Focal application of low-dose-rate brachytherapy for prostate cancer: An ethics approved pilot study

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Introduction: Focal therapy (FT), a potential alternative to whole-gland prostate cancer treatment and active surveillance (AS), has been the subject of interest in recent years. However, its widespread adoption is held back due to limitations: Current cancer localization methods lack the required precision, and post-treatment PSA values are not reliable for treatment evaluation due to healthy tissue sparing. In this study we aim to 1) explore correlations between prostate cancer as mapped by trans-perineal template mapping biopsy (TTMB), and multi-modal imaging. 2) compare the impact of focal low-dose-rate brachytherapy (LDRB) on QoL compared to whole-gland LDRB.

Methods: Eligibility criteria at entry: ≤2 cores positive from one lobe, GS ≤3+4, clinical stage ≤T2a, and iPSA ≤10ng/mL. Consented participants undergo 3-Tesla, multi-parametric (mp) MRI, MR elastography (MRE), and trans-rectal ultrasound elastography (TRUS-E), followed by TTMB. Subjects in which TTMB yields ≤4 positive cores (GS ≤3+4) within one lobe and no more than two adjacent sectors (apex, mid-gland, base), will be offered FT besides conventional treatment. For patients electing FT, the focal-LDRB plan is created based on TTMB results. Follow-up includes PE, PSA, and patient-reported QoL/IPSS/SHIM at 6 weeks and q3 monthly to 2 years and every 6 months thereafter. Imaging is repeated at 12 and 24 months and TTMB at 24 months. TTMB results are correlated to pre- and post-FT imaging to assess the clinical validity of imaging methods for pre-treatment cancer detection and the presence of residual/recurrent cancer post-treatment.

Results: Ten patients have been accrued and undergone mpMRI and MRE; eight have received TRUS-E and TTMB. Pathology reviews for seven TTMBs show FT eligibility for three patients. Two patients are scheduled to receive focal-LDRB and one decided to remain on AS.

Conclusion: LDRB is a reasonable FT candidate and is being conducted in the context of an ethics-approved trial.

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Figure 1: Multi-modality imaging (mpMRI, TRUS) and TTMB map of a patient eligible for focal LDRB. a) T2-weighted, b) dADC (decreased apparent diffusion coefficient), computed from DWI. c) TRUS B-mode, d) TTMB core map showing the location of extracted cores marked by colored circles on the template grid. Core depths are also recorded. At some locations, multiple cores were required, shown by green, orange and red circles (proximal to distal). e) Dynamic contrast enhanced (DCE). f) The volume transfer constant, Ktrans, computed from DCE, g) Reconstructed elasticity using direct mixed finite element method from MRE, h) TRUS-E showing inverse of stiffness (i.e. dark is stiff). Two positive cores (both GS 3+3) were detected from TTMB, one of which – shown by arrows – is also visible in the images.