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Improvement of three-dimensional treatment-planning models of small lung targets using high-speed multi-slice CT imaging

Y. Kazunari, T. Soejima, E. Yoden, T. Maruta, T. Okayama, K. Sugimura. *Japan*

Purpose: It is difficult to recognize three-dimensional tumor movement using an ordinary CT scan, but a multi-slice CT scan could provide sagittal and coronal information regarding tumor movement. Respiratory gating technology for imaging and treatment is not yet widely available. The purpose of the current study was to explore an intermediate step to improve the reliability of the patient model and reduce treatment volume by acquiring multi-slice CT data with the patients single holding their breath at normal inhale and exhale.

Methods and Materials: We analyzed 9 tumors from 7 patients with small peripheral lung cancers. We used the multi-slice CT scanner GE Light Speed QXi (GE Medical System, Milwaukee, WI). CT scans were performed under 3 respiration conditions: free-breathing (FB), shallow inspiration (SI), and shallow expiration (SE). We created two treatment-planning fields for each tumor with three phase data sets.

1) Two-phase planning: planning target volume was created with a 1-cm margin for all dimensions from mixed CTV, which included SE CTV and SI CTV.

2) Free-breathing planning: with a 1-cm margin (ventro-dorsal, medial-lateral) and a 2-cm margin (cranio-caudal direction) from FB CTV.

To compare these treatment plans, 60Gy crossfire fields and two parallel-opposed fields were set up. These treatment parameters were transferred for use with the two sets of CT data at inhalation and exhalation. Three-dimensional dose calculation was performed with 10-MV photon beam data using Clarkson's summation technique with the 3D-RTP system (FOCUS, CMS, St. Louis, MO).

Results: There was no significant difference between minimum doses of the SI and SE CTV in the two plans using two parallel-opposed fields, but there was a significant difference between the minimum doses of the CTV of the two-phase plan and free breathing plan using crossfire fields ($p= 0.04$). Comparison of the ipsilateral lung V20 based on inhalation and exhalation CT data revealed that the V20 of the two-phase plan was smaller than the others($p<0.001$).

Conclusion: Compared to current free-breathing CT patient models, modeling lung treatments with two-phase planning using multi-slice CT provide an immediate reduction in the amount of normal tissue treated and improved reliability of patient data for DVH modeling. Spatial information using multi-slice CT has the potential to determine the planning target volume of moving lung tumors more precisely than conventional CT planning.

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Targeting somatostatin receptor positive tumours with Y-90 Lanreotide

J. Buscombe[1], K. Piggott[1], M. Caplin[1], A. Watkinson[2], J. Tibbles[2], L. Savy[2], A. Platts[2], A. Valentine[2], I. Virgolini[3], A. Hilson[1]. [1] *Royal Free Hopsital, NET clinic, London, UK;* [2] *Royal Free Hospital, Radiology, Lonodon, UK;* [3] *University Hospital, Nuclear Medicine, Lienz, Austria*

Targeted radio-therapy with beta emitting labelled peptide Yttrium-90 (Y-90) Lanroetide may be appropriate in patients who have tumours which express somatostatin receptors. Many of these patients, for example, such as those with carcinoid, do not respond to chemotherapy or external beam radiotherapy. The aim of this study is to review our experience in using Y-90 Lanreotide on such tumours

A total of 54 cycles of Y-90 lanreotide have been given to 24 patients over an 18 month period. All patients had failed or found to be unsuitable for other cancer treatments. They all had to have avid uptake of In-111 Octreotide in known tumour sites.All had good or stable markers of renal, liver and bone marrow function. There were 15 patients with carcinoid, 5 with gliomas, 2 fibrolamellar cancers, 1 ACTH secreting cancer and one malignant histiocytoma. The youngest was 19 and the eldest 76.

Patients were infused with 0.8-1.2 GBq on a 3-4 week basis for 3 treatments and if there was response this was repeated afer a 3 month gap in one patient. Those with intra-cerebral tumours were treated with 200-400 MBq Y-90 Lanreotide given intra-arterially into the tumour bed via a radiologically positioned catheter.

Most patients had fatigue for 7-10 days post treatment. There has been mild bone marrow toxicity in 4 patients and no renal toxicity. Response as measured by >25% reduction in tumour size on CT has occurred in 6 patients, stability of previously growing disease in 9 patients. All the remaining 9 patients with progressive disease have died of their disease. Poor prognostic indicators are massive tumour bulk and bone or lung metastases.

