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ORIGINAL ARTICLE

Management of acute and chronic pelvic sepsis after total mesorectal excision for rectal cancer—a 10-year experience of a national referral centre

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Abstract

Aim: Uncontrolled pelvic sepsis following rectal cancer surgery may lead to dramatic consequences with significant impact on patients' quality of life. The aim of this retrospective observational study is to evaluate management of pelvic sepsis after total mesorectal excision for rectal cancer at a national referral centre.

Method: Referred patients with acute or chronic pelvic sepsis after sphincter preserving rectal cancer resection, with the year of referral between 2010 and 2014 (A) or between 2015 and 2020 (B), were included. The main outcome was control of pelvic sepsis at the end of follow-up, with healed anastomosis with restored faecal stream (RFS) as co-primary outcome.

Results: In total 136 patients were included: 49 in group A and 87 in group B. After a median follow-up of 82 months (interquartile range 35–100) in group A and 42 months (interquartile range 22–60) in group B, control of pelvic sepsis was achieved in all patients who received endoscopic vacuum assisted surgical closure (7/7 and 2/2), in 91% (19/21) and 89% (31/35) of patients who received redo anastomosis ($P=1.000$) and in 100% (18/18) and 95% (41/43) of patients who received intersphincteric resection ($P=1.000$), respectively. Restorative procedures resulted in a healed anastomosis with RFS in 61% (17/28) of patients in group A and 68% (25/37) of patients in group B ($P=0.567$).

Conclusion: High rates of success can be achieved with surgical salvage of pelvic sepsis in a dedicated tertiary referral centre, without significant differences over time. In well selected and motivated patients a healed anastomosis with RFS can be achieved in the majority.

KEYWORDS
colorectal, pelvic sepsis, rectal cancer, total mesorectal excision

Sarah Sharabiany and Johanna J. Joosten contributed equally.

INTRODUCTION

Anastomotic leakage (AL) following a low anterior resection (LAR) is a dreaded complication and occurs in up to 28% of rectal cancer patients after total mesorectal excision [1–5]. Even more concerning is that half of the ALs do not heal, and these patients are left with ongoing pelvic sepsis [5]. Even in the case of primary Hartmann's procedure (HP), pelvic sepsis occurs in up to 20% of patients [6, 7]. Pelvic sepsis is more common in irradiated patients and is often accompanied by secondary severe complications including fistula formation, ureteral fibrosis, necrotizing fasciitis and higher local recurrence rates. In addition, it greatly affects quality of life and increases mortality [8–10].

Management of these patients is complex and represents a real surgical challenge. The main principle of salvage surgery is adequate pelvic debridement, which may be difficult in a fibrotic and mostly irradiated field with subsequent pelvic filling using healthy well vascularized tissue. This can be the new colonic conduit in the case of a redo anastomosis, while in the non-restorative setting pelvic filling is obtained by a pedicled omentoplasty or a tissue flap [11–13]. Over the last decade, novel treatment options and techniques have been implemented in an attempt to improve outcomes, such as endoscopic vacuum therapy, transanal minimally invasive surgery (TAMIS) for better access to the area of sepsis deep within the pelvis and fluorescence angiography to verify a well perfused colonic conduit, omentoplasty or tissue flap [14–17].

Literature on this topic is scarce, and large cohorts with long-term outcomes are almost non-existing. Therefore, this observational study aimed to analyse all referred patients with pelvic sepsis to a tertiary centre, with a description of patient characteristics and their disease course until referral, details of salvage management and associated long-term outcomes, stratified for two consecutive time periods to assess improvement of management.

What does this paper add to the literature?

Management of acute and chronic pelvic sepsis after total mesorectal excision represents a real surgical challenge, whilst literature on this topic is scarce. This study represents the largest cohort of patients with long-term outcomes to provide further insights into the management of this challenging complication to optimize current care.

METHODS

Patients

This was a single-centre retrospective observational study of prospectively collected data of consecutive patients with pelvic sepsis after LAR or HP for rectal cancer referred for further treatment between January 2010 and January 2020. To evaluate changes in patient characteristics, surgical management and success rates over time, patients were divided into two groups of 5 years each based on the year of referral: January 2010–December 2014 (group A) and January 2015–January 2020 (group B).

The primary resection for rectal cancer (i.e., LAR or HP) was defined as the index procedure. Pelvic sepsis was defined as uncontrolled persisting inflammation within the pelvic cavity following AL, including leakage from a rectal remnant after low HP or dismantled anastomosis. Pelvic sepsis was diagnosed during physical examination, endoscopy, radiology or a combination of diagnostic modalities, and defined as chronic when sepsis was still present 12 months following the index procedure.

