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ORIGINAL ARTICLE

Survival and peri-operative outcomes among patients with rectal cancer: the role of prior radiotherapy due to prostate cancer

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Abstract

Purpose Patients with rectal cancer (RCa) and prior radiation for prostate cancer (PCa) are clinically complicated and may have worse outcomes than other RCa patients. This study investigates the impact of previous radiation for PCa on survival for patients with RCa.

Method We conducted a population-based study identifying men who underwent surgical treatment of RCa from 2002 to 2010. Patients were classified into three cohorts: no prior PCa, prior PCa treated without radiotherapy, and prior PCa treated with radiotherapy. The primary outcome was overall survival. Secondary outcomes included RCa surgical approach, ICU admission, length of stay, ER visits, and delayed formation of a new stoma.

Results Seven thousand ninety-six men underwent surgery for RCa; 6867 patients had no prior PCa, 58 had prior PCa treated without radiotherapy, and 171 had prior PCa treated with radiotherapy. The 5-year overall survival was 62% (95% CI 61–64%) for patients without prior PCa, 46% (95% CI 25–65%) for patients with prior PCa treated without radiotherapy, and 42% (95% CI 29–54%) for patients with prior PCa treated with radiotherapy ($p < 0.0001$). In multivariable analysis, patients with prior PCa treated with radiotherapy were at increased risk of death (aHR 1.38, 95% CI 1.12–1.69) compared to those without prior PCa. Furthermore, patients with prior PCa treated with radiotherapy had a significantly increased risk of resection with permanent stoma.

Conclusions Prior radiotherapy for PCa is a poor prognostic factor in RCa patients with significantly increased risk of death. Additionally, patients with prior radiotherapy for PCa are more likely to require a permanent stoma.

Keywords Colorectal neoplasia · Radiation · Survival · Outcomes · Colorectal surgery · Prostate cancer · Radiotherapy for prostate cancer

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Introduction

Patients with rectal cancer and a prior history of prostate cancer pose a unique clinical challenge. Often, radiation, in the form of brachytherapy or external beam radiation, is part of the prostate cancer treatment. The risk of secondary malignancy varies according to radiation modality, with EBRT consistently associated with an increased risk [1–3]. In particular, several studies have shown an increased risk of rectal cancer after radiation for prostate cancer [3–5]. There is minimal literature on the outcomes for patients who are treated for rectal cancer after previous treatment with radiation to the prostate [4, 6].

Neoadjuvant chemoradiation in rectal cancer has been shown to decrease the risk of local recurrence [7, 8]. Previous pelvic irradiation poses significant challenges when planning treatment for rectal cancer. First, depending on the

timing and dose of the patients' radiation treatment, the patient may not be a candidate for further pelvic radiation [9]. Second, surgical planes may be scarred from previous radiation, making it difficult to determine the extent of resection required to ensure clear margins. In a small series, patients with previous pelvic radiation for prostate or endometrial cancer had significantly higher rates of a positive circumferential resection margin following resection of rectal cancer [10]. Pelvic exenteration provides a more extensive resection which may increase the probability of achieving negative margins, but with significant added morbidity [11]. It is unknown whether rectal cancer patients with a history radiation therapy for prostate cancer have worse outcomes than those patients who have not been previously treated with radiation for prostate cancer.

Thus, given the limited available evidence, the objective of this study was to compare the 5-year survival and surgical morbidity for (1) patients with rectal cancer and a past history of radiation for prostate cancer to (2) those with prostate cancer who had not been radiated and (3) those without a history of prostate cancer.

Methods

Study design

We conducted a population-based, comparative retrospective cohort study using data linked at the Institute for Clinical Evaluative Sciences (ICES) in Toronto, Canada. The Research Ethics Board of Sunnybrook Health Sciences Center, Toronto, Canada, approved the study. This research was conducted and reported according to the RECORD statement [12].

