairment of lung function.

1.3.4. In individual cases a narrative report by the reader of the radiograph as well as an interpretation of the relationship between the observed appearances and the occupational history is helpful.

1.3.5. Where possible comparison of the most recent film with earlier films is highly desirable.

1 The ILO International Classification of Radiographs of Pneumoconiosis (1980) is designed to ensure international comparisons of radiological data. This classification is purely descriptive and was specifically designed for epidemiological purposes and not for evaluating an individual. Sets of films are obtainable from ILO Publications, International Labour Office, CH-1211, Geneva 22, Switzerland

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1.3.6. A dose response relationship has been demonstrated between the extent of asbestos exposure and the radiological parenchymal changes. Parenchymal change correlates in general with an adverse effect on the long-term prognosis of an individual. However, in the absence of mesothelioma, there is no adverse prognostic significance associated with pleural changes unless they are unusually severe.

1.3.7. Since pleural changes may occur in the absence of parenchymal fibrosis, the use of the term "pleural asbestosis" is undesirable.

1.3.8. Other causes of radiological changes must be carefully excluded prior to making the diagnosis of asbestosis. This is important in the early stages of the disease when the radiological changes are slight.

1.4. Other Investigations. 1.4.1. Asbestos (Ferruginous) Bodies. When a productive cough is present asbestos fibres or ferruginous bodies in the sputum are evidence of exposure to asbestos but are not diagnostic of asbestosis.

1.4.2. Biopsy is very seldom justified as a diagnostic procedure for asbestosis. The effects of exposure should already have been recognised on the grounds outlined in the foregoing criteria. Biopsy is justified if it is thought that an asbestos-exposed patient may be suffering from some other potentially treatable lung disease. Any surgeon about to conduct a throacic operation on a person known to have been exposed to asbestos should be asked to obtain a specimen of lung tissue for histological examination.

1.5. Lung Function Abnormalities. The characteristic abnormalities are those of restrictive lung disease.

1.5.1. It is recommended that the FVC, FEV_1 and FEV_1/FVC ratio be recorded routinely in standard fashion. A comparison of periodic lung function testing over a number of years is of much greater value than a single observation compared to the standard "normal" values. In assessing the results, allowance must be made for certain ethnic differences and the effects of smoking habits.

1.5.2. While a restrictive pattern is consistent with the diagnosis of asbestosis, it is not specific to this disease. Asbestosis may develop with little or no detectable restrictive defect in the early stages. A predominantly obstructive picture is uncommon in the absence of a smoking history.

1.5.3. More sophisticated measurements in the assessment of restrictive lung disease (e.g. the measurement of transfer factor and lung compliance) are diagnostically helpful, but are not essential to the routine medical surveillance of a group of asbestos-exposed workers.

1.6. Differential Diagnosis. When there are clinical, radiological, or lung function abnormalities in asbestos workers, the exclusion of simulative disease is necessary for the correct management of the individual. This is increasingly important as, with improving occupational hygiene standards, asbestosis becomes less common.

1.7. Comment. The art of diagnosis, always a matter of weighing probabilities and looking at the total evidence, demands expert judgement based on the interpretation of the above criteria. Each of them is on a scale of severity and it is possible to find high values in some, low values in others, or any permutation or

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combination of criteria in the individual cases. According to the circumstances the elements of the decision and action will vary.

Section 2 — Mesothelioma

2.1. Diffuse malignant mesothelioma of the pleura or peritoneum is a rare primary tumour in the general population. When attributable to asbestos the latent period between initial asbestos exposure and onset of the disease is usually 20 to 40 years or longer.

