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Carbon ion irradiation suppresses metastasis related genes in human prostate carcinoma cells.

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Hadrontherapy is a form of external radiation therapy, which uses beams of charged particles such as carbon ions. Compared to conventional X-ray therapy, the main advantage of hadrontherapy is the precise dose localization along with an increased biological effectiveness. This high ballistic accuracy allows depositing the maximal dose to the tumor, while damage to the surrounding healthy tissue is limited. First results obtained from prostate cancer patients treated with carbon ion therapy, show good local tumor control and survival rates. However, the impact of hadrontherapy on cancer metastasis is not well characterized yet. Previous studies show that hadrontherapy may inhibit metastasis by suppressing cell motility and migration. In contrast, clinical studies show evidence that X-rays might promote the metastatic potential of cancer cells. In the present study we investigated the effect of carbon and X-irradiation on changes in metastasis related genes in a human prostate adenomacarcinoma cell line, PC3.
PC3 cells were irradiated with various doses (0, 0.5, 1 and 2 Gy) of accelerated 13C-ions (75 MeV/u; LET = 33.4 keV/µm) at the GANIL facility (France). A similar experiment with X-rays (Pantak HF420 RX machine; 250 keV, 15 mA; dose rate= 0,25Gy/min) was performed at SCK•CEN. RNA was extracted 2h, 8h and 24h after irradiation. So far, samples irradiated with 0, 0.5 and 2 Gy (carbon ions and X-rays) were selected for further whole genome transcriptomic analysis using micro-arrays (8h time-point). After labeling samples were hybridized to Human Gene 1.0 ST Array chips (Affymetrix). Gene expression profiles are currently being analyzed using Partek software. Our initial results demonstrate that carbon irradiation induced different effects at the level of gene expression compared to X-rays. For instance, within a set of genes related to cell motility and migration we found seven genes (APC, NEXN, MYH10, CCDC88A, ROCK1, FN1 and MYH9) with a significant fold change of < -3 after 2 Gy of carbon ion irradiation which were not affected by X-rays. Although these findings need further validation, they seem to support the abovementioned data concerning the inhibitory effects of hadrontherapy on cancer metastasis. In conclusion, this study helps gaining more insight into genes and pathways differentially regulated following exposure of cancer cells to different radiation qualities thereby leading to a better biological evaluation of various types of radiotherapy.

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