Radiobiology Experiments for Characterization of the low-energy TOP-IMPLART Proton Beam

M. Vadrucci[a], A. Ampollini[a], P.Anello[b], M. Balduzzi[c], G. Bazzano[a], G. Esposito[b,d], C. Patrono[c], L. Picardi[a], C. Ronsivalle[a], C. Snels[c], M. A. Tabocchini [b,d], A. Testa[c]

[a]ENEA Radiation Sources Laboratory, Research Center Frascati, Rome, Italy
[b] Istituto Superiore di Sanità - Technology and Health Department, Viale Regina Elena 299, 00161 Roma, Italy
[c] ENEA C.R. Casaccia, UT. BIORAD Radiobiology, Via Anguillarese, 301, 00123, Roma, Italy
[d] INFN-Sezione di Roma1, Gr.coll.Sanità

e-mail: monia.vadrucci@enea.it

Keywords: proton beam, clonogenic survival, V79 cells, CHO cells.

The TOP (Oncological Therapy with Protons)-IMPLART (Intensity Modulated Proton Linear Accelerator for RadioTherapy) [1] accelerator is a facility for proton-therapy under construction in ENEA C. R. Frascati Radiation Sources Laboratory in collaboration with ISS and IFO. It is a completely linear pulsed accelerator consisting of a 7 MeV injector followed by a high frequency booster up to 150 MeV. A vertical beam extraction-line at the exit of injector has been devoted to in-vitro radiobiology experiments for the characterization of the low-energy proton beam.
Irradiation experiments were carried out on V79 and CHO Chinese hamster cells. Both cell lines have been widely used in radiobiology studies with different radiation qualities – including by the authors - thus allowing the evaluation and the comparison of results.
In order to carry out the biological characterization of the facility, the radiation responses of V79 and CHO cells have been evaluated in terms of clonogenic survival. Moreover, a protocol of Micronuclei Assay for the in situ evaluation of radiation induced DNA damage has been adapted to the specific exposure conditions of the vertical proton beam.
Cells were plated in stainless steel Petri dishes, especially designed for charged particle irradiation [1], and grown attached to a 60 μm mylar foil representing the base of the dish.
The irradiations have been performed with protons extracted in air and impinging on the cells with energy of 5 MeV (incident LET=7.7 keV/μm in MS20); the clonogenic survival was evaluated in the dose range 0.5-8 Gy.
The dose-response curves - characterized by an initial shoulder followed by a straight portion - were well fitted by a linear-quadratic function.
The obtained results were found in good agreement with literature data [3, 4].

[1] C. Ronsivalle et al., The TOP IMPLART Project, Eur. Phys. J Plus (2011) 126, number 7, 68
[2] Belli et al, NIM 1987
[3] Belli et al, IJRB 1998
[4] JT Tang'et al, BJC 1997