Published in final edited form as:

J Urol. 2010 May ; 183(5): 1751–1756. doi:10.1016/j.juro.2010.01.014.

Impact of Previous Radiotherapy for Prostate Cancer on Clinical Outcomes of Bladder Cancer Patients

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Abstract

Purpose—The impact of prostate cancer radiotherapy on the biological behavior of bladder cancer remains unclear. We compared outcomes of bladder cancer patients previously treated for prostate cancer with radiotherapy versus other treatment modalities.

Materials and Methods—We identified 144 patients diagnosed with bladder cancer between January 1992 and June 2007 with a previous prostate cancer diagnosis. Clinicopathologic data and outcomes were compared between irradiated (brachytherapy and/or external beam radiation therapy; n = 83) and nonirradiated (androgen deprivation therapy, radical prostatectomy, and/or surveillance; n = 61) patients.

Results—Median time between prostate and bladder cancer diagnoses was longer in irradiated versus nonirradiated patients (59 months [IQR 25–88] versus 24 months [IQR 2–87], p = 0.007). Irradiated patients presented with higher tumor grade (high: 92% versus 77%, p = 0.016) and progressed to higher stage (muscle-invasive: 70% versus 43%, p = 0.001) than nonirradiated patients. In patients undergoing cystectomy, irradiated patients had a numerically higher rate of non-organ confined disease (75% versus 56% for nonirradiated patients, p = 0.1). Among all bladder cancer patients, 5-year cancer-specific survival was 73% (95% CI 59–87) for irradiated patients versus 83% (95% CI 71–95) for nonirradiated patients (p = 0.07). Median followup was 53 months (IQR 24–75).

Conclusions—More time elapsed between prostate and bladder cancer diagnoses for irradiated patients, and irradiated patients presented with more advanced disease. Future studies are needed to further establish clinical differences in bladder cancer between irradiated and nonirradiated patients and whether biological differences exist.

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Supplementary Table 3 URL address: www.mskcc.org/previousrt

Keywords

urinary bladder neoplasms; cystectomy; prostatic neoplasms; radiotherapy; survival

INTRODUCTION

Prostate cancer is the most common malignancy in men, with an estimated 186,320 new cases and 28,660 deaths in the United States in 2008.¹ One in approximately every 6 American men over the age of 50 will be diagnosed with prostate cancer in his lifetime.² Since the advent of PSA screening, prostate cancer patients are diagnosed at a younger age and earlier disease stage. Earlier diagnosis and therapeutic advances have contributed to the increased use of local treatment, including RP, EBRT, and BT. According to the CaPSURE data, almost 25% of contemporary patients with prostate cancer received radiation therapy (EBRT, BT, or both) as initial treatment.³

Several studies show a link between ionizing radiation and urothelial dysplasia or DNA damage.^{4–5} The association between malignancy and radiation exposure has been well documented in atomic bomb survivors and Chernobyl nuclear accident survivors.^{6–7} However, the association between therapeutic radiotherapy and risk of second malignancy is unclear. Specifically, there is controversy whether radiotherapy for prostate cancer leads to an increased risk of bladder cancer.^{8–18}

In 2006, we first reported that bladder cancer patients who had received radiotherapy for prostate cancer had higher grade disease and presented at a higher stage than nonirradiated patients.¹⁹ We now update our cohort and review the pathological features and survival outcomes of bladder cancer patients previously treated with or without radiotherapy for prostate cancer.