Study population

In Ontario, medical care is reimbursed by a single, government-operated health insurance system (Ontario Health Insurance Plan). The OHIP database tracks claims paid for physician billings, laboratories, and out-of-province providers [13]. In addition, we made use a number of other validated databases including the Canadian Institute for Health Information (CIHI) Discharge Abstract Database (DAD) which contains records for hospitalizations [14]; the CIHI National Ambulatory Care Reporting System which contains records for ambulatory and emergency room visits; the Ontario Cancer Registry (OCR) which is estimated to capture more than 95% of all cancers diagnosed in Ontario [15]; and the Registered Persons Database for demographic and vital status information [16].

Using the OCR, we identified men diagnosed with rectal cancer (International Classification of Disease 10th edition C20) between January 1, 2002 and December 31, 2010. We then limited our study population to those who underwent surgical resection of their disease within 12 months of diagnosis using rectal surgery procedural codes from the Cancer Surgery in Ontario Technical Appendix [17]. We excluded patients with invalid identification numbers, those coded as female, and those under the age of 18 at the time of rectal cancer surgery. Patients were followed from the date of rectal cancer surgery until death, emigration or the end of follow-up.

Exposure definitions

Using the OCR, we identified those patients who had a diagnosis of prostate cancer (International Classification of Disease 10th edition C61) a minimum of 12 months prior to their rectal cancer diagnosis. A 12-month period was selected in order to avoid identification of patients with concomitant diagnoses. We then identified those patients who received radiotherapy in the treatment of prostate cancer (whether brachytherapy or external beam radiotherapy) using OHIP physician billings, the DAD, and the National Ambulatory Care Reporting System. Based on these two exposures, we defined three cohorts: (1) patients without a prior history of prostate cancer, (2) patients with a prior history of prostate cancer treated without radiotherapy, and (3) patients with a prior history of prostate cancer treated with radiotherapy. Patients in the second group may have been treated with surgery or with a watchful waiting approach.

Outcome assessment

Our primary outcome was overall survival, as determined from the Registered Persons Database. We considered several secondary outcomes which captured the intra-operative and post-operative course: type of rectal cancer resection performed, need for multi-visceral resection, admission to ICU, hospital length of stay, number of emergency room visits, and the need for delayed formation of a new bowel stoma (greater than 6 months following rectal cancer resection). The type of rectal cancer resection performed was ascertained from the DAD and classified as resection with permanent stoma; resection with potentially reversible stoma; resection without stoma; and other rectal cancer procedure in keeping with the methods of the Cancer Surgery in Ontario Technical Appendix [17]. We subsequently classified these procedures as those with a permanent stoma or no permanent stoma. The need for multi-visceral resection was ascertained by identifying patients undergoing exenteration, bladder resection, prostate or seminal vesicle resection, ureteric resection, removal of the coccyx, resection, or repair of major pelvic or abdominal vessels using the DAD. We used the Special Care Unit (SCU) coding in DAD to identify patients who required intensive care unit (ICU) admission following surgery. Using DAD, we calculated the hospital length of stay following rectal

cancer surgery. We used the National Ambulatory Care Reporting System to identify the number of emergency room visits following rectal cancer surgery. Finally, we used the DAD to identify patients who underwent the formation of a new stoma more than 6 months following rectal cancer resection. A complete list of the procedural codes used to identify the secondary outcomes is provided in Supplementary Table 1.

Statistical analyses

We used the Kaplan-Meier method and multivariable Cox proportional hazards models to examine the association between prostate cancer history and radiotherapy treatment (three exposure cohorts) and overall mortality and calculate adjusted hazard ratios (aHR) and 95% confidence intervals (95% CI). Patients were followed from the date of rectal cancer surgery until death, emigration or the end of follow-up. We used a multivariable multinomial logistic regression model to examine the association between the exposure status and type of rectal cancer resection; multivariable logistic regression models to examine the association between exposure status and need for permanent stoma, multivisceral resection, ICU admission and delayed formation of a new stoma; and multivariable negative binomial regression models to examine the association between exposure status and hospital length of stay and emergency room visits. Each model was adjusted for the effect of patient age, comorbidity, income quintile, geographic region of residence, type of hospital where the rectal cancer resection was performed (academic vs. community hospital), volume of rectal cancer resections at the hospital of rectal cancer resection (operationalized in quartiles), history of radical prostatectomy (prior to rectal cancer diagnosis), and administration of neoadjuvant radiotherapy for rectal cancer (administered between date of rectal cancer diagnosis and rectal cancer surgery).

