Heavy ion radiobiology - Further progress

S-II-1 Advance in High LET radiobiology using HIMAC

Koichi ANDO
Clinical Radiation Biology and International Space Radiation Laboratory, National Institute of Radiological Sciences, Chiba, Japan

HIMAC synchrotron was installed and started to accelerate particle beams in 1994, providing therapy beams at day time and experimental one at night. A program promoting research activities of physics and biology was also initiated as a nationwide cooperative research, and have produced scientific findings that are important for the risk/benefit estimation of high LET in radiotherapy and space radiation. First, an important question what LET is beneficial for therapy is now answered, partly at lease, by comparing RBE for between tumor growth inhibition and normal skin damage. An intermediate LET of 40 keV/μm is superior to either a low LET of 20 keV/μm or a high LET of 80. Th superiority is originated from a difference between tumor and skin in response to fractionated irradiation. Second, a question whether induction of cytokines depends on LET is answered by irradiating cultured human tumor cells. Vascular endothelial growth factor (VEGF) mRNA and protein increased with dos but not with LET, indicating that radiation-induced DNA damage and/or its repair may not be prerequisite to the induction of VEGF mRNA. Third, a question how high LET radiation causes functional damage is responded by measuring the behavior of mice receiving local irradiation to brain with carbon ions. Memory impairment is detected. Other topics such as carcinogenesis and DNA repair genes will also b referred to during presentation .

S-II-2 RBE of Scid Cells for Heavy Ions.

Yutaka OKUMURA; Dept. of Radiation Biophys., Atomic Bomb Disease Institute, Nagasaki University School of Medicine

Scid cells which defect DNA-dependent protein kinase, DNA-PK, are highly sensitive to X-irradiation. Hybrid cells which are scid cells introduced a fragment of human chromosome No. 8, resume radiosensitivity as to parental cells of scid cells. By obtaining RBE for heavy ion beams, the repair of DNA-PK dependent lethal damages induced by high LET beams was analyzed. Scid cells, hybrid cells and Balb/c for wild type were used for the analysis. X-rays (200 kV) and heavy ion beams (carbon ions, 50 keV/micron) were used to obtain radiosensitivity. The results of experiments were; (1) Scid cells showed higher radiosensitivity than hybrid cells to X-rays as well as to heavy ion beams. (2) RBE of scid cells was 1.3, and that of hybrid cells was 1.47. (3) Rejoining of DNA double-strand breaks was observed to X-rays as well as to heavy ion beams. Followings were elucidated; (1) Amount of DNA-PK dependent repair of lethal damages induced by X-rays was equal to that induced by heavy ions. (2) Amount of DNA-PK independent repair of lethal damage was reduced in heavy ion beam irradiation compared to X-irradiation.