Cellular Radiobiology

Comparative analysis of gene expression data after exposure to Iodine-123 labeled 5-Iodo-2´-deoxyuridine, γ-rays and α-particles

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To investigate whether exposure to different radiation qualities is reflected in a significant differentially gene expression respective analysis were carried out in human T-lymphoma Jurkat cells after exposure to Iodine-123 labeled 5-Iodo-2´-deoxyuridine (I-123-UdR), γ-rays and α-particles. Potential gene markers were identified.

Equi-effect radiation doses, i.e. radiation doses and exposure conditions causing the same biological effect level, were determined in human T-lymphoma Jurkat cells with regard to micronucleus formation, γ-H2AX foci signal intensity and apoptosis induction after γ-irradiation (Cs-137, 0.7 Gy/min), α-irradiation (Am-241, 0.032 Gy/min) and exposure to the Auger electron emitter I-123 which was incorporated as I-123-UdR into the DNA for 20 h. Radiation dose for I-123 exposure was assessed by point-kernel calculations and 3-D morphology of the cells. Whole human genome DNA-microarrays (Agilent) were employed to measure gene expression after exposure to equi-effect doses. RNA was isolated 6 and 24 h post-exposure. The criteria for candidate genes were a significant expression change (>1.5 fold; $p<0.05$) and no altered or even a conversely regulation in response to the other radiation qualities. Expression of selected candidate genes was validated via qRT-PCR. Biological processes and pathways of significantly regulated genes were subsequently analyzed.

At equi-effect doses 1055, 318 and 165 genes were exclusively regulated after exposure to γ-rays, α-particles and I-123-UdR, respectively. The biological processes *Apoptosis* and *Nucleosome Organization* were activated. According to the strict requirements for potential gene markers, we identified 4, 1 and 1 gene(s) allowing a robust discrimination between γ- vs. I-123-UdR-exposure, γ- vs. α-radiation and α- vs. I-123-UdR-exposure, respectively.

The presented results indicate that gene expression analysis might be an effective tool for the discrimination between high- and low-LET radiation. In addition, it seems to be possible to distinguish between different types of high-LET radiation.

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