

RADIATION LEUKEMOGENESIS: AN ANALYSIS OF THE PROBLEM.*

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Leukemia induction following known exposure to ionizing radiation was studied in the reports of Japanese irradiated at Hiroshima and Nagasaki, patients irradiated therapeutically for ankylosing spondylitis, children exposed over the thymic region, prenatal exposure from diagnostic pelvic x-rays, patients irradiated therapeutically in various clinical conditions, and individuals exposed occupationally to x-radiation. The results, in conjunction with animal data, indicate clearly that leukemia is a consequence in a small percentage of individuals exposed to large doses of radiation delivered to a sizeable portion of the body. Only two sets of data, that from Japan and that from patients irradiated for ankylosing spondylitis, are suitable for the investigation of possible dose effect relationships. A plot of the incidence of leukemia versus dose for the exposed Japanese is shown in Figure 1. The formidable difficulties in dosimetry, particularly in a mixed gamma-neutron field are discussed. In Figure 2, the case reports of leukemia in a closed ageing population of exposed Japanese as a function of time following the bomb detonation is presented. The incidence appears to be falling.

The following conclusions are made: following a single dose exposure of man, the instance of leukemia appeared to be approximately linear with dose at dose levels of perhaps 100 r equivalent or greater. The

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incidence is small, approximately 2 per 10^6 persons at risk per year per rad, at least from approximately the second to the fifteenth year following exposure (the total number of leukemias following exposure to radiation, from all sources, is only approximately 225 cases to date). Below dose levels of approximately 100 r equivalent, the available data are inadequate for prediction for other than the single acute dose, i.e., it is not known if a dose-rate dependency exists. It is not known if the risk continues beyond approximately the first fifteen years from exposure, although there is evidence that large dose radiation of sizeable portions of the marrow may be leukemogenic. There are no adequate grounds for assuming that the highly localized radiation from internal emitters such as Sr^{90} and radium are leukemogenic. It is not possible to determine whether a threshold dose for the induction of leukemia exists. The potential hazard from exposure to radiation is discussed. It is emphasized that the search for leukemogenic radiation factors, indeed for all harmful environmental factors, must be on a broad base and not focused upon radiation in general or the by-products of nuclear weapon-testing particularly.

Legend for Figure 1.

Incidence of leukemia versus dose of radiation for period of 1945 through 1957 showing statistical era of the estimate and systematic era of the dose.

Legend for Figure 2.

Histogram of cases of leukemia found per year at Hiroshima between 1945 and 1958,