fractions to the prostate bed, versus the same dose and volume with the addition of 2.25 Gy daily SIHB to the MRI identified GTV (BED = 80Gy, \( z/\beta = 1.5 \)). While still accruing, this report provides the first dosimetric assessment.

**Materials/Methods:** Two plans were generated for each of 14 patients treated per the MAPS protocol. The MRI identified GTVs were contoured in the Varian Eclipse TPS (Version 11.0); IMRT was utilized. The trial stipulates that no more than 35% and 55% of the rectum (\( R \)) should receive \( \geq 65 \) Gy and \( \geq 40 \) Gy, respectively, and no more than 50% and 70% of the bladder minus the prostate bed CTV (B-CTV) should receive \( \geq 65 \) Gy and \( \geq 40 \) Gy respectively. Doses to targets and normal tissues were compared.

**Results:** Prostate bed CTV volumes ranged from 84.8 to 202.7 cc, mean (SD) of 145.3 cc (39.2). GTV volumes ranged from 0.31 to 10.4 cc, mean (SD) of 2.34 cc (2.8). Normal tissue criteria were achieved for all variables aside from bladder. Five plans had \( > 70\% \) of the bladder receiving \( \geq 40 \) Gy, and one plan had \( > 50\% \) of the bladder receiving \( \geq 65 \) Gy. Coverage ranged from 95.0% to 97.9% for the PTV, and 95.0% to 100% for the GTV. There was no difference between the SIHB and SFRT plans per patient or overall in terms of constraints or coverage.

**Conclusions:** This study demonstrates that while most GTVs are located in close proximity to critical structures, dose escalation can be achieved without exceeding constraints for the rectum in all cases and the bladder in the majority, a logical result when considering that unavoidably small bladders are encompassed by the CTV. Long term follow-up will determine the clinical outcomes associated with using a SIHB to deliver definitive doses to MRI identified prostate bed lesions.

**Scientific Abstract 2506; Table**

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<th>Normal Tissue Criteria</th>
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**2507**

**Computationally-Obtained Thermal Distributions for LDR Thermobrachytherapy Seeds in Clinical Implants**

G.R. Warrell,1 D. Shvydkya,2 and E.I. Parsai;1 University of Toledo, Toledo, OH; 2University of Toledo Health Science Campus, Toledo, OH

**Purpose/Objective(s):** Despite decades of work in technological and clinical developments in the concurrent use of radiation therapy and hyperthermia, including clearly demonstrated advantages over radiation therapy alone, the practical difficulty of delivering clinically-adequate hyperthermia to deep-seated targets remains a major hurdle to common use of this technique. To address this problem, we propose a modification of the ubiquitous low dose-rate permanent implant brachytherapy seeds and treatment. This consists of replacing the tungsten radiographic marker in the ubiquitous low dose-rate permanent implant brachytherapy seeds and of this technique. To address this problem, we propose a modification of the radiation dose distributions to MRI identified prostate bed lesions.

**Materials/Methods:** The results of the thermal distributions calculated using modeled TB seeds in place of the standard brachytherapy seeds. These are based on LDR prostate permanent implant geometries. These are based on LDR prostate permanent implant brachytherapy patient plans of the modified peripheral seed loading design delivered to past patients. These seed distributions were reproduced in the finite element analysis software package COMSOL. Multiphysics 4.4, using modeled TB seeds in place of the standard brachytherapy seeds.

**Results:** Thermal distributions resulting from TB seeds as well as from combinations of TB and geometrically identical but non-radioactive hyperthermia-only seeds were obtained. Isothermal and radiation isodose distributions, dose volume histograms, temperature volume histograms, and thermal dose volume histograms were obtained and compared for these seed distributions.

**Conclusions:** For a modified peripheral seed loading implant design, optimized strictly for a clinically-desirable radiation dose distribution for a given PTV, the temperature and thermal dose distributions are computationally shown to adequately cover the PTV. This is expected to remain true even after post-implant motion and migration of seeds. Improved thermal distributions are possible when hyperthermia-only seeds are also used with the TB seeds. These results hold true for prostate sizes and blood perfusion rates throughout the range likely to be encountered in a clinical setting.

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D. Shvydkya: A. Employee; University of Toledo.

