



## Anastomotic leakage after anterior resection in patients with rectal cancer previously irradiated for prostate cancer



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### ABSTRACT

**Introduction:** There are little data on the post-operative outcome of anterior resection (AR) for rectal cancer in men who had received radiotherapy for prostate cancer previously. The aim of this study was to assess the rate of anastomotic leakage (AL) after AR in these patients.

**Methods:** All men who underwent bowel resection because of rectal cancer between 2000 and 2016 and had been diagnosed previously with prostate cancer were identified by linking the Swedish Colorectal Cancer Registry with the National Prostate Cancer Register. The medical records of men who underwent AR and had previously received radiotherapy for prostate cancer were reviewed.

**Results:** In total, 13299 men had undergone a bowel resection for rectal cancer, 188 of whom had previously received radiotherapy for prostate cancer. Among those who had received radiation therapy, 59 men (31%) had an AR: 50 men (85%) received a diverting ileostomy, 42 men (71%) had an American Society of Anesthesiologists score of 1–2 and 36 men (61%) had tumour stage 1–2. AL was found in 12/59 men (20%), one of whom had a re-laparotomy. There was no 90-day mortality.

**Conclusions:** In the combined national population-based registries, a minority of patients with rectal cancer had an AR after previous radiotherapy for prostate cancer. These patients were healthy with early cancer stages and, in this selected group of patients, the AL rate was much lower than that reported previously.

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### Introduction

Rectal cancer and prostate cancer are the two most common types of cancer in men [1]. Curative treatment options for localized prostate cancer include radiotherapy (RT) and radical prostatectomy [2]. In some studies, RT for prostate cancer has been associated with an increased risk of developing rectal cancer [3–8]. If such patients develop rectal cancer later in life, further radiation is not feasible because of the risk of cumulative radiation toxicity. Excellent local control can be achieved by treating patients with rectal cancer pre-operatively with RT followed by total mesorectal excision (TME) [9–13]. However, RT is a risk factor for the development of post-operative surgical complications, such as

anastomotic leakage (AL), pelvic abscesses and deep perineal wound infections [14–16]. Increased surgical complications after surgery for rectal cancer in patients who were previously treated with high-dose RT for prostate cancer has been reported in two small cohort studies that included 20 patients in total [17,18]. The selection of a proper treatment strategy for this patient cohort is a clinical challenge and requires thorough consideration. Access to two nationwide registries, the Swedish Colorectal Cancer Registry (SCRCR) [19] and the National Prostate Cancer Register (NPCR) [20], allowed us to address the treatment strategies in these patients. The aim of this study was to assess the AL rate after anterior resection (AR) in patients with rectal cancer who had previously received RT for prostate cancer.

### Materials and methods

All hospitals in Sweden (approximately 10 million inhabitants)

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treating patients with colorectal cancer and prostate cancer report clinical, surgical, pathological and follow-up data to the SCRCR and NPCR, respectively. In 2010, the NPCR was linked to a number of other population-based registries in Sweden, which resulted in the creation of the Prostate Cancer Database Sweden (PCBaSe) [20]. All men included in the SCRCR who had undergone bowel resection because of rectal cancer between 2000 and 2016 and were treated with RT for prostate cancer before the diagnosis of rectal cancer were identified in the PCBaSe. The men included in this study consisted of two groups: men who underwent bowel resection for rectal cancer and had previously received RT for prostate cancer (RT-prost) and patients who underwent bowel resection for rectal cancer after pre-operative RT with or without a previous diagnosis of prostate cancer without receiving RT for prostate cancer (RT-rect).

### Definitions

Rectal cancer was defined in the SCRCR as an adenocarcinoma of the rectum located within 15 cm from the anal verge. Prostate cancer was defined as a malignant tumour of the prostate. The most common pre-operative RT regime for rectal cancer during the study period was short-course RT (5 Gy five times over 1 week), followed by immediate surgery. If a concomitant chemotherapy (CRT) regime was needed, a long course of RT (1.8–2 Gy for 25–28 days over 6–8 weeks) was delivered with chemotherapy. The most common curative RT regime for prostate cancer was external brachytherapy with a total dose of 78–80 Gy using 2 Gy/fraction.

