158 Increase of mitotic indices in a human salivary gland tumor xenograft after irradiation with particle beams.

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We previously demonstrated that the HSG tumor, a human salivary gland tumor and growing in nude mice, showed neutron's RBE as large as 10 when tumor growth delay time was used for endpoint. We here investigated and reported time factor in the HSG tumor after irradiation with low- and high-LETs. The results obtained were as follows. (1) Mitotic index(M.I.) of unirradiated HSG tumor was 2%. Gamma rays of 15 Gy increased M.I. to 3.5% at Day 3and 4.5% at Day 5 through Day 8. Ki-67 index also increased from 20% to 60% by 5 days. (2)M.I. at Day 5 was significantly lower for tumors irradiated under clamped hypoxia than under normal condition. (3) M.I. at Days 5 showed dose-dependence after both γ rays and cyclotron fast neutrons. RBE of 6 was obtained for neutrons. (4) 135MeV/u Carbon-12 induced higher M.I. than γ rays at Day 5. Proximal peak (80 keV/μ m) showed the highest M.I., followed by middle peak(103keV/μ m) and distal peak (173keV/μ m). Recruitment of Go cells to cell cycle could account for the increase of M.I. after irradiation.

159 **LET dependence of biological effects in normal human cells irradiated with accelerated neon ions.**

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We investigated the linear energy transfer(LET) dependency of cell death, mutation induction in human embryo(HE) cells irradiated with accelerated neon ion beam. We have also examined mutation spectra of hypoxanthine-guanine phosphoribosyltransferase(HPRT) exons by polymerase chain reaction(PCR). Neon ions were accelerated with the RIKEN ring cyclotron and LET of neon ions was varied with Lucite absorber. Mutation frequency was determined to measure the 6-thioguanine resistant colony forming ability.

The effects of cell death were several times higher than that by X-rays. On the other hand, the frequency of mutation induction was independent of LET. In molecular study, almost all the mutants induced by neon ions were partially deleted in 7 exons of HPRT locus.

160 **Analysis of Survival Curve Parameters caused by High-LET Accelerated Ion Beams, Cell Strains, and LETs**

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Radiobiological effects by accelerated heavy ions that has high-LET are compared with that by ordinal ionizing radiations as relative biological effectiveness (RBE). The cell survival parameters are usually determined by several models of radiobiological theory such as the target theory, the molecular theory, and so on. We investigate the difference of survival parameters revealed by the difference of accelerated ion spaces, LETs of the beam, and irradiated cell strains.

Exponentially growing Chinese Hamster V79 cells and HSG cells (human salivary grand tumor) were exposed to accelerated ^{3}He-, ^{12}C-, and ^{20}Ne-ions. These ions were accelerated to be 12 MeV/u and 135 MeV/u, at NIRS and RIKEN cyclotrons, respectively. By the range-shifter, LET of the beams was adjusted to adequate value among 20 to 600 keV/μm. After the cell culture, cell colonies were counted and analyzed with curve-fitting computer programs.

Different LET-RBE relationships were found for each ion species for the same cell strains, and each cell strain for the same ion spaces. Also different characteristic's behavior of survival parameters such as α, β, D_0, Dq, and n, against the beam LET was observed.