ELSEVIER

Brachytherapy ■ (2015) ■

BRACHYTHERAPY

Health-related quality-of-life changes due to high-dose-rate brachytherapy, low-dose-rate brachytherapy, or intensity-modulated radiation therapy for prostate cancer

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ABSTRACT

PURPOSE: To compare urinary, bowel, and sexual health-related quality-of-life (HRQOL) changes due to high-dose-rate (HDR) brachytherapy, low-dose-rate (LDR) brachytherapy, or intensity-modulated radiation therapy (IMRT) monotherapy for prostate cancer.

METHODS AND MATERIALS: Between January 2002 and September 2013, 413 low-risk or favorable intermediate-risk prostate cancer patients were treated with HDR brachytherapy monotherapy to 2700−2800 cGy in two fractions (n = 85), iodine-125 LDR brachytherapy monotherapy to 14,500 cGy in one fraction (n = 249), or IMRT monotherapy to 7400−8100 cGy in 37−45 fractions (n = 79) without pelvic lymph node irradiation. No androgen deprivation therapy was given. Patients used an international prostate symptoms score questionnaire, an expanded prostate cancer index composite-26 bowel questionnaire, and a sexual health inventory for men questionnaire to assess their urinary, bowel, and sexual HRQOL, respectively, pretreatment and at 1, 3, 6, 9, 12, and 18 months posttreatment.

RESULTS: Median follow-up was 32 months. HDR brachytherapy and IMRT patients had significantly less deterioration in their urinary HRQOL than LDR brachytherapy patients at 1 and 3 months after irradiation. The only significant decrease in bowel HRQOL between the groups was seen 18 months after treatment, at which point IMRT patients had a slight, but significant, deterioration in their bowel HRQOL compared with HDR and LDR brachytherapy patients. HDR brachytherapy patients had worse sexual HRQOL than both LDR brachytherapy and IMRT patients after treatment.

CONCLUSIONS: IMRT and HDR brachytherapy cause less severe acute worsening of urinary HRQOL than LDR brachytherapy. However, IMRT causes a slight, but significant, worsening of bowel HRQOL compared with HDR and LDR brachytherapy.

Keywords: Prostatic neoplasms; Radiotherapy; Brachytherapy; Quality of life

Introduction

Treatment options for low-risk and favorable intermediate-risk prostate cancer patients who have a life expectancy of at least 10 years include radical prostatectomy (1), high-dose-rate (HDR) brachytherapy (2−4), low-dose-rate (LDR) brachytherapy (5, 6), or external beam radiation therapy (EBRT) (7−10).

Brachytherapy provides comparable outcomes and is more cost-effective than EBRT (11, 12). Also, brachytherapy offers a potential radiobiological benefit over conventionally fractionated EBRT by delivering hypofractionated treatment, which may increase the sensitivity of prostate cancer to radiation therapy by favorably affecting the α/β ratio (3, 13, 14). Because cure rates are similar between treatment options (15), health-related quality of life (HRQOL) is an important factor in a prostate cancer patient's decision-making process (16).

Received 26 June 2015; received in revised form 6 August 2015; accepted 31 August 2015.

Financial Disclosures: None.

Conflicts of Interest: None.

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1538-4721/$ - see front matter
http://dx.doi.org/10.1016/j.brachy.2015.08.012

Physician-assessed HRQOL changes do not correlate with patient-assessed changes. Physicians underestimate worsening in symptoms and overestimate improvement in symptoms relative to patients (17). As a result, it is important to measure patient-assessed HRQOL.

Studies have demonstrated different HRQOL with HDR brachytherapy, LDR brachytherapy, and EBRT (16, 18). As a result, we assessed urinary, bowel, and sexual HRQOL with HDR brachytherapy, LDR brachytherapy, and intensity-modulated radiation therapy (IMRT).

