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Transanal Minimally Invasive Surgical Management of Persisting Pelvic Sepsis or Chronic Sinus After Low Anterior Resection

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BACKGROUND: Redo surgery of persisting pelvic sepsis or chronic presacral sinus after low anterior resection for rectal cancer is challenging. Transanal minimally invasive surgery improves visibility and accessibility of the deep pelvis.

OBJECTIVE: The aim of this study was to compare the conventional approach with transanal minimally invasive surgery for redo pelvic surgery with or without anastomotic reconstruction.

DESIGN: This is a retrospective cohort study.

SETTINGS: This study was conducted in a tertiary referral center.

PATIENTS: All consecutive patients undergoing redo pelvic surgery after low anterior resection for rectal cancer between January 2005 and March 2018 were included.

INTERVENTIONS: Redo surgery was divided into redo anastomosis and intersphincteric completion proctectomy. Transanal minimally invasive surgery procedures since November 2014 were compared with the conventional approach.

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MAIN OUTCOME MEASURES: Primary end points were procedural characteristics and 90-day major complications.

RESULTS: In total, 104 patients underwent redo surgery; 47 received a redo anastomosis (18 conventional and 29 transanal minimally invasive surgery) and 57 underwent intersphincteric completion proctectomy (35 conventional and 22 transanal minimally invasive surgery). The transabdominal part of the transanal minimally invasive surgery procedures was performed laparoscopically in 72% and 59% of redo anastomosis and intersphincteric completion proctectomy, compared with 6% and 34% in the conventional group ($p < 0.001$ and $p = 0.100$). The 90-day major complication rate was 33% and 45% after redo anastomosis ($p = 0.546$) and 29% and 41% after intersphincteric completion proctectomy ($p = 0.349$) in conventional surgery and transanal minimally invasive surgery.

LIMITATIONS: A limitation of this study is the relatively small sample size.

CONCLUSIONS: This study suggests that transanal minimally invasive surgery is a valid alternative to conventional top-down redo pelvic surgery for persisting pelvic sepsis or chronic sinus, with more often a laparoscopic approach for the abdominal part. See **Video Abstract** at <http://links.lww.com/DCR/B87>.



MANEJO QUIRÚRGICO TRANSANAL MÍNIMAMENTE INVASIVO DE LA SEPSIS PÉLVICA PERSISTENTE O DE UN SENO CRÓNICO DESPUÉS DE RESECCIÓN ANTERIOR BAJA

ANTECEDENTES: La cirugía de reoperación por sepsis pélvica persistente o un seno presacro crónico después

DISEASES OF THE COLON & RECTUM VOLUME 62: 12 (2019)

de una resección anterior baja por cáncer de recto es un desafío. La cirugía transanal mínimamente invasiva mejora la visibilidad y la accesibilidad a la región profunda de la pelvis.

OBJETIVO: El objetivo de este estudio fue comparar el abordaje convencional con la cirugía transanal mínimamente invasiva para cirugía pélvica de reoperación con o sin reconstrucción anastomótica.

DISEÑO: Este es un estudio de cohorte retrospectiva.

ESCENARIO: Este estudio se realizó en un centro de referencia terciario.

PACIENTES: Se incluyeron todos los pacientes consecutivos que se sometieron a una cirugía pélvica de reoperación después de una resección anterior baja por cáncer de recto entre enero de 2005 y marzo de 2018.

INTERVENCIONES: La cirugía de reoperación se dividió en reconstrucción de anastomosis y proctectomía interesfintérica. Los procedimientos de cirugía transanal mínimamente invasiva desde noviembre de 2014 se compararon con el abordaje convencional.

PRINCIPALES MEDIDAS DE RESULTADOS: Los puntos primarios fueron las características del procedimiento y las complicaciones mayores a 90 días.

RESULTADOS: En total, 104 pacientes fueron sometidos a cirugía de reoperación; 47 recibieron una reconstrucción de anastomosis (18 abordaje convencional y 29 cirugía transanal mínimamente invasiva) y 57 se sometieron a una proctectomía interesfintérica (35 abordaje convencional y 22 cirugía transanal mínimamente invasiva). La parte transabdominal de los procedimientos de cirugía transanal mínimamente invasiva se realizó por vía laparoscópica en el 72% y el 59% de las reconstrucciones de anastomosis y las proctectomías interesfintéricas, respectivamente, en comparación con el 6% y el 34%, respectivamente, en el grupo convencional ($p < 0.001$ y $p = 0.100$). La tasa de complicaciones mayores a los 90 días fue del 33% y del 45% después de la anastomosis de reconstrucción ($p = 0.546$) y del 29% y 41% después de la proctectomía interesfintérica ($p = 0.349$) en cirugía convencional y cirugía transanal mínimamente invasiva, respectivamente.

LIMITACIONES: La limitación de este estudio es el tamaño relativamente pequeño de la muestra.

CONCLUSIONES: Este estudio sugiere que la cirugía transanal mínimamente invasiva es una alternativa válida para la cirugía pélvica de reoperación convencional en sepsis pélvica persistente o seno crónico, con un abordaje laparoscópico utilizado más frecuentemente para la parte abdominal. Vea el Abstract del video en <http://links.lww.com/DCR/B87>.

KEY WORDS: Intersphincteric completion proctectomy; Redo anastomosis; Redo surgery; Transanal minimally invasive surgery.

