ASBESTOS

Introduction

Asbestos is a generic term which includes a variety of fibrous materials. It has been used in Scandinavia, particularly, Finland, as early as 4500 years ago where it was used as a binder in pottery. It is not, however, until the past 100 years that asbestos has come into significant commercial use, and its increase in use has been remarkably fast for the past 60 years. There are presently at least 3,000 uses for this remarkable mineral.

The recognition of the health hazards posed by the use of asbestiforme materials has been relatively recent. The first clear case of asbestosis was reported in 1907. The first association with respiratory cancer occurring in people with asbestosis was in the 1940's. It was not until 1955 that an association with respiratory cancer in the absence of asbestosis was recognized.

The first pleural and peritoneal mesotheliomas began to be studied in 1955 and the study of this disease still requires much additional data.

The possibility that asbestos material may be a hazard to the community, and not only the asbestos worker, first became of serious concern in 1960. At times the level of concern has been higher than that justified by the known facts, but I have no doubt increasing attention will be paid to this factor in the future.

It is not until the past two years that sufficient evidence has developed to suggest that the presently "acceptable" levels of occupational exposure are too high. It can be reasonably predicted that the present level of acceptable exposure will be decreased shortly and new methods of establishing ambient levels will be prescribed.

We should very seriously keep in mind several potential types of exposure.

(1) The exposure of the asbestos worker.

(2) The exposure of other workers who do not work with asbestos, but are exposed incidental to its use by the asbestos worker.

(3) The family exposure through material carried home on clothing, etc., and,

(4) The potential for exposure to members of the community due to careless dissemination of airborne dust and careless disposal of asbestos-containing waste.

Types and Biologic Properties of Asbestos

There are five main types of asbestos which fit into two separate types, according to their crystalline structure.

Serpentine asbestos of which chrysotile is the only type, and,

Amphibole asbestos of which there are amosite, crocidolite, anthophyllite and tremolite.

The most commonly used is chrysotile.

The different types vary chemically, depending on the source, and contain many associated impurities both organic and inorganic. All types are associated with many trace metals. It would be realistic to assume that even the same type of asbestos coming from different sources will show some variation in biologic activity, and there is some evidence to this effect but it is not yet conclusive. Some factors that may influence biologic effects are:

(1) Chemistry;

(2) Trace mineral phases;

(3) Trace elements;

(4) Surface properties;

(5) Combination with other materials;

(6) Sorbed organics such as waxes and oils.

Some of the "contaminating" materials may be present at the mine, but others may be added at the mill or become contaminants during the use of the material, and the question of what part these contaminants play in the development of disease is not known.

Animal Toxicology

Various techniques for demonstrating the fibrogenic and tumorogenic properties of asbestos have been developed. The work of William E. Smith of Fairleigh Dickinson University is a good example. He has demonstrated both the fibrogenic properties and the tumorogenic properties by intrapleural injection in hamsters. This route of administration will produce tumors with many materials; however, it is of great interest that he produced some fibrosis but no tumors by the use of intrapleural fiberglass.

Intratracheal administration did not produce significant tumors unless benzpyrene was added, in which case he demonstrated a significant increase when the two substances were combined, an increase well above what would be expected from either substance alone. Work of this type lends support to the possibility that contaminants, such as those associated with cigarette smoke, will enhance the harmful effects in a human population.

Studies using cell cultures have tended to support the hazardous potential of asbestos.

Clinical Asbestos Disease

Too many epidemiologic studies have been done to quote them all here, but they have produced convincing evidence of the hazard of asbestos exposure.

There is information that in the chemical industry cases of outright asbestosis are very rare, but there is evidence that the other forms of asbestos disease are occurring with a significant enough frequency to merit serious attention.

Unfortunately, the present state of knowledge would indicate that once an exposure has occurred, asbestos disease will occur in a significant number of individuals even though they do not continue the exposure.

The disease occurs after a long lapse period of 20 - 30 years and, therefore, unless a very careful history is conducted the possible association with asbestos exposure may be missed.

The pathology produced by asbestos exposure is:

(1) classical asbestosis;
(2) pleural placques and calcifications;
(3) bronchiogenic neoplasms;
(4) certain G.I. neoplasms; and,
(5) mesotheliomas, both chest and abdominal.

The signs or symptoms of asbestos are initially basilar rales, followed by dyspnea and, eventually, cor pulmonale. Clubbing of the fingers may occur.