Statistical significance was set at $p < 0.05$ based on a two-tailed comparison. Statistical analyses were performed using SAS 9.3 (SAS Institute Inc., Cary, NC, USA).

Results

We identified 7096 eligible men who underwent surgical resection for rectal cancer in Ontario between January 1, 2002 and December 31, 2010, and were eligible for inclusion. Of these, 6867 (96.8%) patients had no prior history of prostate cancer, 58 (0.8%) had a history of prostate cancer treated without radiotherapy, and 171 (2.4%) had a history of prostate cancer treated with radiotherapy. Patients without a prior history of prostate cancer were significantly younger and had lower levels of comorbidity than those with a history of prostate cancer, whether treated with or without radiotherapy (Table 1). Radiotherapy prior to surgical resection was administered more commonly in the course of rectal cancer treatment for patients without a prior history of prostate cancer (Table 1). Patients without a prior history of prostate cancer were also more likely to be treated at a community hospital (Table 1).

The 5-year overall survival was 62% (95% CI 61–64%) for patients without a prior history of prostate cancer, 46% (95% CI 25–65%) for patients with a history of prostate cancer treated without radiotherapy, and 42% (95% CI 29–54%) for patients with a history of prostate cancer treated with radiotherapy (log-rank $p < 0.0001$; Fig. 1). In multivariable models adjusting for the effect of age at rectal cancer surgery, comorbidity, region of residence, hospital volume of rectal cancer surgery, hospital academic status, history of radical prostatectomy, and receipt of neoadjuvant radiotherapy, patients with a history of prostate cancer had an increased risk of death, though this was significant only for those treated with radiotherapy (aHR 1.42, 95% CI 1.15–1.74). Increasing age ($p < 0.0001$) was associated with an increased risk of mortality while receipt of neoadjuvant radiotherapy for rectal cancer was associated with a decreased risk (aHR 0.76, 95% CI 0.70–0.82). No association was identified for region of residence ($p = 0.14$), history of radical prostatectomy ($p = 0.06$), hospital volume ($p = 0.26$), or hospital type ($p = 0.53$) (Table 3).

A greater proportion of patients with a history of prostate cancer, whether treated with or without radiotherapy, underwent resection with a permanent stoma, compared with those patients without a history of prostate cancer (Table 2). Median hospital length of stay was 8 days (IQR 6–13 days) for patients with no prior history of prostate cancer, 10.5 days (IQR 8–15 days) for patients with a history of prostate cancer treated without radiotherapy, and 9 days (7–16 days) for patients with a history of prostate cancer treated with radiotherapy (Table 2).

The results of a multivariable multinomial model assessing the association between exposure status and rectal cancer surgical resection approach are presented in Table 3. After adjusting for the effect of age at rectal cancer surgery, comorbidity, region of residence, hospital volume of rectal cancer surgery, hospital academic status, history of radical prostatectomy, and receipt of neoadjuvant radiotherapy, a history of prostate cancer treated with radiotherapy was associated with a significantly increased risk of resection with reversible stoma, resection with permanent stoma, and other rectal cancer procedures (see Supplementary Table 1 for definition), compared to those without a history of prostate cancer (Table 3). Patients with a history of prostate cancer treated without radiotherapy had a significantly increased risk of resection with reversible stoma and resection with permanent stoma, compared to patients without a history of prostate cancer (Table 3).