2.2. It must be emphasized that the definitive diagnosis of mesothelioma is not easy. In asbestos workers it may be associated with asbestosis though the level of fibrosis can be minimal. In some cases there is no evidence of fibrosis even at necropsy. Mesothelioma may occur after relatively brief but intense asbestos exposure. While pleural abnormalities are common in asbestos workers, there is no conclusive evidence that of themselves they predispose to mesothelioma. Early suspicion of the presence of pleural mesothelioma arises when pleural effusion or chest pain occurs in an asbestos worker. The tumour may completely encase the lung. Peritoneal mesothelioma may occupy a large amount of the abdominal cavity and produce ascites with or without abdominal pain. Metastases, although rare, can affect other organs, but local spread is the usual mode of progression. Hitherto no treatment has been successful, the outcome being invariably fatal.

2.3. Ideally, the diagnosis will be based on careful necropsy in which particular attention is given to excluding the possibility of a primary cancer at some distant site. Furthermore, the tumour tissue should be referred to one of the established mesothelioma reference panels so that histopathologists especially skilled in the diagnosis of this tumour may give their opinion. Such panels now exist in many countries.

2.4. While cases of mesothelioma may arise in the general population with no obvious cause, the majority of mesothelioma cases are related to asbestos exposure. The proportion of cases attributable to asbestos exposure varies; it is greatest in the more highly industrialised communities, especially those with a large shipbuilding or ship repairing industry. In industrial populations generally, most mesothelioma cases may be ascribed to asbestos although even in these communities no relationship with asbestos can be established in a proportion varying from 10% to over 30%. In other groups which have been adequately studied, the proportion of mesothelioma cases associated with asbestos exposure is lower but variable. Not all mesotheliomata are due to asbestos; e.g. endemic mesothelioma in some areas of Turkey is believed to be due to a fibrous form of zeolite.

2.5. Smoking habit plays no part in the genesis of mesothelioma as far as can be determined at the present time.

2.6. This tumour is relatively uncommon even among those who have had substantial asbestos exposure. Many believe that the risk of developing mesothelioma is greatest with crocidolite, less with amosite, and apparently less with chrysotile, while anthophyllite appears never to have caused mesothelioma in

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humans. This opinion, however, does not enjoy unanimous support and some authorities hold that there is no justification for differentiating between the various kinds of asbestos and their biological effects.

2.7. There is epidemiological and pathological evidence of an exposure-response relationship between inhaled asbestos and tumour formation. Recent work does not support the often stated idea that any slight, casual or brief asbestos exposure may lead to mesothelioma.

2.8. The long latency period between asbestos exposure and the development of the tumour makes elucidation of a dose-response relationship difficult. Thus, the effects of good dust control on the incidence of mesothelioma will only be determined in the future.

Section 3 — Lung Cancer

3.1. Cancer of the lung is the most common form of cancer in males in industrialised countries, and the primary cause is cigarette smoking. In asbestos workers who smoke, it is many times more common than in members of the general population who are not exposed to asbestos and who do not smoke.

3.2. Epidemiological studies have shown that the risk of bronchogenic cancer is greater at higher levels of asbestos exposure. Non-smoking asbestos workers under the conditions of past exposure appear to be at greater risk than non-smokers in the general population. Even so, these non-smoking asbestos workers are at less risk of bronchogenic cancer than cigarette smokers who have not been exposed to asbestos in the general population. There is also epidemiological evidence that the lower levels of past exposure to asbestos do not pose a detectable excess risk of bronchogenic cancer.

3.3. There are no specific pathological features by which an individual case of lung cancer can be attributed solely to asbestos exposure.

3.4. An adeno-carcinoma situated peripherally and particularly in a lower zone, is the type of tumour more likely to occur in a worker exposed to asbestos more than fifteen years previously. This is especially so in the presence of asbestosis.

Section 4 — Cancer of Other Sites

4.1. The evidence relating asbestos to cancer of other sites is equivocal and further data are awaited.

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The Medical Surveillance of Persons Exposed to Asbestos

HILTON C. LEWINSOHN, M.B.

ABSTRACT — This paper will briefly review the techniques which allow persons exposed to asbestos to be kept under surveillance.

The pre-placement evaluation procedure and its usefulness is discussed.

The periodic medical evaluation is described and an outline of the essential requirements is given. The role of radiological surveillance is briefly discussed.

