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Original Article

Impact of rectal washout on recurrence and survival after anterior resection for rectal cancer

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Abstract

Background: Rectal washout (RW) is routinely performed during anterior resection (AR) for rectal cancer to reduce local recurrence (LR), although is sometimes not performed during minimally invasive surgery (MIS) procedures due to technical challenges and time consumption. The aim was to investigate the impact of RW on the oncological outcome after AR for rectal cancer in a registry cohort.

Methods: Data on patients registered in the Swedish Colorectal Cancer Registry who had undergone elective radical (R0) AR for TNM stage I–III rectal cancer between 2007 and 2017 with a 3-year follow-up were analysed. Multivariable analyses were performed and the primary endpoint was LR at 3 and 5 years after AR. The occurrence of distant metastasis (DM) and overall recurrence (OAR), overall survival, and relative survival were also analysed as a secondary aim. A subgroup analysis was performed for the same outcomes in patients treated with MIS.

Results: Out of 6186 patients (1923 with TNM stage I, 1907 with TNM stage II, and 2356 with TNM stage III), RW was performed in 5706 (92.2 per cent). The median age of the cohort was 67 years. RW did not impact the 3-year risk of LR. LR within 5 years occurred in 104 of 4583 patients (2.3 per cent) in the RW group compared with 16 of 408 patients (3.9 per cent) in the no RW group ($P = 0.037$). In multivariable analysis of the LR risk, the HR was 0.53 (95 per cent c.i. 0.31 to 0.90), favouring RW. There were no differences in rates of DM and OAR, overall survival, and relative survival. A subgroup analysis of the 1410 patients undergoing MIS did not demonstrate any differences between the groups, given, however, the low rate of LR.

Conclusions: RW in AR for rectal cancer does not impact the 3-year oncological outcome; however, after the 5-year follow-up a reduction in LR risk was observed after RW.

Introduction

Implantation of free intraluminal cancer cells is considered to contribute to local recurrence (LR) after anterior resection (AR)[1–3]. Performing an intraoperative rectal washout (RW) can eliminate these cells and is recommended by the Swedish national guidelines to reduce the risk of LR[4–6]. Several studies and meta-analyses have been conducted to evaluate the impact of RW on LR rates with contradictory results, and no randomized clinical trial has been performed on this subject[7–12]; however, the most recent meta-analysis from 2022 recommends RW to be performed[7]. In a cohort including patients with rectal cancer who underwent AR in Sweden between 1995 and 2002[10], patients receiving RW had more favourable LR rates; however, since then, the management and the multidisciplinary treatment of rectal cancer has greatly improved. LR rates have continued to decrease due to the total mesorectal excision (TME) technique, optimized staging, and use of preoperative chemoradiotherapy[13,14]. The use of minimally invasive surgery (MIS) for rectal cancer has also increased significantly and most rectal cancer resections in Sweden (more than 60 per cent) are currently performed using such an approach[15].

A survey conducted in the UK, however, revealed that surgeons performed RW to a lesser extent in laparoscopic resections compared with open resections[16]. Conversely, RW was reported to be performed routinely in both open and MIS AR to a high extent in a recent Swedish investigation[17].

This study aimed to investigate the impact of RW on LR at the 3- and 5-year follow-up after AR in a registry rectal cancer cohort. The occurrence of distant metastasis (DM) and overall recurrence (OAR), overall survival, and relative survival were also analysed and subgroup analysis was performed for the same outcomes in patients treated with MIS.

Methods

This study was approved by the Swedish Ethical Review Authority (2020-02227 and 2021-00753) and complies with the guidelines of the Declaration of Helsinki.

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The Swedish Colorectal Cancer Registry

The study is based on data from the cohort of patients registered in the Swedish Colorectal Cancer Registry (SCRCR) from 2007 through 2017 (Fig. 1). Patients with rectal cancer TNM stage I–III, who had undergone elective R0 AR with available data on the 3-year follow-up and RW were analysed. Patients with recurrence or death within 90 days after surgery were excluded.

