Dosimetry modeling for focal LDR prostate Brachytherapy

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Methods

Following the report of a consensus meeting on focal prostate brachytherapy, it was agreed to retrospectively model treatment planning techniques. For each case, three treatment plans were produced for each approach: standard, hemi and ultra focal. Target volume coverage was adequately achieved for all plans with V100 above 97.8%. D90 for the target was increased by 6% and 9% for hemi and ultra focal plans respectively (Table 1). Meanwhile, D10 of urethral dose was reduced by 7% and 55% for hemi and ultra focal plans respectively (Table 1). Similarly, D2cc of the bladder was reduced by 28% and 60% for hemi and ultra focal plans respectively (Table 1). Inter-seed attenuation (ISA) was measured and its effect on the quality of implant was assessed.

Results

On average the total number of seeds compared to the standard plan is 32% and 70% lower for hemi and ultra focal plans respectively. Plan robustness shows that a random shift in seed position as in treatment and treatment planning setup. MRI imaging and template biopsy results were used to contour target volumes and organs at risk on the treatment planning system. Nine were selected to be suitable for this study according to their PSA, Gleason score, and concordance of TPM and mpMRI for the location of the cancer lesion.

Conclusion

Treatment planning for hemi and ultra focal options is feasible. Dose constraints are easily met with a notable reduction to organs at risk such as the bladder, urethra and rectum.

Table 1: DVH comparison

| Brain | Planned value | With-ISA | % difFT
|-------|---------------|----------|----------|
| Standard | 131.2 | 176.3 | -1.8%
| Hemi    | 99.8 | 99.6 | -0.2%
| Ultra focal | 59.2 | 56.6 | -2.6%
| Hemi plan (CTV) | 154.8 | 190.5 | -2.2%
| Hemi plan (CTV) | 97.7 | 97.3 | -0.4%
| Ultrasound | 81.4 | 79.6 | 2.0%
| Ultrasound | 59.8 | 59.0 | -0.2%

Table 2: inter-seed attenuation

| Brain | Planned value | With-ISA | % difFT
|-------|---------------|----------|----------|
| Standard | 131.2 | 176.3 | -1.8%
| Hemi    | 99.8 | 99.6 | -0.2%
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References


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