The point is made that both the exposed persons and their management place reliance upon the physician to inform them of adverse findings so that the problem of alternative employment and future protection can be dealt with in a sound and equitable manner.

Medical surveillance should continue for the lifetime of the individual once exposure has been documented and post-retirement or post severance examinations should be provided whenever practicable.

Asbestos-related diseases can be preveneted by good industrial hygiene practices and engineering controls. The physician is able to intervene at the interface between worker and work and hopefully alter the final outcome to the good.

Introduction

Exposure to asbestos in various industries and occupations has been associated with three major lesions involving the intrathoracic organs. Asbestosis, first recognized at the beginning of this century, is a form of interstitial pulmonary fibrosis which has been shown to be related to the dust levels in the workplace and to be dependent upon the duration of such exposure. Lung cancer in heavily exposed workers in industries such as insulation, construction, ship-building and asbestos textiles manufacture, has been adequately documented and related to asbestos exposure. Asbestos exposed persons who smoke cigarettes appear to have a 90 times greater chance of dying from lung cancer than non-smoking non-asbestos exposed persons.[1] The third condition to be associated with exposure to asbestos is diffuse malignant meso-

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thelioma of the pleura (or peritoneum).[3] Unlike asbestosis and lung cancer, this rare tumor has been more difficult to characterize in terms of dose-response and pathologic features.

Less clear-cut associations have been described by some observers between asbestos exposure and cancers involving the gastrointestinal tract[1,4] and cancers in other organs such as the larynx[5] or renal organs.[6] Cancer of the ovary in women has been ascribed to asbestos exposure.[7] It is suggested that the cases described were actually of peritoneal origin and due to malignant mesothelioma of the peritoneum. It may be difficult to distinguish ovarian carcinoma from peritoneal mesothelioma.

Because of its increasing and widespread use in the U.S.A. in many industries during the past 50 years, lasting up until very recent times, it has been estimated that millions of people have been exposed in various ways to various varieties of asbestos.[8]

The asbestos-related diseases are not readily amenable to therapy. Asbestosis is slowly progressive, the outlook for the person with lung cancer is very poor and diffuse malignant mesothelioma of the pleura or peritoneum is invariably fatal within a short period of time after diagnosis. The physician practicing in the industrial environment is faced with a dilemma of severe proportions when attempting to intervene or prevent undue suffering on the part of exposed individuals, but with diligence and perserverence can definitely exert a meaningful influence.

Physicians whose practice includes providing a service to industry must be actively involved with workers and management, must be completely familiar with the properties of asbestos in use, must understand the manufacturing processes in the plant and have a clear concept of the plant design and layout. The doctor who has taken the trouble to become educated in this way will be better equipped to manage the health of people at work. In addition to gaining practical experience of the workplace, the physician also needs to gain a thorough working knowledge of the etiology, pathogenesis, epidemiology and therapy of work-related diseases. The physician should acquire a working knowledge and appreciation of the theory and practice of industrial hygiene, including an understanding of sampling and monitoring procedures.

The role of the physician is to insure that industry employs people who are suited to the tasks required of them and that they do not suffer injury or illness as a result of the work they are called upon to do.

Pre-Placement Medical Evaluation of Persons Exposed to Asbestos

The pre-placement medical evaluation is designed to determine the suitability of the employee for the job and the suitability of the particular job for the individual concerned. When asbestos exposure is likely the workplace conditions must be known before decisions can be made about a prospective employee with medical contraindications to such employment. As the result of experience already gained in the development of medical surveillance programs, the suitability of prospective employees for the specific tasks in question may be estimated and based upon defined selection criteria.[10] Applicants should be appropriately counseled regarding their fitness or otherwise for employment in an asbestos-exposed occupation and if any restrictions need to be imposed on medical grounds they should be indicated to the applicant and the employer prior to placement in the job. There are certain broadly defined conditions which should contraindicate employment: a history of previous work in another industry with a recognized dust hazard such as coal mining or stone quarrying, an existing pulmonary disability due to pneumoconiosis or from any other source, the presence of obstructive airways disease with or without emphysema, asthma, and organic heart disease. Other contraindications to employment in a dusty job which have been recommended are: (1) Nasal obstruction or deformity of such a degree as to make the wearing of a dust mask difficult or impossible, (2) gross physical deformity of the chest such as scoliosis or kyphosis, or as a result of thoracic surgery, (3) chronic bronchitis, bronchiectasis or emphysema, (4) gross hypertension with cardiac impairment and (5) the presence of rheumatoid arthritis.