Anastomotic leakage remains a significant problem following surgery for rectal cancer and has been reported to occur in up to 20% of cases following low anterior resection.¹ Anastomotic leakage mandates early management including fecal diversion, transanal or percutaneous drainage, treatment with endo-SPONGE (B. Braun Medical B.V., Melsungen, Germany), or endo-SPONGE assisted transanal closure of the anastomotic defect.² However, pelvic sepsis might persist or a symptomatic chronic sinus might ultimately develop.^{1,3}

In the fit patient, who is highly motivated to preserve bowel continuity, the leaking anastomosis can be excised and a new anastomosis constructed after further mobilization of the descending colon. In less fit patients with additional comorbidities or patients with less motivation for preservation of bowel continuity, a chronic sinus may require intersphincteric completion proctectomy (ICP) with excision of the leaking anastomosis, debridement of the abscess cavity and fistula tracts, and filling of the presacral cavity with omentoplasty to control chronic sepsis and its secondary complications.

The most distal part of the pelvic dissection deep down in the pelvis is very demanding because exposure behind the prostate or vagina is limited. The pelvic dissection removing the leaking low anastomosis is quite demanding because of inflammatory, radiation-induced, and surgical fibrotic scarring and adhesions. A recent systematic review on conventional redo surgery describes an overall success rate for redo anastomosis after pelvic sepsis of 70%, with a pooled rate of major postoperative morbidity of 16%.⁴

Since its first introduction as a technique for the resection of rectal cancer in 2010, transanal minimally invasive surgery (TAMIS) has gained popularity.⁵ Total mesorectal excision (TME) through TAMIS (TaTME) has shown to be a feasible and safe approach in comparison with conventional laparoscopic TME when considering postoperative and short-term oncological outcome.⁶⁻⁹ The strength of the TAMIS platform is the facilitated dissection deep down in the pelvis because of improved visibility and accessibility. The TAMIS platform might therefore be particularly helpful in redo surgery for the leaking anastomosis, overcoming the hazards in the deep pelvis caused by prior surgery, radiotherapy, and chronic sepsis. The aim of this study is to describe the procedural characteristics and postoperative short-term outcomes of TAMIS redo surgery after low anterior resection for rectal cancer including both redo anastomosis and ICP, and to compare these with outcomes following conventional redo pelvic surgery.

MATERIALS AND METHODS

Patients and Data Collection

All patients undergoing redo pelvic surgery after low anterior resection for rectal cancer, consisting of a redo anastomosis or ICP, were prospectively registered in our center. Conventionally, redo pelvic surgery consisted of open or laparoscopic abdominal surgery, combined with an open transanal approach. Since November 2014, the transanal part of the procedure has been performed by using TAMIS. All consecutive patients undergoing TAMIS redo surgery between November 2014 and March 2018 were compared with a consecutive cohort of patients who underwent conventional redo surgery between January 2005 and August 2016. Patients undergoing conventional redo surgery included between late 2014 and August 2016 were only patients undergoing ICP in whom adequate visualization using only a Lone Star Retractor (Cooper Surgical, Trumbull, CT) could be achieved. All indications for redo surgery were included. All patients had a primary failed anastomosis within 5 cm from the anorectal junction, both in the conventional and redo group. Patients with a primary underlying disease other than rectal cancer and patients with a follow-up of less than 90 days were excluded, not excluding patients who died within the 90-day postoperative period. Patient and treatment characteristics were retrospectively collected from patient charts. The Institutional Review Board of the Academic Medical Centre in Amsterdam approved of this study and concluded that written informed consent was not obligatory because of the retrospective data collection and anonymous analysis of data.

Surgical Technique

Redo pelvic surgery for leaking anastomosis consists of a rendezvous between a top-down abdominal phase, either open or laparoscopic, and a bottom-up transanal phase. The top-down dissection was conventionally continued toward the pelvic floor with a limited open transanal approach to complete intersphincteric dissection, followed by handsewn anastomosis in case of restoration of continuity. With the use of TAMIS, the top-down dissection can be restricted to the upper pelvis, and the bottom-up approach is extended toward the mid-pelvis. This combines the most effective parts of the 2 approaches, aiming to perform a more precise dissection and to theoretically avoid the risk of nerve injury and hemorrhage. Furthermore, this enables a 2-team approach that facilitates a complex procedure with reduction of operative time.

The abdominal phase consists of adhesiolysis, if necessary, and further mobilization of the left colon to enable sufficient reach to bring the conduit down. Preferably, the left colonic artery is preserved. The inferior mesenteric vein, which limits the reach of the efferent colon to the deep pelvis, is always ligated, if not done so during the

primary operation, and sometimes it is necessary to take down the inferior mesenteric artery as well if still present. The abdominal phase can be done open, hand-assisted, or by straight laparoscopy, depending on the extent of the adhesions and fibrosis and the presence of incisional hernia.

The operative technique for TAMIS was first elaborately described by Atallah et al⁵ in 2009 and more recently by Trépanier et al.¹⁰ TAMIS for redo anastomosis starts with installation of a Lone Star Retractor (Cooper Surgical, Trumbull, CT). A pudendal nerve block with levobupivacaine is given to optimize anal sphincter muscle relaxation, after which the single port (GelPOINT Path Transanal Access Platform, Applied Medical, Rancho Santa Margarita, CA) is introduced. There is no lower limit to what can be managed by TAMIS. In the lowest cases, dissection starts with only Lone Star retraction, followed by the GelPOINT single port when the level of the puborectal sling is passed. In most cases, a pursestring is not possible because of the limited distance between the anus and the anastomosis. The rectum is transected just below the old anastomosis, and the dissection is continued bottom-up close to the neorectum to avoid damage to the pelvic sidewall structures. After resection of the leaking anastomosis, extensive debridement of the septic pockets is necessary before pulling through the newly created afferent colon loop. The new (redo) anastomosis can either be handsewn or stapled by use of an intraluminal circular stapling device (Chex, Frankenman International Ltd, Sheung Wan, Hong Kong) depending on the length of the remaining rectal cuff. It is our practice to reinforce the stapled anastomosis with an intraluminally placed running suture Monoplus 3.0, and a diverting ileostomy may be created if not already present.