The primary end-point was the percentage of patients with control of pelvic sepsis at the end of follow-up, with rate of healed anastomosis with restored faecal stream (RFS) as co-primary end-point. Control of pelvic sepsis was defined as either a healed anastomosis without any further collections on imaging in restorative procedures, or healing of the perineal wound, without any features suggesting ongoing sepsis based on clinical symptoms, laboratory results and cross-sectional imaging in non-restorative procedures. A healed anastomosis was defined as no contrast extravasation visible on CT scan and/or an intact anastomosis during endoscopy, independent of the presence of a diverting stoma. A healed anastomosis with RFS was defined as a healed anastomosis with closure of the defunctioning stoma. Secondary outcomes were perioperative morbidity, reinterventions after salvage management, hospital stay and mortality.

Some of the patients in this cohort overlap with previously published studies [12, 18, 19]. The Institutional Review Board of the Academic Medical Centre in Amsterdam waived the need for informed consent.

Data collection

Patient and treatment characteristics were collected from medical charts and stored in an electronic database (Castor EDC) [20]. Treatment after referral was differentiated into surgical and non-surgical management. Surgical management included restorative (i.e., endoscopic vacuum assisted surgical closure [EVASC] and redo anastomosis) and non-restorative procedures (i.e., intersphincteric resection of the anastomosis or rectal stump). EVASC included all patients in which the AL was closed after vacuum therapy without excision of the anastomosis. Redo anastomosis was defined as restoration of continuity after resection of the leaking anastomosis or rectal stump.

Only major complications within 30 days were reported according to the Clavien–Dindo classification (Grades III–V) [21, 22].

Statistical analysis

Categorical data are presented as numbers and proportions and were compared using the chi-squared test or the Fisher exact test when appropriate. Numerical data are reported as means with standard deviation (SD) or medians with interquartile range (IQR) and were compared using the independent *t* test or Mann–Whitney *U* test according to distribution. The median time from index to referral is presented with 95% confidence interval (95% CI). The median number of reinterventions per patient is reported with IQR, as well as the minimum and maximum range to represent inter-individual variability. Subgroup analyses were performed in patients with restorative and non-restorative salvage surgery, and in patients with and without major pelvic surgery prior to referral. Crude rates for control of pelvic sepsis were calculated as well as the probability for control of pelvic sepsis by Kaplan–Meier analysis, which was compared using the log-rank test. The statistical significance level was set at a *P* value of <0.05. IBM SPSS Statistics for Windows (v.26.0, IBM Corp., Armonk, New York, USA) was used for the statistical analyses.

RESULTS

Patients

In total, 152 patients were referred with pelvic sepsis between 2010 and 2020. Of these 152 patients, eight patients were excluded due to pelvic sepsis after abdominoperineal resection, and four patients were excluded because of the underlying disease (i.e., villous adenoma, Morbus Crohn). In addition, four patients were excluded because they had already undergone an intersphincteric proctectomy at the referring centre. As a result, a total of 136 patients were included in this analysis, 49 patients in group A and 87 patients in group B (Table 1).

Treatment prior to referral

The median time between index surgery and referral was 17 months (IQR 7–37) in group A and 18 months (IQR 9–57) in group B ($P=0.165$; Table S1). The median number of reinterventions prior to referral in group A was 1, with an IQR of 1–2 and range of 0–28; corresponding results for group B were median 1 reintervention with an IQR of 0–2 and range of 0–10 ($P=0.607$). Reinterventions in the referring centre were surgical in 76% (37/49) and 75% (65/87) ($P=0.918$), which included major pelvic surgery in 32% (12/37) and 29% (19/65), respectively ($P=0.735$). The most common major pelvic surgery in both groups was takedown of the anastomosis and creation of an end colostomy (75% [9/12] vs. 84% [16/19]; $P=0.653$). Information regarding therapeutic measures performed prior to surgery can be found in Table S1.

Management of pelvic sepsis after referral

The pelvic anatomy at time of referral is shown in Table 2; an anastomosis was in situ in 78% (38/49) of patients in group A and 72% (63/87) of patients in group B ($P=0.511$).

TABLE 1 Patient characteristics.