Apart from identifying people who should not be employed in dusty work, the pre-placement evaluation serves the purpose of establishing base-line data for longitudinal prospective follow-up. The data which should be incorporated in the medical records for this purpose are summarized in Tables 1 and 2 and conform with the requirements of the Occupational Health & Safety Administration's "Asbestos Standard."

Table 1

Identification characteristics required to establish a data base for long term follow-up of asbestos workers.

A. 1. Name (include maiden name for married women)
   2. Identification number (social security number, etc.)
   3. Date of Birth
   4. Place of Birth
   5. Address
B. 1. Name of spouse
   2. Identification number of spouse (social security number, etc.)
   3. Spouse's date of birth
C. 1. Names, dates of birth, addresses and identification number of children
D. 1. Employee's company I.D. number (clock no., etc.)*
   2. Employee's occupation (job description, including raw materials handled)
   3. Latest dust levels in job and department

*The employee I.D. number should never change and should be reallocated to the same employee upon rehiring after termination of employment.

The physician should take the opportunity which the pre-placement evaluation affords to counsel and advise the job applicant regarding the known facts about asbestos-related diseases. It is essential to emphasize the special risks the person will run if he or she smokes cigarettes and every effort should be made to discourage the habit.

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Table 2

Minimum requirements to be recorded to establish a data base for long term follow-up of asbestos workers.

Complete, detailed, occupational history since leaving school
Family history
Smoking history
Social history (drugs, alcohol, etc.)
Previous illnesses of note, especially respiratory ailments
Detailed respiratory symptoms history (MRC or ATS Respiratory Symptoms Questionnaire)
Vital and physical signs
Special investigations: 17" x 14" Postero-anter chest roentgenogram*
Measurement of lung function (ventilatory capacity, lung volumes, gas transfer, etc.)
Sputum cytology (value not proven in screening)
Measurement of angle between nail and cuticle to document appearance of clubbing of fingers.

*Oblique views, and occassionally lateral views, may be required to clarify pleural abnormalities.

It has previously been pointed out that the pre-placement medical evaluation "is an essential tool for use in the medical supervision of asbestos workers because it establishes the principles upon which future management will be based. It gives the prospective applicant an insight into the seriousness of the problem and enables the physician to recommend suitability, limited suitability or total unsuitability of the individual for the job. The opportunity which the pre-placement physical examination provides for the medical staff to counsel the individual and establish rapport is unique and should not be missed. This period in the career of the job applicant provides the best opportunity for the recording of identification details and verifying them, in order to establish the data base for long-term follow-up."[12]

Periodic Medical Evaluation

Persons exposed to asbestos in their occupation should be kept under medical surveillance. The object of periodic examinations is not only to determine changes in the physical condition, physiological status or radiological appearances of the exposed person but also to re-evaluate the workplace conditions and the individual's suitability to continue doing the same job. Medical findings can be recorded on an ongoing basis to allow comparison from one examination to the next. The periodicity of the evaluation process will depend upon demonstrated need and available man-power as well as regulatory requirements. The Occupational Safety and Health Administration promulgated the Asbestos Standard (CFR 1910.1001) in July 1972.[11] Section 1001(j)(3) requires that every employer shall provide, or make available, at least annually, comprehensive medical examinations to each employee engaged in an occupation exposed to airborne concentrations of asbestos fibers. The minimum requirement is for "a chest roentgenogram (posterior-anterior 14 x 17 inches), a history to elicit symptomatology of respiratory disease, and pulmonary function tests to include forced vital capacity (FVC) and forced expiratory volume at 1 second ($FEV_{1.0}$)."