Intersphincteric completion proctectomy by TAMIS starts with an incision of the anoderm in the intersphincteric groove after installation of the Lone Star Retractor (Cooper Surgical). The dissection of the anus and rectal remnant is then continued cephalad following the intersphincteric plane until enough space is created to dock the single port (GelPOINT, Applied Medical). The rest of the dissection is done via TAMIS after creating a pneumopelvis. Once again, care is taken to stay close to the afferent colonic conduit to avoid any inadvertent damage to the surrounding vital structures. After rendezvous with the top-down mobilization, the afferent colon loop is trimmed, resecting the leaking part. An omentoplasty vascularized by either the left or right gastroepiploic artery is created, large enough to fill the pelvic cavity after extensive debridement.

Evaluation of the Redo Anastomosis

Local protocol for evaluation of the redo anastomosis in an uncomplicated postoperative course comprises an endoscopy 2 weeks postoperatively. If endoscopy shows a healed anastomosis, confirmation by CT scan with rectal contrast

is pursued. When early postoperative complications are suspected, a CT scan is the modality of first choice. If a leak is detected in either CT or endoscopy, endo-SPONGE treatment is started.

End Points and Definitions

Primary end points were procedural characteristics (ie, proportion of laparoscopy and technique of the anastomosis) and major complications, including pelvic sepsis, reinterventions, readmissions, and mortality, all within 90 days postoperatively. Bowel continuity after redo anastomosis was also assessed. Complications were only scored if they were directly related to the redo surgery. Complications were graded according to the Clavien-Dindo classification and major complications were defined as graded class 3 or higher, including all complications requiring surgical, endoscopic, or radiological intervention (grade 3), life-threatening complications requiring intensive care management (grade 4), or death (grade 5).^{11,12} Anastomotic leakage was defined as a disruption of the anastomosis, diagnosed at endoscopy, at radiological imaging, or during reoperation. Pelvic sepsis was defined as either anastomotic leakage, pelvic abscess, or fistula. Pelvic sepsis was considered *chronic* when present for at least 1 year after index surgery.

Statistical Analysis

Numerical data were presented as mean with SD and range or median with interquartile range (IQR) according to distribution. Categorical variables were presented as number and proportion in percentages. Comparison between groups for discrete variables was made by the χ^2 test, the χ^2 test for trend, or the Fisher exact test when appropriate. The independent *t* test was used to compare normally distributed continuous variables, and the Mann-Whitney *U* test was used to compare continuous variables not normally distributed. $p < 0.05$ was considered statistically significant. Analyses were performed using IBM SPSS Statistics for Windows (Version 24.0. Armonk, NY: IBM Corp).

RESULTS

In total, 104 patients undergoing redo surgery after low anterior resection for rectal cancer were included, of whom 47 received a redo anastomosis (18 via conventional technique and 29 via TAMIS) and 57 underwent redo ICP (35 via conventional technique and 22 via TAMIS). All procedures were performed by the same surgeons (W.A.B. and P.J.T.). Of the patients undergoing TAMIS, 10 (7 redo anastomosis and 3 ICP) were previously reported by Borstlap et al,¹³ who described outcomes for a group of patients undergoing redo surgery for a variety of indications via TAMIS. Also, 25 patients in the conventional ICP

group and all patients in the conventional redo anastomosis group were previously described by Musters et al¹⁴ and Westerduin et al.¹⁵ For all these patients, additional data from extended follow-up were obtained.

A total of 96 patients (92%) were referred for redo surgery from other centers. Baseline characteristics for both redo anastomosis and ICP are shown in Table 1.

Procedural Characteristics

In TAMIS redo surgery, a successful rendezvous between the top-down and bottom-up approach was achieved in all patients. An overview of procedural characteristics for redo anastomosis and ICP is presented in Table 2. The abdominal phase in the redo anastomosis group was performed with an open approach in 28% of the patients (8 of 29) in the TAMIS group and 94% (17 of 18) in the conventional group. The TAMIS bottom-up dissection enabled the top-down dissection to be done with a minimally invasive approach in a significantly higher percentage than the conventional redo procedures (72% versus 6% ($p < 0.001$)). In ICP, 41% of the patients (9 of 22) in the TAMIS group underwent an open abdominal approach, compared to 66% (23 of 35) in the conventional group. Subsequently, 13 of 22 (59%) and 12 of 35 (34%) patients undergoing TAMIS and conventional ICP had minimally invasive procedures ($p = 0.100$).

Intraoperative complications during redo anastomosis occurred in 1 patient (6%) in the conventional group and 4 patients (14%) in the TAMIS group ($p = 0.636$). In the patient in the conventional group, a full-thickness injury of the bowel was made, for which sutures were placed. In TAMIS, all 4 patients had venous bleeding requiring blood transfusion. Intraoperative complications during ICP occurred in 5 patients (14%) with the use of a conventional approach, and in 2 patients (9%) with the use of TAMIS ($p = 0.695$). In the conventional group, complications consisted of 2 bladder injuries including the ureter in one, 2 bleedings requiring transfusion and intensive care unit admission, and 1 bowel injury requiring segmental resection. After TAMIS ICP, complications were bowel perforation requiring partial resection and presacral bleeding with temporary desaturation.

