ENVIRONMENTAL MUTAGENESIS AND DISEASE IN HUMAN POPULATIONS

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SUMMARY

Environmental chemicals can affect the genetic material and cause a variety of different mutations. Mutations in somatic tissues can lead to cancer while germinal mutations can cause various genetic diseases. The impact of germinal mutations on health will depend upon their frequency; their nature (point mutation vs. chromosomal change, dominant vs. recessive); and upon the mechanisms maintaining a given mutation in the population. Mutations causing early prenatal lethality have fewer public health effects than genetic diseases associated with prolonged medical and social problems. Differences between and within species in metabolism of environmental chemicals and in DNA repair make mutational estimates in humans imprecise. Results on mutation frequency in somatic cells cannot be readily transferred to conclusions regarding germinal mutations until appropriate comparisons have been made. Studies on atom bomb survivors suggest an increased mutational frequency but such results failed to reach conventional statistical significance. Current estimates of the role of induced germinal mutation in human populations have wide confidence limits. An accurate assessment of the potential hazards of environmental human mutagenesis requires better fundamental understanding of human genetics and continued attention to studies on humans and their tissues and fluids. Crash programs on environmental mutagenesis at the expense of other biomedical research appear unwarranted.

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INTRODUCTION

Modern environments differ from those of earlier times in human exposure to many different manmade contaminants. Pesticides, fungicides, food additives, synthetic drugs, and atmospheric and water pollutants did not exist until the advent of the industrial age some five human generations ago. 70,000 of such substances exist and more than 25,000 are in common use in the United States. More compounds are being synthesized every year and human exposure to them is increasing. Many chemicals have been shown to be mutagenic in lower species and concern regarding the implications of chemicals on human health is therefore warranted. A detailed consideration of environmental mutagenesis in man has been provided recently in comprehensive publications (7,14,18).

CANCER AND MUTATIONS (4)

Mutations of the genetic material of somatic cells can lead to malignant neoplasms. Such carcinogenic effects are much delayed between the initial mutation and the actual diagnosis of a clinical cancer. The latency period ranges from about 5 years for certain chronic leukemias to 15-20 years for solid cancers. It will, therefore, take many years before carcinogenic effects are apparent. A variety of environmental chemicals have already been clearly implicated in cancer development [e.g., asbestos: lung and pleural cancer; benzene: marrow cancers; vinyl chloride: certain liver malignancies and others (4)]. A major environmental hazard concerns tobacco. The evidence relating cigarette smoking to cancer of the lung is overwhelming. Mortality continues to increase in the United States and pulmonary cancer is now the most frequent lethal malignancy in males (20). Mortality from lung cancer in women, whose widespread smoking began at a later date, has also risen continuously over the past 15 years. No other common cancers have shown such trends in either sex. Age-specific mortality has remained at similar rates for the past 30 years for common cancers such as carcinoma of the breast in women and of the colon and rectum in men (20). Considering the long latent period between exposure and development of clinical cancers, these data suggest that these cancers are not related to novel environmental carcinogens introduced between 1930 and 1960. It is conceivable that new chemical substances introduced since the 1960s could raise the frequency of these cancers and other mutants in the next few years. Continued careful monitoring of the mortality of different cancers is therefore essential.

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2Carcinoma of the colon and rectum in women has slightly decreased in frequency.