	2010–2014 (*n*=49)	2015–2020 (*n*=87)	*P* value
Sex (male)	31/49 (63)	67/87 (77)	0.086
Age, mean ± SD (years)	61 ± 10	63 ± 11	0.374
BMI, median (kg/m^2, IQR)	25 (23–27)	25 (23–28)	0.329
Missing (*n*)	2	5	
ASA classification			
ASA I	16/47 (34)	14/83 (17)	0.061
ASA II	26/47 (55)	53/83 (64)	
ASA III	5/47 (11)	16/83 (19)	
Active smoker	7/47 (15)	11/81 (14)	0.837
Diabetes mellitus type II	6/49 (12)	14/87 (16)	0.543
Tumour distance from anal verge, median (cm, IQR)	7 (5–10)	7 (6–9)	0.947
Missing (*n*)	13	37	
Neoadjuvant therapy			
None	2/49 (4)	7/87 (8)	0.896
Short-course radiotherapy only	25/49 (51)	39/87 (45)	
Long-course radiotherapy only	0/49 (0)	2/87 (2)	
Radiotherapy only, type unknown	3/49 (6)	6/87 (7)	
Short-course radiotherapy followed by chemotherapy	1/49 (2)	3/87 (3)	
Chemoradiotherapy	18/49 (37)	30/87 (35)	
Index surgery			
Low anterior resection	47/49 (96)	79/87 (91)	0.329
Hartmann procedure	2/49 (4)	8/87 (9)	
Distance from anastomosis/rectal stump to the ARJ, median (cm, IQR)	3 (2–4)	4 (3–5)	0.173
Missing (*n*)	12	12	
Primary tumour pathological stage			
Stage 0	3/39 (8)	8/72 (11)	0.758
Stage I	12/39 (31)	26/72 (36)	
Stage II	10/39 (26)	13/72 (18)	
Stage III	14/39 (36)	23/72 (32)	
Stage IV	0/39 (0)	2/72 (3)	
Time between index surgery and clinical presentation anastomotic leakage			
<30 days	34/49 (69)	61/87 (70)	0.564
30–90 days	3/49 (6)	5/87 (6)	
90 days–1 year	5/49 (10)	4/87 (5)	
>1 year	9/49 (14)	17/87 (20)	

(Continues)

TABLE 1 (Continued)

	2010–2014 (n = 49)	2015–2020 (n = 87)	P value
Secondary complications of (chronic) pelvic sepsis[a]			
None	24/49 (49)	40/87 (46)	0.736
Back/leg pain	12/49 (25)	22/87 (25)	
Enteroperineal fistula	3/49 (6)	6/87 (7)	
Enterocutaneous fistula	1/49 (2)	5/87 (6)	
Small bowel fistula	1/49 (2)	2/87 (2)	
Uterus fistula	1/18 (6)	1/20 (5)	
Vaginal fistula	2/18 (12)	4/20 (20)	
Hip fistula	10/49 (20)	15/87 (17)	
Bladder fistula	3/49 (6)	6/87 (7)	
Ureter fistula	0/49 (0)	1/87 (1)	
Urethra fistula	1/49 (2)	2/87 (2)	
Sacral osteomyelitis	2/49 (4)	3/87 (3)	
Type referring hospital			
Non-teaching	8/49 (16)	8/87 (9)	0.364
Teaching	40/49 (82)	78/87 (90)	
Academic	1/49 (2)	1/87 (1)	
Time between index surgery and last date of follow-up, median (months, IQR)	101 (68–131)	74 (47–114)	0.074

Note: Descriptive statistics are presented as proportions, unless otherwise stated.

Abbreviations: ARJ, anorectal junction; ASA, American Society of Anesthesiologists classification; BMI, body mass index; IQR, interquartile range.

[a]More than one complication could be present in a patient.

A restorative procedure was attempted in 61% (28/46) of patients in group A and in 46% (37/80) of patients in group B (*P* = 0.114). These patients were significantly younger (57 ± 10 years vs. 69 ± 9 years; *P* < 0.001) and had lower American Society of Anesthesiologists scores compared to patients with a non-restorative procedure (Table S2). A redo anastomosis was evenly distributed over both groups (46% [21/46] vs. 44% [35/80]; *P* = 0.836), while local reconstruction by EVASC was more often attempted in group A (15% [7/46] vs. 3% [2/80]; *P* = 0.012). The abdominal approach for redo anastomosis was significantly more often laparoscopic in group B (80% [28/35] vs. 42% [8/19]; *P* = 0.005) and the perineal approach was significantly more often TAMIS in group B (94% [33/35] vs. 11% [2/18]; *P* < 0.001). The median length of hospital stay after redo anastomosis was significantly longer for patients in group A (7 days [IQR 6–12] vs. 6 days [IQR 4–7]; *P* = 0.022).