The national registration of rectal cancer in Sweden started in 1995. Clinical (age and sex) variables, tumour features (distance from the anal verge), and data on surgical treatment (hospital volume, surgical competence, use of RW, use of MIS, conversion to open surgery, and operating time), clinical, radiological and pathological examination (TNM stage), oncological treatment (neoadjuvant and adjuvant therapy), and short- and long-term follow-up (postoperative complications, recurrence, and death) are registered in the SCRCR and were reviewed for the purpose of this analysis. Data are reported 30 days after surgery or at diagnosis if no surgery was performed. According to the national guidelines of colorectal cancer care recommended during the study interval[5], for the group with low risk of LR (less than 6–8 per cent) based on clinical and radiological examination, no neoadjuvant therapy was recommended. Neoadjuvant radiotherapy (RT) 5×5 Gy was recommended for patients with a LR risk of more than 6–8 per cent with surgery alone. In rectal cancer with a high risk of developing DM or locally advanced rectal cancer, neoadjuvant long-course RT 1.8–2.0×25–28 Gy with concomitant capecitabine was recommended. Patients with rectal cancer TNM stage II with high-risk criteria or TNM

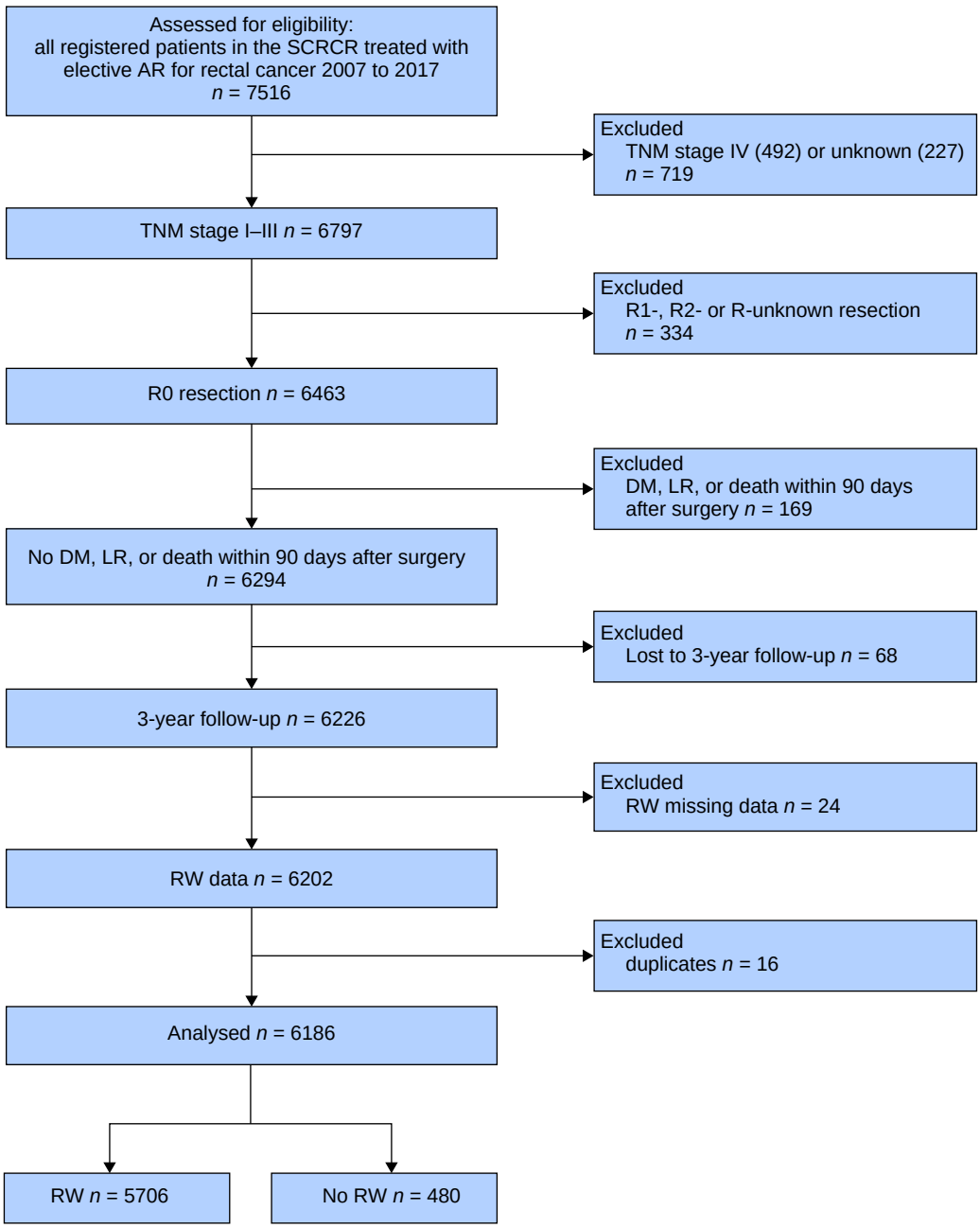

Fig. 1 Study flow chart

AR, anterior resection; DM, distant metastasis; LR, local recurrence; RW, rectal washout; SCRCR, Swedish Colorectal Cancer Registry.

