2066 POSTER

Lung Stereotactic Body Radiation Therapy − Ensuring Accurate Target Volume Delineation

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Background: Four-dimensional computed tomography (4DCT) is increasingly used to account for intrafractional tumour mobility from respiratory motion in lung stereotactic body radiation therapy. For rapid generation of an internal tumour volume (ITV), some institutions frequently use a maximum intensity projection (MIP) image set created from the 4DCT. The purpose of this study is to compare the ITV generated using the MIP to an ITV generated from contouring the gross tumour volume in each of the 10 phases of the 4DCT acquisition.
Materials and Methods: 4DCT image data sets of 16 lesions in 9 patients with primary or metastatic lung tumours amenable to high-dose image-guided hypofractionated radiotherapy treatment were analyzed. For each lesion, an ITV was generated using the single MIP image (ITV-MIP) and a composite ITV was formed from delineating the gross tumour volume on each of the 10 phases of the 4DCT (ITV-10phase). Analysis of target volumes was performed by comparing the volumes of the two ITVs created for each lesion. Algebraic operators on the Varian Eclipse system were also used to examine the volume encompassed by ITV-10phase but not by ITV-MIP and, similarly, the volume encompassed by ITV-MIP but not ITV-10phase. The data was also analyzed by tumour location characteristics.
Results: Overall, the delineated ITV-10phase volume was equal or greater than the ITV-MIP volume for each case. The mean ratio of the volume of ITV-10phase to ITV-MIP was 1.21 with a standard deviation of $\pm$0.22 (ideal ratio = 1.00 when ITV-10phase is identical to ITV-MIP). For the subgroup of well-defined peripheral lesions (n = 7), further algebraic analyses revealed that the median percentage of potential gross tumour not covered by the MIP was 3.3% (range 1.0–10.9%). For the subgroup of tumours near the diaphragm or mediastinum (n = 5), the median percentage of potential gross tumour not covered by the MIP was 18.8% (range 10.7–39.6%). However, only 1.5% (range 0.7−3.8%) and 0.7% (range 0.3−2.6%) of the ITV-MIP was not covered by the ITV-10phase for the above subgroups, respectively.
Conclusions: Caution must be exercised when using MIP to delineate ITV to avoid under treatment of gross disease. For well-defined peripheral lesions entirely surrounded by low density lung parenchyma, an ITV generated from the MIP represented a relatively accurate estimate of the composite ITV created from each of the 10 phases of a 4DCT. However, significant differences in delineation occurred in cases where the lesion adjoined normal tissue structures with a similar density to tumour. In such cases, the MIP cannot be reliably used to delineate ITV.

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Predictors of Peritumoral Edema After Stereotactic Radiosurgery for Benign Brain Tumours

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Background: Peritumoral edema (PTE) is a well known adverse effect of stereotactic radiosurgery (SRS) for benign brain tumours. The aim of this study was to evaluate the potential risk factors of PTE after SRS for benign brain tumours.
Materials and Methods: The records of 45 patients with 48 benign brain tumours managed with linear accelerator-based SRS were retrospectively reviewed. Meningioma, cavernous hemangioma, arteriovenous malformation and schwannoma were included. A median marginal prescribed dose, 16.2 Gy (12.6–21.6 Gy), was delivered in 1 fraction. Median follow up period was 23.6 month (9.3–37.8 month). The incidence of overall PTE, symptomatic PTE and potential risk factors for PTE were analyzed using simple and multiple logistic regression analysis.
Results: Of the 48 cases, 13 (27%) developed overall PTE and 8 (16.7%) developed symptomatic PTE. Tumour volume (p = 0.033, odds ratio(OR)=1.216), parasagittal location of tumour (p = 0.003, OR=21.7), V18 (normal brain tissue volume receiving more than 18 Gy (p = 0.004, OR=1.672)), V15 (p = 0.006, OR=1.362), V10 (p = 0.012, OR= 1.184), D10cc (minimum dose in the most irradiated 10 cc volume of normal brain tissue (p = 0.003, OR=1.798)), D20cc (p = 0.002, OR=1.782), D30cc (p = 0.004, OR=1.694) were related to occurrence of symptomatic PTE in simple logistic regression analysis. Maximum normal tissue dose was not related with symptomatic PTE (p = 0.094). Only D20cc (p = 0.016, OR=7.362) was associated with occurrence of symptomatic PTE in multiple analysis. For overall PTE, V18 (p = 0.02, OR=1.392), V15 (p = 0.026, OR=1.201), V10 (p = 0.016, OR= 1.125), D10cc (p = 0.008, OR=1.320), D20cc (p = 0.007, OR=1.372), D30cc (p = 0.014, OR=1.402) and parasagittal location of tumour (p = 0.012, OR=18.86) were all related to occurrence of overall PTE in simple analysis. In multiple analysis, parasagittal location of tumour (p = 0.012, OR=24.085) affected the occurrence of overall PTE.
Conclusions: D20cc and parasagittal location of tumour were important risk factors for the development of symptomatic PTE and overall PTE after SRS, respectively. To decrease the development of PTE, the effort to decrease the volume of normal brain tissue that received high dose radiation and to reduce dose in adjacent normal brain are needed. And more caution is needed for tumours in the parasagittal location.