The abdominal approach of intersphincteric resection was more often laparoscopic in group B (57% [24/42] vs. 31% [5/16]; *P* = 0.078). The perineal approach was significantly more often TAMIS in group B (70% [30/43] vs. 0% [0/17]; *P* < 0.001), and therefore patient positioning for the perineal phase was significantly more often lithotomy over time (95% [41/43] vs. 71% [12/17]; *P* = 0.016). An omentoplasty was performed in 89% (16/18) of patients in group A and 77% (33/43) of patients in group B (*P* = 0.481), and a tissue flap reconstruction in 0% (0/18) and 9% (4/43), respectively (*P* = 0.310). The flaps performed were V-Y advancement flap (twice), gluteal turnover flap (twice) and a gluteus flap. The median length of hospital stay after a non-restorative procedure was 10 days (IQR 7–13) for patients in group A and 7 days (IQR 5–18) for patients in group B (*P* = 0.611). Secondary HP following LAR prior to referral significantly affected salvage management. Following secondary HP, salvage surgery consisted of a restorative procedure in 16% (4/25) and a non-restorative procedure in 68% (17/25) (*P* = 0.001). Corresponding percentages without prior takedown of the anastomosis were 58% (59/101) and 36% (36/101) (*P* < 0.001), respectively. In addition, a restorative procedure was performed in 55% (34/62) of patients who did not have any surgical reintervention prior to referral, in 58% (25/43) if only a minor surgical reintervention was performed and in 19% (6/31) after major surgical reintervention(s) (*P* = 0.001).

After referral, it was decided to manage the pelvic sepsis non-operatively in three patients of group A and in seven patients of group B.

Control of pelvic sepsis

Median follow-up after salvage management in our tertiary centre was 49 months overall (IQR 22–72), and this was 82 months (IQR 35–100) in group A and 42 months (IQR 22–60) in group B. Total reintervention rate during follow-up was 41% (19/46) in group A (median 0, IQR 0–2, range 0–6) and 41% (33/80) in group B (median 0, IQR 0–2, range 0–7; *P* = 0.995). These reinterventions consisted of major pelvic surgery in 53% (10/19) and 42% (14/33) of patients (*P* = 0.477), respectively. Median time between salvage surgery and surgical reinterventions was 10 months (IQR 3–35) in group A and 1 month (IQR 1–4) in group B (*P* = 0.001). The mean overall length of readmission related to pelvic sepsis was 17 ± 11 days and 14 ± 10 days in groups A and B, respectively (*P* = 0.275) (Table S3).

Patients in group A had control of pelvic sepsis at the end of follow-up in 96% (44/46), and this was 93% (74/80) in group B (*P* = 0.709), with an overall rate of 94% (118/126) (Table 3 and Figure 1). The 12-month pelvic sepsis control rate was 76% in patients of group A and 87% in patients of group B (*P* = 0.216) (Figure 2). Median time between salvage and control of pelvic sepsis was 25 days for patients in both groups (IQR 8–375 and IQR 8–124; *P* = 0.683, respectively).

The restorative sepsis control rate was 93% (26/28) in group A and 89% (33/37) in group B (*P* = 0.692). The proportion of healed anastomosis was 71% (5/7) and 100% (2/2) after EVASC (*P* = 1.000), and 67% (14/21) and 69% (24/35) after redo anastomosis (*P* = 0.883). Corresponding proportions for healed anastomosis with RFS were 57% (4/7) and 50% (1/2) (*P* = 1.000), and 62% (13/21) and 69% (24/35) (*P* = 0.610), respectively. The non-restorative sepsis control rate after reinterventions for failed local reconstruction of redo

TABLE 2 Management of pelvic sepsis after referral.