stage III must be assessed for possible adjuvant therapy. For patients with colorectal cancer who underwent radical surgery, follow-up with abdominal and chest CT together with serum carcinoembryonic antigen testing is recommended after 1 and 3 years[5]. Follow-up data were obtained by the SCRCR 3 and 5 years after surgery. Reports from the SCRCR are published annually. The coverage ratio of the SCRCR remains high and was 99.7 per cent in 2020[15]. The most recent evaluation of the SCRCR showed that the registry is of high validity and is a reliable source of information for quality assurance and research[18,19].

Definitions

An adenocarcinoma completely or partly located within 15 cm from the anal verge measured with rigid sigmoidoscopy during withdrawal is registered as rectal cancer in the SCRCR.

AR is the standard procedure for mid- and high-rectal cancers. The TME technique was introduced in Sweden in the early 1990s. TME is performed in tumours located in the mid or lower part of the rectum. Alternatively, in high-situated tumours where a distal margin of 5 cm or more is possible, partial mesorectal excision can be performed.

Intraoperative RW is conducted using transanal irrigation of the rectal stump before resection, with the bowel clamped below the tumour.

Hospital volume refers to the annual number of rectal cancer resections performed and is defined as low (1–10), medium (11–25) ,and high (26 or more) according to definitions of the SCRCR.

A colorectal surgeon is an accredited colorectal surgeon, or a surgeon trained in the TME technique.

R0 is defined as a locally radical procedure with neither macroscopic nor microscopic tumour tissue left behind according to the surgeon and the pathologist.

Outcomes of interest

The primary outcome of interest was LR (defined as the presence of tumour tissue below the level of the promontory related to the primary rectal cancer diagnosed by clinical, radiological, pathological, or endoscopic examination) at the 3- and 5-year follow-up. DM (defined as the presence of tumour tissue in any lymph node or organ located outside the pelvis diagnosed by clinical, radiological, pathological, or endoscopic examination), OAR (defined as isolated LR or DM, or both LR and DM), overall survival, and relative survival (defined as the ratio of the observed survival to the expected survival) were also analysed as secondary aims.

Statistical analysis

IBM SPSS® Statistics for Windows, version 25.0. (IBM, Armonk, NY, USA) and Stata 16.1 (StataCorp, College Station, TX, USA)

Table 1 Patient, tumour, and treatment characteristics of patients treated with elective R0 anterior resection for TNM stage I–III rectal cancer in Sweden, 2007 to 2017

