regression of the extra osseous masses, High dose group only had tumor regression (19.5–55%). All sites treated with single fraction had growth of the extra masses after RT and had re-growth of intra masses after 4 months. Seven sites had re-calcification of bone metastases after 4 months, which were all treated with high dose. The median overall survival time was 5.5months.
Conclusion: RT is an effective for pain relief of bone metastases from HCC, but correlation was not found between the total dose and pain relief. High dose group had longer duration of pain relief. Single fraction could not be controlled growth of intra destructive osseous masses after four months. Therefore, high dose RT seemed to be necessary to control osseous masses.

1408 POSTER

Effect of respiration on kidney in radiotherapy

P.S. Sridhar, R. Prabhakar, M.B. Pandey, P.K. Julka, G.K. Rath. *All India Institute of Medical Sciences, Radiotherapy and Oncology, New Delhi, India*

Introduction: Conformal radiotherapy and Intensity modulated radiotherapy allows improvement in the treatment outcome due to increased targeting accuracy through advanced beam shaping techniques to precisely conform radiation dose to the geometry of the tumor. Organ motion and treatment set-up uncertainties are unavoidable factors that are limiting the accuracy in treatment delivery and have to be accounted during treatment planning. Radiotherapy treatment planning needs optimum definition of the target volume in its relative position to normal tissue. The limited radiation tolerance of the kidneys is an important consideration in radiotherapy to estimate the movement of kidney during respiration. In this study, an effort has been made to quantify the variation of kidney movement during deep inspiration and deep expiration.
Materials and Methods: Twenty radiotherapy patients for whom abdominal imaging is required were selected for this study. Siemens Volume Zoom CT (Spiral CT) was used for this study. The CT imaging of theabdomen was done with both deep inspiration and deep expiration. After imaging the two-CTdatasets for deep inspiration and deep expiration were then pushed to the Eclipse Treatment Planning System through the Dicom network. The difference between the positions of the kidney during deep inspiration and deep expiration was then estimated based on the CT table position.
Results: In four patients the right kidney was found to be displaced slightly more than the left kidney. No difference was found between the right and left kidney for the rest of the patients during the deep inspiration and deep expiration. The maximal vertical motion of the superior and the inferior pole from its end-expiratory to its end-inspiratory position was found to be 1.7 $\pm$0.6 cm for both right and left kidney, maximum 4 cms. The lateral movement for both the kidneys was found be 0.3 $\pm$0.1 cm.
Conclusion: The shift in the kidney during deep inspiration and deep expiration clearly dictates the need for accounting the kidney motion during radiotherapy treatment planning. For tumors close to the kidney care should be taken while giving the margin to the Clinical Target Volume.

1409 POSTER

Radiation therapy in patients with cardiac pacemakers and implantable cardio-defibrillators: a survey of patterns of practice among radiation oncology in Japan

T. Soejima[1], E. Yoden[1], K. Tsujino[1], O. Fujii[1], Y. Ichimiya[1], Y. Nishimura[2], H. Fukuda[3], R. Sasaki[4], A. Yoshida[4]. *[1]Hyogo Medical Center for Adults, Radiation Oncology, Akashi, Japan; [2]Kinki University School of Medicine, Radiation Oncology, Osakasayama, Japan; [3]Osaka Prefectural Medical Center for Respiratory and Allergic Diseases, Radiology, Habikino, Japan; [4]Kobe Graduate University School of Medicine, Radiology, Kobe, Japan*

Backgrounds: Patients with cardiac pacemakers (PM) and implantable cardio-defibrillators (ICD) were increasing, and radiation therapy department should expect to face the prospect of treating a patient with these devices. Although the risk of potentially life-threatening malfunction secondary to electromagnetic interference or ionizing radiation is recognized, there are no practical clinical guidelines for radiation therapy with PM and ICD in Japan. Our objective was to determine the current patterns of practice of radiation oncologist in Japan.
Materials and methods: A survey was sent to 174 main radiation departments in Japan. Questionnaires were consists of experience of radiation therapy for patients with PM or ICD, and policies of management of patients with PM or ICD during radiation therapy.
Results: Total 108 questionnaires were returned (61%). Ninety-one departments had experience of radiation therapy for patients with PM or ICD (84%), and of these, two departments had experiences of malfunction of PM during or after radiation therapy. Policies of management of PM and ICD during radiation therapy were as follows; Keep PM and ICD device outside of the direct radiation beam in 65 departments (60%). Keep the device from 1 cm to 10 cm outside of the radiation fields edge in 34 departments (31%). Keep the device outside the collimated radiation beam during portal filming in 18 departments (17%). Only 18 departments estimated the absorbed dose received by the device before treatment (17%). ECG monitoring during radiation therapy in 19 department (18%). Consult cardiologists in 18 departments (17%), and check the functions of the device before radiation therapy in 21 departments (19%).
Conclusion: Malfunction of PM and ICD during radiation therapy was not recognized enough and practical clinical policies were deferent between departments in Japan.