Periodic medical evaluation is designed to detect the biological effects of inhalation of asbestos as early as possible and hopefully at a stage when removal from further occupational exposure to asbestos may arrest or significantly delay the progress of asbestosis or the occurrence of other asbestos-related conditions. Epidemiologic evidence of the value of this procedure is not yet available and the changing environmental conditions in the workplace throughout the asbestos industry over the past fifty years only serves to confuse the issue when attempting to assess the value of early diagnosis.[13]

The periodic evaluation should include a physical examination even though the OSHA standard does not specify it. The examiner should concentrate on the physical signs associated with pulmonary fibrosis such as bilateral end-inspiratory fine crackles at the lung bases, finger-clubbing and breathlessness. In the case of long-service employees, especially heavy-smokers, the possibility of lung cancer should always be borne in mind. Transient pleural effusions occur in asbestos workers.

The aim of radiologic surveillance of asbestos workers is to compare serial roentgenograms taken throughout the exposure period at regular intervals in order to detect the earliest changes which would result in deciding whether the individual should be advised to consider alternative employment. Radiographic evidence of predominantly basal diffuse interstitial fibrosis is the characteristic change seen. The Medical Advisory Panel (MAP) of the Asbestos International Association has prepared a document entitled "Criteria for the Diagnosis of Asbestosis and Considerations in the Attribution of Lung Cancer and Mesothelioma to Asbestos Exposure" which will become available in early 1982.[14] The MAP recommend that to ensure comparability of radiographs they must be of good technical quality, of full size (14" x 17") and both costophrenic angles should be visible. Ideally inspiration should be such as to have brought the diaphragm below the fifth rib anteriorly and the tenth rib posteriorly. The recording of changes on the radiograph should be in accordance with the ILO International Classification of Radiographs of Pneumoconioses (1980).[15]

Pleural lesions are often the first radiological indicator of exposure to asbestos. These changes may consist of diffuse or localized pleural thickening or circumscribed pleural plaques, with or without calcification, may occur and need not be associated with obvious parenchymal fibrosis. The pleural abnormalities can be sufficiently extensive to obscure the lung fields and may, in rare cases, lead to impairment of lung function.

It has been shown that whereas parenchymal radiographic patterns change in relationship to dust concentrations experienced over the course of time, pleural changes are related to length of exposure, irrespective of dose. Pleural changes probably represent an important radiologic sign which is part of a constellation of changes observed in low-grade exposure groups where parenchymal effects are less likely to be seen.[16]

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Weill[17] has attempted to evaluate the basis for clinical decision making by the physician evaluating patients who have had occupational exposure to asbestos. In an asbestos worker, definite radiographic evidence of diffuse pulmonary fibrosis, even if it is minimal in profusion or extent, should be an indication to advise the individual that further exposure to asbestos dust may increase the probability that the condition will progress with time. The greater the past cumulative dust exposure, the higher the probability of progressive pulmonary fibrosis according to Weill. Cessation of exposure is only likely to minimize the degree of progression of fibrosis and, because the excess risk for development of respiratory cancer has been shown to be dose-related, this should also be minimized by not adding further to the dust dose of individuals with radiographic signs of asbestosis.

Pleural thickening and pleural plaques are apparently related to length of exposure and time since first exposure but not to dose, and are not therefore likely to be influenced by modest additional exposure. Weill believes that when only pleural stigmata of asbestos exposure are present, continued medical surveillance and periodic evaluation is indicated but job transfer is not necessary. The patient should be told about the pleural lesions which have been noted so that the subsequent election to change to a job without further asbestos exposure can be considered if so desired.

