UNION CARBIDE HEALTH SAFETY AND ENVIRONMENTAL AFFAIRS

HILTON C. LEWINSOHN, MB.BCH., F.C.C.P.
Assistant Corporate Medical Director
P2590
(203) 794-5214

June 7, 1983

TO: Dr. S. Austin
Dr. B. Ballantyne
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Dr. T. G. Fortney
Dr. W. F. Gorham
Mr. V. H. Johnkoski
Dr. A. A. Lang
Dr. T. A. Lincoln

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J. B. CORNELL

The attached "abstracts" are from papers presented May 27-29, 1983 at the Thirteenth Annual Symposium on Chest Disease of the The Fleischner Society.

They may be of interest to you.

Hilton

OLD RIDGEBURY ROAD, DANBURY, CT 06817

ASBESTOS RELATED DISEASE:EPIDEMIOLOGIC & CLINICAL ASPECTS

Edward A. Gaensler

There are about 4 million persons alive today who have had heavy exposure to asbestos and an equal number with significant but lesser exposure (1). Among the several asbestos related disorders asbestosis, a term that should be reserved for pulmonary fibrosis (2), will remain an important but diminishing concern among the heavily exposed. The 3 pleural manifestations, hyaline plaques, benign asbestos effusion and mesothelioma, because of the lesser required exposure and long latent period, very likely will become increasing problems in all of the 8 million exposed persons. Concerning bronchogenic carcinoma, it is thought that 2 per cent of the 135,000 cases reported each year are related to asbestos exposure. Indeed, estimates of the percentage of all cancers caused by the single substance asbestos have varied from 1 to 18 per cent (1).

The radiologist's contribution in sorting out the asbestos related problems can be greatly enhanced by 1.) a strict adherence to accepted terminology and definitions, 2.) a working knowledge and use of the International Labor Organization Radiologic Classification of the Pneumoconioses, 3.)an effort to assemble old films for comparison, 4.) a detailed acquaintance with exposure history and with past history and 5.) an acquaintance with relevant epidemiology.

Asbestos: Fibrous hydrated silicates:Serpentine (chrysotile): white, curly, filamentous (90% of industrial use) and amphiboles, mainly Crocidolite (blue) and Amosite (brown). Others, including Anthophyllite and Tremolite mainly contaminants of talc.

Occupations at risk: (Incomplete list)

Process	Products (more than 3,000)	Occupations (Ex)
1. Production		
Mining, Milling	Asbestos Fiber	Mining,Crushing Transport, etc.
2. Primary use		
Spray Insulation	Fiber mixed with oil	Insulators, Construction
3. Manufacturing		
Textile	Cloth,Belts,Padding	Spinning,Card.
Cement Products	Roofing,Pipes,Gutters	Blending,cut.
"Paper" products	Felt,Electrical paper	Paper makers
Friction material	Gaskets,Clutch,Brake	Mixers,Blenders
Insulation	Pipe,Boilers,Bulkhead	Slurry,Chemical workers

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Process	Products	Occupations
4. Application		
New Construction	Boards,Tile,Siding	Carpenters, Laggers,Heat.
Repair,Demolition		
Shipbuilding	Insulation:Pipes,hull	Laggers,Pipe-coverers
"Repair, Refits	"	Direct & In-direct (all)
Automotive	Undercoating,brake,etc.	Service,body shop

Epidemiology:

a.) Disease is dose-related.Exposure may have been brief and massive or lower dose for many years.
b.) "Twenty-year rule": Regardless of severity of exposure, signs and symptoms today are never seen until 10 or 15 years later and usually not until 20 years later.
c.) Asbestos manifestations correlate best with years since first exposure rather than number of years exposed. Manifestations progress despite removal from exposure.

I. Asbestosis:

This term should be reserved for a pneumoconiosis consisting of a diffuse chronic pulmonary interstitial pneumonia and fibrosis due to respirable asbestos fibers. The term should not be used for other asbestos-related manifestations or disease (2).

Asbestosis is demonstrably dose related, requires a considerable dose and therefore is not seen with out-of-plant neighborhood exposure or in relatives.

Cigarette-smoking is not a co-factor; and COPD occurs in asbestos workers with the same frequency and severity as in controls matched for age, sex and smoking history (3).

