II. BIOLOGICAL EFFECTS

Multiple Myeloma among Atomic Bomb Survivors

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Multiple myeloma/Life span study/Dose effect

Multiple myeloma (MM) is a malignant tumor of B-cell lineage. Whether this disease occurs as a result of radiation exposure is of interest because B-cell chronic lymphocytic leukemia (CLL), another type of malignancy of B-cell lineage, has not been shown to be increased among atomic bomb survivors and other irradiated populations. An excess frequency of MM has been found in some of the irradiated populations, including U.S. radiologists, Hanford workers, thorotrast patients, radium-dial painters, and others.

An increase of MM in the atomic bomb survivors had not been observed until 15 years after the bombing. During 1963-65, we observed several cases of MM among the atomic bomb survivors and suspected that the occurrence of MM could be influenced by atomic bomb radiation. This led to the conduct of a specific investigation on this malignancy in the Life Span Study (LSS) population in 1982. In this study, clinical data on M-protein and bone changes, hematological and bone marrow findings were reviewed to confirm diagnosis for patients who were suspected to have MM. A total of 29 cases of MM was identified among 109,000 individuals in the LSS sample. Data on these cases were analyzed using bone marrow dose based on T65D. Increased risk of MM in the high dose group (0.5 Gy or more) was apparent after 1965 (Figure 1), suggesting a prolonged latency period for radiation-induced MM. By age at time of bomb (ATB), the dose effect was most evident in those aged between 40–59 years ATB, followed by those aged 20–39 ATB. However, there was no increase of MM in high dose group among those aged 60 years or older and age 0–19 years ATB (Fig. 2).

More recently, an attempt was made to update the MM series in the LSS cohort through 1985, which resulted in the identification of over 80 cases. A significant dose-response relationship was found between DS86 bone marrow dose and the incidence of MM. There still was no significant dose effect among those who were young ATB. Since MM is predominantly a disease of elderly persons, a further follow-up was deemed necessary to characterize the risk among those who were exposed at young ages and thus who still have not entered the age groups in which the high background incidence of MM is expected.

B-cell chronic lymphocytic leukemia (CLL) and MM are both proliferative disease of B-cell lineage. However, they are different in that the former cells show the morphology of mature
lymphocytes and are considered to proliferate in the periphery whereas the latter cells generally appear as young cells such as nucleolus and proliferate basically in the bone marrow. As stated earlier, B-cell derived CLL has not been shown to be induced by radiation exposure. There is also no definite evidence on increased incidence of T-non-Hodgkin’s lymphoma or adult T-cell leukemia, which are malignant lymphoma of differentiated T-lymphocytes among atomic bomb survivors. On the other hand, a recent theory states that MM results from abnormality of hemopoietic stem cells. Because many types of leukemia derived from stem cells of the bone marrow are associated with radiation exposure, it is biologically reasonable that MM occurs as a result of exposure to radiation, and further efforts would be worthwhile to define more precisely the nature and magnitude of the risk of MM in the atomic bomb survivors.

REFERENCES

Fig. 2. Crude annual incidence rate of multiple myeloma (by age ATB and total marrow dose) for atomic bomb survivors and controls in the LSS sample, Oct. 1950–Dec. 1976, Hiroshima and Nagasaki.
