

ORIGINAL ARTICLE

Quality of Life and Satisfaction with Outcome among Prostate-Cancer Survivors

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ABSTRACT

BACKGROUND

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We sought to identify determinants of health-related quality of life after primary treatment of prostate cancer and to measure the effects of such determinants on satisfaction with the outcome of treatment in patients and their spouses or partners.

METHODS

We prospectively measured outcomes reported by 1201 patients and 625 spouses or partners at multiple centers before and after radical prostatectomy, brachytherapy, or external-beam radiotherapy. We evaluated factors that were associated with changes in quality of life within study groups and determined the effects on satisfaction with the treatment outcome.

RESULTS

Adjuvant hormone therapy was associated with worse outcomes across multiple quality-of-life domains among patients receiving brachytherapy or radiotherapy. Patients in the brachytherapy group reported having long-lasting urinary irritation, bowel and sexual symptoms, and transient problems with vitality or hormonal function. Adverse effects of prostatectomy on sexual function were mitigated by nerve-sparing procedures. After prostatectomy, urinary incontinence was observed, but urinary irritation and obstruction improved, particularly in patients with large prostates. No treatment-related deaths occurred; serious adverse events were rare. Treatment-related symptoms were exacerbated by obesity, a large prostate size, a high prostate-specific antigen score, and older age. Black patients reported lower satisfaction with the degree of overall treatment outcomes. Changes in quality of life were significantly associated with the degree of outcome satisfaction among patients and their spouses or partners.

CONCLUSIONS

Each prostate-cancer treatment was associated with a distinct pattern of change in quality-of-life domains related to urinary, sexual, bowel, and hormonal function. These changes influenced satisfaction with treatment outcomes among patients and their spouses or partners.

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ASSessment of the outcome of prostate-cancer treatment entails measuring not only the duration of survival but also the health-related quality of life.^{1,2} Early studies of patient-reported outcomes of prostatectomy or conventional radiotherapy found concern about urinary incontinence, bowel function, and sexual activity.³⁻⁵ However, little is known about the quality of life after newer treatments such as brachytherapy and androgen-suppression therapy as an adjunct to radiotherapy.⁶⁻⁸ Single-institution studies and one retrospective analysis of a longitudinal, multicenter cohort used instruments that had been developed for assessment of standard external-beam radiotherapy and prostatectomy to probe the quality of life after brachytherapy,⁹⁻¹¹ but prospective, multiregional studies of the quality of life after brachytherapy, radiotherapy (including hormonal treatment), and prostatectomy have been lacking.

There is no consensus regarding the best way to assemble the distinct domains of the quality of life of cancer survivors into a unified end point.² Donabedian^{12,13} and others^{14,15} proposed that satisfaction with outcome is the ultimate arbiter, but most measures of satisfaction focus on cancer care, rather than outcome. We sought to characterize the quality of life after contemporary treatments for prostate cancer, to identify factors influencing this outcome, and to determine how the quality of life relates to overall satisfaction with the outcome of treatment from the perspective of the patient and his spouse or partner.

METHODS

PATIENTS

Patients were enrolled from March 2003 to March 2006 after approval by the institutional review boards at nine university-affiliated hospitals. Men with previously untreated stage T1 to T2 prostate cancer who had elected prostatectomy, brachytherapy, or external-beam radiotherapy as primary treatment and their spouses (partners) were eligible. All patients and their partners provided written informed consent. The group we studied consisted of 1201 such patients who had completed a pretreatment evaluation and 625 partners.

DATA COLLECTION AND FOLLOW-UP

Patient-reported outcome measures, including the Expanded Prostate Cancer Index Composite

(EPIC-26) and Service Satisfaction Scale for Cancer Care (SCA),¹⁶⁻¹⁹ were collected by a third-party phone-survey facility before treatment and at 2, 6, 12, and 24 months after the start of treatment. (For details regarding the interview process, see the Supplementary Appendix, available with the full text of this article at www.nejm.org.) The Service Satisfaction Scale for Cancer Care for Partners (SCA-P) and EPIC-Partner modules were administered to partners at 2, 6, 12, and 24 months after the start of the patient's treatment. At the time of this analysis, patients had been followed for a median of 30 months. Of the 1201 patients, 112 did not complete follow-up for the following reasons: 12 died (from causes unrelated to prostate cancer or its treatment), 84 withdrew from the study, and 16 missed two consecutive interviews.

