hepatic tumors.

P900

The methods to quantify the radiation quality in association with the biological response: RBE, DRF, CBE and w_f

S. Savolainen[1], I. Auterinen[2], T. Seppälä[3], M. Kortesniemi[1]; [1]HUS Helsinki Medical Imaging Center, University of Helsinki, Helsinki, FINLAND, [2]Vtt, Processes, Helsinki, FINLAND, [3]Boneca Corp., Helsinki, FINLAND.

Aim: Survey of relative biological effectiveness (RBE) definitions with the reported values for different forms of radiation in therapy. In association with RBE the dose rate factors (DRF) and in binary therapies, like boron neutron capture therapy (BNCT), compound biological effectiveness (CBE) have been taken into account. **Materials & Methods:** In BNCT, the dose consists of a mixture of radiations with different quality: incident fast neutrons giving rise to recoil protons, protons from the $^{14}N(n,p)^{14}C$ reaction, alpha and lithium particles from the $^{10}B(n,\alpha)^{7}Li$ reaction in boron compounds administered for therapeutic purposes and γ-rays from both the $^{1}H(n,\gamma)^{2}H$ reaction in hydrogen present in tissue and from the neutron source. Consequently, a new formalism has been taken into use to describe the total therapeutic dose. Each dose component is multiplied by the experimental weighting factor (w_f) and the total dose is expressed as the weighted dose, which equals the sum of the weighted doses [$D_W = w_\gamma D_\gamma + w_B D_B + w_N D_N + w_{fast\_n} D_{fast\_n}$]. The equivalent formalism has been used also when testing the RBE of radioisotopes emitting different forms of radiation [$RBE_{expected}(^{99m}Tc) = f_{photons} RBE_{photons} + f_{CE} RBE_{CE} + f_{Auger} f_{DNA} RBE_{Auger}$]. In these applications it is assumed that the doses and their effects are linear quantities. **Results:** The calculated RBE factors depend on the selected definition of the RBE concept and also on the assumptions made in the dose calculations. Based on the published data the RBE factor for the Finnish BNCT beam for a canine brain is 1.2-1.4 depending on the selected endpoint. The RBE of the high-LET components varies by the factor of two depending on the selected DRF in calculations. RBE's for commonly used diagnostics isotopes are one. DRF of the γ radiation is not known in the mixture of low- and high-LET radiation and based on the reported studies, the usage of DRF cannot be unequivocally deduced. **Conclusion:** The used macroscopic quantities RBE, DRF, CBE are insufficient to describe the biological response of the different kind of radiations when mixed radiation such as BNCT is used for therapy. Microdosimetric analysis may give a better understanding of the dose responses in a mixed radiation field.

P901

Evaluation Of A Novel Radiation Detector System For In Vitro

P916

Co-Registration of Tomographic Images for BNCT Treatment Planning

E. Salli[1], T. Seppälä[2], K. Van Leemput[1], J. Hämäläinen[1], J. Collan[3], H. Minn[4], H. Joensuu[3], M. Kouri[3], S. Savolainen[1], M. Kortesniemi[1]; [1]HUS Helsinki Medical Imaging Center, HUS, Helsinki, FINLAND, [2]Boneca Corporation, Helsinki, FINLAND, [3]Department of Oncology, Helsinki University Central Hospital, Helsinki, FINLAND, [4]Department of Oncology and Radiotherapy/Turku PET Centre, Turku University Central Hospital, Turku, FINLAND.

Aim The aim of this study was to co-registrate multimodal tomographic images for boron neutron capture therapy (BNCT) treatment planning. CT images are used to delineate soft tissues, bones and air cavities, in which neutron transport differs. Macroscopic tumor and the planning target volume are defined on the MR images. Accumulation of boron in tissue can be estimated from fluorine-18-boronophenylalanine (FBPA) PET images. The boron dose may constitute up to about 90% of the total tumor dose. **Material and Methods** Co-registration of the treatment planning images was permormed for 3 treatments. The image download from the HUSpacs, image co-registration, and resampling were carried out using a software developed at HUS Helsinki Medical Imaging Center. The rotation and translation parameters (using a rigid body model) between the modalities were determined by maximizing the mutual information between their intensities. The accuracy of the registration was visually checked by an oncologist. The MR and PET data were resampled to correspond with the image matrix of CT to import the images into the SERA treatment planning program. **Results** and **Conclusions** According to visual inspection of the anatomical cranial landmarks the registration accuracy of the applied method is satisfactory for BNCT. However, in the caudal slices the errors were larger, since the neck-brain entity is not a rigid object. The errors in MR/CT/PET-registration were reduced by using a similar head support in all modalities. Additional research concerning elastic transformations to improve the registration accuracy is indicated. Quantification of registration error is also needed for further validation.

P917