To assess the level of transection of the rectum and the anastomoses, we looked at the height of the tumour from the anus. In patients requiring AR with a partial mesorectal excision (PME), transection 5 cm distal to the tumour is recommended according to the Swedish national guidelines. If the tumour was located 10 cm or less from the anus, we classified the operation as a low AR with TME, which is defined as a transection of the rectum below the peritoneal reflection, just above the levator ani.

To ensure that all anastomotic complications were recorded in patients with rectal cancer undergoing an anterior resection who

had previously received RT for prostate cancer, their medical records were reviewed and the presence of AL up to 90 days after the operation was graded according to the International Study Group of Rectal Cancer (ISGRC). The ISGRC defines an AL as a defect of the intestinal wall at the anastomotic site leading to a communication between the intra- and extra-luminal compartments. Grade A AL requires no active therapeutic intervention; grade B requires active therapeutic intervention, but is manageable without re-laparotomy; and grade C requires re-laparotomy [21]. The overall post-operative complications were graded according to the Clavien–Dindo classification [22].

### Statistical analysis

Descriptive statistics were summarized according to the status of exposure to radiotherapy for prostate cancer. The distribution of the baseline characteristics of primary interest was compared between groups using the chi-squared test for categorical variables and the Mann–Whitney *U* test for continuous ones. Differences in the absolute risk of any complication after surgery were evaluated between groups according to type of surgery and, as a whole, using Fischer's exact test. Logistic regression models were employed to evaluate the effects of age, ASA score, rectal cancer stage, the level of rectal tumour, diverting stoma and previous radical prostatectomy on the crude and adjusted risk of AL, by inspecting odds ratios (ORs) and confidence intervals (CIs) in patients who underwent AR. A two-sided significance level of 5% was set for all hypothesis tests and the null hypothesis was always one of equal distribution. R version 3.4.4 was used for all statistical analyses.

### Results

In total, 13299 men were operated for rectal cancer. A previous diagnosis of prostate cancer was found in 1122 men, among whom 188 (17%) had received RT for prostate cancer (RT-prost). A total of 8678 men did not receive RT for prostate cancer but received RT for rectal cancer (RT-rect) (Fig. 1). AR was performed in 63/188 (34%) patients in the RT-prost group (Table 1). The majority (66%) of men

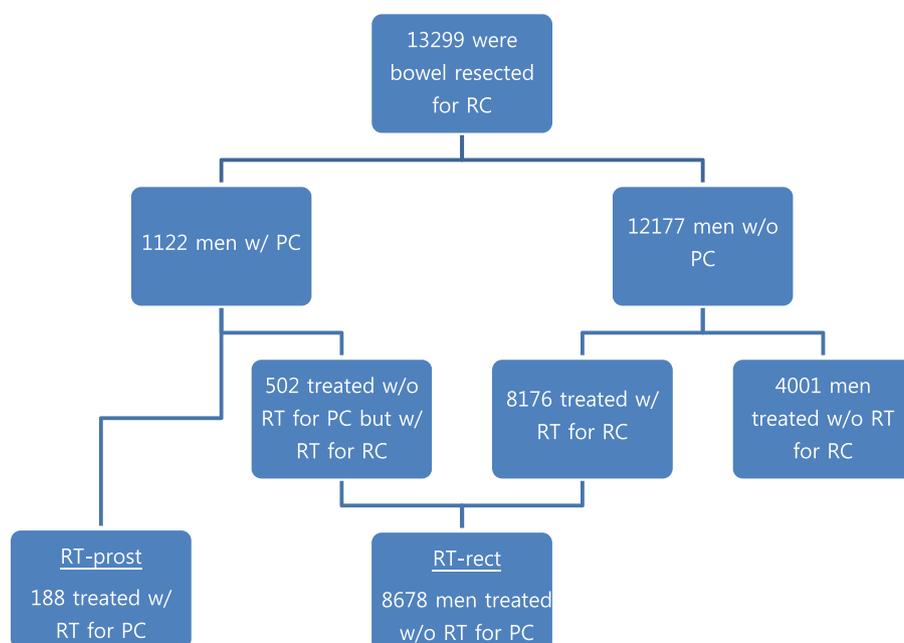


Fig. 1. Study flow chart. RC, rectal cancer; PC, prostate cancer; RT, radiotherapy; w/, with; w/o, without.