2068 POSTER

Dosimetric Features of RapidArc Plan Using Different Internal Target Volume in Radiotherapy of Hepatocellular Carcinoma

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Purpose: To investigate the dosimetric features of RapidArc plans for hepatocellular carcinoma (HCC) radiotherapy using different target volumes which determined by four dimension computed tomography (4D-CT) and 3D-CT.
Methods: 12 patients with HCC were selected to undergo 4D-CT and 3D-CT simulation associated with ABC in end inspiration hold (EIH), end expiration hold (EEH), and free breathing (FB). The GTVs were contoured on 4D-CT and 3D-CT images respectively, and the internal gross target volume (ITV_1, ITV_2) were acquired respectively. The individual margins were obtained from GTV_{FB} to ITV_1 and ITV_2, ITV_3 and ITV_4 were obtained from GTV_{FB} plus the individual margins respectively. PTV_{-1} was acquired from GTV_{FB} using conventional margins; and PTV_{-2} using individual margins and PTV_{-3} was acquired from GTV_{EIH}. For the PTV_{-1} and PTV_{-3}, RapidArc plan with three 135º arcs (ARC_1, ARC_4) were designed; for PTV_{-1} and PTV_{-2} with 360º arc (ARC_2, ARC_3). The volume of GTVs, ITVs, PTVs, the individual margins and the dosimetric features of four RapidArc plans were compared.
Results: The volume differences between ITV_1 and ITV_2, ITV_3 and ITV_4 were not significant ($p > 0.05$). The volume of PTV_{-1} was larger than PTV_{-2}, PTV_{-3} ($p < 0.05$). The three axial margins differences from GTV_{FB} to ITV_1 and ITV_2 were not significant ($p > 0.05$). The differences of dose distribution for target volume in four plans were not significant ($p > 0.05$). The differences of OARs irradiation dose of ARC_1 and ARC_2 were not significant ($p > 0.05$). The dose of normal liver was ARC_1 >ARC_3 >ARC_4 ($p < 0.05$).
Conclusions: 3D-CT associated with ABC could achieve the determination of individual internal target volume and individual margins for HCC comparing with 4D-CT. Associated with ABC or using individual target volume determined by 3D-CT associated with ABC or 4D-CT in RapidArc plan for HCC radiotherapy can achieve perfect target dose coverage and spare more OARs.

