only three weeks of treatment.[1] Second, his tooth discoloration developed while he was wearing orthodontic appliances. After the literature was reviewed, only one situation was found wherein a single tooth, which had a metal bracket bonded to it, developed a green-black pigmentation on debonding.[11] Pretreatment photographs showed the presence of a single white lesion at the site of the subsequent acquired pigmentation, representing decalcification, a common dental finding. It is unlikely that the pattern and type of tooth staining seen in all the teeth in patient 3 (which is similar to that observed in the other three cases) is related to wearing orthodontic appliances.

Studies of minocycline-induced skin hyperpigmentation may elucidate its mechanism of action on teeth. Two patterns have been described in the skin. A generalized "muddy-brown" pigmentation, prominent in sun-exposed areas, histologically shows increased pigment in the basal layer and dermal macrophages.[4,10,11] Histochemically this pigment is suggestive of melanin. The second pattern is a blue-black focal discoloration associated with areas of inflammation. Electron microscopy and histochemistry suggest a hemosiderinlike deposit, but it is not clear if this is in fact hemosiderin, a minocycline degradation product, or a drug-hemosiderin complex.[9,10,12] X-ray microanalysis has shown these pigment deposits to contain iron and, most recently, lesser amounts of calcium.[10,11]

Tetracycline and minocycline may cause tooth discoloration by different mechanisms. Tetracycline's apparent ability to chelate calcium-orthophosphate may explain its specificity for staining developing deciduous and permanent teeth. Tetracycline's inability to stain the teeth beyond the age of 7 years may be a function of the unavailability of free calcium for complexing. Minocycline, unlike tetracycline, complexes poorly with calcium. Prior experience with tetracycline restricted the use of minocycline in children; therefore, little information is available about its effect on developing teeth. Minocycline's ability to chelate with iron and to form insoluble complexes may explain its role in causing pigmentation of the permanent teeth.

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Case Reports

Asbestos Bodies in Carcinoma of Colon in an Insulation Worker With Asbestosis

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CARCINOMAS involving the gastrointestinal tract, as a group, are the most common forms of cancer in the United States, with the colon and the rectum being the most frequently involved sites.

Geographic pathology suggests that environmental factors play a strong role in the etiology of these tumors. There is an increase in the number of deaths from colon cancer in asbestos workers. In a study of 17,800 asbestos insulation workers, instead of 38.1 expected deaths due to cancer of the colon and rectum, there were 59.[1] Other studies support the association between asbestos exposure and colon-rectal cancer.[2]

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Report of a Case

A 66-year-old asbestos insulator had worked for over 32 years putting asbestos around pipes and removing asbestos from old pipes.

Dyspnea on exertion, without angina, started about 1967. Clubbing of fingers and bilateral extensive rales were found on physical examination.

The clinical diagnosis of advanced asbestosis was made by three physicians, based on the findings of severe parenchymal and pleural disease on roentgenogram as well as pulmonary restrictive ventilatory defects.

On June 27, 1983, a 20-cm segment of colon and a portion of mesentery were resected for a well-differentiated adenocarcinoma of the colon.

A mild tissue reaction was found in the muscularis of the normal bowel, consisting of foci of fibrosis. The serosa revealed a fibrotic replacement of fat. The peritoneum covering the serosa was fibrotic (Fig 1). Asbestos bodies were not seen.

Histoiogical sections of five patients with colon cancer who had no known asbestos exposure were examined microscopically as controls. Fibrosis in the muscularis or serosa was not seen in these specimens.

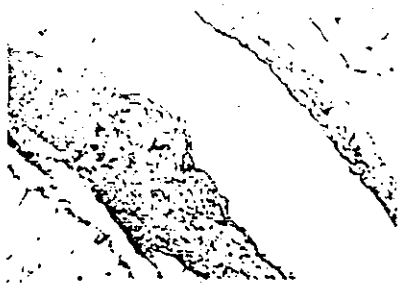

Fig 1.—Fibrotic thickening of peritoneal layer, covering serosa and mesentery (hematoxylin-eosin, original magnification ×160).

Fig 2.—Some asbestos bodies found in digest of colon carcinoma and mesentery (original magnification ×320).