TREATMENT

Brachytherapy was performed with the use of a transperineal technique with permanent low-dose-rate isotopes.²⁰ Brachytherapy was administered alone in 271 patients; 35 received brachytherapy in combination with external-beam radiotherapy, androgen-suppression therapy, or both. External-beam radiotherapy was accomplished by intensity-modulated radiotherapy or highly conformal techniques⁷ by itself in 202 patients and with androgen-suppression therapy in 90 patients. Pretreatment interviews were conducted before the start of hormonal treatment. Prostatectomy was performed with the use of retropubic, laparoscopic, or robot-assisted techniques.²¹⁻²³ A total of 561 patients underwent nerve-sparing procedures, and 41 underwent procedures that were not nerve-sparing; surgical-plan data were incomplete for 1 patient. There were three serious adverse events (two patients with pulmonary emboli and one with a rectourethral fistula). There were no treatment-related deaths. (For details regarding treatment and acute adverse effects, see the Supplementary Appendix.)

STATISTICAL ANALYSIS

We assessed differences in baseline demographic characteristics and variables related to cancer severity according to study group with the use of generalized chi-square and nonparametric Wilcoxon rank-sum tests. Scores for patient-reported outcomes, as measured by EPIC-26 and SCA, were calculated as described previously.¹⁶⁻¹⁹ Resulting domain scores for both instruments are on a 0 to

100 scale, with higher values representing a more favorable health-related quality of life or outcome satisfaction. To account for correlation among repeated measures from the same patient, the longitudinal study was analyzed with the use of linear generalized estimating equations (GEE), a multivariate analogue of linear regression for longitudinal data.^{24,25}

First, to assess which quality-of-life domains were affected over time by a specific type of treatment, we evaluated the time profiles of EPIC quality-of-life scores, stratified according to study group, with the use of models containing indicators for each post-treatment time point to assess whether the average score at each time point differed significantly from that at baseline. Standard errors were calculated with the use of the GEE sandwich method to account for within-patient correlation. A clinically relevant change in the quality of life (or a minimum important change) was defined as a difference from baseline to follow-up that exceeded half a standard deviation of the baseline value.^{1,26}

Second, to assess baseline factors that affected changes in quality of life within study groups, we evaluated the independent effects of factors with respect to patients and treatments on changes from baseline by fitting linear regression GEE models for the repeated-measures data. The baseline quality-of-life score was included in each model as a covariate. (See the Supplementary Appendix for additional details regarding model building and other analyses.)

Third, to determine whether changes in quality of life were distressing to the partner, we evaluated the association between the patient's change in quality of life and distress in his partner due to the patient's symptoms at 1 year with the use of Spearman's rank correlation. (For data on survey items that queried spousal distress, see the Supplementary Appendix.)

Fourth, to assess the relative effect of various domain changes of quality of life on overall outcome, we assessed the relationship between the patient's change in quality of life and satisfaction with treatment outcome at 1 year among patients and partners with the use of Spearman's rank correlation and linear regression models.^{24,25,27} Finally, to identify baseline factors that affected outcome satisfaction, we assessed the relationship between baseline covariates and satisfaction with treatment outcome with the use of linear regression models. Analyses were performed with the

use of SAS software. A two-sided P value of less than 0.05 was considered to indicate statistical significance.

RESULTS

PATIENTS

Table 1 shows the characteristics of the patients and baseline differences among the study groups. The median age of the patients was 63 years (range, 38 to 84). The 625 enrolled partners (99% of whom were female) were, on average, younger than the patients (median age, 59; range, 23 to 89; $P < 0.001$). Nine percent of patients and 7% of their partners were black. The number of coexisting illnesses was greatest among patients in the radiotherapy group, intermediate among those in the brachytherapy group, and least in the prostatectomy group. The severity of patients' cancer was greatest in the radiotherapy group, intermediate in the prostatectomy group, and least in the brachytherapy group. Recurrence of prostate cancer was detected in only 14 patients (1%) during follow-up.

Health-related quality of life was evaluated primarily as the change over time, stratified according to study group, in domains of sexual function, urinary incontinence, urinary irritation or obstruction, urinary function, bowel or rectal function, and vitality or hormonal function (Fig. 1 and Table 2). Sexual quality of life was affected in each group (Fig. 1A, 1B, and 1C; $P < 0.001$ for the change from baseline to follow-up in each study group). Among patients who underwent prostatectomy, nerve-sparing procedures were associated with better recovery of sexual quality of life than were procedures that were not nerve-sparing. Among patients who received external-beam radiotherapy, recovery of sexual function was worse in patients who received androgen-suppression therapy than in those who received radiotherapy alone (Table 3). Factors that were associated with worse sexual function after treatment, as compared with baseline, were an older age, a large prostate size, and a high pretreatment prostate-specific-antigen (PSA) score. Changes in the patient's sexual quality of life were reflected in reports from his partner. Distress that was related to the patient's erectile dysfunction was reported by 44% of partners in the prostatectomy group, 22% of those in the radiotherapy group, and 13% of those in the brachytherapy group (Table 4, and the Supplementary Appendix).