	All patients (*n* = 6186)	RW (*n* = 5706)	No RW (*n* = 480)	*P*
Age at diagnosis (years)*	67 (60–74)	67 (60–74)	68 (60–75)	0.218
Sex ratio (M:F)	3636:2550 (58.8, 41.2)	3358:2348 (58.9, 41.1)	278:202 (57.9, 42.1)	0.690
Tumour height (cm)				
Low 0–5	178 (2.9)	163 (2.9)	15 (3.1)	0.002
Medium 6–10	3072 (49.7)	2874 (50.4)	198 (41.3)	
High 11–15	2901 (46.9)	2643 (46.3)	258 (53.8)	
Missing data	35 (0.6)	26 (0.5)	9 (1.9)	
TNM stage				
I	1923 (31.1)	1753 (30.7)	170 (35.4)	0.020
II	1907 (30.8)	1784 (31.3)	123 (25.6)	
III	2356 (38.1)	2169 (38.0)	187 (39.0)	
Neoadjuvant radiotherapy	3522 (56.9)	3301 (57.9)	221 (46.0)	<0.001
Missing data	3 (0.0)	3 (0.1)	0	
Neoadjuvant chemotherapy	828 (13.4)	781 (13.7)	47 (9.8)	0.016
Missing data	3 (0.0)	3 (0.1)	0	
Hospital volume				
Low (1–10)	203 (3.3)	183 (3.2)	20 (4.2)	<0.001
Medium (11–25)	1008 (16.3)	888 (15.6)	120 (25.0)	
High (26 or higher)	4975 (80.4)	4635 (81.2)	340 (70.8)	
Surgical competence				
Colorectal	6113 (98.8)	5643 (98.9)	470 (97.9)	0.016
General	43 (0.7)	35 (0.6)	8 (1.7)	
Missing data	30 (0.5)	28 (0.5)	2 (0.4)	
Minimally invasive surgery	1410 (22.8)	1263 (22.1)	147 (30.6)	<0.001
Missing data	32 (0.5)	25 (0.4)	7 (1.5)	
Conversion to open surgery	269 (19.1)	241 (19.1)	28 (19.0)	0.989
Missing data	1 (0.1)	1 (0.1)	0	
Operating time (min)*	242 (186–322)	245 (187–323)	215 (170.5–305)	<0.001
Missing data	112 (1.8)	93 (1.6)	19 (4.0)	
Postoperative complication	2269 (36.7)	2086 (36.6)	183 (38.1)	0.494
Surgical complication	1283 (20.7)	1159 (20.3)	124 (25.8)	0.004
Intraoperative perforation	116 (1.9)	101 (1.8)	15 (3.1)	0.034
Missing data	36 (0.6)	31 (0.5)	5 (1.0)	
Adjuvant chemotherapy	1647 (26.6)	1511 (26.4)	136 (28.3)	0.465
Missing data	298 (4.8)	280 (4.9)	18 (3.8)	

Values are *n* (%) unless indicated otherwise. *Values are median (i.q.r.). i.q.r. presented as range (i.q.r.1–i.q.r.3). R0, radical surgery; RW, rectal washout; i.q.r., interquartile range.

were used for data analyses. Categorical data are presented as numbers with percentages. Continuous data are presented as median and range. Groups were compared with the chi-square test, Fisher's exact test, and independent sample *t* test when appropriate. Kaplan–Meier curves with log rank test were performed. The relative survival was calculated by using the Ederer II method for estimating expected survival and population mortality rates were obtain from the Human Mortality Database[20]. Univariable and multivariable Cox regression analysis to evaluate the impact of RW on the risk of recurrence and survival were used. For relative survival, Poisson regression was used[21]. Variables considered as clinically relevant potential confounders as age at diagnosis, sex, TNM stage, tumour height, neoadjuvant RT, neoadjuvant chemotherapy, hospital volume, MIS, intraoperative perforation, postoperative complication, and adjuvant chemotherapy were included in the multivariable analysis. The proportional hazards assumption was not fulfilled, resulting in the HR to be interpreted as an average HR over time. A *P* value of less than 0.05 was considered as statistically significant and all tests were two-sided.

Results

Patient characteristics

All patients who underwent elective surgery with AR for rectal cancer during 2007 through 2017 were collected from the SCRCR. After exclusion, a total of 6186 patients with a follow-up time for at least 3 years or until death were analysed (*Fig. 1*). RW was performed in 5706 of the patients (92.2 per cent).

Patient characteristics, treatment details, and tumour data are presented in *Table 1*. The RW and no RW group differed on several aspects, including tumour height, TNM stage, operating time, and use of neoadjuvant RT and chemotherapy. In the RW group more procedures were performed at high-volume hospitals and the surgical competence was higher. MIS, surgical complications, and intraoperative perforations were more frequent in the no RW group. Among the patients who underwent MIS, 590 (41.8 per cent) had robotic-assisted surgery. RW was more commonly performed in patients in the robotic-assisted group, than in the laparoscopic group (92.5 *versus* 87.4 per cent; $P = 0.002$).

Recurrence data

In total, at the 3-year follow-up, LR was registered in 109 patients (1.8 per cent). In the RW and no RW group, 97 (1.7 per cent) and 12 patients (2.5 per cent) respectively developed LR, with no difference between the groups (*Table 2*). Similarly, the groups did not differ regarding DM and OAR rates within 3 years (*Table 2*).

Multivariable analysis

Univariable and multivariable Cox regression analysis are presented in *Table 3*. RW did not impact the 3-year risk of LR, DM, and OAR, nor did RW effect overall and relative survival. Postoperative complications, surgical complications, surgical competence, and hospital volume were not considered as clinically relevant confounders for developing LR, DM, and OAR, and when included in the multivariable analyses, they did not impact the results and are therefore not presented.

