and, if needed, a new plan was re-optimized adaptively. Set up was verified with gated orthogonal X rays and non-gated cone beam CT in treatment room. Threshold for gate-on signal was initially set at 10% pressure signal dynamic and qualitatively adjusted in an asymmetric way according to results of plan recalculation in 30% expiration and inspiration. Gating signal was fed to the accelerator to enable beam delivery. Each slice was re-scanned 5 times to smear out possible interplay effects. Acute and early toxicity was scored according to CTCAE 4.0 scale.

Results: GTV and diaphragm excursion between end expiration and adjacent 30% phases was reduced to less than 5 mm. GTV (95%) and critical OAR (D1%) DVH in 30% inspiration and expiration phases showed on average minimal (less than 3%) differences as compared to planning end expiration plan. Toxicity was minimal with no G3 event; 15% acute G2 and 10% G2 toxicity at 3 months was observed. Median follow up was rather short (3 months) nevertheless in 23 patients the dose limiting OAR was either stomach or small bowel or esophagus, therefore early toxicity data are informative.

Conclusion: Active scanning with carbon ion beams for the treatment of moving target using abdominal compression, 4D simulation, robust planning gating and rescanning is feasible and safe. Longer follow up is needed to evaluate oncological outcome

Keywords: organ motion, active scanning

86 Carbon ion radiotherapy: do we understand each other? How to compare different RBE-weighted dose systems in the clinical setting

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In carbon ion radiotherapy (CIRT), mainly two calculation models are adopted to define relative biological effectiveness (RBE)-weighted doses (D_{RBE}): the Japanese Kanai model and the Local Effect Model (LEM). Taken the Japanese longest-term clinical data as a reference, the use of a different RBE model, with no correction for the Gy (RBE) scale, leads to deviations in target absorbed dose (D_{abs}) with D_{RBE} = 5 Gy (RBE). Aside from unavoidable differences in dose profile shape, severe target under-dosage was shown in LEM-based optimized plans, when uncorrected D_{RBE} were prescribed. The delivery of a voxel by voxel iso-effective plan, if different RBE models are employed, is not feasible; it is however possible to minimize differences in dose deposited in the target. Dose prescription is a clinical task which ultimately depends only on the radiation oncologist clinical decision; in this study we made an attempt to avoid systematic errors which could potentially compromise tumor control.

Keywords: Relative Biological Effectiveness, carbon ion radiotherapy, Local Effect Model

References:

87 Experimental study of Radiation induced DNA damage by internal Auger electron cascade compared to external γ-rays

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In carbon ion radiotherapy (CIRT), mainly two calculation models are adopted to define relative biological effectiveness (RBE)-weighted doses (D_{RBE}): the Japanese Kanai model and the Local Effect Model (LEM). Taken the Japanese longest-term clinical data as a reference, the use of a different RBE model, with no correction for the Gy (RBE) scale, leads to deviations in target absorbed dose (D_{abs}) with D_{RBE} = 5 Gy (RBE). Aside from unavoidable differences in dose profile shape, severe target under-dosage was shown in LEM-based optimized plans, when uncorrected D_{RBE} were prescribed. The delivery of a voxel by voxel iso-effective plan, if different RBE models are employed, is not feasible; it is however possible to minimize differences in dose deposited in the target. Dose prescription is a clinical task which ultimately depends only on the radiation oncologist clinical decision; in this study we made an attempt to avoid systematic errors which could potentially compromise tumor control.

Keywords: Relative Biological Effectiveness, carbon ion radiotherapy, Local Effect Model

References:

Purpose: The aim of this study is to compare the radiation induced DNA damage done by internal Auger-electron cascades with external exposures of sparsely ionizing radiation such as γ-rays.

Background: Auger emitters decay by internal conversion (IC) or electron capture (EC) producing a number of Auger cascades with external exposures of sparsely ionizing radiation such as γ-rays. These clusters of DNA damage are much harder to repair and are therefore believed to be much more harmful to the cell than dispersed DNA damage, which are primarily produced by low LET radiation. Due to their short range and the severe DNA damage produced, Auger emitters may be able to kill not only the target cell while sparing non-targeted cells. This makes them a potential tool for radionuclide therapy(1,2,3,4).

Material/Methods: In order to compare the radiation effects by the Auger emitter to that of external γ-rays we need to be able to estimate the dose delivered. As Auger cascade electrons have a very short range the precise spatial distribution of the decays is of high importance.

We are currently working with two Auger emitters, Cs-131 and La-135. First experiments have been performed using HeLa cells, which were incubated with either Cs-131 or La-