Table 1 Baseline demographics of men undergoing surgery for rectal cancer in Ontario

	No prior history of prostate cancer	History of prostate cancer treated without radiotherapy	History of prostate cancer treated with radiotherapy	*p* value
Sample size (*n*)	6867	58	171	
Age				< 0.001
Median (IQR)	66 (57–74)	76 (71–81)	74 (70–79)	
Age distribution (n, %)				< 0.001
18–49 years	624 (9)	0	0	
50–59 years	1450 (21)	< 5*	9 (5)	
60–69 years	2089 (30)	5–10*	26 (15)	
70–79 years	1918 (28)	20 (50)	97 (57)	
80 years and older	786 (11)	20 (35)	39 (23)	
Comorbidity (*n*, %)				< 0.001
ADG 0–1	95 (1)	0	0	
ADG 2–3	406 (6)	0	< 5*	
ADG 4–5	1238 [18]	< 5*	10–15*	
ADG 6–9	3431 (50)	32 (55)	99 (58)	
ADG ≥ 10	1697 (25)	20–25*	54 (32)	
Income quintile (*n*, %)				0.67
1—lowest	1231 [18]	16 (28)	27 (16)	
2	1497 (22)	8 (14)	37 (22)	
3	1341 [20]	10 (17)	34 (20)	
4	1359 [20]	11 (19)	40 (23)	
5	1412 (21)	13 (22)	33 (19)	
Missing	27 (0)	0	0	
Radiotherapy for rectal cancer (*n*, %)	2554 (37)	16 (28)	28 (16)	< 0.001
History of radical prostatectomy (*n*, %)	0	19 (33)	46 (27)	< 0.001
Hospital type (*n*, %)				0.01
Academic hospital	2541 (37)	25 (43)	85 (50)	
Community hospital	4285 (62)	33 (57)	86 (50)	
Missing/unknown	41 (1)	0	0	
Hospital volume (*n*, %)				0.37
Quartile 1—lowest	1730 (25)	10 (17)	39 (23)	
Quartile 2	1723 (25)	15 (26)	32 (19)	
Quartile 3	1711 (25)	19 (33)	50 (29)	
Quartile 4—highest	1696–1703 (25)	14 (24)	50 (29)	
Missing	< 5*	0	0	

*In keeping with ICES privacy regulations, cells which are smaller than 5 (and any cell which would allow the derivation of a cell < 5) must be suppressed

In multivariable models adjusting for the effect of age at rectal cancer surgery, comorbidity, region of residence, hospital volume of rectal cancer surgery, hospital academic status, history of radical prostatectomy, and receipt of neoadjuvant radiotherapy, a prior history of prostate cancer treated with radiotherapy was associated with an increased risk of permanent stoma, but no other secondary outcome (Table 4). A history of prostate cancer treated without radiotherapy was not significantly associated with any secondary outcome (Table 4).

Discussion

Among a large population-based cohort of patients undergoing surgery for rectal cancer, patients with a history of radiotherapy for prostate cancer had a significantly decreased overall survival compared to patients with no prior history of prostate cancer. Patients with a prior history of prostate cancer treated without radiotherapy also had decreased survival, though this was not statistically significant. On multivariable analysis,

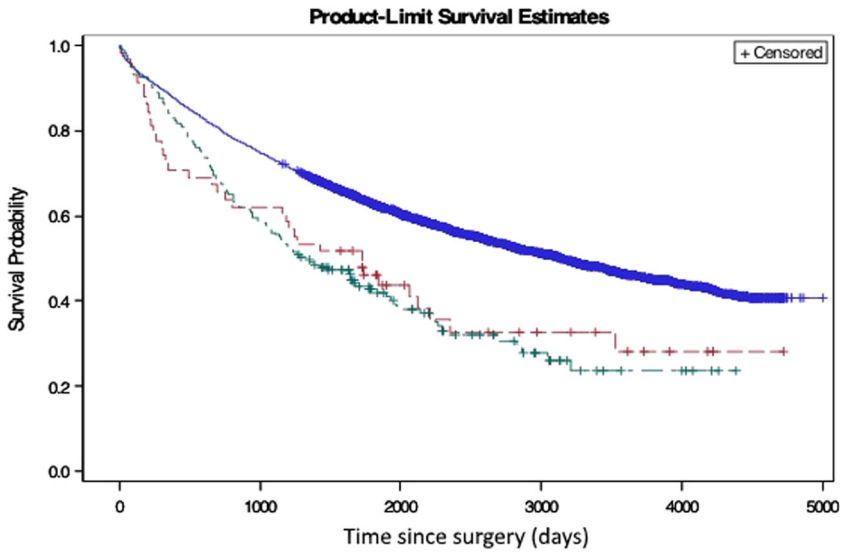

Fig. 1 Kaplan-Meier survival analysis, among patients without a history of prostate cancer (blue), patients with prostate cancer treated without radiotherapy (red), and patients with prostate cancer treated with radiotherapy (green)