Survival analysis

Kaplan–Meier curves with log rank test of overall and relative survival did not differ between the RW and no RW groups (*Fig. 2*).

Subgroup analysis of minimally invasive surgery

In the subgroup analysis of the 1410 patients who underwent minimally invasive AR, LR was registered in 21 of the 1263 patients (1.7 per cent) in the RW group and in three of the 147 patients (2.0 per cent) in the no RW group ($P = 0.732$). DM and OAR were observed in 154 (12.2 per cent) and 167 patients (13.2 per cent) in the RW group respectively, compared with 15 (10.2 per cent) and 17 patients (11.6 per cent) in the no RW group. No differences were observed in rates of DM ($P = 0.480$) or OAR ($P = 0.570$).

Table 3 Univariable and multivariable Cox regression analysis of impact of rectal washout on 3-year recurrence and survival after elective R0 anterior resection for TNM stage I–III rectal cancer in Sweden, 2007 to 2017

	Univariable analysis		Multivariable analysis	
	HR	P	HR	P
Local recurrence	0.67 (0.37,1.22)	0.190	0.57 (0.31,1.05)	0.073
Distant metastasis	1.03 (0.79,1.33)	0.840	0.99 (0.76,1.29)	0.936
Overall recurrence	0.97 (0.76,1.24)	0.820	0.92 (0.72,1.18)	0.522
Overall survival*	0.94 (0.69,1.28)	0.687	0.93 (0.67,1.28)	0.648
Relative survival*	1.05 (0.37,2.92)	0.932	1.15 (0.52,2.53)	0.734

Values in parentheses are 95 per cent c.i. Data are adjusted for age at diagnosis, sex, TNM stage, tumour height, neoadjuvant radiotherapy, neoadjuvant chemotherapy, minimally invasive surgery, intraoperative perforation, and adjuvant chemotherapy. *Data are adjusted for age at diagnosis, sex, TNM stage, tumour height, neoadjuvant radiotherapy, neoadjuvant chemotherapy, hospital volume, minimally invasive surgery, intraoperative perforation, postoperative complication, and adjuvant chemotherapy. R0, radical surgery. HR, hazard ratio.

Table 2 Three-year recurrence data after elective R0 anterior resection for TNM stage I–III rectal cancer in Sweden, 2007 to 2017

		All patients (*n* = 6186)	RW (*n* = 5706)	No RW (*n* = 480)	P
Local recurrence	No	6068 (98.1)	5600 (98.1)	468 (97.5)	0.203
	Yes	109 (1.8)	97 (1.7)	12 (2.5)	
	Missing data	9 (0.1)	9 (0.2)	0	
Distant metastasis	No	5309 (85.8)	4893 (85.8)	416 (86.7)	0.631
	Yes	869 (14.0)	805 (14.1)	64 (13.3)	
	Missing data	8 (0.1)	8 (0.1)	0	
Overall recurrence	No	5248 (84.8)	4840 (84.8)	408 (85.0)	0.973
	Yes	930 (15.0)	858 (15.0)	72 (15.0)	
	Missing data	8 (0.1)	8 (0.1)	0	

Values are *n* (%). R0, radical surgery; RW, rectal washout.

Subgroup analysis of patients with 5-year follow-up

Patients with available 5-year follow-up data who underwent elective R0 AR for TNM stage I–III rectal cancer between 2007 and 2015 were also analysed (4991) (*Table 4*). The DM and OAR rates did not differ between the patients whether RW was performed or not; however, 104 of the 4583 patients in the RW group (2.3 per cent) had a registered LR within 5 years compared with 16 of the 408 patients (3.9 per cent) in the no RW group ($P = 0.037$).

In univariable Cox regression analysis of the impact of RW on LR risk, the HR was 0.57 (95 per cent c.i. 0.33 to 0.96; $P = 0.034$), favouring RW. When adjusted for age at diagnosis, sex, TNM stage, tumour height, neoadjuvant RT, neoadjuvant chemotherapy, MIS, intraoperative perforation, and adjuvant chemotherapy in the multivariable analysis, the HR was 0.53 (95 per cent c.i. 0.31 to 0.90; $P = 0.018$), still favouring RW (*Table S1*).