who had previously received radiotherapy for prostate cancer had non-restorative surgery. The distance from the tumour to the anal verge was above 5 cm in 53% of patients in the RT-prost group. The overall complication rate in AR patients was 46% in the RT-prost group vs 43% in the RT-rect group. The surgical complication rate was 22% and 27%, respectively. After AR, AL occurred in 6/63 men (10%) in the RT-prost group and in 589/4052 men (15%) in RT-rect group (Table 2). In the RT-prost group, 7/188 patients (4%) had previously undergone prostatectomy and the RT was administered post-operatively because of prostate cancer recurrence.

Patients treated with RT for prostate cancer did not have a higher risk for AL compared with those operated with AR without RT for prostate cancer, after adjustment for different confounders in a logistic regression model (OR, 1.57; 95% CI, 0.67–3.70) (Appendix 1).

#### Review of patient records

The medical records of all 63 patients operated with AR who had previously received RT for prostate cancer were reviewed. Four patients were excluded because of inaccurate registration as having undergone AR (Hartmann's or abdominoperineal excision were performed). Moreover, 26/59 patients had a PME and 33/59 patients had a TME in this group. A diverting stoma was constructed in 50 patients (85%). A total of 12 patients (20%) had an AL, among whom one patient needed a re-laparotomy (Grade C) and five patients needed other surgical interventions with or without general anaesthesia (Grade B). Two patients with an AL did not have a diverting stoma; one of them needed a re-laparotomy. Of the 12 patients that had AL, one patient had received pre-operative chemotherapy, and none had received additional pre-operative RT for rectal cancer. In eight patients (14%), the complications were graded as Clavien–Dindo  $\geq 3b$  (two wound ruptures, one wound infection, one explorative laparotomy where the anastomosis was intact, one stoma complication and three AL); in three of these patients, the complication was managed without a re-laparotomy (Table 3).

Stage IV rectal cancer was a risk factor (OR, 8.7; 95% CI, 1.04–73.38) for developing AL in patients who had undergone AR after being treated previously with RT for prostate cancer (Appendix 2).

#### Discussion

In this population-based study that used data from two national registries, 188 patients with rectal cancer who had previously received RT for prostate cancer were scrutinized. The majority of these patients had non-restorative surgery, most probably because of the awareness of an increased risk of anastomotic complications. The AL rate after AR in a selected group was 10%, and additional review of patient records and grading of the leakage according to ISGRC revealed that the leakage rate increased but was still much lower than that reported previously. The majority of these previously irradiated patients who underwent AR were healthy and had a diverting stoma and early tumour stages, which are factors that probably explain the low re-laparotomy rate and the absence of 90-day mortality.

A symptomatic AL after anterior resection for rectal cancer has been reported to occur in up to 24% in prospective trials [23,24]; however, to our knowledge, only two small cohort studies have addressed the issue of post-operative AL in male patients with rectal cancer who had been previously treated with RT for prostate cancer. Guandalino et al. reported a leakage rate of 62.5% in eight patients who had previously received curative RT for prostate cancer [17], while Buscail et al. reported a leakage rate of 50% in 12

patients who had previously received RT for metachronous or synchronous prostate cancer [18].