Urinary incontinence was at its worst by

Table 1. Characteristics of the Patients.*

Variable	Radical Prostatectomy (N = 603)	External-Beam Radiotherapy (N = 292)	Brachytherapy (N = 306)	P Value†
Age				<0.001
Median — yr	59	69	65	
Range — yr	38–79	45–84	44–84	
Age group — no. (%)				
<60 yr	304 (50)	41 (14)	67 (22)	
60–69 yr	253 (42)	116 (40)	146 (48)	
>70 yr	46 (8)	135 (46)	93 (30)	
Race — no. (%)‡				<0.001
White	548 (91)	238 (82)	260 (85)	
Black	31 (5)	47 (16)	36 (12)	
Other	15 (2)	2 (1)	5 (2)	
Not reported	9 (1)	5 (2)	5 (2)	
College graduate or postgraduate education — no. (%)	375 (62)	152 (52)	169 (55)	0.009
Married or with partner — no. (%)	523 (87)	226 (77)	242 (79)	<0.001
Mean number of coexisting illnesses§	0.9±1.1	1.5±1.2	1.3±1.1	<0.001
Mean body-mass index	28.0±4.5	28.6±5.4	28.5±4.7	0.24
Mean prostate size — ml	42±19	49±28	40±19	0.001
PSA¶				<0.001
Mean — ng/ml	6.7±5.7	9.1±10.1	5.8±3.6	
Median — ng/ml	5.5	6.3	5.1	
Range — ng/ml	0.5–71.6	0.5–99.3	0.6–44.0	
Group — no. (%)				
<4 ng/ml	126 (21)	46 (16)	67 (22)	
4–10 ng/ml	399 (66)	177 (61)	217 (71)	
>10 ng/ml	78 (13)	69 (24)	21 (7)	
Gleason score on biopsy — no. (%)¶				
<7	371 (62)	129 (44)	227 (74)	<0.001
7	207 (34)	123 (42)	76 (25)	
>7	25 (4)	40 (14)	2 (1)	
Clinical stage — no. (%)				
T1	436 (72)	202 (69)	254 (83)	<0.001
T2	167 (28)	90 (31)	51 (17)	
Mean proportion of biopsy cores with cancer — %	0.33±0.24	0.36±0.24	0.26±0.18	<0.001
Overall cancer severity — no. (%)				
Low risk	267 (44)	80 (27)	182 (59)	<0.001
Intermediate risk	302 (50)	159 (54)	119 (39)	
High risk	34 (6)	53 (18)	4 (1)	

* Plus-minus values are means ±SD. Of the patients who received neoadjuvant hormone therapy (NHT), 90 were in the radiotherapy group and 21 were in the brachytherapy group. The mean duration of NHT was 5 months; 94% of patients received NHT for less than 1 year. Twenty patients received an external-beam radiotherapy boost with brachytherapy. The body-mass index is the weight in kilograms divided by the square of the height in meters. Percentages may not total 100 because of rounding. PSA denotes prostate-specific antigen.

† P values are for the overall comparisons among study groups.

‡ Race was self-reported.

§ Values are for patients who had received medical diagnoses for conditions that were being treated or that limited activity, as measured with the use of a scale adapted from the Prostate Cancer Outcomes Study.⁴

¶ Data regarding the prostate-specific antigen (PSA) and Gleason scores and clinical stage (and therefore the cancer-risk category) were missing for one patient in the brachytherapy group.

|| The categories of cancer severity are defined as follows: low risk (PSA score <10, Gleason score <7, and T1), high risk (Gleason score >7 or PSA score >20), and intermediate risk (all patients who are not at low or high risk).

2 months after surgery and then improved in most patients. Factors that were associated with worse incontinence were an older age, black race, and a high PSA score at diagnosis (Fig. 1 and Table 3). In contrast, mean scores on urinary irritation or obstruction improved after prostatectomy. Effects of radiotherapy on urinary symptoms had resolved at 12 months and improved over baseline at 24 months. Patients in the brachytherapy group reported significant detriments in urinary irritation or obstruction and incontinence as compared with baseline ($P < 0.001$). Incontinence after brachytherapy was reported by 4 to 6% of patients at 1 to 2 years after treatment. Eighteen percent of patients in the brachytherapy group, 11% of those in the radiotherapy group, and 7% of those in the prostatectomy group reported having moderate or worse distress from overall urinary symptoms at 1 year (Table 2).

Large prostate size and hormonal treatment exacerbated urinary irritation after brachytherapy or radiotherapy, whereas large prostate size at baseline was associated with improvement in urinary irritation after prostatectomy (Table 3). At 1 year, 5% of partners reported being bothered by the patient's incontinence after prostatectomy or brachytherapy, whereas 7% of partners in the brachytherapy group and 3% each in the radiotherapy group and the prostatectomy group reported being bothered by the patient's symptoms of urinary obstruction, such as urinary frequency (Table 4 and the Supplementary Appendix).