Clinical Diagnosis is based on history of exposure at least 15 and more usually 20 years earlier and at least 4 of the following 6 signs and symptoms:

1.) X-Ray: Linear-irregular markings (usually of lower lung fields) of ILO severity 1/1 or greater
2.) Dyspnea of Fletcher grade 2 or greater
3.) End inspiratory crackles (cellophane or velcro rales in 2 or more areas)
4.) Definite finger clubbing (usually late manifestation)
5.) Vital Capacity less than 80% of predicted
6.) Single breath diffusing capacity less than 80% of pred.

A clinical diagnosis is made when 4 of 6 of the above manifestations are present. "Permanent and total disability"

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usually is associated with at least 2/2 radiographic profusion, an FVC of less than 50% and D_LCO of less than 40%. Lung biopsy should be required only in persons with a good exposure history but with atypical clinical or radiographic findings, or, on the contrary, when there are suggestive clinical findings but the exposure history is brief or unconvincing. The recently fashionable transbronchial biopsy may result in recovery of asbestos bodies but it is not a suitable technique for evaluating the presence or severity of interstitial pneumonia and fibrosis.

II. Parietal Pleural Hyaline Plaques:

The most recent I.L.O. classification distinguishes between diffuse pleural thickening and plaques or circumscribed pleural lesions (4). The latter, hyaline plaques, are the most common and also the most benign asbestos-related disorders.

Neither the early descriptions of the pathology of asbestosis nor the first clinical surveys in the 1930's called attention to parietal pleural lesions because at that time exposure was often severe and workers became disabled or died of asbestosis before plaques could form (5). Radiographic pleural calcifications of occupational origin were first noted in talc miners probably due to tremolite. Jacob and Bohlig (6) in their study of Dresden asbestos workers first mentioned calcifications as one of several roentgenographic features of asbestos exposure, and soon thereafter pleural plaques became established as markers of both occupational and non-occupational endemic asbestos exposure. More recent epidemiologic studies have led to the following generalizations concerning pleural plaques: (1) They are seen only following exposure to fibrous silicates. (2) Unlike asbestosis, they may result from casual, peripheral or neighborhood exposure. (3) They are rarely seen in less than 15 to 20 years after initial exposure. (4) Among asbestos workers first exposed 30 to 40 years ago, the prevalence may be as high as 35 to 60 per cent (5). (5) Only a small percentage of those present are seen radiographically. (6) They are an almost invariable finding at autopsy. (7) Plaques and calcifications occur on the parietal pleura and rarely cause pleural symphysis. The mechanism of their development is not known but probably they are due to mechanical rather than chemical irritation. (8) In the absence of asbestosis they are not harmful in that 1.) they are not associated with functional loss, 2.) they are not associated with symptoms and 3.) they do not predispose to other asbestos-related disease (CA, Fibrosis, Mesothelioma) compared to similarly exposed persons who do not have plaques. (9) Asbestos-related plaques and calcifications must be recognized and

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propery labeled as such by radiologists. This usually requires an occupational history and review of earlier films. Proper recognition of such lesions will avoid much anxiety, unnecessary surgery and unwarranted litigation.

III. Benign Asbestos Pleural Effusion:

Benign asbestos effusion was not described as an entity until 1971 and the several series of cases reported since then have been summarized recently (7). Our definition is based on 4 criteria: 1) direct or indirect exposure to asbestos, 2) an effusion confirmed by a transient pleural change in serial chest films, by thoracentesis or surgery, 3) lack of evidence for any other disease related to pleural effusions, and 4) no malignant tumor detected within 3 years after the effusion.

collected fluid

Such effusions may result from slight or peripheral exposure much as all the other pleural manifestations. However, the 20-year-rule does not apply in that they may occur earlier than the other asbestos-related disorders. Indeed benign effusion is the most common asbestos-related manifestation during the first 20 years after initial exposure (7).

A recent epidemiologic study of 1,135 exposed workers followed for 3 to 40 years revealed 35 cases (5.2%) of otherwise unexplained effusions compared to none in an unexposed control group of 717 persons observed over a similar period (7). Effusions generally were small, one-fourth recurred and two-thirds were asymptomatic. Incidence was related to exposure: there were 9.2 effusions per 1,000 person-years for individuals working directly with asbestos, 3.9 effusions for those working in proximity to asbestos use by others, and 0.7 for administrative and office personnel who worked in shipyards or asbestos plants but probably had insignificant exposure.