We report a leakage rate of 20%, which is considerably lower than those values and closer to previously published data on leakage rates [23–26]. The patients who underwent AR in the RT-prost group were a highly selective cohort in which the great majority of individuals had a less-advanced tumour stage, lower ASA

**Table 1**

Clinical characteristics of all patients with rectal cancer treated with a bowel resection in Sweden between 2000 and 2016.

|  | RT-prost (%) | RT-rect (%) |
|--|--------------|-------------|
| <b>Men</b>   | 188 (100)    | 8678 (100)  |
| <b>Age (years)</b>   |              |             |
| Median (IQR)   | 72 (68–76)   | 67 (60–74)  |
| <70  | 58 (31)      | 5044 (58)   |
| 70–74  | 63 (34)      | 1623 (19)   |
| $\geq 75$  | 67 (36)      | 2010 (23)   |
| Missing data   | 0 (0)        | 1 (0)       |
| <b>ASA</b>   |              |             |
| 1–2  | 111 (59)     | 4239 (49)   |
| 3–4  | 52 (28)      | 1210 (14)   |
| Missing data   | 25 (13)      | 3229 (37)   |
| <b>Prostate cancer stage</b>   |              |             |
| No PC  | 0 (0)        | 8176 (94)   |
| Low-risk PC  | 43 (23)      | 105 (1)     |
| Intermediate-risk PC   | 72 (38)      | 132 (2)     |
| High-risk PC   | 49 (26)      | 110 (1)     |
| Metastatic PC  | 10 (5)       | 101 (1)     |
| Missing risk category  | 14 (7)       | 54 (1)      |
| <b>Rectal cancer stage</b>   |              |             |
| Stage I–II   | 113 (60)     | 4466 (51)   |
| Stage III  | 51 (27)      | 3011 (35)   |
| Stage IV   | 22 (12)      | 930 (11)    |
| Missing data   | 2 (1)        | 271 (3)     |
| <b>Mean (SD) delay between RT for prostate cancer and rectal cancer surgery (months)</b> | 72.6 (47.9)  |             |
| <b>Level of rectal tumour</b>  |              |             |
| Median (IQR)   | 7 (4–11)     | 7 (4–10)    |
| 0–5  | 82 (44)      | 3661 (42)   |
| 6–10   | 58 (31)      | 3476 (40)   |
| 11–15  | 42 (22)      | 1325 (15)   |
| >15  | 0 (0)        | 0 (0)       |
| Missing data   | 6 (3)        | 216 (2)     |
| <b>Pre-operative RT</b>  |              |             |
| No   | 176 (94)     | 1845 (21)   |
| Yes  | 12 (6)       | 6833 (79)   |
| <b>Pre-operative CRT</b>   |              |             |
| No   | 183 (97)     | 6833 (79)   |
| Yes  | 5 (3)        | 1845 (21)   |
| <b>Pre-operative chemotherapy</b>  |              |             |
| No   | 177 (94)     | 8678 (100)  |
| Yes  | 11 (6)       | 0 (0)       |
| <b>Type of operation</b>   |              |             |
| AR   | 63 (34)      | 4052 (47)   |
| Diverting stoma  | 48           | 3068        |
| APE  | 98 (52)      | 3779 (44)   |
| HP   | 27 (14)      | 847 (10)    |
| <b>Laparoscopic surgery</b>  |              |             |
| No   | 164 (87)     | 6792 (78)   |
| Yes  | 17 (9)       | 859 (10)    |
| Missing data   | 7 (4)        | 1027 (12)   |
| <b>Local radical resection</b>   |              |             |
| No <sup>a</sup>  | 13 (7)       | 575 (7)     |
| Yes  | 175 (93)     | 8074 (93)   |
| Missing data   | 0 (0)        | 29 (0)      |
| <b>Previous prostatectomy</b>  |              |             |
| No   | 181 (96)     | 8645 (100)  |
| Yes  | 7 (4)        | 33 (0)      |

RT, radiotherapy; PC, prostate cancer; IQR, interquartile range; ASA, American Society of Anesthesiologists; SD, standard deviation; CRT, chemoradiotherapy; AR, anterior resection; APE, abdominoperineal excision; HP, Hartmann's procedure.

<sup>a</sup> Includes "Uncertain" and "Indeterminable".

