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Purpose/Objectives

Radiation therapy (RT) for the treatment of prostate cancer after radical prostatectomy (RP) is widely accepted. With technological advances, radiation treatment technique and dosimetry may vary. The purpose of this study is to quantify dosimetric difference of proton therapy versus VMAT and IMRT focusing on bladder and rectal dose sparing and target coverage.

Materials/Methods

This study analyzes a subset of twenty patients who received post-RP RT at our institution and builds on initial work comparing 3DRT to IMRT for these patients. All volumes were delineated by a single observer in accordance with EORTC consensus guidelines. A CTV expansion of 7mm (5mm posteriorly) was used to determine the PTV. All plans met a minimum of 95% target coverage to a prescription dose of 68.4 Gy. Optimal beam arrangement for IMRT was previously studied at our institution, leading to selection of a 9-field technique. The VMAT planning utilized either 1 or 2 full arcs depending upon optimizer performance. The proton arrangement was opposed laterals and utilized active scanning. As this was a strict dosimetric analysis, density corrections were not employed. Five patients were analyzed for this initial study. Differences of DVH values between plans were evaluated using 2-tailed paired t-tests.

Results

Planning with all three treatment techniques demonstrated comparable PTV coverage. Difference in dose sparing of bladder or rectum between 9-field IMRT and VMAT planning was not significant. Improvement in rectal doses, proton versus VMAT and IMRT was significant when comparing V_{40Gy}, $V_{34.2Gy}$ (28%, vs 48.16% and 45.33%, p=0.016 & p=0.0004). Bladder doses showed significance at V_{30Gy}, $V_{17.1Gy}$ (32.58% vs 57.27% & 62.76%, p=0.045 & p=0.04). Differences for V_D when D>40Gy for rectum and V_D when D>30Gy for bladder across all planning techniques were not significant.

Conclusion

Proton planning resulted in greater sparing of normal tissues at lower doses with equivalent planned target coverage. Further research is necessary to determine the significance of better planned doses with protons compared to photon treatment with regard to toxicity and proven efficacy of photon therapy. The delivery efficiency with VMAT may prove a viable advantage. Cost effectiveness research is necessary to determine if the increased cost of proton therapy is outweighed by benefit to the patient if these dosimetric improvements translate into improved clinical outcomes for PC patients.