Brachytherapy and radiotherapy were both associated with a reduced quality of life related to bowel function early after treatment, and the change lasted for a year or more (Fig. 1). Rectal urgency, frequency, pain, fecal incontinence, or hematochezia caused distress related to bowel function in 9% of patients a year after radiotherapy or brachytherapy (Table 2). No substantive change in bowel symptoms was detected after prostatectomy (Fig. 1). The reported bowel symptoms were associated with spousal distress: 5% in the radiotherapy group and 4% in the brachytherapy group reported being bothered by the patient's bowel symptoms (Table 4).

Vitality and other outcomes related to hormonal therapy (such as fatigue, weight change, gynecomastia, depression, and hot flashes) were worse after radiotherapy or brachytherapy among patients who received hormonal treatment (90 pa-

Figure 1 (facing page). Changes in Quality of Life after Primary Treatment for Prostate Cancer.

The graphs show unadjusted changes in mean quality-of-life scores over time for each domain, stratified according to study group. Scores on the Expanded Prostate Cancer Index Composite domains range from 0 to 100, with higher values representing a more favorable health-related quality of life. In the prostatectomy group, non-nerve-sparing procedures consisted of wide excision of both neurovascular bundles. In the radiotherapy group, patients received either external radiation alone or external radiation with neoadjuvant hormone therapy (NHT). In the brachytherapy group, patients received either brachytherapy alone or brachytherapy in combination with NHT, radiotherapy, or both. Asterisks designate time points at which scores differed from those at pretreatment baseline by more than half a standard deviation²⁶ and the comparison was significant ($P < 0.01$, to account for Bonferroni adjustment). Daggers (†) designate time points at which differences from baseline were significant but were below the threshold of clinical relevance. Double daggers (‡) designate mean scores that showed improvement over pretreatment levels. Error bars represent 95% confidence intervals; confidence intervals were symmetric, but error bars are shown as one-sided to avoid overlap with mean scores. Panel D shows the number of patients for whom sufficient time had elapsed after treatment to enter each follow-up period (including patients who were lost to follow-up) and the corresponding number who completed their prescribed follow-up interview at each time point.

tients in the radiotherapy group and 21 in the brachytherapy group), as compared with baseline (Fig. 1 and Table 2). After radiotherapy, these symptoms persisted for up to 2 years (despite < 1 year of treatment in 94% of men who received androgen-suppression therapy). Obesity, hormone therapy, and prostate size were each associated with worse quality-of-life scores related to vitality or hormonal function (Table 3). Overall, 10 to 19% of patients or their partners reported being distressed by symptoms attributable to hormonal therapy (Tables 2 and 4).

We also examined the relationship between quality-of-life changes in patients or their partners and satisfaction with the overall outcome of treatment. Changes in each of the five quality-of-life domains, as measured by EPIC, were associated with overall outcome satisfaction among both patients and their partners in bivariate analyses (Table 5). Multivariable analysis showed that, in descending significance, symptoms related to sexual function, vitality, and urinary function were

