the mines, in the crude processing of the fibers, or in other phases of the manufacturing.[5, 10, 11] However, it is well known that asbestos is now being utilized to a greater degree in the manufacture of products that aparently bear no direct relationship to asbestos, such as in insulating material, rope, wallboard, mortar with cement, and plaster of paris. If we accept the cases presented as asbestosis, then these individuals, even though known exposure is lacking in the history, have been exposed to asbestos dust in some form and for prolonged periods of time to induce changes compatible with asbestosis and the subsequent development of pulmonary carcinoma. The fact that no known exposure existed in 4 cases indicates that the disease can occur without prolonged exposure to known sources. The average time lapse from the initial exposure to asbestos dust to the development of asbestosis is 9 years according to Egbert and Geiger,[5] although this figure varies according to different authors, and much shorter exposure times with development of asbestosis have been recorded. In individuals who have developed carcinoma of the lung, the asbestos exposure time averages 15 years, with a range of 3 to 27 years,[13, 14] and with latent periods of from 15 to 22 years between the initial exposure to the asbestos dust and the development of a malignant tumor.[3]

There have been cases, however, in which an unusually short exposure time was recorded. In a case cited by Owen,[24] pulmonary carcinoma developed in an individual exposed to asbestos dust for only 12 months, approximately 20 years after the exposure.

The majority of the lung carcinomas associated with asbestosis recorded have been of the squamous cell type. In our series, bronchiolar carcinoma and undifferentiated carcinoma were present in equal numbers.

Localization of the tumor in these cases is of some interest. Carcinoma of the lung usually occurs more frequently in the upper lobes, whereas in asbestosis, approximately 80% of the cases reported occurred in lower lobes where the pneumoconiosis is most severe.[17] Our cases showed a majority of the malignant tumors occurring in the upper lobes (Table 1).

Other agents that are believed to be related to cancer of the lung are uranium, chromium, and possibly nickel. In the case of asbestos, although experimental proof is lacking, there appears to be sufficient clinical pathological evidence to make it highly probable that this is a carcinogenic agent.[20] It must be admitted that the carcinogenic stimulus is a weak one, and the mode of action is still obscure. Particle size is apparently of importance in the production of asbestosis. Those fibers less than 20 μ in length have no apparent deleterious effect.[15] The fibrotic reaction in the lung is produced by both physical and chemical changes secondary to the asbestos fiber.[8, 17] The fibrosis is a progressive phenomenon, with progression after exposure has ceased.[15] Multifocal areas of metaplasia of the bronchiolar epithelium have been described in the areas of fibrosis and the suggestion made that these represent early stages in carcinogenesis.[20] The silicate portion of the fiber is apparently not responsible for this activity. Carcinoma of the lung occurs in only 1.3% of cases of silicosis in contrast to 13% in cases of asbestosis.[4, 14, 15] It has even been suggested that silicosis may be a deterrent or even offer protection against carcinoma of the lung.

SUMMARY

Eleven cases of asbestosis associated with carcinoma of the lung are presented. A known exposure to asbestos dust was obtained in 7 of these cases. In at least 2 cases, evidence is described for multifocal origin of the tumor. Typical asbestos bodies were identified in the tumor-bearing area of the lung in each case. The possible relationship of asbestos bodies as a carcinogen in the production of cancer of the lung is discussed.

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