biological imaging to target an ablative dose at known regions of significant tumour burden and a lower, therapeutic dose to low-risk regions. We describe our methods for defining target volume and prescription dose.

Material and Methods: To demonstrate how tumour characteristics may be extracted from multi-parametric MRI (mpMRI) to inform the previously validated biological model(1), 21 patients underwent in vivo mpMRI prior to radical prostatectomy. Co-registration of histology and imaging data using rigid and deformable registration was validated by matching feature points and annotated zonal regions. Automated methods for defining tumour location, tumour cell density (TCD) and Gleason Score (GS) in histology were developed to provide high resolution ground truth data(2,3). Similarly, using ground truth histology data, machine learning methods have been developed and tested to predict tumour location in mpMRI. Further developments are underway to predict TCD, GS and hypoxia in mpMRI to build a multi-level voxel map defining tumour location and characteristics to inform the biological treatment planning model.

Results: Co-registration of the in-vivo mpMRI with histology was achieved with an overall mean estimated error of 3.3 mm (Fig 1).

An ensemble-based supervised classification algorithm, trained on textural image features, demonstrates a highly sensitive method for automated tumour delineation in high resolution histology images(2). Colour deconvolution and the use of a radial symmetry transform provides measures of cell density, shown to highly correlate with an expert pathologist markup of tumour location(3). A Gaussian-kernel support vector machine demonstrated a tumour location predictive accuracy of >80% with potential for significant improvement using Bayesian methods to incorporate neighbourhood information. Similar statistical methods have demonstrated potential for mpMRI parameter/pharmacokinetic maps to be correlated with tumour characteristics including TCD, GS and hypoxia. Whilst imaging methods for hypoxia exist, providing reliable, high spatial resolution ground truth data remains challenging.


OC-0062
High-dose-rate HDR boost for localized prostate cancer decreases long term rectum toxicity
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Purpose or Objective: A High-Dose-Rate Brachytherapy (HDR-BT) boost combined with external beam radiotherapy (EBRT) produced excellent long term outcome and is an alternative for escalated EBRT (>72 Gy) for low and intermediate risk prostate cancer (PC) patients. The question remains whether the use of HDR-BT results in lower complication rates for equal tumour control. The aim of this study was to compare HDR-BT/EBRT combined to EBRT-only in terms of long-term patient-reported toxicity and oncological outcome for low and intermediate risk PC patients.

Material and Methods: Between 2000 and 2007 low and intermediate risk PC patients (n=231) were treated (stage T1b-T2a, G7, IPSA≤17) with a HDR-BT boost (3x6 Gy) combined with EBRT (23x1.8 Gy). Patients with a maximum prostate volume of 120 cc and a PSA, T-stage, and Gleason in the same range were selected (68 Gy: n=83, 78 Gy: n=74) from the Dutch randomized dose-escalation study (1997-2003). At least 1 follow-up questionnaire had to be completed. Genitourinary (GU) and gastrointestinal (GI) toxicity symptoms were prospectively assessed using same questionnaires in the period 1-7y years post-treatment. Prevalence of long term GU and GI symptoms were calculated with intervals of 1 year and compared between treatment groups (chi-square test). Biochemical failure free survival (BFFS) using the Phoenix definition (stratified for Gleason score) was calculated and compared (log-rank test).

Results: Median follow up was 8.8y for both 68 Gy and 78 Gy patients, and 6.8y for HDR-BT/EBRT. Median age was 69y and 68y, respectively. In general, post-treatment GU complaints were comparable between groups (dysuria, nocturia, day frequency, incontinence). Rectal blood loss was significantly lower for HDR-BT compared to 78 Gy, from the first year of follow-up and onwards (p<0.001). Rectal discomfort (pain/cramps) was significantly lower at 3y follow-up (p<0.01). Rectal incontinence showed lower rates as well, but these were not significant (p=0.08). Differences in stool frequency > 4 were small and not significant. BFFS rates at 7y were 79%, 90%, and 96% (68 Gy, 78 Gy, HDR-BT) for Gleason ≤7 and 43%, 75%, and 91% for Gleason 7. BFFS was significantly higher in both the HDR-BT and 78 Gy group compared to 68 Gy (p<0.001 and p=0.034 respectively), the difference between HDR-BT and 78 Gy was not significant (p=0.11).

Conclusion: HDR-BT/EBRT is associated with significantly lower long-term GI toxicity compared to escalated EBRT-only (78 Gy) with a favorably comparable 7 years tumor control.

OC-0063
Real-time in-vivo dosimetry in HDR prostate brachytherapy
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Purpose or Objective: Implement routine in-vivo dosimetry in HDR prostate brachytherapy and develop error detection thresholds for real-time treatment monitoring.