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Postoperative and long-term outcomes of nerve-sparing segmental rectal resection and complete nodular resection of rectal endometriosis

Harald Krentel[1-3], Antoine Naem[4,5], Argyrios Andrikos[6], Katharina Otto[7], Simon Schimmack[8], Rudy Leon De Wilde[2], Jörg Keckstein[9], Petya Tanovska[1], Dimitrios Andrikos[3]

[1]Department of Gynaecology, Obstetrics and Gynaecological Oncology, Klinikum Aschaffenburg-Alzenau, Aschaffenburg, Germany
[2]Clinic of Gynaecology, Obstetrics and Gynaecological Oncology, University Hospital for Gynaecology, Pius-Hospital Oldenburg, Medical Campus University of Oldenburg, Oldenburg, Germany
[3]Department of Gynaecology, Obstetrics and Gynaecological Oncology, Bethesda Krankenhaus, Duisburg, Germany
[4]Central Surgical Unit, St. Joseph-Stift Hospital, Bremen, Germany
[5]Faculty of Mathematics and Computer Science, University of Bremen, Bremen, Germany
[6]Department of Senology, Interdisciplinary Breast Center, Sana Kliniken Duesseldorf, Duesseldorf, Germany
[7]Department of Obstetrics and Gynaecology, Helios Klinikum Berlin-Buch, Berlin, Germany
[8]Department of General and Visceral Surgery, Bethesda Hospital Duisburg, Duisburg, Germany
[9]Endometriosis Clinic Dres. Keckstein, Villach, Austria

ABSTRACT

Background: Rectal endometriosis is a severe form of deep endometriosis affecting up to 12% of patients, causing significant pain and bowel dysfunction. The optimal surgical approach can be individually tailored based on lesion size and localization as assessed by preoperative imaging.

Objectives: To compare the postoperative and long-term clinical results of two alternative surgical approaches to symptomatic rectal endometriosis.

Methods: A retrospective single-centre study of 115 patients who had surgical resection of rectal endometriosis either by complete nodular resection (CNR) (n=55) or segmental rectal resection (SRR) (n=60). The surgical approach was indicated based on #Enzian related presurgical transvaginal sonography. #Enzian C1-2 lesions were planned for CNR, and #Enzian C3 lesion for SRR. Postoperative pain and satisfaction data were collected.

Main Outcome Measures: Satisfaction and change in pre-operative and post-operative pain symptoms and overall improvement in symptoms, urinary and bowel dysfunction measured at follow-up and complications following surgery.

Results: 68/115 (59%) women provided follow up data. There were significant reductions in dysmenorrhoea, dyspareunia and dyschezia following surgical resection compared to pre-operative levels in both groups ($P \leq 0.001$). Patients treated with CNR had significantly lower postoperative defecation dysfunction compared to SRR (12.1% vs. 42.9%, $P=0.007$) and lower postoperative C-reactive protein (CRP) levels ($P<0.001$), but satisfaction and complication rates were comparable between the two surgical approaches. One case of leakage occurred following SRR and no cases of fistulisation or bowel stenosis were observed.

Conclusions: CNR and SRR are both safe and effective in treating symptomatic rectal endometriosis. CNR may be associated with lower postoperative defecation dysfunction rates and lower postoperative CRP levels.

Corresponding Author: Prof. Harald Krentel, MD, Department of Gynaecology, Obstetrics and Gynaecological Oncology, Klinikum Aschaffenburg-Alzenau, Aschaffenburg; Clinic of Gynaecology, Obstetrics and Gynaecological Oncology, University Hospital for Gynaecology, Pius-Hospital Oldenburg, Medical Campus University of Oldenburg, Oldenburg; Department of Gynaecology, Obstetrics and Gynaecological Oncology, Bethesda Krankenhaus, Duisburg, Germany
E-mail: krentel@cegpa.org **ORCID ID:** orcid.org/0000-0002-1238-9207

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ABSTRACT

What is New? Complete nodular mucosa-sparing resection of rectal endometriosis seems to be feasible and potentially efficacious in lesions up to 3 cm. Compared to SRR, CNR may be associated with less post-operative defecation dysfunction.