In both TAMIS redo anastomosis and TAMIS ICP, all intraoperative complications could be managed by TAMIS. There were no ureter injuries diagnosed intraoperatively in TAMIS, but ureter injury was diagnosed postoperatively in 1 patient for which the patient was readmitted.

Postoperative Outcome

An overview of modalities used for the evaluation of the redo anastomosis is presented in Supplemental Table 1 (Supplemental Digital Content, <http://links.lww.com/DCR/B16>). Pelvic sepsis requiring one or more reinterventions after redo anastomosis, including endo-SPONGE treatment, transanal closure of the anastomotic leak,

TABLE 1. Baseline characteristics redo anastomosis and intersphincteric completion proctectomy

Characteristics	Redo anastomosis		<i>p</i> value	Intersphincteric completion proctectomy		
	Conventional (n = 18)	TAMIS (n = 29)		Conventional (n = 35)	TAMIS (n = 22)	<i>p</i> value
Sex, male, n (%)	13 (72)	21 (72)	1.000	23 (66)	17 (77)	0.391
Age, y, mean \pm SD (range)	55 \pm 8.4 (43–68)	59 \pm 10.4 (36–76)	0.221	64 \pm 10.3 (33–78)	68 \pm 6.7 (54–79)	0.216
BMI, kg/m ² , median (IQR)	25 (23–26)	25 (22–27)	0.974	26 (23–29)	26 (24–30)	0.737
ASA classification, n (%)						
ASA 1	11 (61)	5 (17)	0.517	9 (26)	2 (9)	0.567
ASA 2	7 (39)	22 (76)		13 (37)	14 (64)	
ASA 3	0	2 (7)	0.517	13 (37)	5 (23)	0.567
ASA 4	0	0		0	1 (4)	
Neoadjuvant radiotherapy, n (%)						
Any form	17 (94)	26 (90)	1.000	33 (94)	22 (100)	0.518
Short-course radiotherapy	9 (50)	13 (45)	0.834	23 (66)	14 (64)	0.433
Long-course chemoradiotherapy	8 (44)	13 (45)		8 (23)	7 (32)	
Index surgery, n (%)						
Low anterior resection	18 (100)	29 (100)	1.000	34 (97)	19 (86)	0.288
Hartmann procedure	0	0		1 (3)	3 (14)	
Index anastomosis, n (%)						
CRA	17 (94)	27 (93)	1.000	29 (83)	17 (77)	0.222
CAA	1 (6)	2 (7)		2 (6)	2 (9)	
None	0	0		1 (3)	3 (14)	
Time between index surgery and redo surgery						
Months, median (IQR)	16 (11–27)	16 (10–32)	0.913	42 (20–73)	46 (21–107)	0.486
At least 12 months, n (%)	10 (56)	18 (62)	0.763	34 (97)	20 (91)	0.553
Indication redo surgery, n (%)						
Pelvic sepsis	18 (100)	25 (86)	0.257	35 (100)	21 (96)	0.386
Stenosis of anastomosis	0	3 (10)		0	0	
Cancer recurrence	0	1 (3)		0	0	
Functional failure	0	0		0	1 (4)	

CAA = coloanal anastomosis; CRA = colorectal anastomosis; IQR = interquartile range; TAMIS = transanal minimally invasive surgery.

drainage of pelvic abscess, creation of a new ileostomy, and salvage surgery, was observed in 6 (33%) and 12 (41%) patients in the conventional group and TAMIS group ($p = 0.759$). An overview of postoperative outcome within 90 days after redo anastomosis and ICP is presented in Table 3. All reinterventions shown in Table 3 were performed because of pelvic sepsis, except for nephrostomy placement in 2 patients that was performed because of hydronephrosis. Three patients (17%) in the conventional group and 10 patients (29%) in the TAMIS group were readmitted one or more times within 90 days because of pelvic sepsis ($p = 0.315$). Other reasons for readmission within 90 days after redo anastomosis were ileus, high-output ileostomy, pulmonary embolism, and urosepsis.

After ICP, 6 patients in both the conventional group and the TAMIS group (29% and 41%) experienced pelvic sepsis requiring one or more reinterventions ($p = 0.506$), which led to readmission within 90 days for 2 patients in both groups (6% and 9%, $p = 0.635$). Two patients (9%) in the TAMIS group developed necrosis of the omentoplasty that required necrosectomy. Other major complications after ICP included pneumosepsis, urosepsis, and cardiac failure. Other postoperative reinterventions were negative pressure wound therapy in the TAMIS group and a diagnostic lapa-

rotomy for sepsis in the conventional group. In the latter, no focus for sepsis was found. Other reasons for readmission after ICP included wound infection and urosepsis.

There was no postoperative mortality after redo anastomosis. In the conventional ICP group, 2 patients died, one because of pneumosepsis and the other because of sepsis caused by a pelvic abscess. In the TAMIS ICP group, 1 patient died of cardiac failure.