MATERIALS AND METHODS

With institutional review board approval, we reviewed the Memorial Sloan-Kettering Cancer Center Tumor Registry and identified 144 patients diagnosed with bladder cancer between January 1992 and June 2007 and a previous diagnosis of prostate cancer. Patient sociodemographic, clinical, treatment, and pathological characteristics were compared after stratifying patients into irradiated versus nonirradiated groups. Irradiated patients had received BT and/or EBRT as a primary treatment for prostate cancer. Nonirradiated patients had been treated with androgen deprivation therapy, RP, and/or surveillance. Specimens were staged according to the 2002 TNM clinical staging system.²⁰

Fisher's exact test and the chi-square tests were used to compare categorical variables between groups. Differences in continuous variables were assessed using the Mann Whitney U test. Multivariable logistic regression analysis was used to test for the association between irradiation and pathologic stage and grade, adjusting for age and time between prostate and bladder cancer diagnoses. The Kaplan-Meier method was performed to calculate recurrence-free and cancer-specific survival, and differences were assessed with the log rank statistic. To minimize the effect of diagnostic bias, we performed a subgroup analysis restricted to

patients diagnosed with bladder cancer more than 5 years after prostate cancer diagnosis. In the analysis of cystectomy patients, aborted radical cystectomy (n = 5) and partial cystectomy (n = 4) patients were included among the cystectomy group. All p values are 2-sided; $p < 0.05$ was considered statistically significant. Statistical analyses were performed using SPSS v. 16 (SPSS Inc., Chicago, IL).

RESULTS

Table 1 lists clinical and pathological features of 144 bladder cancer patients who had a previous diagnosis of prostate cancer. Median followup of living patients was 53 months (IQR 24–75; range 2–163). Presenting symptoms among all patients included gross hematuria (71%), microhematuria (12%), lower urinary tract symptoms (8%), and incidental finding on imaging (8%). The median time from prostate to bladder cancer diagnosis was longer in irradiated (n = 83) versus nonirradiated (n = 61) patients (59 months [IQR 25–88] versus 24 months [IQR 2–87], $p = 0.007$). Irradiated patients were older than nonirradiated patients at bladder cancer diagnosis (median age 76 [IQR 71–80] versus 71 [IQR 66–76], $p < 0.001$) and presented more often with gross hematuria (80% versus 60%, $p = 0.039$). There was no difference in smoking status, positive cytology, or perioperative chemotherapy.

Irradiated patients presented with higher tumor grade (high: 92% versus 77%, $p = 0.016$) than nonirradiated patients. Irradiated patients had also progressed to a higher stage (muscle invasive: 70% versus 43%, $p = 0.001$) than nonirradiated patients. After adjusting for effects of age and time between diagnoses, irradiated patients had higher risk of developing muscle invasive disease (OR 2.7, 95% CI 1.3–5.7, $p = 0.008$).

Cystectomy was undergone by 51% of patients, 47 (57%) irradiated and 27 (44%) nonirradiated (table 2). Of those considered candidates for cystectomy (ie, recurrent high grade T1 or clinical stage T2 or higher), 82% of nonirradiated and 71% of irradiated patients underwent cystectomy ($p = 0.3$). Cystectomy was aborted in 4 patients due to unresectable disease and in 1 patient due to unresectable disease and mesenteric lymphadenopathy. For the ‘aborted’ cystectomy cases with available data, findings from the CT scan or exam under anesthesia were compatible with resectability. Neoadjuvant chemotherapy was primarily given to patients with locally advanced disease, and primarily included gemcitabine and carboplatin/cisplatin or MVAC combination chemotherapy. In patients undergoing cystectomy, irradiated patients had a numerically higher rate of non-organ confined disease compared to nonirradiated patients (75% versus 56%, $p = 0.1$). The likelihood of undergoing a lymph node dissection during cystectomy was similar for irradiated and nonirradiated patients (90% versus 80%, $p = 0.2$), and the 2 groups had comparable median numbers of lymph nodes removed (9 [IQR 4–14] versus 10 [IQR 3–21], $p = 0.524$).

With regards to tumor location, irradiated patients had a higher risk of having urothelial cancer in the trigone or bladder neck area than nonirradiated patients (27% versus 0%, $p = 0.007$). Among all cystectomy patients, 14% (10/74) had urothelial cancer in the trigone or bladder neck. In addition, when compared to nonirradiated patients who had received androgen deprivation therapy or surveillance for prostate cancer (n = 15), irradiated patients

presented with a higher rate of pathologically documented prostatic invasion by urothelial carcinoma (36% versus 0%, $p = 0.007$).