Keywords: Endometriosis, rectum, defecation, rectal surgical procedures, transvaginal ultrasonography, laparoscopy

Introduction

Intestinal endometriosis is a less common form of deep endometriosis, as it affects 8-12% of patients with deep disease.[1] Intestinal endometriosis is only diagnosed when the muscularis layer of the bowel wall is invaded by the endometriotic lesions.[2] Rectal endometriosis can cause dyschezia, defecation dysfunction and a variety of symptoms including diarrhea, obstipation, bloating and nausea. Medical treatment might be able to control these symptoms and in some patients rectal endometriosis can be asymptomatic.[3] In such cases, surgical resection can be avoided and imaging can be used to follow-up the lesions.[4,5] Persistence of symptoms under medical treatment, bowel dysfunction or infertility despite reproductive treatments are indications for the surgical removal of rectal endometriosis. Three different surgical techniques have been reported: rectal shaving, discoid excision, and segmental rectal resection (SRR).[6]

The preoperative assessment of disease complexity can be performed by transvaginal ultrasonography (TVUS) and/or magnetic resonance imaging (MRI).[7] Nonetheless, the final treatment decision is confirmed intraoperatively. A meta-analysis of seventeen studies including 2,861 patients showed that SRR is related to a lower recurrence rate when compared to rectal shaving, while shaving is related to a lower risk of stoma formation and rectal stenosis. The comparison of discoid excision and colorectal resection showed no difference in recurrence rates, complications and functional outcomes.[8] The term "rectal shaving" has been widely adopted in the literature. An international consensus-based terminology considered shaving as a partial thickness excision, without entering the lumen but requiring suture of the bowel. Lesions located on the peritoneal surface of the rectum are considered peritoneal endometriosis and not rectal endometriosis.[9] However, different types of excision on the rectal wall are referred to as "shaving" in published literature. For this reason, we prefer to use the term "Complete Nodular Resection (CNR)" instead. We aim with this work to present our single-center experience in indicating either CNR or SRR for symptomatic rectal endometriosis in accordance with lesion size based on presurgical imaging and to evaluate the postoperative and long-term outcomes of both techniques.

Methods

Study Design

This is a single-centre retrospective cohort study that aims to investigate the outcomes of the surgical management of rectal endometriosis. The study included endometriosis patients who were admitted to and operated on at the Department of Obstetrics, Gynecology and Gynecological Oncology of Bethesda Hospital (Duisburg, Germany) between 2020 and 2022.

Ethical Considerations

This study adheres to the guidelines of the Committee on Publications Ethics and conforms with the ethical standards of the Declaration of Helsinki (2013). All included participants granted written patient consent regarding the study's procedures and the use of their anonymized medical data for research purposes. The study protocol was reviewed and approved by an Independent Ethical Review Board of Bethesda Hospital Duisburg and Evangelic Hospital Duisburg Niederrhein the 19th of June 2023 under the number IR-12-2023.

Patient Characteristics

We included in this study all patients with imaging-based and histologically proven diagnosis of rectal endometriosis. Twenty-seven patients were diagnosed by TVUS or MRI with rectal endometriosis but were treated conservatively. To better characterize the presentation of rectal endometriosis, their data were pooled with the entire cohort for the general descriptive analysis but excluded from the main analysis. The main analysis included all patients who were managed surgically by means of CNR or SRR. The decision about the specific surgical procedure was based on the lesion size according to the #Enzian C1-C3 classification in imaging and made before the intervention. In case of lesions larger than 3 cm and multiple lesions, we opted for SRR. In case of intraoperative additional findings, the pre-operative plan was adopted accordingly. The goal of all

surgeries was the complete excision of the lesions. Rectal endometriosis was defined by disease infiltration of the muscularis layer. Discoid excision of rectal endometriosis was not performed in this cohort as we opted for CNR instead of disc excision. We excluded from the main analysis: 1) patients with rectal endometriosis diagnosed by imaging who were treated medically, 2) patients with rectal endometriosis who were operated on for deep endometriosis but declined bowel surgery and 3) patients without a histologically evident endometriotic invasion of the bowel musculature.

Surgical Management

All patients were managed with comparable surgical strategies, either CNR or SRR, by a multidisciplinary team with more than 10 years of experience in the management of colorectal endometriosis. All the surgical procedures have been carried out laparoscopically under general anesthesia with the patients in the dorsal lithotomy position. Endometriosis is classified surgically according to the #Enzian classification. The distance of the nodules from the anal verge was >7 cm in all included cases.

