Abstract

Objective: Low dose rate (LDR) prostate brachytherapy (permanent 125I or 103Pd seeds) is an accepted treatment option for low risk prostate cancer patients. However, differences in prostate spatial location, volume and gland deformation between the images obtained during pre-planning and later on during the implant procedure prevent the pre-planned intended dose to be accurately delivered. We are reporting on a new technique based on interactive real-time dynamic intra-operative dose calculation with avoidance of post-implant CT for final dosimetry. The reasons leading us to implementing this new technique are discussed and preliminary results reported. Methods: A pre-planning TRUS for volumetric analysis is performed in all our patients prior to implantation. This TRUS accomplishes two objectives: 1) assessment of implantability of the gland, of organs at risk and anatomical considerations and 2) determination of seed activity and total number of seeds. On the day of the implant, new TRUS images from base to apex are obtained using a motorized stepper connected to the ultrasound and planning system. Each real time needle position placed on the target is identified and capture by the planning system in the true position. Once all real needle positions have been captured, dosimetry is performed intra-operatively and the physician approves the corresponding isodoses on real time. Flexible cystoscopy is then performed followed by seed placement. Each seed implanted is then identified upon withdrawing the needle using TRUS guidance. This allows real-time intra-operative dosimetric analysis, allowing for correction of under-dosed zones during implantation in an interactive dynamic manner. Peripheral loading is used. Results: We began our LDR prostate brachytherapy program on 1999. While we have treated 700 patients with LDR, the last 63 patients were treated with our real time dynamic intra-operative planning system. The median time duration for the procedure was 90 minutes. The median follow up time for these 63 patients was 20 months with a range of 10-36 months. At presentation, Stage T1c was seen in 55%, T2a in 36% and 9% as T2b. The Gleason grade was <7 in 81% of the patients. The median PSA value was 9 ng/ml (range 4.2-30). The median age was 64 years (range 47-78 years). For the real-time dynamic planning, the acute GU grade 1&2 toxicity was reduced from 28% and 21% to 16% and 6% respectively. Acute urinary retention was seen in 2/63 or 3% requiring a temporary post-implant bladder catheter. In addition, a decrease in chronic GU grade 1-2 toxicity was also seen.
from 16% and 17% to 11% and 2% respectively. No change in GI toxicity pattern was noted. No severe grade 3-4 intra-operative complications were noted. Conclusión: Real-time intra-operative planning was successfully implemented in our center. It avoids the possible implant quality and dose delivery disadvantages of the standard post-implant CT-based dosimetry by improving the accuracy of seed placement on real time, which was translated in lower rates of acute and chronic GU morbidity. In addition, avoids the unnecessary time, effort and cost of post-implant CT-based dosimetry.

Keywords
Prostate cancer, Brachytherapy, Dynamic dose calculation, Real-time.