IV. Mesothelioma:

Malignant mesothelial tumors have been described for 100 years and, notwithstanding recent interest, they have remained rare with incidences from 0.8 to 2.1 per million per year. Approximately 20 per cent are primarily abdominal. A relationship to asbestos exposure was first described by Wagner et al (8) in 1960 and this is now generally accepted. The actual percentage of the some 1,000 mesotheliomas reported in this country each year that result from asbestos exposure is not clear. Large cancer centers have reported infrequent asbestos exposure, 13 to 27%, but occupational histories before 1960 clearly were deficient. Other series reporting 100% exposure have come from near shipyards

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or asbestos plants. Other types of exposure include long fiber Zeolites used for stucco and buildings. Sugar cane work, radiation and thorotrast cholangiography, as well as tuberculous empyema all have been associated with mesothelioma. McDonald and McDonald (9) have well summarized present knowledge by saying that the proportion of mesotheliomas due to occupational exposure is increasing but is certainly less than 100%, unlikely less than 50%, and probably accounts for two-thirds of all cases. They and others also have shown a gradient in mesothelioma-inducing potential from crocidolite down to chrysotile and anthophyllite.

Mesothelioma, much like the other pleural manifestations of asbestos exposure, may result from brief, slight or peripheral exposure - a finding of great concern. The latent period from initial exposure is usually very long, often 30 years or more and very rarely less than 20 years. Among asbestos workers the death rate from mesothelioma appears to be proportional to the third or fourth power of time from first exposure and is unrelated to smoking habits. The histologic diagnosis has remained difficult because the tumor arises from pleuripotential mesothelial cells and in consequence may present with widely varying histologic features. Three types are generally recognized: mesenchymal or sarcomatous, epithelial or tubolopapillary and mixed; additionally some tumors are poorly differentiated. Mesotheliomas are often diagnosed because of their typical gross appearance with spread along serosal surfaces, encasing of the lung by a continuous layer of tumor and failure to demonstrate a primary lesion in the lung. However, the same gross appearance may result from bronchogenic or metastatic tumors. These histologic problems explain why thoracenthesis or needle biopsy rarely proves diagnostic. In most of our cases a small open thoracotomy was required but thoracoscopy may be a less invasive alternative.

Mesotheliomas have not responded to any form of therapy. Pleuro-pneumonectomy or "debulking" entail high mortality and no improvement. Concerning recent chemotherapy, at Sloan-Kettering there were only 3 responses among 111 trials; and mean survival of treated and untreated cases has been the same: 9.1 vs. 9.6 months (10) and in our series it was 15.8 months for untreated vs. 12.4 months for chemotherapy.

V. Bronchogenic Carcinoma:

Case reports have accumulated since 1934 but it was not until 1955 that Doll (11) presented epidemiologic evidence

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of an increased prevalence. Although acceptance came slowly it is now concluded beyond any reasonable doubt that commercial asbestos is a cause of human lung cancer, though other agents such as tobacco, may enhance its effect. The relative risk (RR), a number that represents the observed divided by the expected number od deaths from a given disease, tabulated by Backlake (2) and by McDonald (12) for 18 major cohort studies has varied from 1 (no increased risk) to 17, with the lowest values, 1 to 5, in miners and millers and the highest, 8 to 17, in pipecoverers and insulation workers. The interaction of smoking to asbestos exposure as risk factors is most important in clinical practice. Lung cancer develops only very rarely in nonsmoking asbestos workers whereas the risk from smoking and asbestos is more than additive, and more likely multiplicative. A relationship to intensity of exposure has been difficult to demonstrate because dust concentrations were rarely measured until 10 or 15 years ago. However the best available data suggest that the dose response relationship is essentially linear, but steeper for asbestos manufacture than for mining. The increased risk appears at about 20 years after first exposure and reaches a peak at 30 years, although obviously there is an interaction between age and lung cancer mortality.

The question of causal relationship or attributability is not a great problem with asbestosis or hyaline plaques which are specific for asbestos nor even for mesothelioma when there has been significant exposure. With bronchogenic carcinoma the situation is quite different in that only 1-2% of all cases can be related to asbestos exposure. The probability that a given case of lung cancer is due to asbestos exposure is based primarily on two factors: the intensity of exposure and the time since first exposure. For example, data of Enterline et al (13) indicate no increased risk (RR = 1.2) for asbestos workers who were exposed to less than 10 million particles per cubic foot (mppcf) and who were first exposed less than 20 years ago, whereas RR rose to 4.7 for those who were first exposed more than 30 years ago to more than 10 mppcf. The time since first exposure can be identified whereas in clinical practice the intensity of exposure almost invariably must be inferred from clinical and histologic evidence.

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