	2010–2014 (*n* = 49)	2015–2020 (*n* = 87)	*P* value
Status pelvis at time of referral			
Anastomosis still in situ	38/49 (78)	63/87 (72)	0.542
Primary Hartmann[a]	2/49 (4)	8/87 (9)	
Secondary Hartmann[b]	9/49 (18)	16/87 (18)	
Duration of pelvic sepsis			
>12 months	29/49 (59)	58/87 (67)	0.383
Surgical management	46/49 (94)	80/87 (92)	1.000
Restorative procedures	28/46 (61)	37/80 (46)	0.114
EVASC	7/46 (15)	2/80 (3)	0.012
Redo anastomosis	21/46 (46)	35/80 (44)	0.836
Operation time, mean ± SD (min)	303 ± 83	321 ± 93	0.476
Surgical approach			
Transabdominal only	2/21 (10)	0/35 (0)	0.048
Laparoscopic (vs. open)	0/2 (0)	NA	
Conversion	NA	NA	
Transperineal only	1/21 (5)	0/35 (0)	
TAMIS (vs. open)	0/1 (0)	NA	
Combined	18/21 (86)	35/35 (100)	
Abdominal laparoscopic (vs. open)	8/17 (47)	28/35 (80)	
Conversion	0/8 (0)	0/28 (0)	
TAMIS (vs. transperineal open)	2/17 (12)	33/35 (94)	
Lithotomy (vs. prone)	7/17 (41)	35/35 (100)	<0.001
Abdominoperineal synchronous	1/19 (5)	15/35 (43)	0.004
Omentoplasty	4/21 (19)	2/35 (6)	0.183
Tissue flap (muscle, fascio- and subcutaneous flap)	1/21 (5)	0/35 (0)	0.375
Fluorescence	0/21 (0)	6/35 (17)	0.074
Perfusion omentoplasty	–	1/6 (17)	
Perfusion anastomosis	–	6/6 (100)	
Extensive adhesiolysis	7/18 (39)	9/35 (26)	0.322
Urological complication	2/19 (11)	4/35 (11)	1.000
Length of hospital stay after salvage, median (days, IQR)	7 (6–12)	6 (4–7)	0.022
Non-restorative procedures	18/46 (39)	43/80 (54)	0.114
Operation time, mean ± SD (min)	278 ± 102	292 ± 91	0.612
Surgical approach			
Transabdominal only	1/18 (6)	0/43 (0)	0.073
Laparoscopic (vs. open)	0/1 (0)	NA	
Conversion	NA	NA	
Transperineal only	2/18 (11)	1/43 (2)	
TAMIS (vs. open)	0/2 (0)	0/1 (0)	
Combined	15/18 (83)	42/43 (98)	
Abdominal laparoscopic (vs. open)	5/15 (33)	24/42 (57)	
Conversion	0/5 (0)	3/24 (13)	
TAMIS (vs. transperineal open)	0/15 (0)	30/42 (71)	
Lithotomy (vs. prone)	12/17 (71)	41/43 (95)	0.016

(Continues)

TABLE 2 (Continued)

	2010–2014 (*n* = 49)	2015–2020 (*n* = 87)	*P* value
Abdominoperineal synchronous	1/18 (6)	17/43 (40)	0.012
Omentoplasty	16/18 (89)	33/43 (77)	0.481
Tissue flap (muscle, fascio- and subcutaneous flap)	0/18 (0)	4/43 (9)	0.310
Fluorescence[c]	0/18 (0)	14/43 (33)	0.006
Perfusion omentoplasty	–	14/14 (100)	
Perfusion anastomosis	–	0/14 (0)	
Extensive adhesiolysis	6/18 (33)	20/43 (47)	0.343
Urological complication	2/18 (11)	7/43 (16)	0.713
Length of hospital stay after salvage, median (days, IQR)	10 (7–13)	7 (5–18)	0.611
Non-surgical management	3/49 (6)	7/87 (8)	1.000
Time between index surgery and salvage surgery, median (months, IQR)	20 (9–41)	22 (14–67)	0.062

Note: Descriptive statistics are presented as proportions, unless otherwise stated.

Abbreviations: EVASC, endoscopic vacuum assisted surgical closure; IQR, interquartile range; TAMIS, transanal minimally invasive surgery.

[a]Hartmann procedure as index surgery.

[b]Hartmann situation after anastomotic takedown in referring hospital.

[c]Multiple reasons may apply.

TABLE 3 Control of pelvic sepsis.

	2010–2014 (*n* = 46)	2015–2020 (*n* = 80)	*P* value
Control pelvic sepsis	44/46 (96)	74/80 (93)	0.709
Restorative sepsis control	26/28 (93)	33/37 (89)	0.692
Healed anastomosis	19/28 (68)	26/37 (70)	0.835
Healed anastomosis with restored faecal stream	17/28 (61)	25/37 (68)	0.567
Restorative: EVASC	7/7 (100)	2/2 (100)	NA
Healed anastomosis	5/7 (71)	2/2 (100)	1.000
Healed anastomosis with restored faecal stream	4/7 (57)[a]	1/2 (50)[b]	1.000
Restorative: redo anastomosis	19/21 (91)	31/35 (89)	1.000
Healed anastomosis	14/21 (67)	24/35 (69)	0.883
Healed anastomosis with restored faecal stream	13/21 (62)[a]	24/35 (69)	0.610
Non-restorative sepsis control (i.e., intersphincteric resection)	18/18 (100)	41/43 (95)	1.000
Clavien–Dindo			
Grade 0–II	24/46 (52)	42/80 (53)	0.944
Grade III	20/46 (44)	32/80 (40)	
Grade IV	2/46 (4)	5/80 (6)	
Grade V	0/46 (0)	1/80 (1)	
Time between salvage and control of pelvic sepsis, median (days, IQR)	25 (7–347)	25 (8–115)	0.683
Time between salvage and last date of follow-up, median (months, IQR)	82 (35–100)	42 (22–60)	<0.001
Mortality within 30 days	0/46 (0)	1/80 (1)	1.000

