Is MRI-based Week Three Post-implant Dosimetry Necessary Following LDR Prostate Brachytherapy?


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Purpose/Objective(s): (1) To compare the intra-operative trans-rectal ultrasound (TRUS) prostate volume with CT/MRI-based pre-operative, day 0, and week 3 volumes in patients treated with low dose rate (LDR) permanent prostate implants. (2) To determine if MRI-based day 0 dosimetry is sufficiently predictive of week 3 post-implant dosimetry to render week 3 studies unnecessary.

Materials/Methods: Patient records of 148 consecutive men treated from 2003-2007 with permanent I-125 prostate implants for favorable risk prostate cancer were retrospectively reviewed. A CT/MRI volume study was performed 1-2 weeks prior to implant to assess prostate anatomy and size. Intra-operatively, a TRUS volume was generated and used for real-time treatment planning with customized needle positions and seed-spacer sequences using the Variseed® planning system. In accordance with the American Association of Physics in Medicine Task Group No. 43 (TG-43) recommendations, 145 Gy was prescribed to 100% of the prostate volume. CT and MRI scans were obtained and fused for post-implant dosimetry several hours (day 0) and approximately 21 days (week 3) following the implant. The pre-implant, intra-operative, day 0, and week 3 prostate volumes were compared using a paired t-test. Day 0 and week 3 V100 and D90 were compared using a paired t-test and Pearson correlation. Logistic regression was used to identify significant predictors of week 3 V100 > 90% and D90>145 Gy.

Results: The pre-implant CT/MRI prostate volume was, on average, 5.5cc (15%) smaller than the intra-operative TRUS volume (33.9cc vs. 39.4cc, p<0.0001). The mean day 0 prostate volume was larger (52.4cc), but began to re-normalize by week 3 (42.9cc). The mean V100 increased from 82% on day 0 to 88% on week 3 (p<0.0001). Likewise, the mean D90 increased from 126 Gy on day 0 to 142 Gy on week 3 (p<0.0001). The correlation between the day 0 and week 3 dosimetry was modest (V100 r=0.54; D90 r=0.52). Week 3 V100>90% was positively associated with day 0 V100 (p<0.001) and number of seeds implanted (p=0.04). Week 3 V100>90% was inversely associated with the intra-operative TRUS volume (p=0.02). Similar results were obtained for week3 D90>145Gy.

Conclusions: MRI-based prostate volume is statistically smaller than the TRUS-based volume. Post-implant edema only partially resolves by week 3. The D90 and V100 on day 0 predict for the counterpart values on week 3, the correlation is modest. Positive predictors of V100>90% and D90>145Gy include day 0 V100 and D90, greater number of implanted seeds, and smaller TRUS volume. These results suggest that week 3 post-implant dosimetry should be performed on all patients receiving a permanent LDR prostate implant for quality assurance purposes.

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