increasing age was associated with an increased risk of mortality while receipt of neoadjuvant radiotherapy for rectal cancer was protective. No association was identified for region of residence, history of radical prostatectomy, hospital volume, or hospital type. Further, while this may reflect a selection bias, patients with a history of radiotherapy for prostate cancer had comparable rates of adverse intra-operative and post-operative outcomes, save for an increased rate of resection with permanent stoma formation.

Our results are consistent with outcomes for other pelvic malignancies arising in a previously irradiated pelvis. Bostrom et al. report on 34 patients who had radical cystectomy for bladder cancer after radiotherapy for prostate cancer [18]. Those patients had significantly poorer overall and bladder cancer specific survival compared to a matched control group. Pothuri et al. report on the clinical pathological characteristics of 23 patients who developed endometrial cancer post radiation for cervical cancer [19]. Their cohort had significantly higher grade and higher stage tumors when compared to sporadic cases. There has been very little previous work examining the effect of prostatic irradiation on rectal surgery outcomes. Cho et al. reported a series of 8 patients who developed rectal or sigmoid cancer after radiation for prostate cancer [6]. In their small series,

Table 2 Crude counts of secondary outcomes

	No prior history of prostate cancer	History of prostate cancer treated without radiotherapy	History of prostate cancer treated with radiotherapy
Resection type (*n*, %)			
Resection with permanent stoma	1686 (24.6)	20 (34.5)	61 (35.7)
Resection with reversible stoma	1065 (15.5)	13 (22.4)	33 (19.3)
Resection without stoma	3011 (43.9)	17 (29.3)	48 (28.1)
Other procedure	1105 (16.1)	8 (13.8)	29 (17.0)
Permanent stoma (*n*, %)	1686 (24.6)	20 (34.5)	61 (35.7)
Multivisceral resection (*n*, %)	671 (9.8)	7 (12.1)	23 (13.5)
Delayed formation of new stoma (*n*, %)	277 (4.0)	4 (6.9)	5 (2.9)
ICU admission (*n*, %)	1759 (25.6)	19 (32.8)	45 (26.3)
Hospital length of stay			
Median (IQR)	8 (6–13)	10.5 (8–15)	9 (7–16)
Mean (SD)	11.6 (13.3)	13.4 (12.0)	13.4 (13.0)
Number of emergency room visits			
Median (IQR)	3 (1–7)	3 (1–8)	4 (2–7)
Mean (SD)	5.3 (6.8)	5.9 (6.8)	5.4 (6.6)

Table 3 Multivariable models examining key endpoints: Cox proportional hazards models for overall survival and multinomial logistic regression model for rectal cancer surgical resection approach