Complete Nodular Resection

The rectal nodule is mapped based on the preoperative imaging and intraoperative palpation with atraumatic graspers. The laparoscopic excision of the nodule is performed by using cold scissors and monopolar energy using the laparoscopic high-frequency needle (KARL STORZ, Tuttlingen, Germany). The muscular layer of the anterior rectal wall is dissected gradually and carefully until macroscopically healthy endometriosis-free margins are reached, and the mucosa is exposed underneath. The nodule is then separated from the mucosa. When necessary, haemostasis is achieved with punctual bipolar energy using short activation. The integrity of the rectal mucosa is examined through air leak test. The healthy intact mucosa bulges through the iatrogenic defect of the rectal musculature forming the "bubble-like sign". Finally, the rectal wall is closed by a transversal single layer suture using absorbable 3-0 barbed suture (V-Loc, Medtronic, Germany) (Figures 1-3). In case of accidental opening of the mucosa, a separate mucosal suture with a 5-0 PDS suture is necessary. To ensure the consistency of the rectal wall, the air leak test is repeated after filling the posterior cul-de-sac with normal saline. It is noteworthy that this technique is applicable in cases with more than one lesion if the distance between bowel lesions is at least >3 cm.

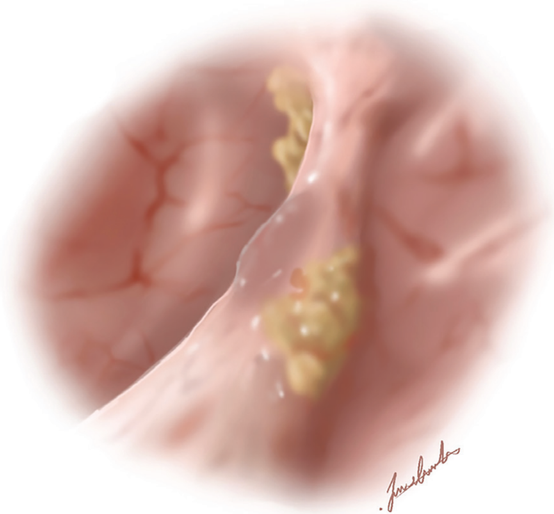

Figure 1. #Enzian C2 lesion of the anterior rectal wall; design Johan S. Krentel.

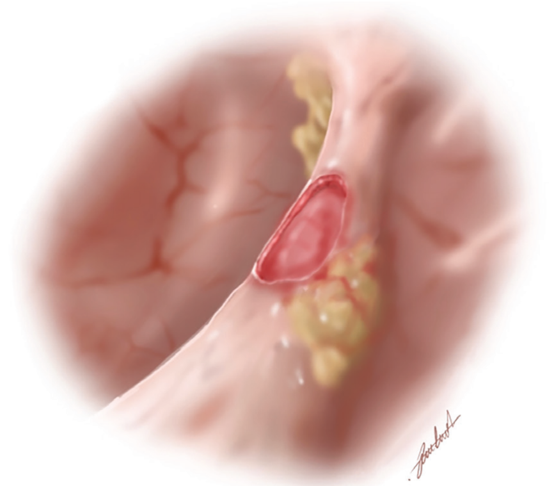

Figure 2. Rectum after mucosa-sparing excision of the endometriotic nodule, design Johan S. Krentel.

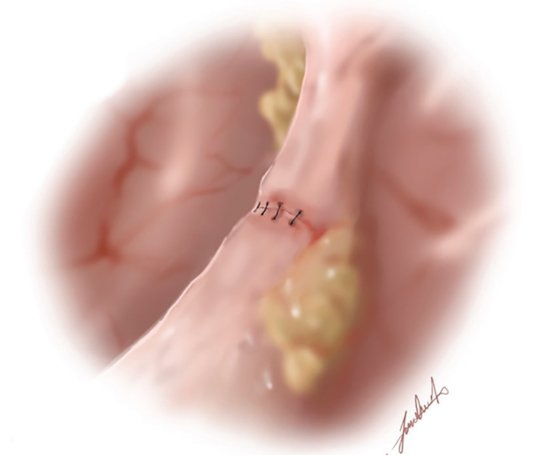

Figure 3. Rectum after transversal continuous suturing of musculature and serosa, design Johan S. Krentel.