In subgroup analysis of the 749 patients with available 5-year follow-up data who underwent elective minimally invasive R0 AR

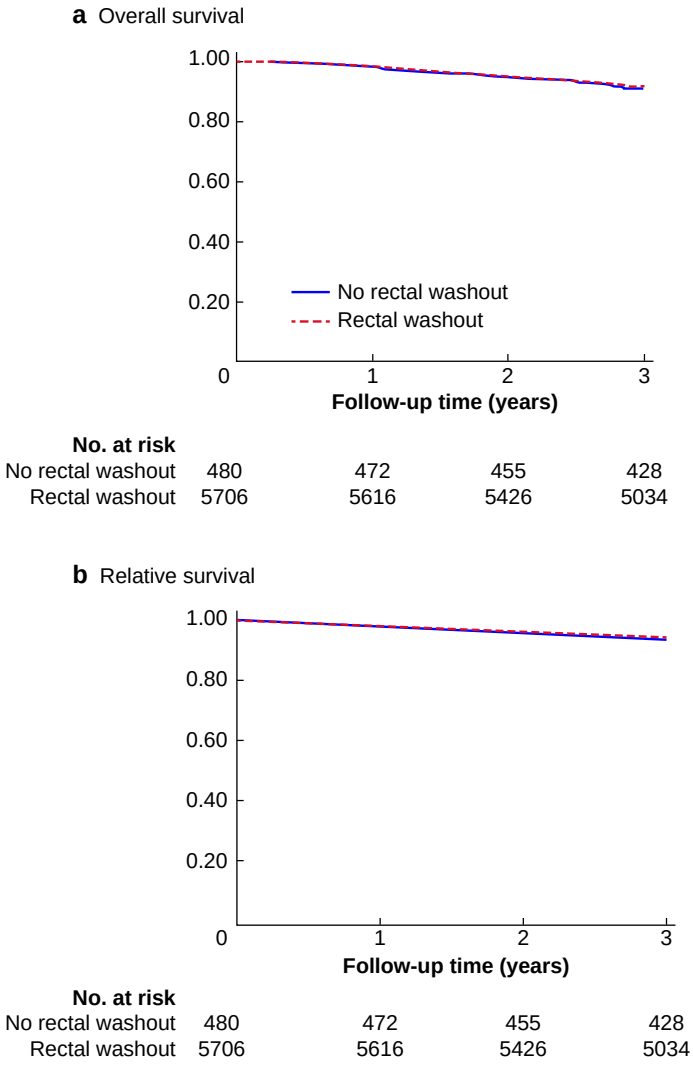

Fig. 2 Three-year overall and relative survival after elective R0 anterior resection for TNM stage I–III rectal cancer in Sweden, 2007 to 2017
a Overall survival ($P = 0.687$). **b** Relative survival ($P = 0.932$, log rank test).

Table 4 Five-year recurrence data after elective R0 anterior resection for TNM stage I–III rectal cancer in Sweden, 2007 to 2015

		All patients ($n = 4991$)	RW ($n = 4583$)	No RW ($n = 408$)	P
Local recurrence	No	4863 (97.4)	4471 (97.6)	392 (96.1)	0.037
	Yes	120 (2.4)	104 (2.3)	16 (3.9)	
	Missing data	8 (0.2)	8 (0.2)	0	
Distant metastasis	No	4134 (82.8)	3790 (82.7)	344 (84.3)	0.449
	Yes	849 (17.0)	785 (17.1)	64 (15.7)	
	Missing data	8 (0.2)	8 (0.2)	0	
Overall recurrence	No	4078 (81.7)	3744 (81.7)	334 (81.9)	0.989
	Yes	905 (18.1)	831 (18.1)	74 (18.1)	
	Missing data	8 (0.2)	8 (0.2)	0	

Values are *n* (%). R0, radical surgery; RW, rectal washout.

for rectal cancer TNM stage I–III between 2007 and 2015, 20 patients (2.7 per cent) developed LR within 5 years. No differences were observed when comparing the RW and no RW group ($P = 0.172$).

Discussion

This study on national SCRCR data investigates the significance of RW on the oncological outcome in a registry cohort of patients with rectal cancer. The data did not reveal an impact of RW on rates of LR within 3 years. Furthermore, this also applied to the risk of DM and OAR as well as overall and relative 3-year survival; however, in a subgroup analysis of the patients with available 5-year follow-up data who had undergone AR between 2007 and 2015, RW decreased the risk of LR.