	Overall survival (HR, 95% CI)	Surgical approach compared to resection without stoma		
		Resection with reversible stoma (OR, 95% CI)	Resection with permanent stoma (OR, 95% CI)	*Other rectal cancer procedure (OR, 95% CI)
Primary exposure				
No history of prostate cancer	Referent	Referent	Referent	Referent
Prostate cancer without RT	1.37 (0.97–1.93)	3.24 (1.44–7.28)	2.82 (1.35–5.87)	1.69 (0.67–4.22)
Prostate cancer with RT	1.42 (1.15–1.74)	3.06 (1.81–5.16)	3.27 (2.05–5.22)	2.15 (1.23–3.74)
RT for rectal cancer	0.76 (0.70–0.82)	1.86 (1.60–2.17)	2.78 (2.44–3.16)	0.53 (0.45–0.63)
RP prior to rectal cancer	0.68 (0.46–1.01)	0.25 (0.10–0.64)	0.45 (0.22–0.93)	0.45 (0.18–1.11)
Age				
18–49 years	Referent	Referent	Referent	Referent
50–59 years	1.04 (0.88–1.22)	0.97 (0.72–1.31)	0.94 (0.74–1.20)	0.86 (0.66–1.12)
60–69 years	1.28 (1.09–1.49)	1.14 (0.86–1.52)	0.95 (0.75–1.20)	0.81 (0.63–1.06)
70–79 years	1.92 (1.64–2.23)	1.25 (0.94–1.66)	1.21 (0.96–1.53)	0.71 (0.54–0.93)
80 years or greater	3.15 (2.67–3.71)	1.99 (1.44–2.75)	1.37 (1.04–1.82)	1.14 (0.84–1.55)
Comorbidity				
ADG 0–3	Referent	Referent	Referent	Referent
ADG 4–5	0.83 (0.71–0.96)	0.66 (0.48–0.90)	1.07 (0.80–1.44)	0.58 (0.44–0.76)
ADG 6–9	0.87 (0.76–1.00)	0.64 (0.48–0.84)	0.94 (0.72–1.23)	0.48 (0.37–0.61)
ADG ≥ 10	0.95 (0.82–1.10)	0.63 (0.47–0.85)	1.07 (0.80–1.43)	0.48 (0.36–0.63)
Hospital type				
Community hospital	Referent	Referent	Referent	Referent
Academic hospital	0.97 (0.87–1.07)	1.00 (0.81–1.23)	0.87 (0.72–1.05)	1.24 (1.00–1.53)
Hospital volume				
Quartile 1	Referent	Referent	Referent	Referent
Quartile 2	1.04 (0.94–1.14)	1.15 (0.94–1.41)	0.93 (0.78–1.10)	1.01 (0.82–1.24)
Quartile 3	1.05 (0.95–1.18)	1.41 (1.14–1.75)	0.86 (0.71–1.04)	1.28 (1.03–1.59)
Quartile 4	0.93 (0.81–1.06)	0.91 (0.69–1.19)	1.08 (0.86–1.36)	0.96 (0.73–1.26)

HR, hazard ratio; *CI*, confidence interval; *OR*, odds ratio; *This category includes more complicated multivisceral resections and vascular interventions

only one patient required abdominoperineal resection but it is not clear how many of the patients truly had rectal cancer. Furthermore, all of these cancers were detected by the radiation oncologist, with a median time of 7 months from radiation treatment to colorectal cancer diagnosis. Some of these patients may have had synchronous cancers with different disease biology than tumors arising in an irradiated pelvis. Sabbagh et al. compared 9 patients with a previously irradiated pelvis for prostate or endometrial cancer to patients who received neoadjuvant chemotherapy for rectal cancer. Those who had previously radiation for pelvic malignancies had higher circumferential resection margin involvement and higher rates of permanent stomas [10]. To our knowledge, this is the first study to use validated databases and present outcomes for a large number of patients undergoing rectal cancer treatment following radiotherapy for prostate cancer.

There are several limitations to this study. First, as this is non-randomized data, there are inherent baseline differences between the patient cohorts. As a result, despite using multivariable models, there is potential for selection bias and residual confounding. However, given the relatively low frequency of secondary rectal cancers

Table 4 Multivariable regression models for each secondary outcome

	No history of prostate cancer	Prostate cancer without radiotherapy	Prostate cancer with radiotherapy
		Adjusted odds ratio (95% CI)*	Adjusted odds ratio (95% CI)*
Permanent stoma	Referent	1.73 (0.95–3.15)	1.97 (1.36–2.85)
Multivisceral resection	Referent	1.43 (0.62–3.31)	1.49 (0.91–2.43)
Delayed formation of a new stoma	Referent	1.43 (0.37–5.56	0.59 (0.19–1.82)
Any ICU admissions	Referent	1.09 (0.59–2.11)	0.85 (0.57–1.28)
Same day as surgery	Referent	1.33 (0.67–2.66)	0.89 (0.54–1.47)
Subsequent day	Referent	0.87 (0.39–1.94)	0.83 (0.50–1.38)
		Adjusted relative rates (95% CI)	Adjusted relative rates (95% CI)
Post-operative length of stay	Referent	0.99 (0.81–1.20)	1.03 (0.92–1.17)
Emergency room visits	Referent	1.01 (0.76–1.36)	0.96 (0.81–1.14)