Irradiated patients had a higher rate of ileal conduit urinary diversion than nonirradiated patients (95% [39/41] versus 68% [15/22], $p = 0.004$). One rectal injury occurred, in an irradiated patient (2%). The rectotomy was recognized intraoperatively and was primarily repaired. Two patients also had deserosalization of the rectum, which was primarily repaired. There was no difference in intraoperative blood loss or overall complications between the groups.

Among all bladder cancer patients, cancer-specific survival was 76% (95% CI 66–86) at 3 years and 73% (95% CI 59–87) at 5 years for irradiated patients and 87% (95% CI 75–99) at 3 years and 83% (95% CI 71–95) at 5 years for nonirradiated patients ($p = 0.07$; fig. 1). There was also no significant difference in cancer-specific survival by stage. In the 74 patients undergoing cystectomy, there were no significant differences between irradiated versus nonirradiated patients in recurrence-free survival (5-year probability 49% [95% CI 29–69] versus 56% [95% CI 32–80], $p = 0.2$) and cancer-specific survival (5-year probability 57% [95% CI 37–77] versus 75% [95% CI 55–95], $p = 0.1$). In a subgroup analysis of bladder cancer patients diagnosed 5 or more years after their prostate cancer diagnosis ($n = 58$), 5-year cancer-specific survival was 62% (95% CI 42–82) for irradiated and 71% (95% CI 45–97) for nonirradiated patients ($p = 0.6$).

DISCUSSION

In this study, the interval between prostate and bladder cancer was significantly longer in the irradiated group. The delay in bladder cancer diagnosis may be due in part to the misconception that hematuria after prostate radiotherapy is a normal finding, leading to a postponement in workup. Another reason might be the biological time period required if radiotherapy does indeed increase bladder cancer risk. Our median 4.9 year latency between radiation exposure and urothelial carcinoma is in agreement with other contemporary reports by Shah et al (4.0 years), Chrouser et al (4.9 years), and Bostrom et al (5.0 years).^{9, 11, 21} The median time from prostate to bladder cancer diagnosis was 2 years in the nonirradiated group, supporting the assumption that bladder cancer in nonirradiated patients develops spontaneously and unrelated to prostate cancer therapy. It also suggests that the shorter time to bladder cancer diagnosis may be related to improved surveillance in nonirradiated patients. The patterns of followup and the duration of most common presenting symptom of hematuria, however, could not be reliably retrieved from our database.

Nearly all patients who received radiotherapy had high grade bladder tumors consistent with in vitro observations. Radiation has been shown to be associated with in vitro progression of low grade to high grade urothelial tumors and a higher rate of p53 mutations.^{5, 22} Suit et al reviewed the data on radiation-induced cancers from mammalian cells in vitro and animal and human studies.²³ Transformation of cell lines in vitro increased linearly with dose from 1 to 5 Gy. Radiation-induced DNA mutation appears to be the initial carcinogenic event leading to aberrant expression of oncogenic and tumor suppressor genes.²⁴ Supporting the direct mutagenic effect of radiation are our study's findings that 27% of irradiated patients

were found to have tumor at the trigone or bladder neck area and that 36% of irradiated patients had urothelial carcinoma involvement of the prostate at radical cystectomy. As in previous reports of prostate cancer patients treated with radiotherapy, the majority of our patients presented with high grade urothelial carcinoma and progressed to muscle invasive disease.^{19, 21}