**Table 2**  
Post-operative complications in patients who underwent bowel resection for rectal cancer in Sweden between 2000 and 2016 (before the review of medical records).

|  | AR           |             | APE          |             | HP           |             |
|--|--------------|-------------|--------------|-------------|--------------|-------------|
|  | RT-prost (%) | RT-rect (%) | RT-prost (%) | RT-rect (%) | RT-prost (%) | RT-rect (%) |
| Men  | 63 (100)     | 4052 (100)  | 98 (100)     | 3779 (100)  | 27 (100)     | 847 (100)   |
| Any complication                                 | 29 (46)      | 1737 (43)   | 49 (50)      | 1761 (47)   | 9 (33)       | 391 (46)    |
| Surgical complication                            | 14 (22)      | 1087 (27)   | 17 (17)      | 1146 (30)   | 6 (22)       | 224 (26)    |
| Intra-abdominal infection or anastomotic leakage | 6 (10)       | 589 (15)    | 4 (4)        | 185 (5)     | 0 (0)        | 71 (8)      |
| Re-laparotomy                                    | 9 (14)       | 486 (12)    | 11 (11)      | 391 (10)    | 2 (7)        | 99 (12)     |
| Mortality within 30 days                         | 0 (0)        | 46 (1)      | 2 (2)        | 48 (1)      | 1 (4)        | 20 (2)      |
| Mortality within 90 days                         | 0 (0)        | 84 (2)      | 5 (5)        | 86 (2)      | 1 (4)        | 43 (5)      |

AR, anterior resection; APE, abdominoperineal excision; HP, Hartmann's procedure; RT, radiotherapy.

The *P*-value for unequal distribution of "Any complication" among patients with and without RT for PC was not significant for any type of surgery.

scores and a diverting loop ileostomy. Furthermore, even though the distance from the tumour to the anal verge was >5 cm in 53% of the patients in the RT-prost group, only 34% of them had an AR with a large proportion of PME. This probably indicates the surgeon's awareness of the possible risk of AL in a previously irradiated pelvis.

The chronic radiation toxicity, which usually presents a few months or even years after the irradiation, affects not only the parenchymal cells in the rectum, but also the vascular endothelial cells, mainly small blood vessels and arterioles, and even fibroblasts, leading to the formation of thrombi, the occlusion of arterioles and fibrosis in the rectum [27]. These events potentially affect the healing of a future colorectal anastomosis. External-beam radiation causes more damaging effects on its surrounding tissue than brachytherapy. Data from the NPCR show that only 4% of the irradiated patients with prostate cancer received brachytherapy alone, while 96% of the patients with prostate cancer received external-beam RT, either alone or in combination with brachytherapy [28], possibly explaining some of the leaks reported.

In our study, the median distance from the tumour to the anal verge was 7 cm, and the mean delay from radiation therapy to surgery with AR was 73 months in the RT-prost group; however, these patients did not have a more advanced stage than did those in the RT-rect group.

We did not find any increase in AL among patients with stage IV rectal cancer treated with RT and operated with AR, even though some retrospective data in the literature suggest such an increase [29]. However, there was an increased risk for AL (OR, 8.72) in patients with stage IV rectal cancer who had been previously treated with RT for prostate cancer, even though this is probably a highly selective group of patients.

This was the largest study to date on this subject, as it included 188 patients with bowel resected rectal cancer who were previously irradiated for prostate cancer; among them, 59 patients were resected and reconstructed with an anastomosis. The two registries, the SCRCR and NPCR, from which we collected the data, have been validated, have almost complete coverage and collect data

**Table 3**  
Clinical characteristics and post-operative complications in patients who underwent anterior resection and had previously received radiotherapy for prostate cancer after the review of medical records.