Since the earlier study on RW and LR, staging, neoadjuvant treatment, and surgery have been optimized in Sweden[10]. In addition, the SCRCR has expanded, new variables have been added, and data have become more detailed[15]. The earlier study emanated from the early TME era with higher LR rates of 10.2 per cent in the no RW group and 6.0 per cent in the RW group. In the present study, proportionally more patients received neoadjuvant treatment and neoadjuvant chemotherapy was rarely used in the earlier cohort. The impact of a previous study combined with the publication of the first edition of the Swedish national guidelines for colorectal cancer care (2007), which recommended RW when performing AR, may explain the lower proportion of patients where RW was omitted in this analysis (18.2 *versus* 7.8 per cent[5,10]).

In recent years, LR among patients where RT was not performed has fallen to rates comparable to those who received RT[22]. Keeping this in mind, some argue that the use of preoperative RT in patients with rectal cancer needs to be more selective because of the potential side effects[23,24]. In patients not receiving RT, RW has previously been suggested to give a near-significant reduction of LR[25]. Based on the RAPIDO-trial data, neoadjuvant short-course RT followed by chemotherapy has replaced chemoradiotherapy in the Swedish national guidelines[5,26]; however, the non-significant higher LR rate in the experimental arm must be acknowledged. Until more data are available, it would be unwise to change standards regarding RW.

According to a recent study, RW seems to be safe and does not increase postoperative complications after AR for rectal cancer[27]; however, as the frequency of MIS in the studied cohort was low, this cannot be applied to RW in MIS. Laparoscopic surgery may require more manipulation of the rectum, technically complicating the performance of RW, compared with robotic-assisted surgery, which may facilitate the procedure, reflected in a higher proportion of patients receiving RW in that group. The rates of surgical complications, intraoperative perforation, and MIS were higher among the analysed patients where RW was not performed. These factors might have contributed to the omission of RW. In Sweden the LR rate within 5 years after resection is now less than five per cent[15]. This is reflected in the studied cohort, with few events of LR. The LR rate in the subgroup of patients that underwent minimally invasive AR was low and unfortunately did not allow multivariable analysis. In the RW group, more of the resections were performed at a high-volume hospital. Swedish rectal cancer surgery has been centralized and only few patients underwent surgery at a low-volume hospital, and surgery at a medium-volume hospital continues to decrease[15]. A recent study found intraoperative adverse events to be a risk factor for LR after rectal cancer resection and demonstrated the importance of RW for LR risk[28]. Multivariable Cox regression analysis adjusted for possible confounders was performed in this study to determine whether RW was an independent factor of importance for LR; however, it might be that not all adverse events have been adjusted for.

In this study, RW was not found to impact the 3-year oncological outcome; however, subgroup analysis of patients with available 5-year follow-up data who had undergone AR between 2007 and 2015 showed that RW decreased the risk of LR. There are indications that SCRCR patients with shorter follow-up than 5 years are less accurately reported[19]. Furthermore, increased use of neoadjuvant chemoradiotherapy in addition to the TME surgery has not only reduced but prolonged time to LR[5,13,14,29,30]. Consequently, LR rates may be too low to detect differences at the 3-year follow-up.

The present study includes a large unselected consecutive population-based cohort. The non-randomized nature of the registry data constitutes a risk of bias. Inevitably the study included surgeons with different technical methods, including that of RW, although the frequency of a general surgeon to perform the resection was very low. Furthermore, RW was performed at the discretion of the surgeon, and there was a lack of data on the method of irrigation and washout solution used. The reason for omission of RW is also not stated in the SCRCR. In addition, there is no consensus on what RW fluid or volume is the most effective in preventing LR[8]. A recent survey of the current practice of RW in Sweden showed that RW was most often performed with sterile water or a mix of sterile water and alcohol[17].

To clearly investigate the true effect of RW in MIS using registry data, more time needs to pass for the cohort to grow larger. In a time when the neoadjuvant therapy for rectal cancer is changing, and based on the results of the present study, it is justified to continue the practice of RW to decrease the risk of LR after AR for rectal cancer.

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Disclosure

The authors declare no conflict of interest.

Supplementary material

Supplementary material is available at *BJS Open* online.

Data availability

Data are available from the authors upon reasonable request.

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