1410 POSTER

Four-dimensional radiation therapy for lung cancer using the second model 256-detector row CT-scanner

M. Shinichiro[1], M. Endo[1], M. Sunaoka[2], S. Kandatsu[2], M. Baba[2]. *[1]National Institute of Radiological Sciences, Medical Physics, Chiba, Japan; [2]National Institute of Radiological Sciences, Hospital, Chiba, Japan*

We developed the second model 256-detecotor row CT was based on the design of the first one, which can obtain approximate 100 mm length in 1 s rotation. Our group previously reported its promise for the amount of diagnostic information and overcomes some of the limitations of present helical CT methods such as shorter scan time in wide cranio-caudal direction, contrast enhancement, cardiovascular circulation, perfusion, and kinematics. The second model 256-detector row CT can solve problems of the first model, especially in temporal resolution. Therefore, we believe the 256-detector row CT is enough to adopt to the four-dimensional (4D) radiation therapy. Here, we describe a preliminary investigation of 4D radiation therapy using the 256-detector row CT and adapted to non-small cell lung cancer (NSCL). The patients in this study were five male patients in our hospital, who were eligible patients having NSCL and American Joint Committee on Caner Stage II. They had given their informed consent to be included in the study and approved by the Institutional Review Board (IRB) of NIRS. All were inpatients of the institute hospital and receiving radiation therapy. The 256-detector row CT used a cine scan mode (continuous axial san with the table remaining stationary) to acquire one respiratory cycle. Scan conditions were 120 kV, 240 mA, 256* 0.5 mm beam collimation, 6 s acquisition time with cine scan mode. The effective dose was estimated as 14.5 mSv (=2.41 mSv/s * 6 s). Eight volumetric cine data (divided one cycle respiratory phase to eight) were transferred to the photon treatment planning system, XIO (CMS, Computerized Medical Systems, Inc. St. Louis, MO) and we planned the photon treatment using commercially available superposition algorithm. The planning target volume (PTV) included the gross target volume (GTV) with a 3 mm setup margin and 5 mm allocated for the penumbra with the MLC, which features a full 40 * 40 mm^2 field and is that offers 5 mm resolution for high precision treatment of small and irregular fields. MLC was used to define the field boundary and changed MLC position by varying the target shape with respiration. The 256-detector row CT showed the potential for 4D therapy and improve accuracy in planning because the 256-detector row CT allows for reconstructions in 0.5 mm isotropic resolution with a high temporal resolution. Although we reached this conclusion using the photon beam, it may be applied to carbon ion beam therapy as well.

1411 POSTER

The utility of multimodality imaging with MRI to determine treatment volumes for chemoradiation in rectal cancer

V. Khoo[2], D. Lim Joon[1], J. Tan[1], G. Fitt[1], M. Feigen[1], M. Marr[1], M. Butcher[1], W. Fernando[1], L. Spiteri[1], M. Chao[1]. *[1]Austin Health, Radiation Oncology, Heidelberg West, Australia; [2]Royal Marsden Hospital, Radiation Oncology, London, United Kingdom*

Purpose: To compare the gross target volume (GTV) derived from CT simulation alone (CT-GTV) to multi-modality GTV (M-GTV) derived from co-registered CT & MRI simulation and diagnostic MRI images
Methods: 15 patients (10 males, 5 females) with locally advanced rectal cancer (T3 and/or N1 disease) undergoing pre-operative chemo-radiation had co-registered CT and MRI simulation images. All had a diagnostic MRI with pre & post-contrast axial, coronal and sagittal T1 & T2 scans and sagittal STIR images. A diagnostic radiologist with a radiation oncologist defined the GTVs. The CT-GTV was defined from CT simulation images whilst blinded to the MRI. The M-GTV was then defined using co-registered CT & MRI simulation images whilst simultaneously reviewing the multiplanar diagnostic MRI. Assessment endpoints included an analysis of the volume and spatial relationship of the CT-GTV with respect to the M-GTV. The volume relationship was examined by calculating the ratio of the overall CT-GTV/M-GTV volume. In addition the volume ratio of the portion of the CT-GTV/M-GTV contained within the anatomically defined true rectum, the sigmoid and the anus was also calculated individually