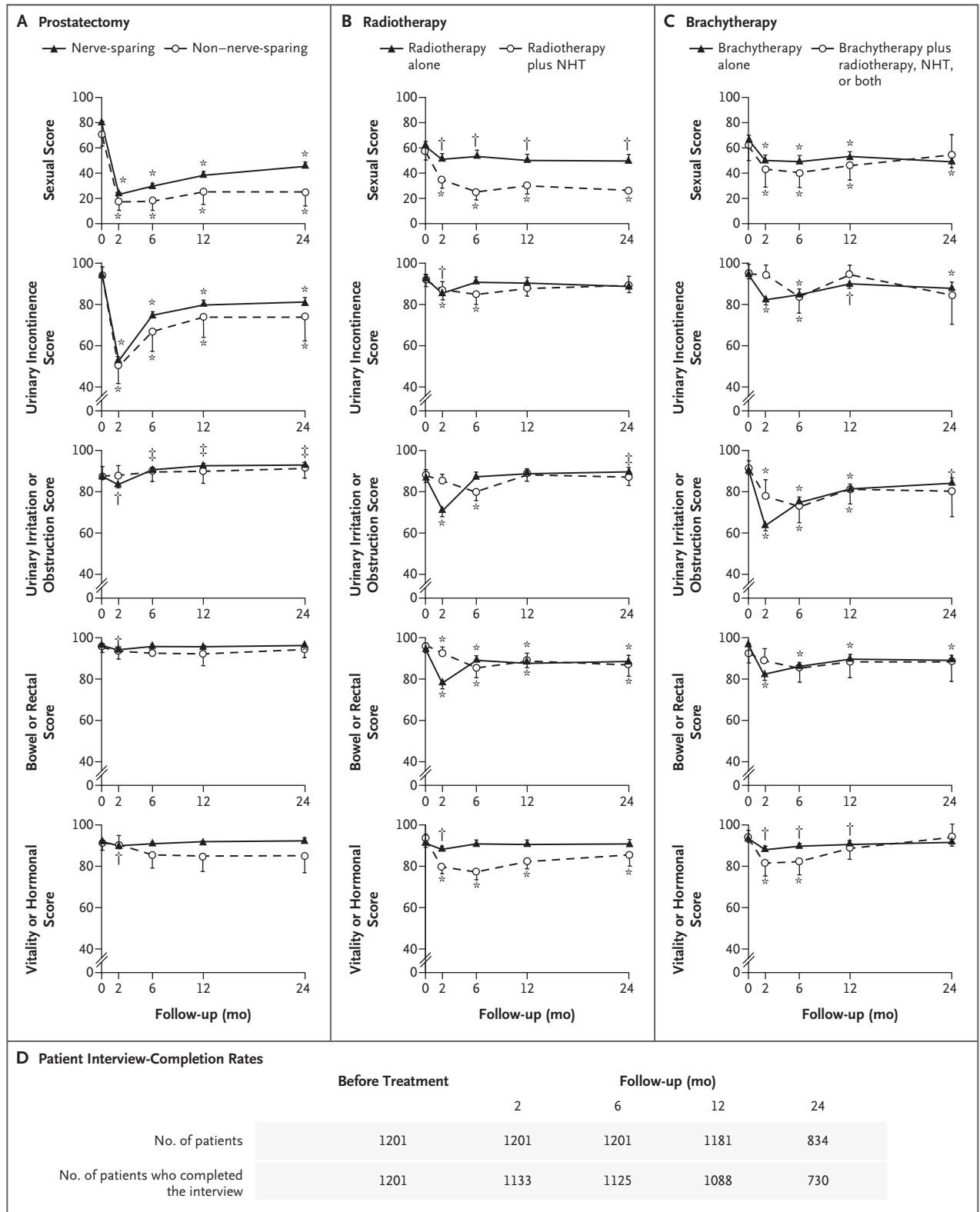


Table 2. Percent of Patients Reporting Specific Levels of Distress or Dysfunction for Each Quality-of-Life Domain, as Queried on the EPIC-26 Survey.*

Quality-of-Life Domain and EPIC Questionnaire Item	Prostatectomy				External-Beam Radiotherapy				Brachytherapy						
	Baseline (N=603)	2 Mo (N=571)	6 Mo (N=573)	12 Mo (N=557)	24 Mo (N=372)	Baseline (N=292)	2 Mo (N=276)	6 Mo (N=264)	12 Mo (N=258)	24 Mo (N=178)	Baseline (N=306)	2 Mo (N=286)	6 Mo (N=288)	12 Mo (N=272)	24 Mo (N=180)
Urinary function															
Irritation or obstruction†															
Dysuria	1	7	1	1	<1	1	12	5	1	1	1	24	11	11	5
Hematuria	<1	1	<1	<1	0	1	<1	2	1	1	<1	1	<1	1	1
Weak stream	12	12	6	3	4	13	23	11	12	10	7	40	26	18	11
Frequency	17	24	14	11	10	16	34	19	13	14	11	45	31	20	20
Incontinence															
Leaking >1 time per day	4	52	23	16	14	6	15	9	8	7	5	13	9	6	10
Frequent dribbling	2	20	6	4	5	2	6	2	3	2	<1	8	5	3	3
Any pad use	1	67	34	24	20	1	4	6	3	5	2	9	9	6	8
Leaking problem‡	2	30	9	8	8	2	6	6	4	5	1	6	7	4	6
Overall urinary problem†	11	29	10	7	7	11	30	12	11	11	8	39	25	18	16
Bowel function†															
Urgency	1	5	3	3	2	3	18	12	14	16	4	19	14	10	9
Frequency	1	3	2	1	<1	2	16	9	9	10	3	17	9	8	7
Fecal incontinence	<1	1	1	<1	<1	<1	5	4	4	2	<1	6	6	4	5
Bloody stools	<1	<1	1	<1	<1	1	3	1	5	5	<1	1	2	3	3
Rectal pain	1	4	3	2	2	2	7	5	3	4	2	10	5	4	4
Overall bowel problem	1	3	3	2	1	3	16	9	9	11	2	15	12	9	8
Sexual function															
Poor erections	14	88	80	67	58	37	52	56	57	60	30	51	50	48	51
Difficulty with orgasm	12	62	51	45	42	32	47	53	52	50	24	49	44	38	45
Erections not firm‡	17	90	84	75	64	48	63	62	64	66	36	58	58	54	56
Erections not reliable‡	10	83	75	60	51	30	46	48	51	51	24	42	47	40	44
Poor sexual function	12	83	74	61	53	34	50	54	53	58	28	47	48	43	46
Overall sexuality problem†	12	59	59	50	43	18	28	30	29	37	18	34	34	29	30
Vitality or hormonal function†															
Hot flashes	<1	2	4	4	4	1	11	12	8	3	1	3	4	1	2
Breast problems	0	0	<1	1	1	1	2	2	2	2	1	1	1	1	1
Depression	9	6	7	6	7	6	5	5	8	4	4	8	5	4	5
Lack of energy	9	11	10	10	12	12	23	21	19	16	7	21	17	14	12
Weight change	4	5	5	6	5	4	5	7	7	7	3	7	7	8	6