In our series of bladder cancer patients, cystectomy was performed in 57% (47/83) of patients previously treated with prostate cancer radiotherapy. This was similar to the Loma Linda series, where 64% (7/11) of patients previously treated with EBRT underwent radical cystectomy.²¹ In our irradiated group, almost all patients (39/41) underwent ileal conduit urinary diversion. Similarly, in the University of Miami study, an ileal conduit was performed in all but 1 patient.⁹ In contrast, the University of Chicago group reported a 40% continent diversion rate (8 neobladders, 6 continent pouches, and 14 ileal conduits) in their group of radical cystectomy patients with prior RP and/or radiotherapy for prostate cancer.²⁵ The University of Michigan group reported a 17% (5/29) rate of orthotopic neobladder diversion in their series of radical cystectomy patients with prior treatment for prostate cancer.²⁶

Prior radiation may complicate radical cystectomy and increase the risk of intraoperative rectal injury due to the lack of planes posterior to the prostate and the need for sharp dissection. In our series, 1 (2%) irradiated patient experienced a rectal injury; it was repaired intraoperatively and did not require a colostomy. There were 2 perioperative deaths, both in the irradiated group, from a myocardial infarction and a pulmonary embolism. No rectal injuries or perioperative deaths occurred in the nonirradiated group. The University of Miami group reported 1 patient (2.9%) with a rectal tear and 1 perioperative death.⁹ The University of Chicago and University of Michigan groups did not report any rectal perforations or deaths.^{25–26}

In the MSKCC patients undergoing radical cystectomy, irradiated patients had a numerically higher rate of non-organ confined disease than nonirradiated patients (75% versus 56%, respectively). This high proportion of locally advanced tumors raises concern. The stage distribution was even more profound than for the University of Michigan group, which reported 60% of cystectomy cases as locally advanced.²⁶ In our series, node dissections were performed 90% of the time in irradiated patients with an average of 9 nodes removed.

Consistent with our initial analysis of 100 patients,¹⁹ in this analysis previous radiotherapy was associated with poorer cancer-specific survival but the differences were not statistically significant (fig. 1). This may be attributable to limited statistical power due to small sample size. Only Bostrom et al have demonstrated significantly poorer bladder cancer-specific and overall survival in cystectomy patients with a history of radiotherapy for prostate cancer compared to a matched control group.⁹

Whether radiotherapy increases bladder cancer risk remains a subject of continued debate.^{8, 10–18, 27–29} The consequences of radiation exposure vary in different animals and even different strains of the same species, and in organs within a species.²³ The development of secondary cancer may not be related to radiotherapy, but rather may be

explained by diagnostic bias, common etiologic factors, or by common pathway of carcinogenesis.³⁰ Some tumor registry^{27–29} and institutional^{11, 14} based studies have not demonstrated an increased bladder cancer risk in prostate cancer patients who received radiotherapy. The studies at Fox Chase Cancer Center¹⁴ and Mayo Clinic¹¹ also did not find an increased risk of second primary cancer in patients treated with radiotherapy for prostate cancer.

The majority of epidemiologic studies support an association between prostate radiotherapy and subsequent bladder cancer, particularly in long-term survivors.^{8, 10, 12–13, 15, 17–18} Four studies utilizing the national SEER database have found a modestly increased bladder cancer risk in prostate cancer patients who received radiotherapy compared to those who did not.^{10, 13, 15–16} These population-based studies included large numbers of patients (range 122,123 to 243,082), and 25% to 67% of the study cohorts received radiotherapy. Most of these studies had an exclusion period (2 months to 5 years) from diagnosis to secondary cancer to minimize the effect of diagnostic bias. When we used an exclusion period of 5 years, the group with previous radiotherapy also had poorer cancer-specific survival, but this was not statistically significant.