E.I. Parsai: A. Employee; University of Toledo.

**2508**

**Comparison of LDR Brachytherapy Versus External Beam Radiation Therapy for Low- And Intermediate-Risk Prostate Cancer: A Propensity-Score Matched Analysis**

G. Rodrigues,1 G. Smith,2 J.M. Crook,3 A. Martin,4 E. Vigneault,4 L. Souhani,3 J. Morris,4 C. Catton,4 H. Lukka,4 A. Warner,1 Y. Yang,1 and T. Pickles;1 2London Regional Cancer Program, London, ON, Canada; 4University of British Columbia, Kelowna, ON, Canada; 3CHUQ - (Hôpital-Dieu de Québec), Quebec City, QC, Canada; 4L’Hôpital-Dieu de Québec, Quebec City, QC, Canada; 5McGill University, Montreal, QC, Canada; 6University of British Columbia, Vancouver, BC, Canada; 7University of Toronto, Toronto, ON, Canada; 8Juravinski Cancer Center, Hamilton, ON, Canada; 9BC Cancer Agency, Vancouver, BC, Canada

**Purpose/Objective(s):** Currently, there is a lack of high quality comparative effectiveness research on prostate cancer radiation therapy survival outcomes available in the literature. This retrospective study compares overall survival (OS) and biochemical failure-free survival (bFFS) in low-risk and intermediate-risk prostate cancer patients that received brachytherapy [low-dose rate brachytherapy (LDR-BT) or high-dose rate brachytherapy with external beam radiation therapy (HDR-BT+EBRT)] or external beam radiation therapy (EBRT) alone.

**Materials/Methods:** Data was obtained from the ProCaRS database, which contains 7974 prostate cancer patients treated with primary radiation therapy at four Canadian cancer institutions from 1994 to 2010. Propensity-score matching was used to obtain the following three matched cohorts with balanced baseline prognostic factors: 1) low-risk LDR-BT vs EBRT; 2) intermediate-risk LDR-BT vs EBRT; 3) intermediate-risk HDR-BT+EBRT vs EBRT. Kaplan-Meier survival analysis was performed to compare ten-year differences in OS and bFFS in each of the three comparison groups.

**Results:** Propensity-score matching created acceptable balance (standardized difference <0.10) in the baseline covariates (age, PSA, Gleason total and T-stage) in all matches. Final matches included two 1:1 matches in the intermediate-risk cohorts, EBRT vs LDR-BT (n = 254) and EBRT vs HDR-BT+EBRT (n = 388), and a 4:1 (LDR-BT:EBRT) match in the low-risk cohort (n = 400). Kaplan Meier survival analysis showed no significant difference in OS in all comparison groups (intermediate-risk LDR-BT vs EBRT hazard ratio = 0.79, \( p = 0.69 \); intermediate-risk HDR-BT+EBRT vs EBRT hazard ratio = 0.64, \( p = 0.47 \); low-risk LDR-BT vs
EBRT hazard ratio = 1.41, p = 0.50). However, all brachytherapy options were associated with significant improvements in bFFS when compared to EBRT in all three cohorts (intermediate-risk LDR-BT vs EBRT hazard ratio = 0.22, p = 0.001; intermediate-risk HDR-BT+EBRT vs EBRT hazard ratio = 0.11, p = 0.007; low-risk LDR-BT vs EBRT hazard ratio = 0.35, p = 0.004).

Conclusions: Propensity-score matched analysis showed that brachytherapy treatment options significantly improved bFFS in low and intermediate-risk prostate cancer patients after ten years of follow-up, but did not lead to statistically significant improvements in OS.

Author Disclosure: G. Rodrigues; D.B. Fuller; E. Chadwick; O. Oncura/GE Healthcare. I. Travel Expenses; Oncura/GE Healthcare.

2509
A Competing Risks Analysis of Clinical Outcomes of Prostate LDR Brachytherapy at a Single Institution
A.A. Edwards, S.E.M. Langley, E. Chadwick, S. Javed, S.J. Khakars, J. Money-Kyrle, and R.W. Laing; Royal Surrey County Hospital NHS Foundation Trust, Guildford, United Kingdom

Purpose/Objective(s): To evaluate prostate cancer-specific survival and relapse-free survival in a cohort of 2253 patients treated with LDR brachytherapy for localised prostate cancer using a competing risks methodology.