* Tabulated are the percent of survey respondents reporting the indicated level of dysfunction in response to each of 26 questions in the Expanded Prostate Cancer Index Composite (EPIC-26) instrument during follow-up.

† Responses for these items were dichotomized on the basis of the response that the quality-of-life concern was "a moderate or big problem."¹⁷

‡ If a respondent reported having erections that were not "firm enough for intercourse," the response was categorized as "erections not firm." If a respondent reported not achieving erections "more than half the time when desired," the response was categorized as "erections not reliable."

Table 3. Factors That Were Associated with Changes in the Quality-of-Life Score after Treatment.

Quality-of-Life Domain	Treatment Group	Independent Variable*	P Value†	
Sexuality	Prostatectomy	Age	0.001	
		PSA score	0.01	
		Nerve-sparing procedure	0.008	
	Radiotherapy	Age	0.009	
		Prostate size	0.001	
		Neoadjuvant hormone therapy	<0.001	
	Brachytherapy	Age	0.01	
		PSA score	<0.001	
Urinary incontinence	Prostatectomy	Age	0.005	
		Black race	0.03	
	Radiotherapy	PSA score	0.02	
		Brachytherapy	Neoadjuvant hormone therapy	<0.001
		Combination with radiotherapy boost	0.002	
	Urinary irritation or obstruction	Prostatectomy	Prostate size	0.005
Radiotherapy			Prostate size	0.005
		Neoadjuvant hormone therapy	0.009	
Brachytherapy		Prostate size	0.02	
		PSA score	0.03	
		Clinical stage T1c‡	0.05	
		Neoadjuvant hormone therapy	<0.001	
Bowel or rectal function	Prostatectomy	>2 Coexisting illnesses	0.02	
	Brachytherapy	Gleason score <7	0.03	
Vitality or hormonal function	Prostatectomy	Obesity	0.02	
		Radiotherapy	Obesity	0.007
			Prostate size	0.01
		Neoadjuvant hormone therapy	<0.001	
		Coexisting illness	0.03	
	Brachytherapy	Prostate size	<0.001	
		Age	0.03	
		Neoadjuvant hormone therapy	<0.001	
		Combination with radiotherapy boost	<0.001	

* Multivariable modeling with the use of linear generalized estimating equations (GEE) identified factors that were significantly associated with changes in quality of life over time, adjusting for the baseline quality-of-life score. Tabulated are the factors that were significantly associated with outcome at one or more time points 6 months or later after treatment and (in the case of categorical variables) that also met the criterion for clinical significance. Not tabulated are baseline function scores, which were significantly associated with changes in quality-of-life scores after therapy for each domain (P<0.01 for each domain baseline score); nevertheless, baseline scores were included in all multivariable GEE models, and the effects of tabulated factors were independent of and adjusted for the baseline score. See the Supplementary Appendix for additional details. PSA denotes prostate-specific antigen.

† P values reflect a test of independent covariate effect across all time points in the GEE model.

‡ Stage T1c indicates that prostate cancer was diagnosed because of an abnormal PSA score in the setting of no palpable abnormality on digital rectal examination.

Table 4. Problems Reported by 543 Patients and Their Partners Regarding Symptoms and the Association between Changes in Patients' Quality-of-Life Scores and Levels of Distress Reported by Their Partners 1 Year after Treatment.*

