September 21 - 24, 2022
Catania - Italy

BOOK OF ABSTRACTS

47° ANNUAL MEETING OF THE EUROPEAN RADIATION RESEARCH SOCIETY

XX MEETING OF THE ITALIAN RADIATION RESEARCH SOCIETY

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Direct and indirect effects of proton and carbon ion irradiations on breast adenocarcinoma cells

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Keywords: protons, carbon ions, direct and indirect effects, DMSO

Radiation-induced DNA damage is considered as the most important cellular damage as it could lead to the loss of clonogenic capacity and cell death.[1,2] Cell inactivation caused by irradiation results both from direct as well as from indirect actions mediated by free radicals.[3] To discriminate the direct from indirect radiation actions is important because it provides essential information about the mechanisms by which radiation ultimately affects cells.[4] Free radical scavengers, such as DMSO, can be used to reduce effects of indirectly induced DNA damages without affecting the direct effects of irradiation.[4,5] The aim of this study is to estimate the contribution of each of these effects on breast adenocarcinoma cells irradiated with three types of irradiations, i.e. γ-rays, protons and carbon ions. The MCF-7 cells were pre-treated with DMSO and then irradiated with ^{60}Co γ-rays, protons or carbon ions with doses ranging from 1-5 Gy. Cells were exposed to 62 MeV/u protons and carbon ions. Radiation position for protons was in the middle of the spread-out Bragg peak, while irradiations with carbon ions were carried out within slightly broadened Bragg peak to obtain LET with the highest biological effectiveness. Degree of protection (DP) was calculated for each dose and plotted as a function of the DMSO concentration. The contribution of indirect action in cell killing was obtained from the maximum DP provided by DMSO.[4,5,6] According to the results, the DP of DMSO increased in all irradiated cells, in a concentration dependent manner. After γ-irradiations, the estimated direct effects were around 35%, while the 65% of total irradiation effects could be attributed to indirect actions. In cells irradiated with protons and carbon ions, higher contribution of direct effects was observed, being around 44% and 48%, respectively. Although contribution of direct effects was higher in

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proton and carbon ion irradiated cells, a substantial fraction of indirect actions was found, being around 56% for proton and 52% for carbon ions. This points to important role of free radical actions in high LET irradiation induced cell death. The calculated relative biological effectiveness at 10% survival (RBE_{D10} values) also show that in high LET radiations, direct actions had a stronger impact on cellular growth inhibition than indirect effects.

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