Segmental Rectal Resection

In all cases of SRR, we mobilised the inferior part of the descending colon, the sigmoid colon, and the rectum by accessing the pararectal spaces. The neurovascular structures were carefully preserved by tubular preparation, and the blood supply of the rectum was skeletonized and coagulated according to the anatomical position and length of the resected rectal segment. All segments were resected as short as possible in accordance to the lesions. After laparoscopic stapling the tissue extraction and insertion of anvil were performed via suprapubic minilaparotomy in all cases of this cohort. After anastomosis with circular stapler the integrity was checked via rigid rectal endoscopy and air leak test as a standard procedure of the colorectal surgeons.

Data Collection and Follow-up

The electronic medical records of the included patients were retrospectively reviewed and data regarding their demographics, medical, and surgical history were extracted. All patients were followed up via phone calls and asked to complete a questionnaire regarding their pre- and postoperative symptomatology, and their overall satisfaction. Time to follow-up was 27.2±11.4 month (CNR) and 28.7±10.9 month (SRR). To assess overall improvement in the patient's postoperative symptoms and quality of life, the Patient Global Impression of Improvement (PGI-I) index was implemented. Urinary and bowel dysfunction were defined as impairment of function compared to the preoperative situation and included missing sensation of bladder filling, incomplete voiding or loss of voiding function, and diarrhoea, constipation and defecation frequency.

Statistical Analysis

Descriptive statistics were used. The distribution of continuous data was assessed using the Shapiro-Wilk test. Normally distributed data were expressed as means ± standard deviation while non-normally distributed data were expressed as medians with interquartile ranges. Categorical data were presented as frequencies and valid percentages. The paired Student's t-test and Wilcoxon signed-rank test were used to compare means and medians of paired samples. Student's t-test and Mann-Whitney U test were used to compare the means and medians of normally and non-normally distributed data, respectively. Chi-square test and Fisher's exact test were used to compare categorical data, as appropriate. The level of significance was set at $P<0.05$. All analyses were carried out using the Statistical Package for Social Sciences (SPSS) software, version 25.0 (SPSS, Chicago, IL, USA).

Results

General Characteristics

A total of 1,226 endometriosis patients were admitted to our department between during the study period. Out of these, 142 patients were diagnosed with rectal endometriosis, making its prevalence 11.5% at our centre. Twenty-seven patients (19%) were not operated on due to being either asymptomatic or unwilling to undergo major bowel surgery and thus were excluded from the main analysis.

In all included patients we performed a complete excision of peritoneal and deep endometriosis. The overall Clavien-Dindo grade III-IV complication rate was 7%. We did not perform any preventive stoma in this cohort. It is noteworthy that more than half of the patients, regardless of their surgical management, underwent at least one previous endometriosis surgery.

Complete Nodular Resection vs. Segmental Rectal Resection

Out of 115 patients who underwent surgery for colorectal endometriosis, 60 patients were managed with SRR (52.2%) and 55 patients were managed with CNR (47.8%). The mean age at presentation of the SRR group and CNR group was comparable. The infertility rate was higher among patients who underwent SRR compared to patients who underwent CNR (71.7% vs. 52.9%, $P=0.048$). Otherwise, both groups were comparable in terms of their demographics, obstetric, and surgical history.

Patients who underwent SRR and CNR presented with similar symptomatology, with dysmenorrhea being the most common complaint in both groups. However, dyschezia was significantly more frequent in the SRR group than the CNR group (60.0 % vs. 30.9%, $P=0.002$). Table 1 presents patients' general characteristics, symptomatology, surgical findings and a detailed comparison between both study groups in terms of their characteristics, symptoms, and laboratory values.

In accordance with the presurgical indication based on lesion size, the #Enzian classification C3 was significantly more prevalent in the SRR group (73.3% vs. 1.8%), and #Enzian C1-C2 lesions were more common in the CNR group (98.2% vs. 26.7%, $P<0.001$). Our data revealed

a significant association between large endometriotic nodules of the rectovaginal septum/vagina and the rectum. Patients with #Enzian classification C3 were more frequently diagnosed with large rectovaginal nodules (#Enzian A3) in comparison with patients with smaller rectal nodules who had smaller nodules of the rectovaginal septum as well (65.9% vs. 33.8%, *P*=0.001). The rate of additional bowel endometriosis in non-rectal bowel localisations (appendix, sigmoid colon, coecum, small bowel; #Enzian FI) was significantly higher in the segmental resection group than in the CNR group (33.3 % vs. 12.9 %, *P*=0.009).