2069 POSTER

An Effective Way for Hepatocellular Carcinoma (HCC) Radiotherapy: RapidArc Combined With Active Breathing Coordinator

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Background and Purpose: To investigate the feasibility of RapidArc (RA) assisted by active breathing control (ABC) for hepatocellular carcinoma (HCC) radiotherapy.
Methods: Twelve patients with HCC after TACE underwent 3D-CT scanning assisted by ABC at end inspiration hold (EIH), end expiration hold (EEH), and free breathing (FB). Three treatment plans were designed as 3D-CRT, IMRT, and RA. The volumes of liver, normal liver (the liver volume minus the PTV), GTV, PTV in three breathing status were compared. The conformity index (CI), the dose homogeneity index (HI) of target volume, and the maximum dose, minimum dose, the monitor unit, treatment time, the dose-volume parameters of normal liver, stomach, duodenum were compared.
Results: There was no significant difference in the volumes of liver, normal liver, and GTV at three breathing status ($p > 0.05$); but the PTV at FB was larger than that at EEH and EIH ($p < 0.05$), The overall CI and HI for RA was better than IMRT and 3D-CRT at three breathing status ($p < 0.05$). The mean dose, V_{20}, V_{30}, V_{40} of normal liver were 3D-CRT > RA > IMRT ($p < 0.05$). For the mean normal liver dose, the V_{10} was FB > EEH > EIH. For the V_{20}, V_{30} and V_{40} of normal liver at FB was greater than that of EEH and EIH. The $D_{5\,cm^3}$ of duodenum was EIH > FB > EEH ($p < 0.05$). The monitor unit for IMRT, RA and 3D-CRT

were 626.33±113.98, 550.28±122.56 and 254.06±18.56 respectively. The treatment time for IMRT, RA and 3D-CRT were 540±45s, 130±10s, 135±10s respectively.
Conclusions: RA assisted by ABC for HCC radiotherapy was feasible, with better dose distribution, fewer monitor unit, less treatment time and sparing more OARs.

2070 POSTER

The "BUONGIORNO" Project − an Italian Survey on the Incidence of Burnout Among Young Italian Radiation Oncologists

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Background: Burnout syndrome is a psychological syndrome due to prolonged exposure to chronic work stress with insufficient recovery and it is characterized by emotional exhaustion (EE), depersonalization (DP) and low personal accomplishment. Even if it is frequent in a wide variety of health care providers, limited data exist about his prevalence among Italian radiation oncologists. We performed a national survey to assess the prevalence of the burnout syndrome among young Italian radiation oncologists.
Methods and Materials: The Maslach Burnout Inventory (MBI) was send to young members (⩽40 years) of the Italian Association of Radiation Oncology (AIRO). They filled it anonymously. The MBI evaluated burnout level and the relationship with demographic variables, practice characteristics, career satisfaction, sources of stress.
Results: From 06/2010 to 11/2010, a total of 112 young radiation oncologists (M/F ratio 39:73) participated to this study; Mean age was 32 years (range: 23−39 years). Specialists and residents were the 60% and 40% of respondents, respectively. Burnout prevalence, defined as a severely abnormal level of either EE or DP, was 35%. Looking at EE, 38% and 9% of the interviewed show a middle or an high level of EE, respectively. The prevalence of middle or high levels of DP was 41% and 26%, respectively. Following items were statistically related ($p < 0.005$) to the risk to suffer of a burnout syndrome: working position (specialist vs resident), number of years of practice, working hours per week, lack of cooperation and/or conflicts with colleagues and chiefs, lack of opportunities for professional development and uncertainties on the working perspectives. High workload and responsibilities, job-related anxiety and lack in the autonomy decision-making in treating patients were reported by 91.1%, 87.6% and 86.7% of participants, respectively. Higher burnout scores have a statistical impact in the private life of the ($p < 0.005$), and 89.6% of respondents feel not to have enough time for personal/family life because of workload. Global health status was good or very good for 85% of interviewed, with only 5% and 2% assuming hypnotic/anxiolytic or anti-depressant medications, respectively. Five respondents (4%) declared a frequent consumption of alcohol (four or more times per week). Finally, 10−12% of the respondents wanted to leave their jobs.
Conclusions: Burnout is common among young Italian radiation oncologists. The statistical relation with some working/organizational and personal factors shows the need for educational tools in order to improve the management of workload and stress.