In the past 5 or 6 years the use of computed tomography (CT) in the diagnosis of asbestos effects on lungs and pleura has shown that both types of lesion are seen more obviously than on conventional radiographs. This diagnostic technique is not yet a practical tool to add to the medical surveillance armamentarium but it is useful in early diagnosis. Early pleural plaques can be reliably diagnosed and are not confused with "companion" shadows adjacent to the ribs as in chest radiographs. Fine interstitial parenchymal disease can also be detected on CT when not visible on the chest radiograph according to Kreel.[18] By the time the changes of asbestosis have become visible on the chest radiograph, the changes on CT scan appear gross. The same author states that in one third of cases with unilateral pleural effusion there will be evidence on CT of pleural plaques particularly in the contralateral hemithorax. CT scans may thus be very useful in the diagnosis of mesothelioma and Kreel postulates that the finding of pleural effusion, rib destruction, pleural plaques or calcifications, intrapulmonary nodules and thickening of pleura, pleural fissures and paramediastinal structures especially at the bases and posteriorly should suggest this lesion. He also feels that the delineation of tumor nodules within effusions allows this tumor to be analyzed sequentially and better evaluated following treatment thus leading to improved therapeutic modalities.

In the periodic evaluation of asbestos exposed persons it is recommended that tests of lung function be used to determine the earliest defects possibly resulting from exposure. The measurement of the timed vital capacity components, namely, forced vital capacity (FVC), forced expiratory volume in the first second of expiration ($FEV_{1.0}$) and the ratio of these ($FEV_{1.0}/FVC$), should be routinely recorded. A restrictive pattern is consistent with the development of pulmonary fibrosis (asbestosis) but other causes should first be ruled out. A predominantly obstructive pattern is uncommon in the absence of a smoking history. A comparison of periodic lung function test results over a number of years is of much greater value in the follow-up of an individual than a single observation where comparisons can only be made to the "predicted normal value." Where facilities exist for more complete studies they should at least include measurement of lung volumes and the single-breath carbon monoxide diffusing capacity.

No mention has been made thus far of the role of sputum examination for exfoliative cytology. A proposal has been made in the United States that this should be performed routinely on persons with 10 or more years of exposure to airborne concentrations of asbestos fibers or who are 45 years of age or older.[19] A large-scale multi-institutional program designed to evaluate periodic screening for early stage bronchogenic carcinoma among asymptomatic asbestos workers is currently in progress.[20] Interim results do not indicate that sputum cytology is of overall benefit to screened individuals and "early data from studies of smoking men at high risk of lung cancer indicate that only one fourth of asymptomatic lung cancers are detected by sputum cytology and the remainder are detected by chest radiography."[21]

The value of the periodic medical evaluation depends upon the manner and thoroughness with which it is performed. The standardization of the protocol will enchance its early diagnostic capabilities. The strictest attention must be paid to the detail of radiologic and physiologic methods employed. It should always be borne in mind that the employee's attitude to periodic evaluation differs from that to the pre-placement evaluation and whereas the concerns at the time of the latter were job suitability, the concerns in the employee's mind at the time of the former are job retention.

Life-Long Surveillance

Persons who are exposed to asbestos should not only be kept under surveillance while exposed, but because of the lapsed interval between first exposure and the detection of biological effects, observation should continue at periodic intervals for the rest of their lives.

Retirees who receive pensions from employers should be easier to follow-up than persons who sever employment prior to reaching retirement age. Employers should endeavor to impress upon such employees the value of remaining under medical surveillance. The follow-up of retirees could be undertaken by means of a health questionnaire sent by mail and incorporating a reminder to each one to see a physician and have a chest radiograph

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taken. In some cases this could lead to the early detection of lung cancer and therapy which could prolong life and alleviate suffering.

Comments

The prevention of asbestos-related diseases depends upon engineering technology and dust control. The role of the physician is the prevention of ill-suited job-placement and intervention at the interface between worker and work. The technique of medical surveillance is merely one cog in the wheel which comprises the total effort required to safeguard employee health. The active collaboration of employer and employee in the surveillance program allows it to achieve significant results of benefit to both.

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