Long-term Outcome

Median duration of follow-up in patients with a redo anastomosis was 36 months (IQR 8–42) in the conventional group and 13 months (IQR 8–20) in the TAMIS group ($p = 0.060$). In patients undergoing ICP, median duration of follow-up was 30 months (IQR 13–45) in the conventional group and 8 months (IQR 3–15) in the TAMIS group ($p < 0.001$). An extensive overview of long-term outcome beyond 90 days after redo anastomosis and ICP can be found in Supplemental Table 2 (Supplemental Digital Content, <http://links.lww.com/DCR/B17>).

After redo anastomosis, 32 of 47 patients (68%) had their bowel continuity restored at the end of follow-up: 11 patients (61%) in the conventional group and 21 patients (72%) after TAMIS ($p = 0.524$). Reason for a presence

TABLE 2. Procedural characteristics redo anastomosis and intersphincteric completion proctectomy

Characteristics	Redo anastomosis		<i>p</i> value	Intersphincteric completion proctectomy		<i>p</i> value
	Conventional (<i>n</i> = 18)	TAMIS (<i>n</i> = 29)		Conventional (<i>n</i> = 35)	TAMIS (<i>n</i> = 22)	
Duration of surgery, min, median (IQR)	286 (237–351)	322 (273–421)	0.084	263 (185–346)	308 (231–387)	0.116
Blood loss, mL, median (IQR)	300 (225–400)	350 (200–819)	0.657	630 (475–1448)	600 (210–875)	0.144
Abdominal approach, <i>n</i> (%)						
Laparoscopy	1 (6)	5 (17)		0	7 (32)	
Hand-assisted laparoscopy	0	16 (55)	<0.001	7 (20)	6 (27)	<0.001
Laparotomy	17 (94)	8 (28)		23 (66)	9 (41)	
Type of anastomosis, <i>n</i> (%)						
CAA	14 (78)	27 (93)		N/A	N/A	
CPAA	4 (22)	1 (3)	0.100	N/A	N/A	N/A
CRA	0	1 (3)		N/A	N/A	
Technique redo anastomosis, <i>n</i> (%)						
Stapled	0	18 (62)	<0.001	N/A	N/A	N/A
Handsewn	18 (100)	11 (38)		N/A	N/A	
Configuration of redo anastomosis, <i>n</i> (%)						
Side-to-end	0	19 (66)	<0.001	N/A	N/A	N/A
End-to-end	18 (100)	10 (34)		N/A	N/A	
Reinforcement of stapled anastomosis, total, <i>n</i> (%)	N/A	16/18 (89)	–	N/A	N/A	N/A
Omentoplasty, total, <i>n</i> (%)	7 (39)	6 (21)	0.169	34 (97)	21 (96)	1.000
Ostomy after redo surgery, total, <i>n</i> (%)	18 (100)	24 (83)	0.141	35 (100)	22 (100)	1.000

CAA = coloanal anastomosis; CPAA = colopouch anal anastomosis; CRA = colorectal anastomosis; IQR = interquartile range; N/A = nonapplicable; TAMIS = transanal minimally invasive surgery.

of stoma at end of follow-up was recurrent pelvic sepsis in five patients (28%) in the conventional group and 7 patients (24%) in the TAMIS group ($p = 1.000$). The remaining patient in the TAMIS group was awaiting stoma reversal at the time of analysis of the data, and the 2 remaining patients in the conventional group died before the diverting ileostomy could be reversed (Fig. 1).

DISCUSSION

This study suggests that TAMIS is a valid surgical technique for redo pelvic surgery after low anterior resection for rectal cancer in comparison with a conventional approach. By extending the transanal dissection further upward by using a TAMIS approach in addition to only Lone Star retraction, the abdominal part could be performed using laparoscopy in two-thirds of the patients.

Nonhealing of a low anastomosis after rectal cancer treatment with persisting and even progressive pelvic infectious complications is a challenging condition. In current literature, redo surgery is associated with high morbidity and success rates ranging from 66% to 100%.^{4,14–20} Within the context of a national referral center for such patients, the potential advantages of the TAMIS approach for primary surgery of rectal cancer were immediately extrapolated to redo surgery, regarding improved access and visualization and application of the double pursestring single-stapled anastomosis.

Although laparoscopy is known to be beneficial with regard to postoperative complications, it has not been

frequently described in redo surgery. Exposure of the failed anastomosis is often very challenging because of adhesions and fibrosis following (chronic) pelvic sepsis, causing the old anastomosis to be reachable only by laparotomy. In the 2 largest series reporting on conventional redo surgery, only 2 of a total of 125 patients were operated on laparoscopically.^{15,19} This study showed that TAMIS facilitates the bottom-up dissection and a laparoscopic top-down approach of the leaking anastomosis with complete debridement of the septic foci, making a rendezvous at the level of the vesicles or top of the vagina possible in all patients. A total of 67% of patients received a fully laparoscopic or hand-assisted approach in TAMIS redo surgery. This might also be explained in part by the increased experience of the surgeons with both redo surgery and laparoscopy. Laparoscopy improves patient outcome compared with laparotomy, in general, by reducing wound infection and postoperative complications, minimizing scars with associated incisional hernias, and reducing postoperative hospital stay and time to first defecation.^{21–24} The increased visibility and exposure of the leaking anastomosis provided by TAMIS might also cause more patients to be eligible for a redo anastomosis. These are reasons that TAMIS is the preferred technique for redo procedures in our institution since its introduction late 2014. However, the theoretical advantages regarding bleeding complications and reduced operative time by the 2-team approach were not observed in this study. There was even slightly more blood loss and increased operative time, probably related to more complex cases in recent years.