Note: Descriptive statistics are presented as proportions, unless otherwise stated. Reason stoma in situ at end of follow-up: [a]metastatic disease, [b]low anterior resection syndrome.

Abbreviations: EVASC, endoscopic vacuum assisted surgical closure; IQR, interquartile range.

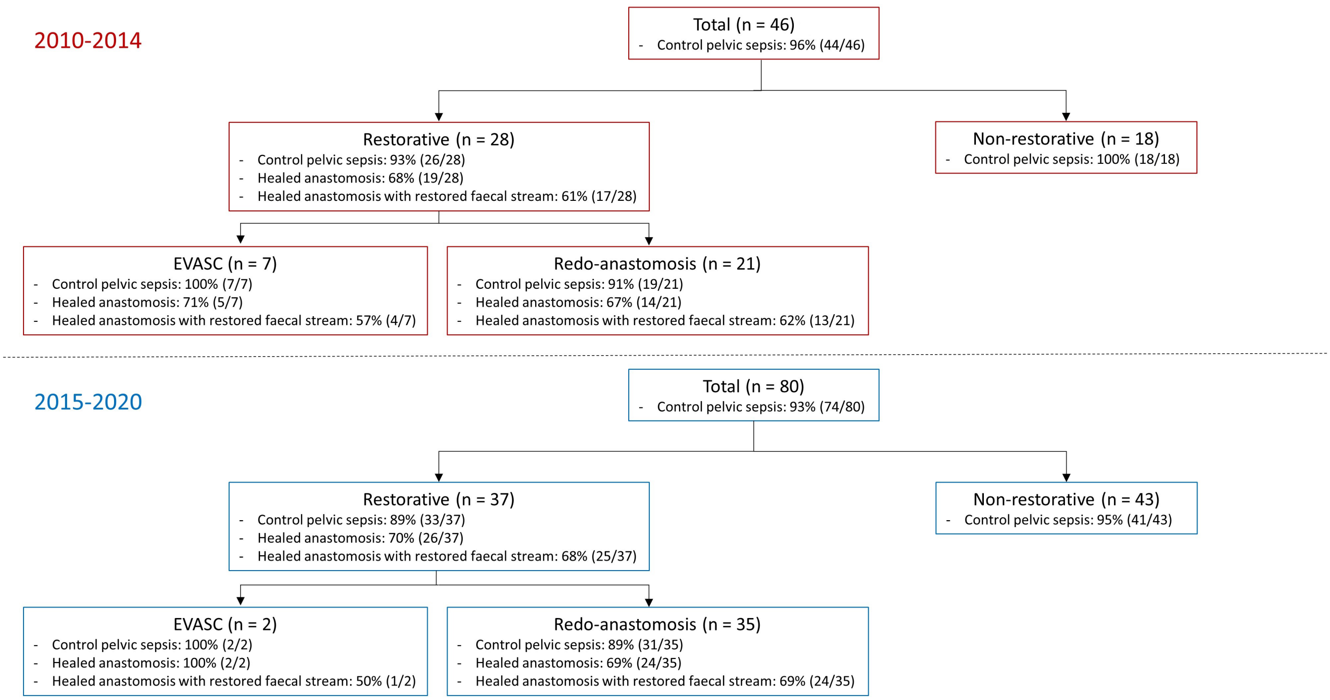

FIGURE 1 Flowchart of control of pelvic sepsis after restorative (i.e., EVASC or redo anastomosis) and non-restorative (i.e., intersphincteric resection) salvage surgery, divided into year of referral (2010–2014) (red boxes) and 2015–2020 (blue boxes). Rates of healed anastomosis and healed anastomosis with restored faecal stream are reported for restorative procedures and rates of healed perineum for non-restorative procedures.

