Testicular Dose as a Function of Robotic Non-coplanar Planimetry: Computing the Effect of Limiting Transtesticular Beam Pathway for Prostate Cancer SBRT

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**Purpose:**
- Robotic Stereotactic Body Radiation Therapy (SBRT) has the potential benefit of non-coplanar beam arrangements to optimize dose distribution.
- Previous citations have highlighted the potential for testicular injury when not limiting trans-testicular beam pathways.
- Testicular doses in excess of 200cGy have been associated with hypogonadism, which can distort PSA outcomes and result in clinical symptoms.
- We report on these dosimetric implications in a cohort of men treated at a busy hospital program.

**Materials/Methods:**
- From August 1, 2016 to November 28, 2016, 102 consecutive patients with prostate cancer were treated with definitive Robotic SBRT.
  - Pre-treatment PSA was 0.93 – 39ng/ml (median 6.1).
  - Gleason scores were < 6 in 27.5%, 7 in 61.7%, and 8-10 in 10.8%.
  - Based on NCCN risk categories, 23.5% had low risk, 65.7% had intermediate risk, and 10.8% had high risk disease.
  - 19.6% of patients received Androgen Deprivation Therapy (ADT).
  - The median prescription dose was 3500cGy (3500-3625) in 5 fractions.
  - The mean CTV size was 80.5cc's (29.3-215.2) and mean PTV size was 139.6cc's (59.1-320.7).
  - 50 (49%) of these patients were treated with Testicular Avoidance (TA) beam arrangements and all patient plans had 95% PTV coverage by prescription dose.

**Results:**
- More non-TA patients received a testicular max dose in excess of 1000cGy (36.5% vs. 0%, p<.0001).
  - The mean testicular dose was significantly higher in this cohort (241.7cGy vs. 11.7cGy, p<.0001).
- Patients with CTV sizes >50cc's had higher mean testicular doses (147.6cGy vs. 35.9cGy, p=.003).
- On univariate analysis, non-TA treatment delivery predicted for mean testicular dose in excess of 200cGy (63.5% vs. 2%, p<.0001), as did CTV >50cc's (38.8% vs. 5.9%, p=.009) and PTV >150cc's (51.4% vs. 23.9%, p=.005). Table 1
- On separate inquiry, patients with mean testicular doses in excess of 200cGy had a higher chance of penile bulb max doses >3000cGy (64.7% vs. 23.5%, p<.0001).
  - CTV size >75cc's also predicted for higher penile bulb dose (50% vs. 22.9%, p=.005).
- On multivariate analysis, non-TA treatment delivery was the sole predictor of higher mean testicular dose (OR 80.6, CI 9.7-668.1, p<.0001).
- The only predictor of penile bulb dose >3000cGy was mean testicular dose >200cGy (OR 4.4, CI 1.3-15.2, p=.02).

**Conclusions:**
- Non coplanar SBRT treatment for prostate cancer has the potential to deliver high doses of radiation to the testicles.
- This represents the largest series exploring the dosimetric outcomes in a robust patient cohort.
- By providing a Testicular Avoidance beam arrangement, acceptable plans can be deployed with extremely low doses of deposited testicular radiation.
  - This appears to decrease maximum penile bulb dose.
- Future study will be required to assess the effect on PSA biochemical response and kinetics, as well as on long-term endocrine function.