
[Findings of this study]
Risk of hemorrhagic stroke rose with increasing atomic bomb radiation dose both in men and women. In women, however, increased risk at doses less than 1.3 Gy was not apparent.

[Explanations]
Stroke is a brain disease caused by an anomalous vein (or artery) that can give rise to sudden paralysis of the limbs, abnormality of the senses, and even death. Stroke incidence is high among the elderly and sometimes blamed for confinement in bed. Prevention of stroke, therefore, is important. In general, the greatest risk factors for stroke include aging, hypertension, and smoking. Increased stroke mortality has recently been reported in relation to radiation dose among atomic bomb survivors.

There are two types of stroke: one caused by a blocked blood vessel (ischemic stroke or cerebral infarction) and the other caused by a ruptured blood vessel (hemorrhagic stroke including cerebral hemorrhage and subarachnoid hemorrhage). In general, the former is caused by thick blood vessel lesions, and the latter by damaged peripheral capillaries.

For elucidation of the mechanisms underlying increased stroke incidence due to radiation exposure, analysis based on ischemic/hemorrhagic stroke classification can provide a clue. For this reason, Dr. Ikuno Takahashi (RERF Department of Clinical Studies in Hiroshima) investigated incidence by stroke type among the participants of the Adult Health Study (AHS), in which the health status of A-bomb survivors in Hiroshima and Nagasaki have been followed up over many years in biennial health examinations, and published the results in the February issue of the BMJ Open.

1. Objective of the study
The objective of this study was to investigate stroke incidence in relation to A-bomb radiation dose.

2. Study methods
A 24-year follow-up was conducted for 9,515 atomic bomb survivors (males: 34.8%) with estimated individual radiation doses who were free from prevalent stroke in 1980, when the follow-up started. Stroke events and deaths were reviewed to confirm first-ever events, and subtypes (ischemic/hemorrhagic stroke) were categorized based on established criteria according to the definitions of typical/atypical stroke symptoms.

3. Results
(1) During the study period, 235 hemorrhagic stroke cases and 607 ischemic stroke cases were confirmed.
(2) Hemorrhagic stroke risk in relation to radiation dose (after adjustment for non-radiation risk factors, such as age, blood pressure, and smoking) (Figure 1)
   a. Males
      Incidence increased in a linear dose-response relationship from <0.05 to >2 Gy (11.6/10,000PY ➔ 29.1/10,000PY, p=0.009). Incidence also rose within the dose
range <1 Gy (p=0.004).

b. Females
While no increased risk was observed within the dose range <1.3 Gy (13.5/10,000PY), it increased to 20.3/10,000PY for doses 1.3-2.2 Gy and to 48.6/10,000PY for doses ≥2.2 Gy (p=0.002).

(3) Dose was unrelated to ischemic stroke risk.

The Radiation Effects Research Foundation has studied A-bomb survivors 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).

* BMJ Open is an open-access medical journal edited by the British Medical Association and issued by the British Medical Journal (BMJ) Group. The open-access journal allows complete free access to entire texts and was developed for the purpose of expanding and improving access to research findings.

BMJ is an advocate of evidence-based medicine. It publishes original research as well as clinical reviews, news, editorials, reader opinions, and career-focused articles, among others. BMJ is considered to be an authoritative journal worldwide and a must read for every physician in Japan.

Figure 1