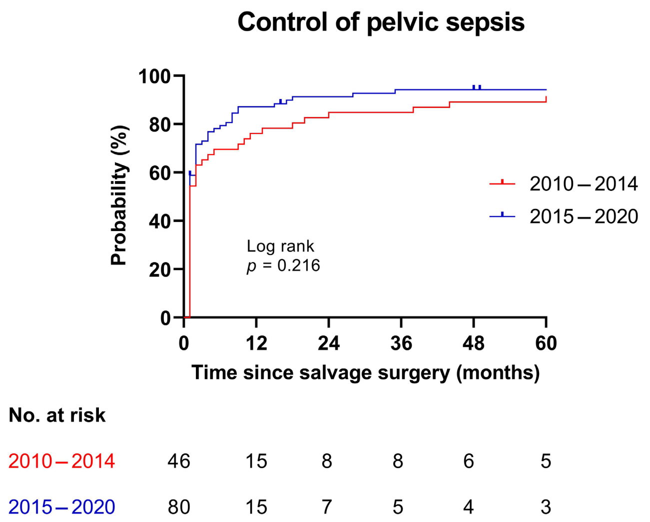

FIGURE 2 Kaplan–Meier curves of control of (chronic) pelvic sepsis after salvage surgery, stratified for year of referral: 2010–2014 (red line) and 2015–2020 (blue line). Log-rank test was used to test the significance, and censored patients are indicated by tick marks. The number of patients at risk are shown at the bottom of the figure.

anastomosis was 100% (18/18) in group A and 95% (41/43) in group B ($P = 1.000$).

Five patients in group A underwent surgical salvage in the latter period (2015–2020), after which control of pelvic sepsis was achieved. Scoring these patients from group A as no control of pelvic sepsis results in a control of pelvic sepsis rate of 85% (39/46) compared to 93% (74/80) in group B ($P = 0.225$).

DISCUSSION

The present study provides detailed insights into a large consecutive cohort of 136 patients with pelvic sepsis after rectal cancer resection who were referred to a tertiary unit during a 10-year study period. In these complex cases of predominant chronic sepsis, almost always following radiotherapy, a healed anastomosis or perineum without any signs of persisting pelvic infection could be achieved in most patients. Restoration of continuity was intended in about half of the patients, and in this group similar sepsis control rates were achieved compared to patients with a non-restorative procedure, although this sometimes required additional salvage procedures for failed local reconstruction or redo anastomosis.

In our first report on the topic in a small cohort of 22 patients, the ability to control pelvic sepsis was only 62% [12]. At that time, we were more reluctant to perform major salvage surgery. Using data from other studies, we found that delayed coloanal anastomosis for failed anastomosis with chronic pelvic sepsis is associated with a high success rate of 79% [23]. In addition, based on our failures, we learned more about the general surgical principles of managing chronic pelvic sepsis. For example, we found that just removing a rectal stump without revision of a previously performed omentoplasty will result in an even larger cavity. Salvage surgery should not be performed as a staged procedure, but resection of the leaking anastomosis should simultaneously be combined with optimal pelvic filling. Furthermore, we became more aggressive in complete surgical debridement, which appeared to be without increased risk of bleeding because of obliterated presacral veins because of chronic inflammation. If any fibrotic capsule or small sinus with granulation tissue remains, this probably results in recurrent presacral abscess formation. By more systematically applying these principles and optimizing our salvage surgery with intersphincteric completion proctectomy combined with optimal debridement and omentoplasty, we were able to improve our results with a pelvic sepsis control rate of 78% in our series until 2014 [11]. At that time, we introduced TAMIS, which was found to improve exposure significantly for complete debridement and with more possibilities for restorative salvage surgery [15]. In the present overview of all consecutive patients who were referred during one decade until January 2020, we now report an overall success rate of 94%. In addition, the time interval to control pelvic sepsis after salvage surgery has become shorter if comparing present results with our initial publication (4 months [IQR 1–31] vs. 1 month [IQR 0–8]).

Although some differences in salvage management over the 10-year period were observed, outcomes were remarkably similar between the early and late cohort. This is mainly explained by the fact that some failures from period A underwent another successful salvage procedure during period B, thereby benefitting from better understanding of these complex conditions and passing the learning curve over time.

As a result of increasing awareness of our unit's approach to acute and chronic pelvic sepsis, and referral pathways among Dutch centres performing rectal cancer surgery, we expected to find a decrease in the interval between index surgery and referral, but this interval remained stable around 17 months. Similarly, the proportion of major pelvic reinterventions prior to referral remained unchanged over time, with the proportion of secondary HPs even increasing from 75% in the early group to 84% in the more recent group.