ICU, intensive care unit; *CI*, confidence interval

*Multivariable model included age, comorbidity, region of residence, history of neoadjuvant radiotherapy for rectal cancer, history of radical prostatectomy prior to rectal cancer diagnosis, hospital volume, and hospital status. Increasing age was associated with increased any ICU admissions ($p < 0.0001$), same day ICU admissions ($p < 0.0001$), subsequent day ICU admissions ($p < 0.0001$), and hospital LOS ($p < 0.0001$). Increasing comorbidity was associated with increased permanent stoma ($p = 0.009$), same day ICU admissions ($p = 0.02$), and number of ER visits ($p = 0.004$). Increasing hospital volume was associated with decreased any ICU admissions ($p < 0.0001$), same day ICU admissions ($p < 0.0001$), and subsequent day ICU admissions ($p < 0.0001$). Increasing hospital volume was associated with increased ER visits ($p < 0.0001$). Academic hospital status was associated with decreased any ICU admissions ($p < 0.0001$), same day ICU admissions ($p = 0.0008$), and multivisceral resection ($p = 0.01$). Academic hospital status was associated with increased hospital LOS ($p = 0.04$). Neoadjuvant RT was associated with increased permanent stoma ($p < 0.0001$), same day ICU admissions ($p = 0.001$). Neoadjuvant RT was associated with decreased subsequent day ICU ($p = 0.003$) and multivisceral resection ($p = 0.03$). History of radical prostatectomy was not associated with any of the outcomes

[3], it is not feasible to examine these outcomes among patients randomized to surgery or radiotherapy for prostate cancer. Second, we did not distinguish between brachytherapy and external beam radiation in the treatment of prostate cancer given the limited number of patients in the radiation group. While the risk of secondary rectal cancers differs between these modalities [3], we were specifically interested in the difficulty of the subsequent resection for rectal. Any modality of prior pelvic radiation may hinder the ability to deliver neoadjuvant chemoradiation for rectal cancer downstaging and result in higher rates of positive circumferential margins [9, 20]. Third, we were unable to ascertain grade or stage information, due to limitations in the available data. Fourth, the available data did not allow for assessment of oncologic outcomes such as margin status, the subsequent development of metastatic disease, or cancer specific survival. Thus, we are unable to assess these important outcomes. Finally, there are some important questions that remain regarding the optimal management of these patients including the role of multivisceral resection and permanent stoma. These data will likely be difficult to acquire from administrative data sources and single-center series will likely prove inadequate. Thus, multi-institutional collaborations may help to inform treatment decisions for these patients.

This study demonstrates that patients with a prior history of radiation for prostate cancer experience significantly worse survival following rectal cancer resection than those without a history of prostate cancer, even after adjusting for a number of important clinical and demographic factors. Moreover, patients with a prior history of radiation for prostate cancer had an increased risk of permanent stoma formation. We believe that, due to their medical and surgical complexity, rectal cancer patients who have had a prior history treatment for prostate cancer pose unique challenges and are likely to benefit from multidisciplinary cancer assessment and treatment at high-volume centers.

Author's contribution Wallis participated in the analysis and interpretation of the data, drafting and revising the article, final approval for the version to be published and accountable for all aspects of the work.

Feinberg participated in the conception of the work, interpretation of the data, drafting and revising the article, final approval for the version to be published and accountable for all aspects of the work.

Nam participated in the interpretation of the data, revising the article, final approval for the version to be published and accountable for all aspects of the work.

Hameed participated in the conception of the work, interpretation of the data, revising the article, final approval for the version to be published and accountable for all aspects of the work.

Compliance with ethical standards

Conflict of interest The authors declare that they have no conflict of interest.

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