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Cellular and molecular biomarkers of radiation exposure in directly irradiated and bystander cells

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Exposure to radiation to biological systems may be implicated to various health effects involving interaction of radiation at various organizational tiers i.e. molecular, cellular, tissue, organ and organism. These changes could be monitored using suitable biomarker(s) for evaluation of dose received and assessment of short and long term radiation risk. Our experiments using various experimental systems showed changes occurred at membrane level, which were further correlated with changes in membrane fluidity. Cellular oxidative changes measured using sensitive fluorescent probe showed linearity at high dose rate. The method was sensitive to detect cellular oxidative stress at low dose rate/low doses (≥0.2 cGy) suggesting suitability of the technique to serve as suitable biomarker at low doses of radiation. Human intestinal cells labeled with ^{3}H-thymidine showed expression of gamma-H2AX, a sensitive biomarker of DNA double strand break, which showed a kinetics of repair during incubation periods. It was interesting to observe that conditioned medium from 3H-thymidine labeled cells resulted in proliferation in bystander cells, which was correlated with regulation of DNA damage and cell cycle regulating proteins/genes. Our recent experiments using proton microbeam showed differential DNA damage in human normal lung fibroblasts and counterpart lung carcinoma cells. Proton microbeam irradiated lung cancer cells exerted double strand break in bystander cancer cells involving gap junction communication. On the contrary, presence of bystander fibroblasts prevented damage in human lung cancer cells. The implications of these results with relevance to human health will be discussed.

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