TABLE 3. Ninety-day postoperative outcome after redo anastomosis and intersphincteric completion proctectomy

Outcomes	Redo anastomosis		<i>p</i> value	Intersphincteric completion proctectomy		<i>p</i> value
	Conventional (<i>n</i> = 18)	TAMIS (<i>n</i> = 29)		Conventional (<i>n</i> = 35)	TAMIS (<i>n</i> = 22)	
Length of hospital stay, days, median (IQR)	8 (6–11)	7 (5–8)	0.129	9 (6–14)	9 (5–20)	0.786
Major complications						
Patients, <i>n</i> (%)	6 (33)	13 ^a (45)	0.546	10 (29)	9 (41)	0.394
Pelvic sepsis	6	12		6	6	
Necrosis of omentoplasty	0	0		0	2	
Ileus	0	0		4	0	
Wound infection	0	0		1	1	
Other	0	2		2	1	
Reinterventions						
Patients, <i>n</i> (%)	6 (33)	13 (45)	0.546	9 (26)	8 (36)	0.553
Endo-SPONGE treatment	13	55		3	0	
Endoscopic clip of anastomotic leak	0	1		N/A	N/A	
Transanal closure of anastomotic leak	2	6		N/A	N/A	
Percutaneous drainage of pelvic abscess	4	4		7	8	
Surgical drainage of pelvic abscess	0	1		0	1	
Creation of new ileostomy	0	2		N/A	N/A	
Redo-redo anastomosis	0	2		N/A	N/A	
Completion proctectomy + colostomy	0	2		N/A	N/A	
Necrosectomy of omentoplasty	0	0		0	2	
Surgical exploration for ileus	0	0		4	0	
Exploration of necrotizing fasciitis	0	0		2	0	
Other	0	2		1	1	
Readmissions						
Patients, <i>n</i> (%)	3 (17)	12 (41)	0.111	5 (14)	4 (18)	0.722
Pelvic sepsis	3	15		2	2	
Ileus	0	0		4	0	
Other	0	5		1	2	
Mortality, total, <i>n</i> (%)	0	0	-	2 (6)	1 (5)	1.000

Postoperative outcome is defined as events occurring within 90 days postoperatively. Major complications are defined as scored grade 3 or higher according to the Clavien-Dindo classification.

IQR = interquartile range; N/A = nonapplicable; TAMIS = transanal minimally invasive surgery.

^a One patient had 2 major complications.

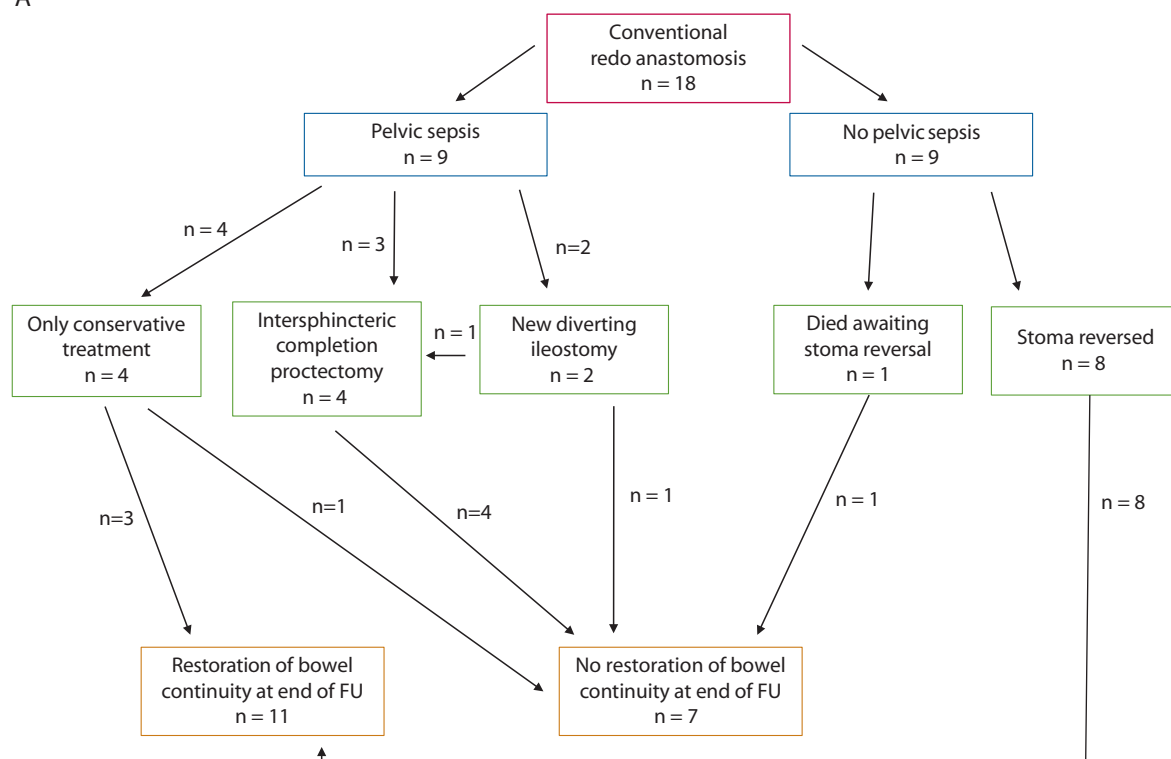
With the use of TAMIS, it is also possible to leave a sufficient rectal cuff to enable a stapled anastomosis (62% vs 0%) instead of a handsewn anastomosis in more patients. With the use of a conventional approach, the open transanal technique does not allow for transection of the rectum above the anorectal junction, leaving insufficient rectum to create a stapled coloanal anastomosis. Whether this has a potential positive impact on functional outcome is yet to be determined. A nonsignificant higher proportion of bowel continuity after TAMIS redo procedures was observed, and some of the surgeries might not have been possible without TAMIS. However, it is difficult to definitively conclude on the additive value of TAMIS based on the present comparative cohort study.