In a contemporary SEER cohort from 1988 to 2003, Nieder et al demonstrated an increased risk of bladder cancer after radiotherapy compared to no radiotherapy.¹⁶ They determined the relative risk of bladder cancer developing after EBRT, BT, and EBRT-BT compared to RP was 1.88, 1.52, and 1.85, respectively. In a contemporary group of men from the CaPSURE database, Boorjian et al evaluated the risk of bladder cancer in patients with prostate cancer diagnosed from 1989 to 2003.⁸ On multivariate analysis adjusted for comorbidity and smoking status, they demonstrated a lower relative risk of bladder cancer in patients who underwent RP compared to radiotherapy (OR 0.51, 95% CI 0.29–0.89).⁸

This study has several limitations regarding size and confounding factors. Given the relatively small number of patients, the study has limited statistical power, particularly in the subgroup of cystectomy patients. The failure to detect differences in recurrence-free or cancer-specific survival may be attributable to insufficient sample size, short followup, and/or small number of events. Also, we were unable to control for the total amount of radiation provided to each patient as this could not be reliably retrieved from our database. Though we evaluated tobacco exposure for the two groups, we did not control for comorbidities that might affect survival in these nonrandomized patients accumulated over 15 years. Finally, the study was performed at a tertiary referral center and may not be applicable to the general population of patients with bladder cancer.

CONCLUSIONS

In patients initially diagnosed with prostate cancer and treated with radiation, more time elapsed between prostate and bladder cancer diagnoses than for nonirradiated prostate cancer patients. Also, the previously irradiated patients presented with more advanced bladder cancer. In irradiated patients, further evaluation — particularly diagnostic cystoscopy — should be performed on all patients with signs or symptoms of bladder

cancer. Future studies are needed to determine if there are biological differences in bladder cancer between irradiated and nonirradiated patients.

Supplementary Material

Refer to Web version on PubMed Central for supplementary material.

Acknowledgments

Supported by: The Sidney Kimmel Center for Prostate and Urologic Cancers. Supported in part by funds provided by David H. Koch through the Prostate Cancer Foundation. Drs. Shariat and Lowrance are research fellows in urologic oncology supported by NIH grant T32-CA82088 and by a gift from the Tina and Richard V. Carolan Foundation.

REFERENCES

1. Jemal A, Siegel R, Ward E, et al. Cancer statistics, 2008. *CA Cancer J Clin.* 2008; 58:71. [PubMed: 18287387]
2. Merrill RM, Weed DL, Feuer EJ. The lifetime risk of developing prostate cancer in white and black men. *Cancer Epidemiol Biomarkers Prev.* 1997; 6:763. [PubMed: 9332756]
3. Cooperberg MR, Broering JM, Litwin MS, et al. The contemporary management of prostate cancer in the United States: lessons from the cancer of the prostate strategic urologic research endeavor (CapSURE), a national disease registry. *J Urol.* 2004; 171:1393. [PubMed: 15017184]
4. Woudstra EC, Brunsting JF, Roesink JM, et al. Radiation induced DNA damage and damage repair in three human tumour cell lines. *Mutat Res.* 1996; 362:51. [PubMed: 8538648]
5. Yamamoto S, Romanenko A, Wei M, et al. Specific p53 gene mutations in urinary bladder epithelium after the Chernobyl accident. *Cancer Res.* 1999; 59:3606. [PubMed: 10446970]
6. Okeanov AE, Sosnovskaya EY, Priatkina OP. National cancer registry to assess trends after the Chernobyl accident. *Swiss Med Wkly.* 2004; 134:645. [PubMed: 15609208]
7. Preston DL, Shimizu Y, Pierce DA, et al. Studies of mortality of atomic bomb survivors. Report 13: Solid cancer and noncancer disease mortality: 1950–1997. *Radiat Res.* 2003; 160:381. [PubMed: 12968934]
8. Boorjian S, Cowan JE, Konety BR, et al. Bladder cancer incidence and risk factors in men with prostate cancer: results from Cancer of the Prostate Strategic Urologic Research Endeavor. *J Urol.* 2007; 177:883. [PubMed: 17296367]
9. Bostrom PJ, Soloway MS, Manoharan M, et al. Bladder cancer after radiotherapy for prostate cancer: detailed analysis of pathological features and outcome after radical cystectomy. *J Urol.* 2008; 179:91. [PubMed: 17997457]
10. Brenner DJ, Curtis RE, Hall EJ, et al. Second malignancies in prostate carcinoma patients after radiotherapy compared with surgery. *Cancer.* 2000; 88:398. [PubMed: 10640974]
11. Chrouser K, Leibovich B, Bergstralh E, et al. Bladder cancer risk following primary and adjuvant external beam radiation for prostate cancer. *J Urol.* 2005; 174:107. [PubMed: 15947588]
12. Liauw SL, Sylvester JE, Morris CG, et al. Second malignancies after prostate brachytherapy: incidence of bladder and colorectal cancers in patients with 15 years of potential follow-up. *Int J Radiat Oncol Biol Phys.* 2006; 66:669. [PubMed: 16887293]
13. Moon K, Stukenborg GJ, Keim J, et al. Cancer incidence after localized therapy for prostate cancer. *Cancer.* 2006; 107:991. [PubMed: 16878323]
14. Movsas B, Hanlon AL, Pinover W, et al. Is there an increased risk of second primaries following prostate irradiation? *Int J Radiat Oncol Biol Phys.* 1998; 41:251. [PubMed: 9607337]
15. Neugut AI, Ahsan H, Robinson E, et al. Bladder carcinoma and other second malignancies after radiotherapy for prostate carcinoma. *Cancer.* 1997; 79:1600. [PubMed: 9118045]