Quality-of-Life Domain and Reported Level of Domain-Specific Distress	Patient						Spouse or Partner				Association between Change in Patient's Quality of Life and Distress for Partner			
	Prosta- tectomy	Radio- therapy	Brachy- therapy	Prosta- tectomy	Radio- therapy	Brachy- therapy	Prosta- tectomy	Radio- therapy	Brachy- therapy	Prosta- tectomy	Radio- therapy	Brachy- therapy	All Groups	
														number (percent)
Sexual function										0.35†	0.11	0.22‡	0.36†	
No. of responses	268	113	116	279	126	122								
No problem or very small problem	78 (29)	53 (47)	61 (53)	114 (41)	83 (66)	83 (68)								
Small problem	55 (21)	25 (22)	20 (17)	42 (15)	16 (13)	23 (19)								
Moderate problem	65 (24)	17 (15)	16 (14)	65 (23)	15 (12)	9 (7)								
Big problem	70 (26)	18 (16)	19 (16)	58 (21)	12 (10)	7 (6)								
Urinary incontinence										0.44†	0.03	0.04	0.27†	
No. of responses	281	124	124	285	129	129								
No problem or very small problem	213 (76)	106 (85)	106 (85)	257 (90)	119 (92)	118 (91)								
Small problem	44 (16)	13 (10)	12 (10)	15 (5)	7 (5)	5 (4)								
Moderate problem	18 (6)	4 (3)	5 (4)	8 (3)	2 (2)	5 (4)								
Big problem	6 (2)	1 (1)	1 (1)	5 (2)	1 (1)	1 (1)								
Urinary irritation or obstruction										0.01	0.14	0.26†	0.13†	
No. of responses	280	122	123	285	128	129								
No problem or very small problem	206 (74)	83 (68)	80 (65)	270 (95)	118 (92)	112 (87)								
Small problem	41 (15)	21 (17)	20 (16)	8 (3)	6 (5)	8 (6)								
Moderate problem	25 (9)	15 (12)	19 (15)	5 (2)	3 (2)	4 (3)								
Big problem	8 (3)	3 (2)	4 (3)	2 (1)	1 (1)	5 (4)								
Bowel or rectal function										0.09	0.23†	0.03	0.14†	
No. of responses	281	120	125	285	128	129								
No problem or very small problem	262 (93)	92 (77)	102 (82)	278 (98)	115 (90)	121 (94)								
Small problem	14 (5)	14 (12)	11 (9)	4 (1)	7 (5)	3 (2)								
Moderate problem	5 (2)	11 (9)	11 (9)	2 (1)	4 (3)	3 (2)								
Big problem	0	3 (2)	1 (1)	1 (<1)	2 (2)	2 (2)								
Vitality or hormonal function										0.14‡	0.31†	0.30†	0.22†	
No. of responses	281	124	125	285	129	129								
No problem or very small problem	227 (81)	91 (73)	87 (70)	214 (75)	93 (72)	98 (76)								
Small problem	27 (10)	11 (9)	19 (15)	28 (10)	17 (13)	16 (12)								
Moderate problem	20 (7)	16 (13)	13 (10)	32 (11)	15 (12)	6 (5)								
Big problem	7 (2)	6 (5)	6 (5)	11 (4)	4 (3)	9 (7)								

* Items involving sexual and bowel or rectal function are assessments of distress associated with global domains, whereas for urinary incontinence, urinary irritation or obstruction, and hormonal function, the items were those most frequently rated as either a "moderate" or "big" problem on the basis of previous validity data from the Expanded Prostate Cancer Index Composite (EPIC-26) survey.¹⁷ Percentages may not total 100 because of rounding. A total of 285 patient-partner dyads in the prostatectomy group, 129 dyads in the radiotherapy group, and 129 dyads in the brachytherapy group were included in the dyadic sample at 1 year; the numbers of patients and partners who had a survey response varied among categories because of unanswered items.

† P<0.01.

‡ P<0.05.

Table 5. Association between Changes in Quality-of-Life Scores and Satisfaction Regarding Treatment Outcome among Patients and Their Partners at 1 Year.*

Quality-of-Life Domain	Patients				Partners			
	Bivariate Association		Multivariable Analysis		Bivariate Association		Multivariable Analysis	
	<i>correlation coefficient</i>	<i>P value</i>	<i>regression coefficient</i>	<i>P value</i>	<i>correlation coefficient</i>	<i>P value</i>	<i>regression coefficient</i>	<i>P value</i>
Sexual function	0.21	<0.001	0.08	<0.001	0.23	<0.001	0.08	<0.001
Vitality or hormonal function	0.13	<0.001	0.11	0.004	0.15	<0.001	0.15	0.05
Urinary irritation or obstruction	0.07	0.02	0.10	0.002	0.04	0.40	0.03	0.54
Urinary incontinence	0.12	<0.001	0.03	0.15	0.13	0.003	0.06	0.08
Bowel or rectal function	0.06	0.04	0.05	0.17	0.05	0.22	0.04	0.41

* The univariate associations are based on Spearman's correlation between changes in quality-of-life scores from baseline to 1 year and the outcome satisfaction score at 1 year. The multivariable model is based on multivariable analysis with the use of generalized estimating equations. P values reflect the significance of the association between the change in quality-of-life domain scores and the satisfaction-with-outcome score.

independently associated with outcome satisfaction among patients. The patient's quality of life related to sexual function was also significantly associated with satisfaction in the partner. Analysis of baseline factors in patients showed that blacks were significantly less satisfied with their overall treatment outcome than were patients of other racial backgrounds ($P=0.04$).

