Comparison of radiosensitivity of human chromosomes 1, 2 and 4 from one healthy donor

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Abstrak

In general, it was assumed that the chromosome aberration induced by ionizing radiation is proportional to the chromosome size. From this viewpoint, the higher chromosome size, the more resistant to radiation. However, different opinions, in which chromosomes are particularly sensitive or resistant to radiation, are also still followed until now. Here in this research, we compared the chromosome sensitivity between chromosomes number 1, 2, and 4 using the FISH (fluorescence in situ hybridization) technique. From this research, we expect that the information obtained could show clearly whether a longer chromosome is more frequently involved in translocations and also more resistant to radiation than a shorter one. The type of chromosome aberration considered was limited only to translocation and we used one sample donor in order to avoid donor variability. The whole blood from a healthy female was irradiated with γ-rays with doses of 1, 3 and 5 Gy, respectively. Isolated lymphocytes from the whole blood were then cultured for 48 hours. After the culture process was completed, preparations of harvest and metaphase chromosomes were carried out. Chromosomes 1, 2, and 4 were stained with different fluorochromes. The translocation of each chromosome at each dose point was subsequently evaluated from 50 images obtained from an automated metaphase finder and capturing system. An additional analysis was performed to identify which chromosome arm was more frequently involved in translocation. Further analyses were also conducted with the aim of determining which chromosome band had a higher frequency of radiation-induced breakage. The experimental results showed that chromosome number 4 was more frequently involved in translocations compared to chromosomes 1 and 2 at 5 Gy. In contrast, at doses of 1 and 3 Gy translocations involving chromosomes number 1 and 2 were more numerous compared to the ones involving chromosome 4. However, if the number of translocation was accumulated for all the doses applied, the chromosome number 4 was the chromosome most frequently involved in translocations. Breakpoint analysis revealed that in chromosome 1, chromosome 2, and chromosome 4, the highest chromosome bands as break position were in band q32, p13, and q21, respectively. It can be concluded that chromosome 4 is more sensitive to radiation in all doses point, despite having less DNA content than chromosomes 1 and 2. Thus, it was showed that our research cannot support the general assumption about chromosome aberration induced by radiation being proportional to DNA content.