Special Article

Pathogenic Effects of Asbestos

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• The enormous increase in the use of asbestos during this century has necessitated the intensive study of its pathogenic effects. The occurrence of pulmonary parenchymal and pleural fibrosis and an increased prevalence of pulmonary and gastrointestinal carcinoma and of pleural and peritoneal mesothelioma have been established. A relationship, also, to laryngeal carcinoma is probable. Mesothelioma has been associated with indirect occupational, domestic, and neighborhood exposure, and the possibility of a similar correlation of pulmonary carcinoma with low exposure has been suggested. Pulmonary fibrosis and pleural plaques have been demonstrated under these circumstances. The physical characteristics of the asbestos fiber appear to be the principal factors in its carcinogenic action. The ability of fine, short fibers, especially fragmented chrysotile, to reach the pleura would appear to account for many of the pathogenetic and anatomical features of asbestos-related disease.

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During the present century, the hydrated fibrous silicate minerals generically designated as asbestos have found enormous and constantly increasing application in many areas of industry. Its worldwide production is calculated to have increased a thousandfold since early in the century, and is estimated to have reached an annual total of 5 million tons in 1974, with a variety of perhaps 3,000 uses.[1-4]

This process has meant that increasing numbers of workers are exposed to asbestos in their occupations. It was estimated in 1972 as 250,000 in the United States alone. However, added to these are undoubtedly much greater numbers of people exposed indirectly at their work, as in shipyards or through domestic, neighborhood, or broader environmental contact.

It was not long after the beginning of the escalation in production and use of asbestos that adverse biologic effects in those people occupationally exposed were observed. By 1930 asbestosis was established as a definite disease entity.[5] The first report of carcinoma of the lung with asbestosis was published in 1935,[6] and during the next 20 years there accumulated substantial proof of such an association.[7] The occurrence of mesothelioma in patients with a history of asbestos exposure was recorded in the late 1940s and the 1950s, and in 1960 the report of Wagner et al[8] of an aggregation of cases of this tumor in one of the asbestos-producing regions of South Africa triggered a surge of interest in all aspects of asbestos pathogenicity.

The marshalling of an impressive array of medical and related scientific disciplines is reported in the proceedings of a series of international conferences,[9-11] and there are a number of excellent reviews of the subject of asbestos-related diseases and their industrial and technical backgrounds.[12-14] Some interesting aspects will be omitted here because of space limitation.

In addition to the conditions referred to above, an increase in the prevalence of gastrointestinal cancer was soon demonstrated[15] and, later, of carcinoma of the larynx in association with asbestos.[16] Recently, the possibility has been raised that some instances of supposedly nonspecific interstitial pulmonary fibrosis may be associated with submicroscopic asbestos particles.[17]

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The quality that defines asbestos minerals is the fibrous form manifested when they are crushed or processed.[18] The fibers, as mined, may be reduced by appropriate techniques to very minute particles that still retain the fibrous form (a fiber being a particle at least three times as long as it is thick). This configuration, based on the molecular structure of the fibers, gives these minerals some of the properties that make them useful and perhaps most of the properties that make them harmful. Asbestos occurs as two mineralogical varieties called serpentine and amphibole. Chrysotile is the fibrous form of serpentine and accounts for over 90% of the world's usage. The type mined in Canada is of this variety. Three

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