The postoperative CRP levels at day 1 (3.64 vs. 1.22 mg/dL, *P*<0.001), day 2 (3.95 vs. 1.01 mg/dL, *P*<0.001) and day 3 (2.43 vs. 1.02 mg/dL, *P*=0.001) were significantly higher in patients with SRR than those with CNR. The Clavien-Dindo grade I-II (13.3% vs. 14.5%) complication rates were comparable between both groups. The Clavien-Dindo grade III-IV complication rates reached 13,3% in the segmental resection group and 3.6% in the CNR group. However, this was not a statistically significant finding. Most of the grade III complications were related to hematoma and local infection of the vaginal cuff when simultaneous hysterectomy was performed. The detailed complications are listed in Supplementary Table 1. It is noteworthy that out of 115 patients who underwent surgery for rectal endometriosis, only 1 case of leakage was documented (0.87%) in the SRR group, while fistulisation or stenosis of the anastomosis did not occur at all. In only 1 case of CNR an accidental opening of the mucosa occurred (1.8%), that was treated with a separate mucosal suture.

Table 1. The general characteristics, symptomatology and surgical findings of patients who underwent complete nodular resection or segmental rectal resection for deep endometriosis.

	CNR (n=55)	**SRR (n=60)**	***P***
General characteristics (n=115)			
Age (years)	35.7±7.6	33.5±5.9	0.09
Previous gynecologic operation (%)	29 (48.3%)	37 (69.8%)	0.109
Abortions (%)	8 (16.7%)	4 (7.1%)	0.13
Infertility (%)	27 (52.9%)	38 (71.7%)	**0.048**
Preoperative symptomatology			
Constipation (%)	7 (12.7%)	11 (18.3%)	0.409
Hematochezia (%)	3 (5.5%)	8 (13.3%)	0.151
Surgical findings			
#Enzian P (%)	47 (85.5%)	59 (98.3%)	**0.013**
#Enzian O (left) (%)	19 (34.5%)	14 (23.7%)	0.203
#Enzian O (right) (%)	18 (32.7%)	19 (31.7%)	0.9
#Enzian T (left) (%)	14 (25.9%)	24 (42.1%)	0.07
#Enzian T (right) (%)	14 (25.9%)	18 (31%)	0.55
#Enzian A (%)	45 (81.8%)	56 (93.3%)	0.059
#Enzian A1-2	32 (71.1%)	21 (37.5%)	**0.001**
#Enzian A3	13 (28.9%)	35 (62.5%)	
#Enzian B (left) (%)	46 (83.6%)	55 (91.7%)	0.18
#Enzian B (right) (%)	36 (65.5%)	47 (78.3%)	0.12
#Enzian C (%)			
#Enzian C1-2	54 (98.2%)	16 (26.7%)	**<0.001**
#Enzian C3	1 (1.8%)	44 (73.3%)	
#Enzian FI (%)	7 (12.7%)	20 (33.3%)	**0.009**
#Enzian FU (%)	0 (0%)	2 (3.3%)	0.49
#Enzian FA (%)	27 (51.9%)	28 (47.5%)	0.63

Continuous data is presented as means ± standard deviations or medians with interquartile ranges, as appropriate. Categorical data is presented as frequencies and percentages. CNR: Complete nodular resection, SRR: Segmental rectal resection.

Outcomes

We managed to gain contact with 68 patients for the follow-up, which makes the follow-up rate 59.1%. The median duration of follow-up is 24.5 months. Neither the follow-up rates nor the durations of follow-up were different between both study groups (Table 2).

The postoperative NRS scores for dysmenorrhea, dyspareunia, and dyschezia were significantly reduced among the entire cohort as well as within each study group (Table 3). The median reduction in NRS in dysmenorrhea, dyspareunia and dyschezia was numerically higher in the CNR group, without reaching statistical significance.

Table 2. Clinical outcomes for 68/115 women who were operated for rectal endometriosis and provided follow up data.

