3. Radiation Effects in the Marshall Islands

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On March 1, 1954, the detonation of a thermonuclear device on Bikini in the Marshall Islands resulted in the accidental deposition of fallout on several inhabited atolls and on a Japanese fishing vessel. The health of the exposed Marshallese people has been carefully monitored since that time, and both early and late radiation effects have been found. The accident was unusual in that the explosion, occurring near ground level, resulted in a heavy, particulate fallout on Rongelap and Ailingnae, about 100 miles away. Utirik, further to the east, experienced a lesser, invisible fallout.

Early radiation effects were observed in many of the 64 inhabitants of Rongelap and the 18 on nearby Sifo Island, consisting of nausea, vomiting and diarrhea, skin burns, epilation and depression of lymphocytes and bone marrow elements. The gastrointestinal symptoms persisted for only a few days, the cutaneous and blood manifestations improved rapidly, and during the ensuing decade the people remained in good health. During the second and third decades after the accident, however, most of the Rongelap children and many adults developed thyroid nodules, some of which proved to be malignant. Varying degrees of thyroid failure were also documented. This accounted for severe growth retardation in 2 boys with thyroid atrophy and may have favored the development of thyroid nodules in the other children. The Utirik people (167 exposed) did not show early radiation effects, but thyroid nodules and thyroid cancer began to appear late in the second decade after exposure. The cancers in both groups were of the papillary type, and no deaths have occurred.

One fatal case of acute myelogenous leukemia occurred in a Rongelap boy, one man died of gastric cancer, and one woman died of an intracranial meningioma. Nonlethal tumors possibly related to radiation include one breast cancer, one colon cancer, one neurofibroma in the thyroid area and at least two cases of pituitary adenomas. However, four deaths from radioinducable type tumors have also occurred in the unexposed population during the 30 year follow-up.

The radiation exposure in the Marshallese people resulted from both external and internal sources. The external, whole body dose was between 100 and 200 rad on Rongelap and Ailingnae, and 11 rad on Utirik. The internal dose absorbed by the thyroid gland is less certain, and has recently been recalculated. The average absorbed dose on Rongelap was age-dependent, ranging from 5,000 rad at age one year to 1,000 rad in adults, 250 rad in newborn infants and 680 rad in a third trimester fetus. On Utirik, the corresponding doses were 670 rad at one year, 150 rad in adults, 48 rad in newborn and 98 to 260 rad in fetuses. From 80 to 90% of this absorbed dose was derived from short-lived isotopes of iodine and tellurium. Continued body burdens of long half-life radionuclides (^{137}Cs, ^{90}Sr, ^{65}Zn, ^{60}Co) were of a low order and are not believed to have contributed significantly to the medical findings.

Calculation of risk coefficients for thyroid nodules and cancer, adjusted for their occurrence in a comparison population, gave a mean nodule risk (all ages) of 8.3 per 10^6 person-rad-yrs, and a mean cancer risk of 1.5 per 10^6 person-rad-yrs. The latter value is similar to that resulting from purely external exposure (e.g., medical x-rays) and is compatible with an equal risk from external x-rays and internal radiation from short half-life isotopes of radioiodine.

The Marshall Islands experience clearly identifies the risk to the thyroid gland from radioiodine fallout in man; however, it gives no information about the risk that can be attributed to ^{131}I, the latter being the major iodine isotope occurring in long-range fallout and in medical use.