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“Heart disease mortality in the Life Span Study, 1950-2008”

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Study Findings

Radiation risks for heart disease mortality in the Life Span Study (LSS) were heterogeneous among subtypes, indicating possible differences in radiation-related pathogenesis among the subtypes. In addition, time-dependent changes in heart disease mortality in Japan during the long observational period may have also impacted risk analysis.

Explanation

With regard to radiation risks for heart disease mortality among the LSS population during the period from 1950 through 2008, we conducted analyses of heart-disease subtypes over different time periods.

1. Study Purpose

The Radiation Effects Research Foundation’s follow-up of atomic bomb survivors for the observation period 1950–2003 reported that total body irradiation at dose levels of 0.5–1.0 Gy or higher could be responsible for increased rates of mortality from heart disease. Heart disease consists of four major subtypes (ischemic heart disease [IHD], valvular heart disease [VHD], hypertensive organ damage [HOD], and heart failure [HF])*, each of which has distinctive pathogenesis, mechanisms, and risk factors. In addition, subtype-specific mortality rates in Japan changed greatly after World War II. Consequently, it has become essential to review radiation effects according to heart disease subtype and to examine the effects of subtype-specific trends in mortality rates in Japan on the estimation of dose response among the LSS cohort. We addressed this factor by analyzing the dose response of A-bomb radiation exposure by heart disease subtype over different time periods and evaluating radiation effects.

***Ischemic heart disease (IHD):** arteriosclerotic disease, with high incidence and mortality rates around the world

Valvular heart disease (VHD): disease characterized by damage to or a defect in heart valve(s), caused by after-effects of infection (rheumatic) and age-related/arteriosclerotic degeneration of valve(s) (non-rheumatic)

Hypertensive organ damage (HOD): hypertension-associated dysfunction of the heart or kidney

Heart failure (HF): dysfunction of the heart due to any heart disease

2. Study Methods

We estimated excess relative risk (ERR)* for heart disease mortality after A-bomb radiation exposure among 86,600 LSS subjects. Based on differences in pathogenesis and related mechanisms, heart disease cases were classified into the aforementioned four subtypes. Taking into account dramatic progress in the quality of medical diagnostic techniques, as well as changes in the coding rules for the International Classification of Diseases (ICD), the total observation period (1950-2008) was divided into four periods: 1950–68, 1969–80, 1981–94, and 1995–2008.

*Excess relative risk: Excess relative risk (ERR) is expressed as relative risk (RR) minus one, or that portion of the total RR accounted for by radiation exposure. RR is the ratio of the risk in an exposed population to that in a comparable unexposed population.

3. Study Results

- 1) For the entire observation period, significant increases in ERR were observed for VHD, HOD, and HF (ERR/Gy = 0.45, 0.36, 0.21, respectively), and ERR for heart disease was 0.14, showing linear dose-response relationships. However, these relationships reflected dose response mainly in the high-dose range: ERR for all heart diseases was statistically significant in the dose range of 0–0.7 Gy and higher. No significant association between radiation exposure and IHD was observed.
- 2) Assessment of specific time periods revealed significant dose responses for HOD and rheumatic VHD in the early period (1950–68), and a significant increase in ERR for non-rheumatic VHS in the recent period (1995–2008).

Study Significance

As was the case in a previous report for the period 1950–2003, the present study revealed significant increases in radiation risk for heart disease mortality among the LSS cohort from 1950 to 2008, but review of specific subtypes of heart disease indicated different trends in association with radiation dose. Subtype-specific review also showed that the significance of dose response differed among the four observation periods, suggesting the possibility that general trends in subtype-specific heart disease mortality in Japan during the long observation period may have impacted risk estimation.

The Radiation Effects Research Foundation has studied A-bomb survivors and their offspring in Hiroshima and Nagasaki for around 70 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.

[§]Radiation Research, which is an official monthly journal of the Radiation Research Society, publishes original peer-reviewed papers and review articles on radiation effects and related issues in the fields of physics, chemistry, biology, and medicine. (Impact factor in 2015: 2.67)