16. Nieder AM, Porter MP, Soloway MS. Radiation therapy for prostate cancer increases subsequent risk of bladder and rectal cancer: a population based cohort study. *J Urol*. 2008; 180:2005. [PubMed: 18801517]
17. Pawlish KS, Schottenfeld D, Severson R, et al. Risk of multiple primary cancers in prostate cancer patients in the Detroit metropolitan area: a retrospective cohort study. *Prostate*. 1997; 33:75. [PubMed: 9316648]
18. Pickles T, Phillips N. The risk of second malignancy in men with prostate cancer treated with or without radiation in British Columbia, 1984–2000. *Radiother Oncol*. 2002; 65:145. [PubMed: 12464442]
19. Sandhu JS, Vickers AJ, Bochner B, et al. Clinical characteristics of bladder cancer in patients previously treated with radiation for prostate cancer. *BJU Int*. 2006; 98:59. [PubMed: 16626308]
20. American Joint Committee on Cancer: AJCC Cancer Staging Manual. 6th ed.. New York, NY: Springer; 2002. Urinary bladder; p. 335-340.
21. Shah SK, Lui PD, Baldwin DD, et al. Urothelial carcinoma after external beam radiation therapy for prostate cancer. *J Urol*. 2006; 175:2063. [PubMed: 16697804]
22. Pazzaglia S, Chen XR, Aamodt CB, et al. In vitro radiation-induced neoplastic progression of low-grade uroepithelial tumors. *Radiat Res*. 1994; 138:86. [PubMed: 8146304]
23. Suit H, Goldberg S, Niemierko A, et al. Secondary carcinogenesis in patients treated with radiation: a review of data on radiation-induced cancers in human, non-human primate, canine and rodent subjects. *Radiat Res*. 2007; 167:12. [PubMed: 17214511]
24. Kohn HI, Fry RJ. Radiation carcinogenesis. *N Engl J Med*. 1984; 310:504. [PubMed: 6363931]
25. Tolhurst SR, Rapp DE, O'Connor RC, et al. Complications after cystectomy and urinary diversion in patients previously treated for localized prostate cancer. *Urology*. 2005; 66:824. [PubMed: 16230146]
26. Schuster TG, Marcovich R, Sheffield J, et al. Radical cystectomy for bladder cancer after definitive prostate cancer treatment. *Urology*. 2003; 61:342. [PubMed: 12597943]
27. Greenberg RS, Rustin ED, Clark WS. Risk of genitourinary malignancies after cancer of the prostate. *Cancer*. 1988; 61:396. [PubMed: 3334974]
28. Kleinerman RA, Liebermann JV, Li FP. Second cancer following cancer of the male genital system in Connecticut, 1935–82. *Natl Cancer Inst Monogr*. 1985; 68:139. [PubMed: 4088295]
29. Osterlind A, Rorth M, Prener A. Second cancer following cancer of the male genital system in Denmark, 1943–80. *Natl Cancer Inst Monogr*. 1985; 68:341. [PubMed: 4088308]
30. Bostrom PJ, Soloway MS. Secondary cancer after radiotherapy for prostate cancer: should we be more aware of the risk? *Eur Urol*. 2007; 52:973. [PubMed: 17644245]

