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“Association of Radiation Dose With Prevalence of Thyroid Nodules Among Atomic Bomb Survivors Exposed in Childhood (2007-2011)”

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Study Findings

A thyroid study conducted among A-bomb survivors 62–66 years after exposure to radiation in childhood (at less than 10 years of age) revealed a significant association between the prevalence* of larger thyroid nodules (those with a diameter of 10 mm or more, or those with past surgery for a nodule) and A-bomb radiation dose to the thyroid; however, no association was observed for small nodules of less than 10 mm in diameter.

*The term “prevalence” here refers to the percentage of the population with a disease at the time of examination, regardless of whether or not they had been previously diagnosed.

Explanation

Adult Health Study (AHS) participants were examined to investigate the association between thyroid nodules and A-bomb radiation in survivors exposed in childhood (at less than 10 years of age). The AHS has examined the health status of A-bomb survivors in Hiroshima and Nagasaki since 1958 through biennial medical assessments.

[Note]

The term thyroid nodule refers to a benign or malignant growth in the thyroid gland. Thyroid ultrasound-based observation classifies such nodules into two major types: cysts or solid nodules. Nearly all cysts are benign, while solid nodules are further classified into malignant tumors (mostly cancers) and benign nodules. Benign nodules include benign tumors, hyperplasia, and thyroiditis-related nodules. Thyroid nodules that are not malignant usually do not require treatment; however, in the case of large nodules with pressure symptoms or when the possibility of malignancy cannot be ruled out, treatment may be necessary. This study focused on relatively large thyroid nodules (diameter of 10 mm or more, or post-surgical cases), which are

likely to emerge as a clinical problem. The study also reviewed small nodules less than 10 mm in diameter, which are unlikely to be a clinical problem.

1. Objectives

It is known that the risk of thyroid cancer is higher after radiation exposure in childhood compared with exposure in adulthood. Determining whether or not the effects of radiation exposure on the thyroid appear among adults many years after exposure in childhood is an important public health issue. On the other hand, thyroid ultrasonography can detect thyroid nodules in 17–67% of the general population who have had little exposure to radiation. This study aims to elucidate the association between thyroid nodules and A-bomb radiation among A-bomb survivors more than 60 years after exposure in childhood.

2. Methods

Thyroid examinations, including thyroid ultrasonography, were conducted on 3,087 A-bomb survivors participating in the AHS between 2007 and 2011 who were less than 10 years old at the time of exposure. The study investigated the association of thyroid dose with the prevalence of larger thyroid nodules (diameter of 10 mm or more, or post-surgical cases), as well as small thyroid nodules (diameter of less than 10 mm) among 2,688 survivors for whom A-bomb radiation dose to the thyroid had been estimated. The mean age of participants was 68.2 years; 1,213 were males and 1,455 females; the median dose was 0.182 Gy (182 mGy); and the dose range was 0–4.040 Gy.

3. Results

(1) The prevalence (17.6% of those examined) of larger thyroid nodules (diameter of 10 mm or more, or post-surgical cases) was significantly associated with thyroid radiation dose; the estimated excess odds ratio** per gray (Gy) of thyroid dose was 1.65 (95% Confidence Interval (CI): 0.89, 2.64). We conducted the analyses by classifying the thyroid nodules into solid nodules and cysts, and then further classifying the solid nodules as malignant tumors or benign nodules. Respective analyses detected a significant association between nodule prevalence and thyroid dose.

**In this study, we considered the odds ratio to be nearly equivalent to relative risk; The odds ratio represents how many times higher the risk is for the radiation-exposed group than for the control group (i.e., those with a

radiation dose of zero Gy). The excess odds ratio is represented by the odds ratio minus one and shows the portion of relative risk that can be attributed to radiation exposure.

- (2) The study revealed that age at exposure significantly affected the association between the prevalence of larger thyroid nodules (diameter of 10 mm or more, or post-surgical cases) and radiation, and that the effects of radiation were greater with earlier childhood exposure. On the other hand, the radiation risk did not vary substantially by sex, family history of thyroid disease, presence of antithyroid antibodies, or intake of seaweed.

[Note]

Generally speaking, thyroid nodules occur with greater frequency in females and in those with a family history of thyroid disease and are also frequently observed in chronic thyroiditis patients (those with positive blood tests for antithyroid antibodies). It is also known that the nodules are affected by intake of iodine, and seaweed is rich in iodine. Consequently, we examined whether or not these factors affected the degree of radiation risk for thyroid nodules.

- (3) No significant association was observed between small thyroid nodules (diameter of less than 10 mm) and radiation dose to the thyroid.

More than 60 years after exposure to radiation in childhood, instances of larger thyroid nodules (diameter of 10 mm or more, or post-surgical cases) were associated with radiation dose; however, such an association was not observed for small thyroid nodules (diameter of less than 10 mm). The term thyroid nodule refers to a variety of clinical states, including cancers, benign tumors, hyperplasia, and thyroiditis-related changes. The difference in effects of radiation in relation to the size of nodules may provide clues to the mechanisms through which radiation exposure affects the clinical state of thyroid nodules.

The Radiation Effects Research Foundation has studied A-bomb survivors and their offspring in Hiroshima and Nagasaki for more than 60 years. RERF's research achievements are considered the principal scientific basis for radiation risk assessment by the United Nations Scientific Committee on the Effects of Atomic Radiation (UNSCEAR) and for recommendations regarding radiation protection standards by the International Commission on Radiological Protection (ICRP). RERF expresses its profound gratitude to the A-bomb survivors and survivors' offspring for their

cooperation in our studies.[§]

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