|  | AR          |
|--|-------------|
| <b>Men</b>   | 59 (100)    |
| <b>ASA</b>   |             |
| 1–2  | 42 (71)     |
| 3–4  | 7 (12)      |
| Missing data   | 10 (17)     |
| <b>Rectal cancer stage</b>   |             |
| Stage I–II   | 36 (61)     |
| Stage III  | 14 (24)     |
| Stage IV   | 7 (12)      |
| Missing data   | 2 (3)       |
| <b>Mean (SD) delay between RT for prostate cancer and rectal cancer surgery (months)</b> | 64.4 (49.1) |
| <b>Level of rectal tumour</b>  |             |
| <5   | 6 (10)      |
| 6–10   | 27 (46)     |
| 11–15  | 26 (44)     |
| Missing data   | 0 (0)       |
| <b>Pre-operative RT</b>  | 3 (5)       |
| <b>Pre-operative CRT</b>   | 3 (5)       |
| <b>Pre-operative chemotherapy</b>  | 2 (3)       |
| <b>Diverting stoma</b>   | 50 (85)     |
| <b>Overall surgical complications</b>  | 24 (41)     |
| Clavien–Dindo ≥3b  | 8           |
| <b>Anastomotic leakage</b>   | 12 (20)     |
| Grade A  | 6           |
| Grade B  | 5           |
| Grade C  | 1           |
| <b>Re-laparotomy</b>   | 5 (8)       |
| <b>Mortality within 30 days</b>  | 0 (0)       |
| <b>Mortality within 90 days</b>  | 0 (0)       |

AR, anterior resection; ASA, American Society of Anesthesiologists; SD, standard deviation; RT, radiotherapy; CRT, chemoradiotherapy.

prospectively.

This study had some limitations because of the inherent weakness of registry-based studies. Despite previous validation, the review of patient records revealed that four patients were registered as having the wrong type of operation. A study of the validity of the SCRCR between 1996 and 2000 performed by Gunnarsson et al. showed that its validity is acceptable regarding severe complications such as AL (25). The review of patient records was performed only for men who were operated with AR in the RT-prost group, and only those with clinically suspected AL based on the reviews were included in the study. The ISGRC definition of AL, including pelvic abscesses, was used during the review of patient records. This definition is not used by the SCRCR; moreover, AL was registered at 90 days, while the SCRCR registers AL at 30 days. This can partly explain the increase in the number of AL cases after the review of patient records, as five of the six cases of AL that were missed in the registry were minor leakages that did not require active therapeutic intervention (Grade A). A recent study performed in Sweden also found a considerable under-reporting of AL in the SCRCR when using the ISGRC classification of AL during journal review [30]. Another limitation of the study was the heterogeneous type of radiation and fractioning used in the treatment of prostate cancer, as 4% of the patients received only brachytherapy, while the majority of patients received external-beam radiotherapy with or without brachytherapy [28].

The important questions that remain include how many of the diverted stomas became permanent and the nature of the functional results after stoma reversal. Unfortunately, we do not have these data. However, based on previous studies, we learned that ~19% of ileostomies performed in Sweden become permanent, often because of advanced age and co-morbidities, severe post-operative complications or advanced cancer disease [31]. In this selected group of patients who underwent AR, the individuals were healthy, had early-stage tumours and a low rate of severe complications, indicating that the majority had their stomas reversed.

The decision to perform an AR in patients who have been irradiated previously for the treatment of prostate cancer is difficult

and a thorough discussion with the patient is warranted, together with a careful selection depending on known risk factors for anastomotic complications. A non-restorative surgery should be recommended to patients with stage IV disease, because of the high risk of AL in these individuals.

## Conclusions

In this nationwide study, we found that the post-operative AL rate in patients operated with AR for rectal cancer after being previously treated with RT for prostate cancer was much lower than that reported previously. The leaks seldom required a re-laparotomy and there was no post-operative mortality. Most of the previously irradiated patients were resected without an anastomosis, and only a selected group of patients had an AR, which indicates that surgeons on a national level were aware of the high risk of anastomotic complications in a previously irradiated pelvis.

## Conflicts of interest

The authors declare that there are no potential conflicts of interest.

## Role of the funding source

The funding source were not involved in this study.

