

AbstractID: 7271 Title: Low dose RBE of therapeutic proton beams

Purpose: To develop a model for calculation of RBE in therapeutic proton fields applicable to low dose regions; determine parameters of the model and evaluate RBE variations throughout realistic treatment fields.

Methods and Materials: The clinically adopted generic RBE of 1.1 is supported by extensive radiobiological data (Paganetti H., et al. *Int. J. Radiat. Oncol. Biol. Phys.* 53:407–21, 2002). However, most of these data are based on measurements at doses exceeding the typical dose of about 2 Gy/fx near the target volume, let alone doses received by normal tissues and organs away from it. Late responding tissues are characterized by low α/β ratios and have RBE increasing significantly with decreasing dose. It is therefore conceivable that the generic RBE underestimates biological effects in some normal tissues that both exhibit late morbidity and receive low doses. Methods of the present study include review of published radiobiological proton data with focus on doses of about 2 Gy and less, and data analysis based Monte Carlo simulations of pertinent proton fields.

Results: A data set comprised of previously published data on in vitro survival of V79 hamster cells was compiled. It includes data relatively accurate at low doses, and covers a range of irradiation conditions, characterized in our study by proton fluence spectrum at the point of measurement. The spectra were calculated with the Monte Carlo program MCNPX and are used to obtain biological response functions that map proton spectra onto parameters of cell survival curves. In this approach RBE variations throughout a treatment field are calculated based on proton doses and spectra at points of interest.

Conclusion: A phenomenological model has been developed for calculation of proton RBE. The model will be further applied to other cell lines and biological endpoints.