Poster Presentations (Sat, 24 Sep, 14:00−16:30)
Imaging

2100 POSTER

Fully Automatic Segmentation of Brain Tumour in CT Images

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Purpose: A new approach is presented to automatically extract brain tumour in CT images.
Methods: The method uses a sequence of brain CT images. Firstly, use morphology operations and wavelets based filter for denoising. Secondly, find out whether CT images contain brain tumour according to the symmetry of the brain CT images, extract the unsymmetric part and its neighbor as the region of interest (ROI). Then, extract the feature (e.g. texture, contrast, homogeneity, etc.) of the ROI. Finally, use k-means clustering and support vector machines (SVM) for classification with the extracted feature of the ROI and get the contour of the brain tumour.
Results: Compared with manually contoured by the physicians, this method enables accurate and automatic extraction of brain tumour in CT images.
Conclusions: The method is shown with better performance than current methods. And it's a fully automatic, fast and accurate method in precise diagnosis and treatment of brain tumour patients.

2101 POSTER

Evaluation and Prediction of the Efficacy of Pleurodesis in Malignant Pleural Effusion by Clinical and Radiological Features

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Background: The standard treatment of recurrent malignant pleural effusion is intrapleural instillation of chemical agent, usually talc, in an attempt to produce pleurodesis. Our study purpose is to elucidate useful clinical and radiological parameters for evaluation and prediction of the efficacy of pleurodesis.
Material and Methods: A retrospective review of 83 consecutive patients treated with pleurodesis from 2002 to 2010. Clinical data were obtained from the hospital charts. All the radiological imaging, before and after the procedure, was reviewed. The patients were divided into two groups: group 1 − those with initial small to medium volume (n = 34, 41%) and group 2 − those with larger volume (fluid level above the hilus on chest x-ray) (n = 49, 59%).
Results: Clinical improvement was better and more rapid in group 1 (97% Vs 90%, and time to response 1.7 days Vs 2.6 days). Complete lung expansion was more frequent in group 1 compared to group 2 (30% vs. 12%, $p < 0.001$). Additional radiological abnormalities (atelectasis, nodules, mediastinal adenopathy, etc) revealed on CT scan were more frequent in group 2 compared to group 1 (84% vs. 58%). The above pathological changes significantly reduced expansibility rate of the lung [57% (19/33)] in group 2, but not in group 1 [80% (12/15)]. Only two patients required an additional pleurodesis within the first 3 months. CT scan done after the pleurodesis showed pleural thickening and calcfications, a desirable consequence, more common in group 1 than group 2 (58% Vs 25%, $p < 0.04$). However, there was no correlation between all the malignant thoracic findings, pleurodesis efficacy and survival. Survival was mainly dependent on the primary malignancy.
Conclusions: Treatment of pleural effusion by talc pleurodesis is highly effective, especially, if it is performed early, while there is small to medium volume of effusion, and minimal additional malignant findings in the thorax. Imaging by CT scan before pleurodesis is recommended in order to predict the outcome of the procedure and to suggest alternative treatments.

2102 POSTER

Bilateral Analysis of the Vascular Surface of the Internal Mammary Arteries and Veins in Patients With Breast Cancer on Magnetic Resonance Mammography (MRM)

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Background: Within the staging of breast cancer MR mammography (MRM) plays an important role. The aim of this study is to analyze the bilateral differences in the vascular surface of the internal mammary artery (IMA) and vein (IMV) in patients with established breast cancer versus healthy control patients.
Material and Methods: MRM of 135 patients was analyzed. Patients with postoperative changes of the breast, bilateral malignancy or patients treated with neo-adjuvant therapy were excluded. Measurements were made on a transverse T2w sequence (scanning parameters: slice thickness 1 mm, field-of-view 280×338×190 mm, matrix 352). Surface of both the AMI and VMI has been determined on both sides particularly on the second and third intercostal space by two independent readers. Differences in vessel surface between patients with and without breast cancer were analyzed using a linear mixed model.
Results: The vascular surface of the AMI was significantly higher on the side with breast cancer in comparison to the contra lateral side (mean difference in size 0.86 mm2, $p = 0.001$). Similar differences were observed for the VMI (mean difference in size 0.83 mm2, $p = 0.005$). There has been no significant difference in vascular area of the AMI and VMI in the group of patients without breast cancer.