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## Appendix

**Table A1**

Logistic regression of risk factors for intra-abdominal infection or anastomotic leakage in patients who underwent anterior resection between 2000 and 2016.

|                               | At risk | Events | Univariable<br>OR | Multivariable<br>95% CI | OR   | 95% CI      |
|-------------------------------|---------|--------|-------------------|-------------------------|------|-------------|
| <b>Treatment group</b>        |         |        |                   |                         |      |             |
| RT-prost                      | 63      | 6      | 1.00              | (Ref.)                  | 1.00 | (Ref.)      |
| RT-rect*                      | 4052    | 589    | 1.62              | (0.69–3.76)             | 1.57 | (0.67–3.70) |
| <b>1-year increase in age</b> | 4115    | –      | 1.00              | (0.99–1.00)             | 1.00 | 0.99–1.01   |
| <b>ASA</b>                    |         |        |                   |                         |      |             |
| 1–2                           | 2048    | 296    | 1.00              | (Ref.)                  | 1.00 | (Ref.)      |
| 3–4                           | 411     | 63     | 1.07              | (0.80–1.44)             | 1.13 | (0.83–1.53) |
| <b>Defunctioning stoma</b>    |         |        |                   |                         |      |             |
| No                            | 967     | 162    | 1.00              | (Ref.)                  | 1.00 | (Ref.)      |
| Yes                           | 3116    | 431    | 0.80              | (0.65–0.97)             | 0.89 | (0.62–1.28) |
| <b>Rectal cancer stage</b>    |         |        |                   |                         |      |             |
| Stage I–II                    | 2152    | 302    | 1.00              | (Ref.)                  | 1.00 | (Ref.)      |
| Stage III                     | 1509    | 234    | 1.12              | (0.93–1.35)             | 0.94 | (0.74–1.20) |
| Stage IV                      | 349     | 48     | 0.98              | (0.70–1.36)             | 0.85 | (0.56–1.29) |
| <b>Level of rectal tumour</b> |         |        | 0.97              | (0.94–1.00)             | 0.97 | (0.93–1.02) |
| <b>Previous prostatectomy</b> |         |        |                   |                         |      |             |
| No                            | 4094    | 591    | 1.00              | (Ref.)                  | 1.00 | (Ref.)      |
| Yes                           | 21      | 4      | 1.39              | (0.47–4.16)             | 1.55 | (0.51–4.68) |

OR, odds ratio; CI, confidence interval; ASA, American Society of Anesthesiologists.

Note: Only registry data.

\* Had not received RT for PC but have received anterior resection with pre-operative RT or CRT.

**Table A2**

Multivariable logistic regression analysis of risk factors for anastomotic leakage in patients who underwent anterior resection and had previously received radiotherapy for prostate cancer between 2000 and 2016.

|                               | Multivariable |        |      |              |
|-------------------------------|---------------|--------|------|--------------|
|                               | At risk       | Events | OR   | 95% CI       |
| <b>1-year increase in age</b> | 59            | –      | 1.10 | (0.95–1.28)  |
| <b>ASA</b>                    |               |        |      |              |
| 1–2                           | 49            | 12     | 1.00 | (Ref.)       |
| 3–4                           | 10            | 0      | –    | –            |
| <b>Diverting stoma</b>        |               |        |      |              |
| No                            | 9             | 2      | 1.00 | (Ref.)       |
| Yes                           | 50            | 10     | 1.72 | (0.19–15.37) |
| <b>Rectal cancer stage</b>    |               |        |      |              |
| Stage I–II                    | 36            | 5      | 1.00 | (Ref.)       |
| Stage III                     | 14            | 4      | 0.79 | (0.10–6.25)  |
| Stage IV                      | 7             | 3      | 8.72 | (1.04–73.38) |
| <b>Level of rectal tumour</b> |               |        | 1.06 | (0.81–1.39)  |
| <b>Previous prostatectomy</b> |               |        |      |              |
| No                            | 57            | 10     | 1.00 | (Ref.)       |
| Yes                           | 2             | 2      | –    | –            |

OR, odds ratio; CI, confidence interval; ASA, American Society of Anesthesiologists. Note: Registry and chart-review data.

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