to assess any differences in these anatomical sub-regions. The spatial relationship was analyzed with respect to points of interest placed at the extreme margins boundaries of the two GTVs i.e. superior, inferior, anterior and posterior. The difference in cm between the CT-GTV and M-GTV points of interest co-ordinates was calculated to quantify the spatial differences.
Results: The mean overall CT-GTV/M-GTV volume ratio for the entire tumor was 1.2 (range 0.5 to 2.9). For the portion of GTV in the true rectum the mean ratio was 1.3 (0.8–2.9) and recto-sigmoid was 1.6 (0.4–4.6). Only one patient had a portion of GTV present in the anus and this was only visible on MRI. With respect to the spatial comparison, the CT-GTV minus M-GTV values showed a mean difference for the superior margin of 0.19 cm (range −2.0 to 4.0 cm), for the inferior margin 0.49 cm (range −3.0 to 4.0 cm), for the anterior margin −0.35 cm (−5.7 to 1.95 cm) and for the posterior margin −0.15 cm (−0.93 to 0.77 cm). Underestimation of the GTV by CT compared to the M-GTV occurred in two patients and was highlighted by volume differences in the sigmoid and with the spatial differences in the anterior and superior boundaries. Overestimation of the GTV by CT could occur in the true rectum or sigmoid and is usually due to faeces in close proximity to the tumor.
Conclusions: CT defined target volumes can provide a reasonable estimate of the GTV compared to MRI but in some cases there is substantial over- and under-estimation of the GTV. Overestimation by CT results primarily from faeces in close proximity to the tumor. Underestimation and potential geographic miss using CT results from difficulty in visualizing the extent of tumor invasion within the sigmoid colon and anus. The use of MRI may avoid these potential problems.

1412 POSTER

Interfractional lung tumour and oesophageal movement using Active Breathing Control (ABC) during fractionated radical radiotherapy (RT)

N. Panakis[1], R. Mendes[1], H. McNair[2], C. Knowles[2], R. Symonds-Tayler[3], J. Bedford[3], S. Ashley[4], M. Brada[1]. [1]*The Institute of Cancer Research, Academic Department of Radiotherapy, Sutton, United Kingdom;* [2]*The Royal Marsden NHS Foundation Trust, Department of Radiotherapy, Sutton, United Kingdom;* [3]*The Institute of Cancer Research, Joint Department of Physics, Sutton, United Kingdom;* [4]*The Royal Marsden NHS Foundation Trust, Department of Information and Computing, Sutton, United Kingdom*

Introduction: Concomitant chemo-radiation appears to result in a survival advantage in patients with Non-Small Cell Lung Cancer (NSCLC) compared to sequential therapy, at the expense of increased radiation-induced pulmonary and oesophageal toxicity. RT planning takes into account tumour movement by adding a margin to the Gross Tumour Volume (GTV) called the Planning Target Volume (PTV). We aimed to immobilise the tumour with ABC to consider PTV margin reduction and assess the extent of oesophageal movement on radiation dose delivered to the oesophagus before introducing techniques to avoid it.
Method: 16 NSCLC patients had CT scans using an ABC device (William Beaumont Hospital, USA) in the first, middle and final week of RT. CT images were registered using bony anatomy. Change in the GTV with treatment was recorded. The GTV centre of mass was defined by the planning system using a spherical method. In 7 patients, the oesophagus was contoured and the position of the oesophageal borders relative to fixed bony anatomy was measured at 4 cm intervals. Displacement of the GTV centre of mass and oesophageal borders relative to the first scan provides a measure of movement.
Results: 12/16 (75%) of patients tolerated ABC for 3 scans. 4 were excluded from the analysis (2 progressed, 2 did not tolerate ABC). Mean reduction in the GTV was 34% by the 3rd CT. Mean displacement and standard deviation (SD) of the GTV and oesophagus is shown in the table. Results quoted are in relation to the first scan.

Direction of displacement	Mean displacement and Standard Deviation (SD) in mm		
	Right–left	Anterior–posterior	Superior–inferior
GTV scan 2	1.4 (1.7)	1.6 (1.8)	1.7 (1.6)
GTV scan 3	1.2 (0.6)	1.7 (1.4)	2.9 (2.4)
Oesophagus scan 2	Right 2.4 (3.2)	Anterior 2.1 (2.7)	–
	Left 2.1 (2.7)	Posterior 2.1 (2.7)	–
Oesophagus scan 3	Right 1.8 (2.8)	Anterior 1.9 (2.6)	–
	Left 2.1 (2.8)	Posterior 1.7 (2.1)	–

GTV displacement was greatest in the superior-inferior direction for the 3rd scan as 2 patients had resolution of collapse distal to the GTV causing a shift in position up to 7.7 mm in this direction. Oesophageal movement varied along its length, more marked at the level of the carina and gastro-oesophageal junction and less marked at the thoracic inlet. The mean SD of oesophageal displacement over all levels was 1.6 mm.
Conclusion: ABC was well tolerated at 3 time points during RT. Incorporation of movement of the GTV and oesophagus with ABC into standard margin calculations may allow reduction of dose to the lung and oesophagus reducing the risk of radiation-induced toxicity.

