Inter-observer variability of intestinal loops delineation after whole pelvis radiotherapy for prostate patients

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Purpose/Objective: At our hospital, a relevant fraction of post-prostatectomy patients (pts) are treated with intensity-modulated whole pelvis radiotherapy (WPRT), leading to the irradiation of an extended area of the intestinal cavity. Bowel loops (BL) need to be contoured and the dose volume histograms (DVH) are evaluated for possible gastrointestinal effects. The aim of this study is to evaluate the inter-observer variability of the bowel volumes obtained by manual contouring, which is still the most used method for this structure.

Materials and Methods: Six experienced observers (1 clinician, 1 radiotherapy technologist, 4 medical physicists) delineated BL contours for three pts enrolled in a multicentric prospectic observational project. The bowel lumen was contoured starting from the most cranial slice where lymph-node planning target volume (PTV) was present. It continued through sigmoid flexure until the rectum contour. Contouring tools included in Eclipse treatment planning system (TPS) were used to manually delineate BL. Contouring differences were quantified in terms of relative volume difference (RD%) and DICE index, that describes the agreement between two delineated contours. Differences between operators were tested with Wilcoxon test.

Results: Mean (± standard deviation, SD) volumes of BL were: (482 ± 54)cc, (681 ± 50)cc (1278 ± 67)cc for pts A-B-C respectively (fig.1). From the point of view of volume variations, BL of the pt A resulted the most difficult to be contoured (11.2%). RD% with respect to average volume values were: 17, 2, -11, 3, -9, 5, -2, -4 for each observer respectively. For pt B, RD% were: -11, -3, 9, 5, -4, 4, -2, 4. For pt C. In summary, observer 5 systematically underestimated the BL volumes with differences of 6.4% on average. This effect is probably due to the contouring habit of observer 5 of being strictly adherent to the bowel lumen and some loops can be missed. Concerning DICE analysis, average DICE values per pairs of observers were assessed. The best agreement was found between observer 1 and 5 (0.86±0.12, 1SD), while the worst value for observer 4 and 6 (0.73 ±0.04, 1SD). Average DICE for all pair observers were: 0.77±0.08, 0.75 ± 0.04 and 0.83±0.04 for pts A, B, C respectively. Differences between pts A-C (p<0.0067) and B-C (p=0,0001) resulted statistically significant.

Conclusions: Overall inter-observers variations indicated a moderately good agreement in the contouring participants as resulted by DICE values (average values between 0.75 and 0.83).

Commissioning of 18F-FMISO PET-CT circuit to determining the hypoxic tumor volume in lung cancer

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Purpose/Objective: Tumor hypoxia is a factor of resistance of cells to radiation. Knowing the location of these hypoxic zones may allow them to act on selectively modifying the standard treatment guidelines. We describe the method used to determining the hypoxic tumor volume from the point of view of radiotherapy technicians, by planner with rigid fusion, as well as the limitations that we have found.

Materials and Methods: The process is:
- We make a full body 18F-FDG PET-CT scan in which radiopaque markers are placed on the skin of the patient, after, this reference points are tattooed.
- We perform 18F-FMISO CT scan and place radiopaque markers on tattoos.
- 4 sets of images are incorporated into Eclipse treatment planning system (TPS) were used to manually delineate BL.
- The radiation oncologist reviewed and suitable volumes and create the FDG GTV, the FDG PTV, and the FMISO GTV and the FMISO PTV.

Results: Currently the method is easy and fast to run by technicians (approximately 1 hour and 30 minutes), but the first cases have generated to us several problems or concerns as:
- The HYPOXIC areas consists of several very small uptakes spread throughout the tumor.
• Appears uptake with a size=1 voxel
• Minimum hypoxic volume to consider in cubic centimeters.
• Part of the FMO5O uptake is outside FDG uptake.
• We can’t visualize 3 series of fused images at once (FDG CT - FDG PET - FMO5O PET).
• Placing the patient in the PET-CT unit has to make it radiotherapy technician so that involves travel to other centers on the PET-CT days.
• We can’t use devices to immobilize the patient because the diameter of the PET-CT unit is smaller than Radiotherapy CT.

