Asbestos, Lead, and the Family: Household Risks

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Although the intrafamilial transmission of infectious diseases has long been recognized, the induction of environmental disease in household contacts is being increasingly documented and requires a higher index of suspicion. An incidental radiographic finding, such as pleural thickening or calcification, or even interstitial pulmonary fibrosis in a young person without obvious occupational exposure to asbestos, should prompt the physician to clarify the parental occupational history. Likewise, unexpected evidence of lead induced abnormalities, such as elevated blood lead and/or erythrocyte protoporphyrin levels, should focus the examiner's attention on possible intrafamilial transmission, treatment, and prevention.

The environment has a strong impact on the quality of human life, and certain specific environmental factors, identified during the past decades, are implicated in some of the leading causes of death in the United States, ie, cardiovascular disease, cancer, and liver disease.[1]

The occupational environment is of particular concern as a cause for ill health because of increased morbidity and mortality rates in working populations. In occupationally induced disease, the documentation on the extension of occupational health hazards from the workplace into the general community warrants concern. The family of the worker may be considered as an interface between the workplace and the general environment; therefore, household members should be considered a group with distinct risk of developing adverse health effects due to the "carrying home" of disease causing agents found in the occupational environment. Since many environmentally related diseases become clinically manifest only after a long period of clinical latency (20 years or longer), some harmful exposures experienced by children in a "polluted home environment" may result in disease during young adult or adult age.

In this paper, attention is focused on two important occupational and environmental pollutants, asbestos and lead, which are known to cause adverse health effects among family members of industrial workers.

Asbestos

Asbestos is the general name for a group of naturally occurring hydrated mineral silicates characterized by fibers or bundles of fine, single crystal fibrils. Because of their unique properties of resistance to heat and chemicals, as well as high tensile strength and flexibility, asbestos compounds are widely used in thousands of commercial products including thermal insulation, heat resistant textiles, floor tiles, gaskets, and brake linings.[2]

Biological Effects

Inhalation of asbestos fibers, especially those that are less than 5μ in length, may be associated with a variety of signs and symptoms. Asbestosis is the diffuse interstitial fibrosis, or chronic respiratory disease caused by asbestos, and is one of the dust related lung diseases (pneumoconioses). Patients commonly present with breathlessness on

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exertion, cough, and chest tightness or pain. Shortness of breath on exertion may be the earliest and most prominent clinical symptom, but usually does not appear for ten years or more following exposure. Physical signs include basilar crepitant rales on auscultation, decreased chest movement, clubbing of fingers, cyanosis, and cor pulmonale in more severe cases. Roentgenographic abnormalities are characterized by a diffuse interstitial pattern quite similar to other types of interstitial fibrosis, but is often more prominent in the lower parts of the lungs. Pleural thickening, plaques, and calcifications (sometimes diaphragmatic) are radiologic signs that are often diagnostic or even pathognomonic. Pulmonary function studies may further characterize the disease, and decreased vital capacity is a typical finding.

There is ample evidence that asbestos is associated with lung cancer, and some epidemiologic studies indicate that 20 percent of all deaths among asbestos insulation workers are due to bronchogenic carcinoma.[3] The risk of developing lung cancer is particularly augmented by cigarette smoking. Asbestos workers who smoke have an eightfold excess of lung cancer when compared with smokers in the general population; and a ninety-twofold excess when compared to the general population of non-smokers.

Pleural and peritoneal mesothelioma, rare diseases in the general population, are also related to asbestos exposure, and approximately eight percent of asbestos workers die of these diseases. (An association between smoking and mesothelioma has not, so far, been indicated.) Repeated pleural effusions are characteristic presenting signs of pleural mesothelioma, although "benign" pleural effusions may be found in individuals with interstitial fibrosis (asbestosis).

Neighborhood and Environmental Exposure

Although industrial sources outside the workplace were not at all suspect in health hazards to the general public, reports from South Africa[4] and England[5] leave little doubt that the risk of asbestos related disease goes beyond the factory gate. Mesothelioma has been reported among individuals whose only contact with asbestos was their residence within half a mile of an asbestos factory, and in individuals residing or working in the immediate vicinity of a shipyard. Another kind of environmental exposure to asbestos has been observed in Turkey, where "endemics" of mesothelioma occur in rural areas containing asbestos bearing rock. Occasionally, asbestos containing material is also used there as whitewash for the houses.[6]

Family Exposure

During the 1960s, reports began appearing in the literature suggesting that household exposure to asbestos is a significant health hazard. This includes both benign asbestos related disease (such as interstitial fibrosis) and pleural abnormalities as well as malignant disease, particularly mesothelioma.