DISCUSSION

Each of three common primary therapies for prostate cancer showed a unique pattern of changes in quality of life related to urinary symptoms, sexual and bowel function, and vitality or hormonal function. Adjuvant hormone therapy exacerbated the adverse effects of radiotherapy or brachytherapy, whereas nerve-sparing surgical procedures mitigated the adverse effects of prostatectomy. Factors that were associated with worse patient-reported outcomes were obesity, a large prostate size, a high pretreatment PSA score, an older age, and black race. The adverse effect of obesity, which was previously linked to urinary incontinence in a single-institution study,²⁸ also exacerbated symptoms related to vitality and hormonal function after radiotherapy or brachytherapy.

Previous multicenter studies that characterized the quality of life after primary therapy for prostate cancer include the Prostate Cancer Outcomes Study (PCOS),⁴ which relied on a recall of pretreatment quality of life to study the effects of prostatectomy and conventional external-beam radio-

therapy, and longitudinal surveys of a limited subgroup of patients in the Cancer of the Prostate Strategic Urologic Research Endeavor (CaPSURE) study.¹¹ Brachytherapy was not evaluated in PCOS, whereas quality-of-life analyses in CaPSURE evaluated a small subgroup of patients, did not measure symptoms related to urinary irritation or hormonal treatment, and had a suboptimal rate of survey response. Our observation that patients who received brachytherapy had symptoms related to sexual or bowel function and urinary irritation or obstruction corroborates effects that were previously noted in single-institution studies.^{9,10,29,30} Moreover, we observed an association between brachytherapy and both urinary incontinence and reduced vitality.

Previous studies have shown that long-term, primary hormonal therapy is associated with quality-of-life effects.³¹ We observed that androgen suppression of limited duration, when administered as an adjunct to radiotherapy or brachytherapy, was also associated with long-lasting symptoms involving sexuality and vitality. Notwithstanding the survival benefit of androgen deprivation in randomized clinical trials involving high-risk patients with prostate cancer,⁸ our findings mitigate enthusiasm for adjuvant hormonal therapy in the setting of disease of low or intermediate risk.

Urinary irritation and obstruction improved after prostatectomy. This observation validates an effect similar to that reported in one single-institution series.³² A Swedish randomized trial, com-

paring prostatectomy with watchful waiting, also showed fewer obstructive urinary problems among patients who underwent prostatectomy, though the patients' pretreatment values were not evaluated.³³

Benefits of nerve-sparing techniques on sexual recovery after prostatectomy have been reported in several high-volume single-surgeon series.³⁴⁻³⁶ In our multicenter study, we also observed better recovery of sexual function among patients undergoing nerve-sparing procedures than among those who did not undergo nerve-sparing procedures, even after adjustment for pretreatment sexual function. Previous multicenter studies may not have detected benefits of nerve-sparing procedures because of differences in surgical technique, limited sample size, or retrospective design.^{4,9,37-39}

Previous studies of satisfaction with prostate-cancer care have focused predominantly on treatment, rather than outcome.^{1,40-43} We found that changes in quality of life were significantly related to satisfaction with overall outcome among both patients and their partners. Black patients were less satisfied with the treatment outcome, despite having received care at the same high-volume institutions as did other patients.

Treatment-related changes in quality of life among patients caused distress in their partners. A previous multicenter trial of chemotherapy for recurrent prostate cancer showed that a patient's therapy had an effect on the well-being of the patient's spouse or partner.⁴⁴ Our study showed that the level of spousal distress arising from a patient's sexual and urinary symptoms after primary prostate-cancer treatment was also associated with the partner's level of satisfaction with the treatment outcome. These findings confirm those of single-institution studies suggesting that patients' urinary or sexual symptoms are problematic for their partners.^{45,46}

Limitations of our study include the lack of randomization to treatment and hence the pos-

sibility that unmeasured selection factors may have influenced the outcomes. Therefore, our analyses are appropriate only for expectations with respect to outcome within study groups and not for a comparison among treatments. The follow-up period of 2 years is relatively short, and measures of quality of life may change further with longer follow-up. Although black patients reported less favorable outcomes than did other patients (despite ostensibly similar care settings), we could not determine whether these differences in outcome reflected disparities in the quality of care, in the expectations of patients, or in cancer biology. Further study will be required to answer these questions.

In conclusion, our measurement of satisfaction with the overall outcome of cancer treatment was sensitive to divergent changes in quality of life of patients and their partners and can provide a unified assessment of the quality of care for patients with prostate cancer.

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