Conclusions:
1. Imaging fusion by existing treatment planning stations is simple and does not require excessive time, but specific training for radiography technicians is necessary.
2. 18F-FMO5O PET is only authorized within the clinical trials, so having few cases, both learning and solving doubts is a slow process.
3. Making a CT in our service can provide a better position by using immobilization devices by an expert radiotherapy technician, but that would cause more radiation to the patient.

Electronic Poster: RTT track: Treatment planning and dose calculation

EP-1629
Dose sparing potential of deep inspiration breath-hold technique for left breast radiotherapy organs-at-risk
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Purpose/Objective: To assess if DIBH achieved dose sparing for organs-at-risk in left breast radiotherapy. These patients have an increased risk of cardiac complications post-treatment compared to right breast patients. Deep inspiration breath-hold (DIBH) could potentially reduce dose to organs-at-risk without compromising target dose, thus potentially reducing complication incidence and improving overall patient survival.

Materials and Methods: Free breathing (FB) and DIBH CT planning scans obtained using Varian RPM Gating software for 28 left breast/ left chest wall (plus minus supracavitular field) patients treated between January 2008-December 2013 were retrospectively re-contoured and re-planned. Organs-at-risk included the combined lungs, left lung, heart and left anterior descending coronary artery (LADCA). Field-in-field tangential technique (mono-isocentric for supracavitular patients) and Anisotropic Analytical Algorithm (AAA) were used for dose calculations. Maximum plan doses were kept within 1% agreement between FB and DIBH plans for comparative purposes. Quantitative analysis of plan dose differences was then carried out.

Results: Lung dose was not affected by DIBH. Heart Dmean was reduced by 34.5% (FB=41.81Gy, SD=3.963Gy vs. DIBH=27.39Gy, SD=12.393Gy, p<0.000). DIBH removed heart in 28.6% (n=8) of participants’ treatment fields. LADCA Dmean was reduced by 47.8% (FB mean=15.56Gy, SD=10.62Gy vs. FB mean=29.82Gy, SD=10.05Gy, p<0.000), and LADCA Dmean by 52% (FB mean=5.23Gy, SD=1.94Gy vs. FB mean=10.88Gy, SD=3.95Gy, p<0.000). Amplitude depths were not correlated with dose reductions.

Conclusions: DIBH results in heart and LADCA dose reductions, without increasing lung dose. Further long-term follow-up is required to evaluate the clinical implications for patients.

EP-1630
Fixed-Jaw technique in volumetric modulated arc therapy plan for nasopharyngeal carcinoma
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Purpose/Objective: To compare the dosimetric difference of volumetric modulated arc therapy (VMAT) and fixed-jaw technique in volumetric modulated arc therapy (FJT-VMAT) for nasopharyngeal carcinoma (NPC).

Materials and Methods: VMAT and FJT-VMAT plans were designed to 15 nasopharyngeal carcinoma patients by planning treatment system (Eclipse 10.0), respectively. The target and risk organ doses, conformity indexes (CI), homogeneity indexes (HI), low dose volume of normal tissue, monitor units (MU) and treatment time (TT) were compared between the two kinds of plans.

Results: Two Plans could meet the clinical objectives. The Dmean, D60, D2 of PET Vnd, PTY1, PTY2 were lower in FJT-VMAT plans than in VMAT plans (P<0.05). There were no significant different in PET Vnx between them. FJT-VMAT plans had lower PRVstem (Dmax, V6), PRVstem (Dmax), Parotid (Dmean, V20) and B-Pr (Vp10, V30) (P<0.05), but no significantly different with other OARs as compared with VMAT plans. FJT-VMAT plans (683±87) increased the monitor units (MU) by 22% (t = 5.78, P = 0.000), as compared with VMAT plans (559±62). The treatment time of two plans were consistent (about 2 min).

Conclusions: FJT-VMAT plans as compared with VMAT plans, showing better target coverage, part of OARs and B-P sparing, which MU was slightly increased but not significantly different between the two plans of treatment time.

EP-1631
A method to achieve homogeneous dose distribution in the IMRT for Stage III lung cancer
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Purpose/Objective: To achieve homogeneous dose distribution in the intensity-modulated radiotherapy (IMRT) for Stage III lung cancer is challenging. A novel method utilizing base dose function (BDF) was proposed to overcome the difficulty and was evaluated in this study.

Materials and Methods: CT scan data of 13 patients were enrolled. Three optimizing approaches were applied to obtain clinically acceptable plans: 1) Conventional optimizing (CO)