X-ray findings show a fibrosis of the lung fields which is usually, but not exclusively, basilar, mid-lung field adhesions, pleural placques and calcifications, "porcupine" heart and various other miscellaneous findings.

The signs and symptoms of malignancies are classical except that they more often begin peripherally and the classical atelectasis seen with malignancy of a mainstem bronchus may not be noted. Establishment of the etiology is based on careful history to seek out asbestos exposure and the association with classical pleural placques or calcifications. The incidence of mesothelioma, both pleural and peritoneal, is very low in the general population and its occurrence indicates the desirability of an extensive search for asbestos exposure in any such a patient.

Employee Health Surveillance

Studies indicate that at physical exam careful attention should be given to the appearance of basilar rales. The timed vital capacity searching for evidence of restrictive pulmonary disease is also very helpful, but only in looking for evidence of classical asbestosis.

X-ray surveillance will be more effective if a regular PA, an over-exposed PA, and both obliques are performed.

Frequency of chest x-ray is open to considerable controversy, but six month intervals appear to be an adequate compromise. Many people feel three months is better, but others feel that development of signs over a three-month period indicate such a highly malignant tumor that five-year cures are almost unknown. The outlook is grave under any circumstance once malignancy has developed. Since there is a long lapse time, some individuals suggest a decreased frequency of surveillance for the young individual and the individual whose exposure has been recent.

Smoking and Asbestos Disease

Smoking vastly enhances the chances of developing a malignancy and, in view of the continued poor outlook following removal from exposure, the discontinuance of smoking is a paramount preventive measure.

Environmental Control

The present level of 2 MPPCF is considered too high by a factor of at least six and shortly a new limit will be announced. This will be in the neighborhood of 2 fibers per cc with a 1 to 3 aspect ratio and counted under phase microscopy at a standardized magnification. The sampling method will probably be standardized to the use of the Casella personal air sampler. Additional, more exact, information should be released soon.

The establishment of a new industrial hygiene standard is based on the concept that there is a dose relationship between exposure to asbestos and the development of malignancy. Though there is suggestive evidence that this is true, many still disagree with this concept.

Community ambient air standards when developed can be expected to be much more stringent and, in exercising control of the work environment, extreme caution must be used to not inadvertently disperse asbestos-containing dusts to the other workers or to the community air.

The disposal of wastes must be such as to not increase the environmental hazard.

Control Techniques

The goal of all control techniques should be to avoid the exposure of all individuals to asbestos dust since the actual no effect level is still unclear.

Engineering Control Methods

(a) Substitution

(b) Isolation of process

(c) Local exhaust ventilation

(d) General exhaust ventilation

(e) Personal protective equipment (respirators should always be a last resort)

Control methods should be such as to not increase the hazard to other individuals.

Medical Control Methods

(a) Preplacement exam

(b) Periodic exams

(c) Rotation of jobs

(d) Limitation of time exposed

The "Asbestos Body"

This topic has not been broached until this point because it has so often been a red herring. Originally described as "curious bodies," these coated fibers containing iron have been called "asbestosis bodies." This is a completely improper term. These bodies may have cores made up of other materials and should be referred to as "ferruginous bodies" or "pseudo-asbestos" bodies unless the core content is actually known.

There is some question as to whether the uncoated asbestos fibre or fibril is not the real culprit. These uncoated fibers can only be seen by more exotic methods, such as electron microscopy, than are available to the usual pathologist.

Unless special techniques are used, the opinion of a pathologist rapidly scanning a slide under ordinary light microscopy cannot be accepted as good evidence that no ferruginous bodies or asbestos fibers or fibrils are absent.

The presence of these bodies must raise suspicion, but disease cannot be completely ruled out in their absence. (They are seldom identified in pleural plaques or tumors.) Conversely, the presence of such bodies does not confirm the existence of asbestos disease.

The general population is exposed to many fibers and to asbestos fibers from many sources. It is of interest that exposure to talc, used extensively in cosmetics, results in some exposure to associated asbestos fibers. Since talc is used in many insecticide formulations, we should remain aware that it also presents a hazard.

Significance To The Chemical Industry

(1) Occupational Health

Control exposures

Maintain surveillance of previously exposed individuals

Discourage smoking

(2) Community Air Pollution

Avoid insofar as possible

Make sure waste disposal is adequate

(3) Production Departments

Encourage a careful investigation of all potential hazards before attempting any new uses of asbestiforme materials or other dust producing materials.