Y-90 Lanreotide can induce stability or regression in 58% of patients but may not be appropriate for those with very advanced disease

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Impairment of immune response after percutaneous low-dose radiation in hepatocellular carcinoma in rats

S.-M. Maksan[1], E. Schmidt[1], J. Schmidt[1], E. Ryschich[1], M.M. Gebhard[1], M. Harms[2], E. Klar[1], C. Herfarth[1]. [1] *University of Heidelberg, Department of Surgery, Heidelberg, Germany;* [2] *Heidelberg, Department of Radiation therapy, Heidelberg, Germany*

Introduction: Leucocyte-endothelium interaction by cell adhesion and cell migration is known to determine humoral tumor detection. The aim of our study was to evaluate the effects of percutaneous low-dose radiation on humoral immune response in experimental hepatocellular carcinoma.

Material and Methods: In 12 male ACI-rats (weight 230,0 ± 39,2g) Morris hepatoma was implanted in the left liver lobe. 10 days afterwards in 6 rats percutaneous single-dose radiation was applicated with 6Gy and 12h later intravital fluorescence microscopy performed with respect to tumor vessel diameter, red blood cell velocity and leucocyte adherence. Values were compared with control animals (n=6, without radiation). Data are given as mean values ± standard deviation; significance analysis was done by Wilcoxon-Mann-Whitney-U-Test.

Results: Vessel diameter and basal red-blood-cell velocity are comparable in hepatic tumor tissue and liver tissue. In tumor tissue leucocyte adherence was significantly reduced versus liver sinusoids ($p<0,05$). After radiation leucocyte-endothelium interaction was significantly enhanced in tumor tissue and sinusoids ($p<0,05$).

	Liver tissue	Tumor tissue
Vessel diameter	34,5μm ± 6,5	39,0μm ± 3,71
Red blood velocity [controls]	1,78 mm/s ± 0,18	1,85 mm/s ± 0,14
Red blood velocity [after radiation]	1,88 mm/s ± 0,10	1,93 mm/s ± 0,14
Adherent leucocytes/mm2 endothelial surface [controls]	0,99 ± 0,79	0,32 ± 0,1*
Adherent leucocytes/mm2 endothelial surface [after radiation]	12,74 ± 1,64 **	13,84 ± 1,21

*p<0,05 Tumor vs. liver **p<0,05 Radiation group vs. controls

Conclusions: The results of the current study showed that leucocyte-endothelium-interaction is significantly reduced in tumor tissue.

One of the main mechanisms for modulation of the immune-response in tumor endothelium is to improve the leucocyte-endothelium interaction. Homogeneous activation of liver sinusoids and tumor tissue after radiation indicates that immune response in endothelium cells could be regulated by unspecific inflammation.

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Comparison of dynamic conformal radiotherapy with micro-multileaf collimator vs arc non conformal radiotherapy vs static conformal radiotherapy

L. Fariselli, M. Mapelli, M. Fumagalli, I. Milanesi. *National Neurological Institute "Carlo Besta", Radiotherapy, Milan, Italy*

Introduction: In dynamic conformal radiotherapy (DCRT) field shape is being modified during gantry rotation in order to obtain a high dose conformity to planning target volume (PTV) and minimize dose to organs at risk and healty surrounding tissues. In the Radiotherapy Dept. of the National Neurogical Institute 'Besta' (Milan, Italy), DCRT is realized by a dynamic micro-multileaf collimator (DMLC, 3DLine) installed on a Philips SL75-5 linear accelerator. DMLC leaves are being moved during gantry rotation conforming the field shape to the PTV. This DMLC has been designed for the treatment of small and irregular size tumors. In particular it can be used for the fractionated stereotactic radiotherapy of brain tumors.

Purpose: To compare the dose conformity to PTV and normal brain dose characteristics obtained with different treatment techniques: DCRT (DMLC, A), dynamic non conformal (arc with fixed square field size, B) and conformal static (MLC conformed field, C). Three types of intracranical tumor has been selected: metastasis, glioblastoma (GBL) and meningioma.

Methods: PTV and brain tissue volumes of interest (VOI) are delineated on CT images. Plans for techniques A, B and C are performed: plan A has been performed by DMS software (Ergo, 3DLine) while B and C plans have