Treatment compliance to linac-based prostate SBRT using real time electromagnetic tracking

Raffaella Lucchini, Denis Panizza, Veronica Vernier, Sara Trivellato, Stefano Arcangeli
Radiation Oncology Department, ASST Monza, Monza, Italy
School of Medicine and Surgery, University of Milan Bicocca, Milan, Italy

Purpose

To investigate treatment compliance and early gastrointestinal (GI) and genitourinary (GU) side effects in patients with organ confined prostate cancer following linac-based Stereotactic Body Radiation Therapy (SBRT) using an electromagnetic (EM) tracking device for real-time intra-fraction organ motion

Figure 1. RayPilot Hypocath Components: A) Balloon in bladder; B) transmitter; C) Connector; D) Standard urine out lumen; E) Valve for balloon) [1]

Material and Methods

Thirteen consecutive patients with prostate cancer (cT2-T3N0M0) were treated with dose escalated prostate SBRT in 4 or 5 fractions, in a single week, for a total dose of 38 Gy or 40 Gy, respectively. A volumetric modulated arc therapy (VMAT) was delivered on VersaHD linac with two 6FFF or 10FFF arcs optimized to have the 95% isodose covering at least 95% of the PTV (2 mm isotropic expansion of the CTV). The EM tracking device consisted in an integrated Foley catheter with a transmitter in a dedicated lumen, which was placed before the first treatment fraction and removed after the last one. After the daily CBCT, the system monitored the transmitter position, and the beam delivery was interrupted whenever the displacement exceeded 2 mm. Organ motion mitigation was obtained by a rectal micro-enema and a 100 cc bladder filling. Acute toxicity was evaluated with Common Terminology Criteria for Adverse Events version 5 (CTCAE_v5) scale at baseline and during treatment.

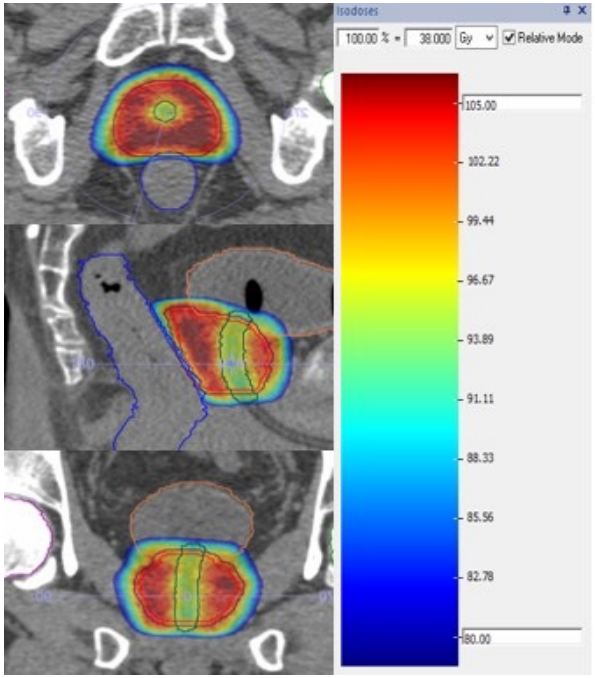

Figure 2. Isodoses of treatment planning

Results

Median age was 77 years (range 63-81). Intermediate and high risk prostate cancer accounted for 69,2% and 30,8% respectively. Median International Prostate Symptom Score (IPSS) score at baseline was 8 (range 2-14). Median PTV volume was 76.2 cc (range 48.9-128.5). Average total treatment time lasted 10.2 minutes (range 5.5-22.7), 6.7 minutes (range 2.7-17.8) for setup and 3.5 minutes (range 2.5-7.3) for beam delivery. In 45% of the monitored fractions, a new CBCT was mandated. The prostate was found within 1 mm from its initial position in 78% of the beam-on time, between 1 and 2 mm in 20%, and exceeded 2 mm only in 2%. All patients completed the treatment in the expected time and their compliance to the procedure was excellent. No clinically significant acute Grade 2 or higher GI (rectal) and GU toxicity was observed. Only one patient experienced acute Grade 1 GI toxicity, while acute Grade 1 GU toxicity occurred in five (38,5%) patients.

Genitourinary	
None	8 (61,5%)
Grade 1	5 (38,5%)
Grade ≥ 2	0 (0%)
Gastrointestinal	
None	12 (92,3%)
Grade 1	1 (7,7%)
Grade ≥ 2	0 (0%)

Table 1. Acute toxicity

Conclusion

Linac-based SBRT by means of VMAT-FFF technique coupled with daily image guidance including real-time EM tracking allowed dose-escalated treatment with negligible early side effects. The procedure was implemented rapidly and resulted well tolerated and less invasive than the surgically implanted transmitter.