Statistical analysis of MRI-only based dose planning - DTU Orbit (14/01/2019)

**Statistical analysis of MRI-only based dose planning**

**Purpose/Objective:** Multimodality imaging is increasingly combined for better tumour delineation. MRI provides additional softtissue contrast to CT, but registration of MRI and CT introduce a systematic error. Further, adaptive RT introduces an increase in scans and additional systematic errors. MRIonly based RT eliminates these errors and reduce the time and costs of a CT scan. The aim of this study is to investigate the dosimetric differences of a treatment plan when the dose calculation is based on MRI as compared to CT.

**Materials and Methods:** Four diagnostic groups are investigated; 12 Head and Neck (HN) patients treated with static IMRT, 5 sarcoma (extremities only) patients treated with APAP, 21 prostate and 5 pelvic (not prostate) patients treated with VMAT. Data for each patient contains a CT scan (Phillips Big Bore CT) and a T2 weighted MRI scan (1T Panorama Phillips) as well as a clinically approved treatment plan. The treatment planning software is Eclipse v.10.0 (Varian Medical Systems). The dose calculation based on MRI data is evaluated in two different ways; a homogeneous density assigned MRI (MRI unit), where the entire body is assigned an HU equal to water and a heterogeneous density assigned MRI (MRI bulk) where in addition the CT segmented bone is transferred to the MRI and assigned an age dependent HU based on ICRU report 46. The CT based clinical treatment plan and structure set are registered to the corresponding MRI unit and MRI bulk. The body is outlined on both the MRI and the CT. The differences in dose distributions of the MRI bulk, MRI unit and CT data are quantified using DVH points. The reported DVH points for the PTV and CTV are Dmedian, D98% and D2% in accordance with ICRU report 83. The DVH points for the organs at risk are based on clinically guidelines used at our hospital and QUANTEC. Oneway twotailed ANOVA and paired ttest are used to investigate the differences in dose, based on MRI bulk, MRI unit and CT. The assumptions of ANOVA are found to be fulfilled, since data is normal distributed with constant variances.

**Results:** The results of differences in DVH points are displayed in the table. MRIonly based RT requires bulk density correction for prostate patients. For the remaining diagnostic groups both the unit and bulk density corrected MRI show nonsignificant deviation for the selected DVH points. The mean differences are in the order of 2 %.

**Conclusions:** The investigated DVH points show that MRIonly based RT seems to be a feasible alternative to CT based RT. However, the analysis only describes similarities in DVH points and not in the shape of the DVH. Even though the mean differences are nonsignificant there might be unacceptable differences for the individual patient. In addition, significant differences may not be detected due to a large variance within a diagnostic group. The obtained results are consistent with those previous reported.