1413 POSTER

Normal tissue radiation sensitivity in cancer patients undergoing radiotherapy

G. Safrany[1], E. Kis[1], G. Bognar[1], K. Lumniczky[1], O. Esik[2]. [1]*NCPH – National Research Institute for Radiobiolog, Molecular and Tumor Radiobiology, Budapest, Hungary;* [2]*Pecs University of Sciences, Department of Oncotherapy, Pecs, Hungary*

Background: Very serious radiation-induced side effects will develop in about 5–10% of cancer patients undergoing radiation therapy. The aim of our experiments is to establish screening methods to identify radiation sensitive patients before the onset of radiation therapy.
Material and methods: Blood samples and skin biopsies were taken from cancer patients undergoing radiation therapy. The in vitro radiation sensitivity of peripheral blood lymphocytes was studied by single-cell electrophoresis (comet) and micronucleus assays. Primary fibroblast cultures were established from skin biopsies and the radiation sensitivity of fibroblasts was investigated by comet assay and by determining the survival fraction after 2 Gy irradiation (SF2 value). The in vitro data were correlated to the clinical symptoms of the patients. The gene expression patterns of radiation sensitive and resistant patients were studied by Agilent's whole human genome micro array system containing 44000 human genes.
Results: The comet and micronucleus assays were not informative. The SF2 values of control patients ranged between 26–40%. The SF2 values of patients with radiation-induced late toxic reactions in the central nervous system moved toward lower ranges and peaked between 8–15%. Similar alterations have been observed in patients with early and late radiation-induced toxic reactions in the skin and mucosa. There the SF2 values peaked between 15–20%. The gene expression analysis revealed genes responsible for radiation response in human fibroblasts and different expression patterns were detected in radiation sensitive and resistant patients.
Conclusions: In vitro assay might be applied to estimate the radiation sensitivity of cancer patients before the start of radiation therapy. This might be used for the individualization of radiotherapy protocols.

1414 POSTER

Induction of fluoropyrimidine metabolizing enzymes after an exposure of a cancer cell to an ionizing radiation – a concept supporting continuous schedules of chemoradiotherapy

P. Vitek[1], O. Taltynov[2], P. Hozák[2], J. Rosina[3], J. Zamecnik[1]. [1]*Institute of Radiation Oncology, Univ. Hospital Na Bulovce, Prague, Czech Republic;* [2]*Institute of Experimental Medicine, Czech Academy of Science, Prague, Czech Republic;* [3]*Institute of Biophysics, 3rd Medical Faculty Charles University, Prague, Czech Republic*

Background: Chemoradiotherapy employing fluorinated pyrimidines is a standard treatment approach although the exact mechanism of mutual potentiation has not been fully clarified. The original concept of an induction of fluoropyrimidine anabolizing enzymes within a post-radiation reaction was introduced in early 90th years. With the aim to establish a time dependence between a radiation dose (fraction) and maximal fluoropyrimidine efficacy a series of experiments was performed assessing the development of both the transcripts and proteins of fluoropyrimidine metabolizing enzymes after a single dose of radiation.
Material and methods: HeLa cells were irradiated by a dose of 200 cGy followed by an array of assessments mRNA encoding thymidine phosphorylase (TP), thymidine kinase (TK), thymidine synthetase (TS) and dihydropyrimidine dehydrogenase (DPD). A real time PCR method was employed using beta-actin (BA) as a reference gene. When mRNA induction was proved, an array of TP, TK, TS and DPD assessments was planned accordingly. A Western blot analysis was performed using specific commercially available antibodies. The time intervals between radiation and onset of increased enzyme concentration were established.
Results: The TP, TS and DPD mRNA levels decrease early after the radiation. A strong increase follows from the 5th hour after the radiation. There is a short early increase of TK mRNA 10 minutes after the radiation, however 5 hrs. later the development is similar to other enzymes. The mRNA levels increase 2–6 fold. The protein levels of TP, TS and DPD