

Session 1-2 : Biological effects of radiation: Radiation epidemiology and medical statistics

Chairperson: K. Yoshikawa

Dr. Mark Little; US National Cancer Institute, Radiation Epidemiology Branch

Title: "Low-dose and low-dose-rate epidemiology of cancer and non-cancer effects "

In the present talk, Dr. Little gave a nice review on the dose response with relatively low level. It was argued that there is accumulating direct evidence of excess risk of cancer and various other health endpoints in a large number of populations exposed at moderate and low doses. In particular, there is evidence of excess risk of most types of cancer associated with radiation exposures of the order of 10-20 mGy from diagnostic x-ray exposure in the Oxford Survey of Childhood Cancers and in various other groups exposed in utero, (Wakeford & Little *Int J Radiat Biol* 2003;79:293-309), although this data remains somewhat controversial. There is also evidence of excess risk of childhood leukemia associated with natural background radiation exposure, at doses of the order of 10-20 mGy, in a large UK population-based case-control study (Kendall et al *Leukemia* 2013;27:3-9). At slightly higher doses, increased risks of leukemia and brain cancer have been observed in pediatrically-exposed groups given multiple computerized tomography examinations, at doses of about 60 mGy to the respective tissues (red bone marrow, brain) (Pearce et al *Lancet* 2012;380:499-505). The excess risks in all of these studies are consistent with those in the Japanese atomic bomb survivor data. Evidence has recently emerged of an association between lower doses (< 0.5 Gy) and late circulatory disease. In particular, a recent systematic review and meta-analysis suggested an excess radiation-associated risk at occupational and environmental dose levels (< 0.5 Gy) (Little et al. *Environ Health Perspect* 2012;120:1503-11). In conclusion, it was stressed that the presence and magnitude of the excess circulatory disease risk at low doses is still relatively controversial, and much remains unknown as to the shape of the dose response.

Dr. Shiro Tanaka; Kyoto Univeristy

Title: "Critiques on epidemiology: How were we being misled?"

Although epidemiology is academically defined as the science of disease, Dr. Shiro explained how there remain many unclear problems. Well-known findings from epidemiology include vitamin B1 and beriberi, smoking and lung cancer, and X-rays and childhood leukemia. Unfortunately, they are selected, successful examples. In its history, epidemiological studies seem almost constitutionally contradictory - positive and negative findings on radon exposure and lung cancer, pesticide residues and breast cancer, abortions and breast cancer, and electromagnetic fields and leukemia. How were we being misled? Statistical analysis in experimental physics is straightforward but not in epidemiology. It was argued the methodological difficulties

of epidemiology, by clarifying the reasons why mathematical techniques like regression modeling often do not work.

Free Discussion:

On this session, hot discussions were carried out especially in response to the questions from the audience. Among them, the talks from the medical doctors coming from Fukushima were very impressive. Based on their actual experiences on the medical care at Fukushima, they mentioned the difficulty to make contact with the inhabitants. The possible effect of low dose exposure is still serious. They asked the physicists to make clear how the low dose radiation is serious or safe. The participants recognized the importance to make clear this problem from basic science, apart from the problem of politics.

Dr. K. Yoshikawa; Doshisha University

Title: "Extending Physics through the Exotic Events in Life: Simple Theory and Real-World Modeling"

Dr. Yoshikawa discussed the dynamical aspects of life accompanied by the development of physical consideration, by considering the hierarchical structure: 1) On-off switching of large number of genes embedded in genomic DNA. Biological significance of the discrete nature of the conformational transition was discussed in relation to robust on/off switching of large number of genes on the process of cell-differentiation. 2) Field hypothesis on living cell. It was shown that unique physico-chemical properties emerge in micro systems, which may concern with the life activity of living cells. 3) Non-Turing scenario of body-organization during development. It was proposed that a simple reaction-diffusion model under the framework with two characteristic features: i) dominant diffusion of activator, and ii) spatial discreteness on the ensemble of cells