Recurrent pelvic sepsis is an important problem in redo surgery for pelvic sepsis. This study shows a recurrent pelvic sepsis rate of 30% within 90 days. This provides an explanation for the frequent use of CT in the early postoperative period. This practice is in contrast to the current protocol in our center, in which endoscopy is described as a first modality for evaluation of the redo anastomosis.

Endoscopy is now more frequently used as a confirmatory test of continuity after prior CT.

Recurrent pelvic abscess still constitutes a problem after resection of the anastomosis and debridement of the septic foci. Complication rates and rates of reinterventions after TAMIS were similarly high compared with the conventional group. These results are also comparable to numbers in the literature reporting on conventional redo surgery, reflecting the difficult underlying condition.^{14,15,17,19} Apparently, technical improvements and increased experience have not yet lowered major complication rates. What we have learned over time is that immediate salvage treatment (<90 days) in case of failure of the redo anastomosis is better, explaining the difference in early reinterventions. Despite the poor outcomes when considering redo anastomosis, it is important to realize that our institution serves as a referral center for patients who have anastomotic leakage and chronic sinus. These patients have often been treated in referring hospitals without expertise, and a redo anastomosis is probably their last chance to preserve bowel continuity. In this complex type of surgery, complications are expected, but

A



B

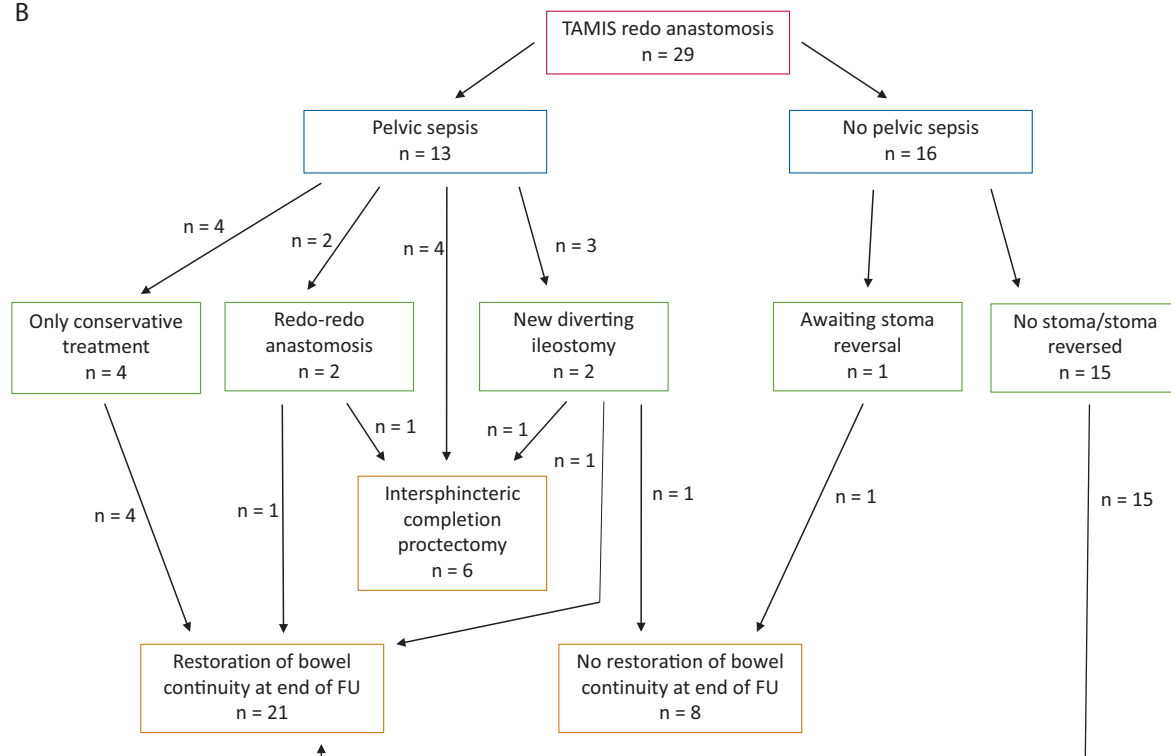


FIGURE 1. Fate of the redo anastomosis. A, Conventional redo anastomosis. B, TAMIS redo anastomosis. The figure includes pelvic sepsis and reinterventions at any time during follow-up. FU = follow-up; TAMIS = transanal minimally invasive surgery.

highly motivated patients should not be precluded from a chance to live without a stoma.

A limitation of this study is the relatively small sample size, which causes limited possibility for statistical analysis. However, to our knowledge, this is the largest cohort describing TAMIS as a technique for redo surgery so far. This can be explained by the overall rarity of redo surgery after failed colorectal or coloanal anastomosis and the slow implementation of TAMIS for benign conditions. This study is a valuable addition to the scarce literature available on redo surgery, and it shows the value of the TAMIS surgical platform to approach complex problems deep down in the pelvis.