A restorative procedure resulted in a 69% rate of healed anastomosis, with a similar healed anastomosis with RFS rate. Only three patients still had a diverting stoma at the end of follow-up due to severe LAR syndrome (LARS) ($n=1$) or development of metastasis ($n=2$). Westerduin et al. compared functional outcomes and quality of life between redo anastomosis and primary successful anastomosis in patients with rectal cancer [19]. They found significantly worse quality of life after redo anastomosis, whereas major LARS was comparable between groups. Therefore, preserving bowel continuity should be considered in highly motivated patients, and this is supported by good outcomes in the restorative cases. Another previous study found that immediate coloanal anastomosis following redo rectal surgery results in better functional outcomes compared to delayed coloanal anastomosis [24].

Higher rates of reconstructive salvage surgery were possible if no major pelvic reintervention was performed at the referring centre to treat pelvic sepsis. Removal of the afferent colon from the pelvis will result in coverage of the rectal stump with the urogenital organs and fibrotic narrowing of the lower pelvis which makes restorative surgery much more difficult. Therefore, one should try to keep the leaking anastomosis in situ, and to control pelvic sepsis initially with faecal diversion and optimal local drainage. A recent publication of Calmels et al. obtained a healed anastomosis with RFS in 80% of patients after redo anastomosis, compared to an overall rate of 66% in our cohort [25]. However, only 37% of their total cohort had chronic pelvic sepsis, whereas this was 63% in our cohort. Another recent publication reported on healed anastomosis with RFS rate in patients after second redo surgery, and found a 63% success rate [26]. These outcomes correspond more to our series, since two-thirds of the patients in our cohort had a surgical reintervention prior to referral. These studies and the current data emphasize the importance of a faster referral process and omission of any major pelvic reintervention.

The strength of the present study is the large number of patients with long-term follow-up that report outcomes of a gradually increasing experience of a national referral unit for anastomotic failure, which forms a unique series in currently available literature. The most important limitation of this current study is the lack of functional evaluation since quality of life and LARS outcomes are essential to this topic and ultimately matter most to the patient. Another significant limitation is its retrospective nature, making it difficult to correct for confounding factors. Other limitations are related to the heterogeneity of patients and interventions, which is inevitable in such a study on pelvic sepsis.

With regard to implications for clinical practice, a shared decision making is of utmost importance to achieve favourable results in this intensive treatment process. The findings of this study might be useful to outline the expected course and outcome for patients. Future studies are needed to evaluate patient experience, using validated questionnaires. Finally, the present study illustrates the potential of organizing centralized care for patients with this rare complex condition within a country.

CONCLUSION

This large observational cohort study shows that surgical salvage of pelvic sepsis in a dedicated tertiary referral centre results in high rates of success, without significant differences over time. This study can raise awareness and provide further insights into the management of this challenging complication following rectal cancer resection, with several lessons learned to improve current practice.

AUTHOR CONTRIBUTIONS

Sarah Sharabiany: Writing – original draft; methodology; writing – review and editing; formal analysis; data curation; conceptualization; investigation. **Johanna J. Joosten:** Conceptualization; investigation; writing – original draft; writing – review and editing; methodology; formal analysis; data curation. **Gijsbert D. Musters:** Conceptualization; investigation; writing – original draft; methodology; writing – review and editing; formal analysis; data curation; supervision. **Kevin Talboom:** Conceptualization; investigation; writing – original draft; writing – review and editing; methodology; formal analysis; data curation. **Pieter Tanis:** Conceptualization; investigation; writing – original draft; writing – review and editing; methodology; formal analysis; data curation; supervision. **Wilhelmus A. Bemelman:** Conceptualization; investigation; writing – original draft; writing – review and editing; methodology; formal analysis; supervision; data curation. **Roel Hompes:** Conceptualization; investigation; writing – original draft; writing – review and editing; methodology; formal analysis; data curation; supervision.

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CONFLICT OF INTEREST STATEMENT

The authors declare that they have no conflict of interest.

DATA AVAILABILITY STATEMENT

The data that support the findings of this study are available from the corresponding author upon reasonable request.

ETHICS STATEMENT

This study has been approved by the medical ethical committee of the UMC—location AMC and has therefore been performed in accordance with the ethical standards laid down in the 1964 Declaration of Helsinki and its later amendments.

PATIENT CONSENT STATEMENT

The Institutional Review Board of the Academic Medical Centre in Amsterdam waived the need for informed consent.

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SUPPORTING INFORMATION

Additional supporting information can be found online in the Supporting Information section at the end of this article.

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