Methods and materials

Patient characteristics

After obtaining investigational review board approval, the records of 1294 men with clinically localized prostate cancer who underwent HDR brachytherapy, iodine (I)-125 LDR brachytherapy, or IMRT between January 2002 and September 2013 were reviewed. Patients were excluded if they had unfavorable intermediate-risk (19, 20) or high-risk (21) prostate cancer, or if they were treated with androgen deprivation therapy (ADT) (22, 23), combined IMRT and HDR brachytherapy or LDR brachytherapy, three-dimensional conformal radiation therapy (3DCRT), IMRT to a total dose other than 7400−8100 cGy in 37−45 fractions (7−10), HDR brachytherapy to a total dose other than 2700−2800 cGy in two fractions, or I-125 LDR brachytherapy to a total dose other than 14,500 cGy in one fraction (24). Seven patients treated with palladium-103 LDR brachytherapy to 12,500 cGy were excluded because of the small patient numbers. The aforementioned exclusions left 413 patients with low-risk or favorable intermediate-risk prostate cancer for analysis.

Patient characteristics are presented in Table 1. Differences between treatment groups were present with respect to patient age, diabetes mellitus status, American Joint Commission on Cancer clinical tumor stage, Gleason score, pretreatment prostate volume, and pretreatment sexual health inventory for men (SHIM) score. IMRT patients were older (median age, 71 years) and more commonly had diabetes mellitus (29%) and a lower pretreatment SHIM score (median, 11) than the HDR and LDR brachytherapy groups. LDR brachytherapy patients had smaller pretreatment prostate volumes (median, 33 mL) than the HDR and IMRT patients (median, 50 and 51 mL, respectively).

HDR brachytherapy monotherapy

Briefly, 14−18 HDR brachytherapy treatment catheters were advanced transperineally into the prostate under general anesthesia under transrectal ultrasound guidance. After catheter placement, a pelvic CT scan using 3-mm cuts was obtained for treatment planning. Prostate, bowel, bladder, and urethral dose-volume histograms were then created. Prostate doses were recorded as the minimum dose that covered more than 90% of the prostate volume expressed as a percentage of the prescription dose (prostate $D_{90,}$ goal >90% and <130%) and the fractional volume of prostate that received 100% of the prescribed dose (prostate $V_{100,}$ goal >90%). Bowel doses were recorded as the maximum

Table 1
Patient characteristics for the HDR brachytherapy, LDR brachytherapy, and IMRT groups

Characteristics	HDR brachytherapy, *n* (%)	LDR brachytherapy, *n* (%)	IMRT, *n* (%)	*p*-Value
Median age (y, range)	67 (44−85)	66 (38−86)	71 (50−84)	<0.001
Race				
Caucasian	75 (88.2)	207 (83.1)	64 (81)	0.42
Black	7 (8.2)	14 (5.6)	5 (6.3)	
Asian	1 (1.2)	3 (1.2)	1 (1.3)	
Other	2 (2.4)	25 (10)	9 (11.4)	
Median body mass index (kg/m^2, range)	29.2 (21.7−49.0)	28.1 (20.0−61.3)	28.7 (17.0−48.8)	0.70
Hypertension	47 (55.3)	125 (50.2)	45 (57)	0.49
Diabetes mellitus	15 (17.6)	32 (12.9)	23 (29.1)	0.004
Median pretreatment PSA (ng/mL, range)	5.0 (1.0−15.4)	5.1 (0.5−19.1)	5.3 (1.5−17.6)	0.31
Clinical tumor stage				
T1c	78 (91.8)	201 (80.7)	50 (78.5)	0.006
T2a	7 (8.2)	48 (19.3)	15 (19.0)	
T2b	0 (0)	0 (0)	2 (2.5)	
Gleason score				
6	60 (70.6)	230 (92.4)	49 (62.0)	<0.001
3 + 4 = 7	25 (29.4)	19 (7.6)	30 (38.0)	
Median prostate volume (mL, range)	50 (23−129)	33 (12−76)	51 (14−130)	<0.001
Median radiation dose (cGy, range)	2800 (2700−2800)	145,000 (145,000−145,000)	7920 (7400−8100)	N/A
Median pretreatment IPSS (range)	7 (0−20)	5 (0−24)	7 (0−28)	0.09
Median pretreatment EPIC-26 (range)	95 (60−100)	100 (60−100)	100 (75−100)	0.08
Median pretreatment SHIM (range)	18 (1−25)	17 (0−25)	11 (0−25)	0.02

IPSS = international prostate symptom score; EPIC-26 = expanded prostate cancer index composite-26; HDR = high dose rate; LDR = low dose rate; IMRT = intensity-modulated radiation therapy; N/A = not applicable; PSA = prostate-specific antigen.