image-guided radiation therapy could improve the treatment accuracy of high precision stereotactic radiosurgery.

P3-043 Protons and C-ions for the treatment of non-small cell lung cancer (NSCLC): What is published the evidence?

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Background: The prognosis of patients with NSCLC is still poor. Amongst distant metastases, also local tumour recurrence is still a problem. Because charged particles (protons and C-ions) have a better dose-distribution than the currently used photons, at least from a theoretical point of view, they should lead to superior results compared to photons. On top of the physical superiority of protons over photons, C-ions also display a biological advantage.

Aim: In this review, we searched for clinical evidence that protons or C-ions would really be beneficial to patients with NSCLC.

Methods: We performed a review based on published literature by means of a standardized query using the following electronic databases (up until January 31, 2007): CINAHL, EMBASE and MEDLINE. There was no limit applied to publication year, language or study design. Search terms (using free text words as well as MESH terms) were used alone or in combination, related to lung cancer and charged particle treatment. This included the following terms: neoplasm, cancer, carcinoma, lung cancer, proton, ion, charged particle and hadron.

Results: Six fully published series (protons:3, C-ions:3), all dealing with NSCLC, mainly stage I, were identified. No phase III trials could be identified. On proton therapy, weighted means of 2-5 year local tumour control rates varied between 68% and 84%. The weighted mean for 2 year/5 year overall survival and 2 year/5 year cause specific survival were 53%/23% and 66%/46% respectively. Radiation induced pneumonitis was observed in about 10% of the patients. On C-ion therapy, the local tumour control rate was 77% and the 5 year overall survival and cause specific survival rates were 42% and 60% respectively.

Conclusion: The results with charged particles, at least for stage I disease, seem to be better than that which is generally achieved by conventional radiotherapy. However, they seem to be similar to what may be achieved with hypofractionated “stereotactic” photon techniques, with which in several phase I/II studies, local tumour control rates of 90 % and more were reported. Due to the overwhelming theoretical data on the beneficial properties of protons and light ions, further investment in the infrastructure needed to perform large trials in patients with different lung cancer stages, is warranted. Until these results are available, for lung cancer, charged particle therapy should be considered as experimental.

P3-044 Image guided gated setup and treatment with implanted fiducials

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Background: Radiotherapy of tumors in the lung is often limited by the relatively low dose tolerance of the lung. One method to reduce the toxicity of these treatments is to reduce the volume of lung irradiated by using image guided setup and/or gating. The current generation of medical linear accelerators have both kVp imaging and gating, allowing the implementation of image guided gated radiotherapy. Tumors, however, are often not evident on kVp projection images, but this limitation can be overcome by the use of implanted fiducials.

Methods: A patient was broncoscopically implanted with 4 fiducials. All but one was lost within the first few days after implantation, and the last one remained for the entire treatment. On each day the patient was imaged using the kVp on-board imager. The imager was triggered with the same respiratory gating system used to the gate the treatment. The fiducial was used to align the patient; if a shift was made a 2nd set of kVp images was taken to validate the shift. The fiducial was aligned using both a point matching tool (ISOLOC, CIVCO, Kalona, IA) and an image overlay tool (4DTC, Varian, Palo Alto, CA). We also validated the setup by examining the projection of the fiducial on cine images acquired during the delivery of one the treatment fields.

Results: We were able to analyze shift data from 24 of 30 treatment days. The values of the initial shifts were -1.4±1.9, 5.3±2.2 and 0.5±2.2 mm in the lateral, cranial-caudal, and AP directions, respectively. The values of the residual error after the initial shifts calculated from the 2nd set of kVp images were -0.4±1.4, -0.6±3.5 and -0.6±1.3 mm in each direction. The point matching and image overlay systems were consistent at the 1 mm level. The cine images were taken in the AP direction and data could only be extracted for the lateral and cranial-caudal directions. These results were 0.1 ± 1.1 and 1.1 ± 2.2 mm respectively. These data suggest that the uncertainty in the gating represented about 4 mm of tumor motion.

Conclusion: Fiducial-based setup of lung patients using either a point-based or image-based system is practical using existing commercially available tools. Gating, however only reduces and does not completely eliminate tumor motion. An internal margin (IM) must therefore be included in the treatment plan to account for the uncertainty in the gated motion.

P3-045 Lung tumor tracking during 4-dimensional stereotactic radiotherapy treatment with the cyberknife: early results

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Purpose: Synchrony, the respiratory tracking system of the CyberKnife requires the insertion of markers in or close to the tumor. However, in this group of inoperable patients, it is associated with high risks like pneumothorax. To reduce the risks, 4 different methods of marker placement were used: 1) intravascular coil placement, 2) percutaneous intrapulmonal, 3) percutaneous extrapulmonal placement (for fixed tumors to the thorax), and 4) the bronchoscopic placement. To evaluate these techniques, we investigated the toxicity of the marker placement and the tumor response of the treatment. Until now 70 tumors are treated, but because the follow up is too short, we report the results of the first 55 patients with 60 tumors.

Methods and Materials: Markers were placed in or around 60 tumors in 55 patients. Forty eight patients were treated with curative intention: 40 patients had a T1-3N0M0 lung cancer and 8 patients had 13 solitary metastases in the lung. Seven patients were treated with palliative...