Materials/Methods: A total of 2253 patients underwent prostate LDR brachytherapy from March 1999 to August 2013. Patients received either monotherapy to a dose of 145 Gy (125I LDR brachytherapy alone), or external beam radiation therapy (EBRT) of 44-45 Gy in 22-25 fractions followed by a subsequent LDR brachytherapy boost to a dose of 110 Gy. Neoadjuvant androgen deprivation therapy (NADT) was used for prostate gland down-sizing or therapeutically for high-risk patients and selected intermediate-risk patients. Prostate cancer specific mortality (PCSM) and other cause mortality (OCM) were evaluated for the whole cohort. Patients with a minimum of three years of PSA follow-up (n = 1320) were selected for analysis of biochemical and clinical relapse-free survival according to Memorial Sloan-Kettering Cancer Center (MSKCC) risk grouping, histological features, treatment modality, PSA nadir and dosimetric parameters. The Phoenix definition of biochemical relapse-free survival (bRFS) was used.

Results: Median follow-up for the whole cohort was 46 months (range 2-169). 8-year overall survival was 94.8%, with 8-year PCSM of 0.7% and 8-year OCM of 4.4%. The estimated 8-year PCSM according to risk group were 0.5%, 1.0% and 1.3% for low, intermediate and high risk groups, respectively (Gray’s test, p = 0.088). Among the cohort of 1320 with at least 3 years’ PSA follow up (n = 1320) were selected for analysis of biochemical and clinical relapse-free survival according to Memorial Sloan-Kettering Cancer Center (MSKCC) risk grouping, histological features, treatment modality, PSA nadir and dosimetric parameters. The Phoenix definition of biochemical relapse-free survival (bRFS) was used.

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Conclusions: Median recurrence Gleason score was 7 (79% > = 7). MRI-defined prostate volume (co-registered with planning CT), including any suspected extraprostatic extension, also comprised the SBRT planning target volume (PTV). A dose of 34 Gy was given in 5 fractions, with fiducial-based inter- and intrafractional SBRT tracking, delivering a non-coplanar “HDR-like” dose pattern (EUD = ~ 42Gy/5 fx; intraprostatic Dmax > 150% of Rx dose). Urethra, bladder and rectal doses (Dmax) were limited to 120%, 100% and 100%, respectively. Toxicities were assessed using CTCAE v 3.0 criteria.

Results: One patient lost to follow-up after 6 months is included for toxicity assessment but otherwise excluded. The remaining 23 patients have a median 24 months follow-up (range 3-54). Median pre-SBRT salvage baseline PSA of 3.7 ng/mL (0.51 - 48.2) decreased to 0.65 ng/mL and 0.07ng/mL at 1 and 4 years, respectively. Absolute biochemical DFS rate measured 87% by both criteria (ASTRO, Phoenix). No clinical failure has occurred. Toxicity > grade 1 has been limited to the GU domain (Acute grade 2 GU toxicity - 4/24 pts, Acute and chronic Grade 3 GU toxicity - 1/ 21 pts, Chronic Grade 4 GU toxicity - 1/21 pts). No GI toxicity > grade 1 has occurred. Presence of preexisting grade1 RT toxicity did not correlate with grade 2 or higher toxicity post-salvage.

Conclusions: Post-SBRT-salvage PSA response resembles “de novo” post-post-radiation therapy PSA kinetics out to 4 years and bRFS appears comparable to that seen with LDR and HDR brachytherapy salvage. Grade 2 or higher GU toxicity is sometimes seen in spite of stringent bladder and urethra Dmax dose constraints, with no obvious specific predictive factor. No serious GI toxicity has occurred. Salvage prostate SBRT efficacy and toxicity appears similar versus LDR and HDR brachytherapy salvage, with the advantage of being non-invasive.


2511
Stereotactic Radiation Therapy Versus External Beam + High-Dose-Rate Brachytherapy Boost in the Treatment of Localized Prostate Cancer: A Quality of Life Analysis

1 Odette Cancer Centre, Sunnybrook Health Sciences Centre, Toronto, ON, Canada, 2Department of Radiation Oncology, University of Toronto, Toronto, ON, Canada

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