The spectrum of asbestos related disease is emphasized in a US study[7] of household contacts of asbestos insulation manufacturing workers examined 25 to 30 years after the onset of household exposure. Of 378 examined family members, 239 (35 percent) were found to have one or more radiographic abnormalities, including irregular opacities (interstitial disease) and pleural thickening, calcification, and plaques. In the same cohort, five cases of pleural mesothelioma have been identified. All are in wives or daughters.

Another study of 52 cases of mesothelioma among women in New York State identified nine cases as having household contact with asbestos, and a relative risk factor of ten was calculated for residents in the home of a worker from an asbestos related industry.[8]

A remarkable conglomerate of malignant asbestos disease was recently reported in a family where the father had worked in a US shipyard in the 1940s and died of lung cancer and asbestosis some 30 years later.[9] His wife (and mother of the household) had died of malignant mesothelioma some ten years before her husband. One daughter also died of mesothelioma at the age of 31. This case of "familial" mesothelioma and asbestos related disease emphasizes the extraordinary risk to which family members of asbestos workers are exposed. The wife, who laundered the dust-laden clothes, developed mesothelioma, while the daughter received her initial exposure at home during early childhood. Although young at the time of death, the latter had already reached the end of clinical latency which is usually between two and four decades for mesothelioma. An additional consideration is that this high-risk family

was judged to have high familial cancer-susceptibility associated with intra-household exposure.[9]

Lead

Lead is one of the earliest metals used by man and has become a ubiquitous environmental pollutant.

Occupational lead risk groups are derived from several industries, such as primary smelting involving the extraction of the metal from ores and secondary lead smelting in which lead is recycled from scrap material, the majority of which is discarded lead storage batteries. The manufacturing of storage batteries is also a significant source of exposure. Other industrial sectors with lead exposure include demolition work, when burning of lead painted iron and steel structures may occur, and the manufacturing of plastics which frequently involves the use of powdered lead stabilizers. In industrial settings, inhalation of lead fumes and dusts poses the greatest risk.

Lead poisoning among children is usually due to the ingestion of lead based paint in dilapidated urban dwellings (''lead belts''). Children with pica in the age group one to six years are particularly vulnerable.[10]

Biological Effects

Lead affects primarily three organ systems; namely, the hematopoietic, the nervous system (central and peripheral), and the kidneys. The interference of lead on the biosynthesis of heme can be detected by various diagnostic tests including inhibition of delta aminolevulinic acid dehydratase (ALA-D) and elevation of erythrocyte protoporphyrin (FEP or ZPP). Anemia may be a later manifestation of lead poisoning.[11]

The symptoms of lead poisoning, in both adults and children, are often nonspecific, and include headaches, dizziness, general fatigue, and irritability. Gastrointestinal symptoms (''lead colic'') may also be present, but more subtle gastrointestinal discomfort with anorexia and weight loss commonly precede the colic. Childhood lead poisoning is an important differential diagnosis to keep in mind when a child complains of vomiting, abdominal pain, history of irritability, and mood changes, or in a child presenting with seizures. Peripheral neuropathy includes primarily motor dysfunction with slowing of the nerve conduction velocity.

Neighborhood Contamination

Emissions from lead industries, particularly smelters, are known to be associated with increased risk of adverse health effects among children living near the industrial facilities.[12]

Household Exposure

As in the case of asbestos contamination, it is now known that workers in the lead industry may carry home a potential health hazard. The most obvious is the lead objects brought home by the parent as toys for the children. A less recognized, more insidious hazardous exposure to children of lead workers may be the lead containing dust carried home unwittingly on the work clothes. Thus, in studies comparing family members of lead smelter workers with those of non-lead workers living in the same neighborhood, a significantly higher blood lead and protoporphyrin level was found in the children of lead workers.[13] Similar results were found when studying children of lead storage battery workers.[14] In both studies the lead contents of the dust were also significantly higher in the lead workers' homes. Although the workers in the second study usually changed their clothes before leaving the plant, the work clothes were laundered at home.

Female workers in lead industries, especially battery plants, have also been found to be an important source of intrafamilial transmission of lead disease.[15] This problem seems to be even more complex, since the unborn child may be the most sensitive target of all for undue lead exposure.[16]

Also of importance is the discovery of high levels of lead containing dust in the homes of smelter workers *even though seemingly appropriate hygienic measures* to reduce lead contamination were taken at the place of work, such as showering and changing clothes.[17] Therefore, possible additional sources of lead to the family may include the lead-dust fallout on cars parked at the plant or carried home in objects (lunch box, cigarettes, keys, etc) from a contaminated parking lot.

It should be emphasized that asbestos and lead represent only two of thousands of industrial agents which may reach the worker's home, and that the developing child may be more sensitive to these agents than adults.

It appears to be mandatory that (1) preventive measures taken to reduce harmful exposures at the work site also include consideration for the work-

er's home and family; and (2) physicians be increasingly sensitive to the household dimensions of occupational or neighborhood toxic exposures.

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