Abbreviations and Acronyms

BT	interstitial prostate brachytherapy
EBRT	external beam radiation therapy
RP	radical prostatectomy
MVAC	methotrexate, vinblastine, doxorubicin (Adriamycin), and cisplatin

Patients at risk

Nonirradiated	50	32	20	9	5
Irradiated	63	35	20	10	5

Figure 1. Probability of cancer-specific survival among nonirradiated (blue) and irradiated (green) bladder cancer patients.

TABLE 1

Clinical and pathological characteristics of 144 patients with bladder cancer who had a previous diagnosis of prostate cancer

	Irradiated	Nonirradiated	p Value
No. pts	83	61	NA
Median age (IQR) at bladder cancer diagnosis, years	76 (71–80)	71 (66–76)	< 0.001
Time between prostate and bladder cancer diagnoses (IQR), months	59 (25–88)	24 (2–87)	0.007
Tumor histology, * n (%)			0.6
TCC	67 (82)	54 (90)	
TCC with squamous differentiation	9 (11)	3 (5)	
Squamous cell carcinoma	2 (2)	1 (2)	
Small cell carcinoma	4 (5)	2 (3)	
High tumor grade, * n (%)	75 (92)	47 (77)	0.016
Presenting tumor stage, † n (%)			0.3
Ta	17 (21)	22 (36)	
Tis	5 (6)	2 (3)	
T1	25 (30)	17 (28)	
T2	31 (37)	18 (29)	
T3	1 (1)	1 (2)	
T4	4 (5)	1 (2)	
Highest clinical tumor stage, † n (%)			0.001
Ta	6 (7)	18 (30)	
Tis	5 (6)	2 (3)	
T1	14 (17)	15 (25)	
T2	16 (19)	12 (20)	
T3	25 (30)	11 (18)	
T4	17 (21)	3 (5)	

* Data missing in 2 patients.

† Data missing in 1 patient.

NA = not applicable; IQR = interquartile range; TCC = transitional cell carcinoma.

TABLE 2

Clinical and pathological characteristics of bladder cancer patients with a previous diagnosis of prostate cancer whose bladder cancer was treated with cystectomy

	Irradiated	Nonirradiated	p Value
No. pts	47	27	
Stage,* n (%)			0.3
pT0	3 (7)	3 (11)	
pTa	0	2 (8)	
pTis	1 (2)	1 (4)	
pT1	2 (4)	2 (8)	
pT2	10 (21)	6 (23)	
pT3	24 (51)	11 (42)	
pT4	7 (15)	1 (4)	
Trigone location, [†] n/N (%)	10/37 (27)	0/22	0.007
TCC prostatic involvement, [‡] n/N (%)	13/36 (36)	0/15	0.007
Urinary diversion, [§] n (%)			0.004
Ileal conduit	39 (95)	15 (68)	
Neobladder or continent cutaneous	2 (5)	7 (32)	
Rectal injury, [§] n/N (%)	1/42 (2)	0/23 (0)	0.2

* Data from 73 patients.

[†] Data from 59 patients.

[‡] Data from 51 patients: 11 irradiated patients were excluded and 12 nonirradiated patients with prior radical prostatectomy were excluded.

[§] Aborted radical cystectomy (n=5) and partial cystectomy (n=4) patients not included.

TCC = transitional cell carcinoma.