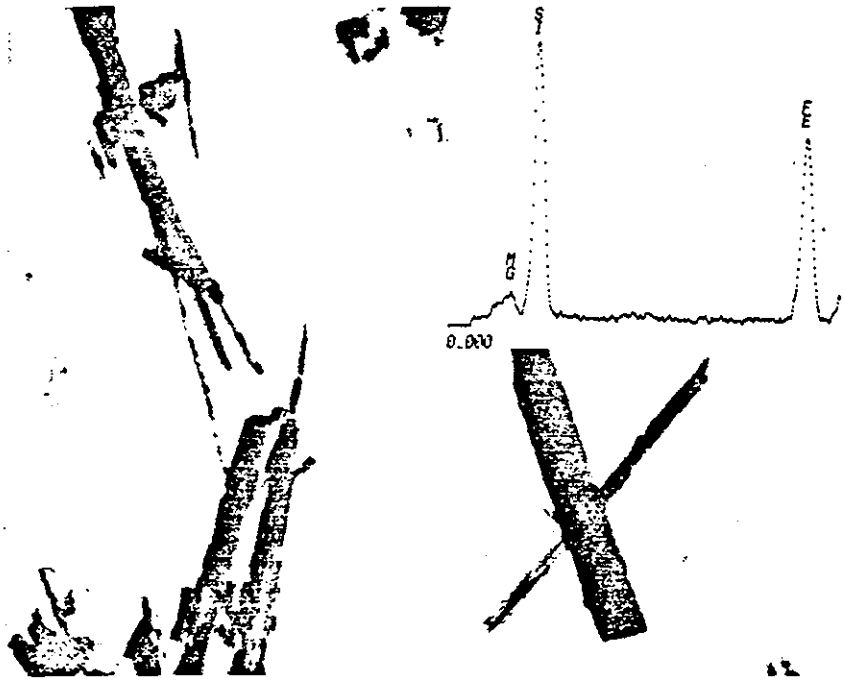

Fig 3.—Electron photomicrograph of amosite fibers found in colon carcinoma and mesentery tissue (original magnification ×20,000). Fibers are identified by electron diffraction pattern and microchemical analysis (inset).

Five grams of tumor and adjacent normal bowel was digested and filtered through a polymer filter (Millipore) membrane.[2] Examination of the membrane microscopically revealed 54 typical asbestos bodies (Fig 2). Thirty asbestos bodies were found in a second similar 3-g sample of digested bowel.

Two hundred ten grams of mesentery and serosal fat was in another container of formaldehyde. Three grams of this specimen was digested.[2,4] Twenty-eight typical asbestos bodies were found microscopically (Fig 2). A second digest of 2.8 g of mesentery revealed 34 asbestos bodies. This was an average of ten asbestos bodies per gram of wet tissue. Such quantitation of asbestos bodies in the colon has never been reported, to the best of our knowledge.

A 2.0-g portion of mesentery was digested in a solution of sodium hypochlorite. The residue was prepared for analysis by transmission electron microscopy. Many amphibole asbestos fibers, identified by electron diffraction of selected areas, were observed. Microchemical analyses were obtained on fibers, using an energy-dispersive detector in conjunction with transmission electron microscopy. All fibers analyzed had the chemical composition of the asbestos amphibole mineral amosite (Fig 3). Amosite is one of the asbestos minerals most commonly used in insulation material. The concentration of amosite in the section of mesentery analyzed was 1.06×10^{6} fibers per gram of dry tissue.

Comment

A substantial number of asbestos bodies was demonstrated in the tumor area and mesentery of an adenocarcinoma of the colon in an asbestos worker with asbestosis. This finding is consistent with the conclusion of epidemiologic studies that asbestos exposure is associated with an elevated risk of gastrointestinal cancer. This is especially so in view of a report[5] in which digestion technique[3,4] was used to study 21 specimens of adenocarcinoma of the colon in the general population. Typical asbestos bodies were not found in any of the specimens.

Asbestos fibers and bodies can be coughed up or swallowed and can be found on or in the bowel mucosa.[6,7] In this case, however, asbestos bodies were found in the mesentery.[8,9] These asbestos fibers may have penetrated the lamina propria of the mucosa, followed by phagocytosis by neutrophils and macrophages, resulting in fibrosis and possible asbestos body formation, similar to the reaction that takes place in the lung.[10] It is possible that the asbestos was biologically active, resulting in tissue injury in the colon, with foci of fibrosis in the muscularis and the serosa. There was also thickening of the peritoneal layer of the mesentery (Fig 1), resembling the pleural fibrosis in pulmonary asbestosis.

An investigation is now in progress to search for asbestos bodies in digests of tissues of carcinoma of the colon in asbestos-exposed and appropriate control populations. The purpose is to explore the possible causal relation between asbestos bodies in the bowel and colon carcinoma. The findings in this case report suggest the need for such a study.

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