REFERENCES

1. Borstlap WAA, Westerduin E, Aukema TS, Bemelman WA, Tanis PJ; Dutch Snapshot Research Group. Anastomotic leakage and chronic presacral sinus formation after low anterior resection: results from a large cross-sectional study. *Ann Surg*. 2017;266:870–877.
2. Blumetti J, Abcarian H. Management of low colorectal anastomotic leak: Preserving the anastomosis. *World J Gastrointest Surg*. 2015;7:378–383.
3. Sloothaak DA, Buskens CJ, Bemelman WA, Tanis PJ. Treatment of chronic presacral sinus after low anterior resection. *Colorectal Dis*. 2013;15:727–732.
4. Westerduin E, Klaver CEL, van Geloven AAW, Westerterp M, Bemelman WA, Tanis PJ. Outcome after redo surgery for complicated colorectal and coloanal anastomosis: a systematic review. *Dis Colon Rectum*. 2018;61:988–998.
5. Atallah S, Albert M, Larach S. Transanal minimally invasive surgery: a giant leap forward. *Surg Endosc*. 2010;24:2200–2205.
6. Ma B, Gao P, Song Y, et al. Transanal total mesorectal excision (taTME) for rectal cancer: a systematic review and meta-analysis of oncological and perioperative outcomes compared with laparoscopic total mesorectal excision. *BMC Cancer*. 2016;16:380.
7. Simillis C, Hompes R, Penna M, Rasheed S, Tekkis PP. A systematic review of transanal total mesorectal excision: is this the future of rectal cancer surgery? *Colorectal Dis*. 2016;18:19–36.
8. Xu W, Xu Z, Cheng H, et al. Comparison of short-term clinical outcomes between transanal and laparoscopic total mesorectal excision for the treatment of mid and low rectal cancer: a meta-analysis. *Eur J Surg Oncol*. 2016;42:1841–1850.
9. Penna M, Hompes R, Arnold S, et al; TaTME Registry Collaborative. Transanal total mesorectal excision: international registry results of the first 720 cases. *Ann Surg*. 2017;266:111–117.
10. Trépanier JS, Fernandez-Hevia M, Lacy AM. Transanal total mesorectal excision: surgical technique description and outcomes. *Minim Invasive Ther Allied Technol*. 2016;25:234–240.
11. Clavien PA, Barkun J, de Oliveira ML, et al. The Clavien-Dindo classification of surgical complications: five-year experience. *Ann Surg*. 2009;250:187–196.
12. Dindo D, Demartines N, Clavien PA. Classification of surgical complications: a new proposal with evaluation in a cohort of 6336 patients and results of a survey. *Ann Surg*. 2004;240:205–213.
13. Borstlap WA, Harran N, Tanis PJ, Bemelman WA. Feasibility of the TAMIS technique for redo pelvic surgery. *Surg Endosc*. 2016;30:5364–5371.
14. Musters GD, Borstlap WA, Bemelman WA, Buskens CJ, Tanis PJ. Intersphincteric completion proctectomy with omentoplasty for chronic presacral sinus after low anterior resection for rectal cancer. *Colorectal Dis*. 2016;18:147–154.
15. Westerduin E, Borstlap WAA, Musters GD, et al. Redo coloanal anastomosis for anastomotic leakage after low anterior resection for rectal cancer: an analysis of 59 cases. *Colorectal Dis*. 2018;20:35–43.
16. Genser L, Manceau G, Karoui M, et al. Postoperative and long-term outcomes after redo surgery for failed colorectal or coloanal anastomosis: retrospective analysis of 50 patients and review of the literature. *Dis Colon Rectum*. 2013;56:747–755.
17. Lefevre JH, Bretagnol F, Maggiori L, Ferron M, Alves A, Panis Y. Redo surgery for failed colorectal or coloanal anastomosis: a valuable surgical challenge. *Surgery*. 2011;149:65–71.
18. Maggiori L, Blanche J, Harnoy Y, Ferron M, Panis Y. Redo-surgery by transanal colonic pull-through for failed anastomosis associated with chronic pelvic sepsis or rectovaginal fistula. *Int J Colorectal Dis*. 2015;30:543–548.
19. Pitel S, Lefèvre JH, Tiet E, Chafai N, Parc Y. Redo coloanal anastomosis: a retrospective study of 66 patients. *Ann Surg*. 2012;256:806–810.
20. Schlegel RD, Dehni N, Parc R, Caplin S, Tiet E. Results of reoperations in colorectal anastomotic strictures. *Dis Colon Rectum*. 2001;44:1464–1468.
21. Vennix S, Pelzers L, Bouvy N, et al. Laparoscopic versus open total mesorectal excision for rectal cancer. *Cochrane Database Syst Rev*. 2014;(4):CD005200.
22. Hida K, Okamura R, Sakai Y, et al; Japan Society of Laparoscopic Colorectal Surgery. Open versus laparoscopic surgery for advanced low rectal cancer: a large, multicenter, propensity score matched cohort study in Japan. *Ann Surg*. 2018;268:318–324.
23. Zhang X, Wu Q, Gu C, Hu T, Bi L, Wang Z. Hand-assisted laparoscopic surgery versus conventional open surgery in intraoperative and postoperative outcomes for colorectal cancer: an updated systematic review and meta-analysis. *Medicine (Baltimore)*. 2017;96:e7794.
24. van der Pas MH, Haglind E, Cuesta MA, et al; COLOrectal cancer Laparoscopic or Open Resection II (COLOR II) Study Group. Laparoscopic versus open surgery for rectal cancer (COLOR II): short-term outcomes of a randomised, phase 3 trial. *Lancet Oncol*. 2013;14:210–218.