	Total (n=68)	**CNR (n=33)**	**SRR (n=35)**	***P* value**
Follow-up overview				
Follow-up rate (%)	68 (59.1%)	33 (60.0%)	35 (58.3%)	1.000
Duration of follow-up (months)	24.5 (17)	27.2±11.4	28.7±10.9	0.590
Postoperative pain [NRS, median (IQR)]				
Dysmenorrhea NRS	1 (4.75)	0 (3.5)	2 (5)	0.230
Dyspareunia NRS	1 (4)	0.5 (4)	1 (4.5)	0.520
Dyschezia NRS	0 (2)	0 (2)	1 (2)	0.300
Postoperative urinary dysfunction				
Urinary dysfunction (%)	11 (16.2%)	4 (12.1%)	7 (20.0%)	0.510
Temporary	10 (90.9%)	4 (100%)	6 (85.7%)	1.000
Permanent	1 (9.1%)	0 (0%)	1 (14.3%)	
Postoperative defecation dysfunction				
Defecation dysfunction (%)	19 (27.9%)	4 (12.1%)	15 (42.9%)	**0.007**
Temporary	6 (31.6%)	4 (100%)	2 (13.3%)	**0.004**
Permanent	13 (68.4%)	0 (0%)	13 (86.7%)	
Additional outcomes				
Postoperative hormonal therapy (%)	38 (55.9%)	22 (66.7%)	16 (45.7%)	0.820
Rate recommending surgery (%)	65 (95.6%)	31 (93.9%)	34 (97.1%)	0.600
Patient Global Impression of Improvement (PGI-I)				
Very much better	27 (39.7%)	12 (36.4%)	15 (42.9%)	0.900
Much better	22 (32.4%)	11 (33.3%)	11 (31.4%)	
Slightly better	14 (20.6%)	7 (21.2%)	7 (20.0%)	
No change	4 (5.9%)	2 (6.1%)	2 (5.7%)	
Slightly worse	0 (0%)	0 (0%)	0 (0%)	
Much worse	1 (1.5%)	1 (3.0%)	0 (0%)	
Very much worse	0 (0%)	0 (0%)	0 (0%)	
		CNR (n=55)	**SRR (n=60)**	***P* value**
Perioperative outcomes				
Clavien-Dindo grade I-II complications (%)		8 (14.5%)	8 (13.3%)	0.851
Clavien-Dindo grade III complications (%)		2 (3.6%)	8 (13.3%)	0.097
Postoperative day 1 CRP (mg/dL)		1.22 (1.8)	3.64 (3.11)	**<0.001**
Postoperative day 2 CRP (mg/dL)		1.01 (1.86)	3.95 (4.56)	**<0.001**
Postoperative day 3 CRP (mg/dL)		1.02 (1.4)	2.43 (3.41)	**0.001**

Continuous data is presented as means ± standard deviations or medians with interquartile ranges, as appropriate. Categorical data is presented as frequencies and percentages. CNR: Complete nodular resection, SRR: Segmental rectal resection, NRS: Numeric rating scale, IQR: Interquartile range, CRP: C-reactive protein.

Table 3. A comparison between the pre- and postoperative pain levels among patients who were operated on for rectal endometriosis. The data is presented as medians with interquartile ranges.

Symptom	Preoperative NRS score	Postoperative NRS score	*P* value
The entire cohort (n=68)			
Dysmenorrhea	9 (2.75)	1 (4.75)	**<0.001**
Dyspareunia	6 (7.25)	1 (4)	**<0.001**
Dyschezia	5 (8)	0 (2)	**<0.001**
Complete nodular resection (n=33)			
Dysmenorrhea	8 (2.5)	0 (3.5)	**<0.001**
Dyspareunia	6 (8)	0.5 (4)	**0.001**
Dyschezia	5 (7)	0 (2)	**0.001**
Segmental rectal resection (n=35)			
Dysmenorrhea	9 (2)	2 (5)	**<0.001**
Dyspareunia	5 (6.25)	1 (4.5)	**0.001**
Dyschezia	5 (7)	1 (2)	**<0.001**

Continuous data are presented as means ± standard deviations or medians with interquartile ranges, as appropriate. Categorical data is presented as frequencies and percentages. NRS: Numerical rating scale.

Most patients reported significant improvement in their symptoms postoperatively, while four patients (5.9%) reported no change and one patient (1.5%) reported worsening of the symptoms. More than half of the patients used postoperative hormonal therapy (55.9%). It is noteworthy that the postoperative pain scores for all three symptoms were not significantly different between patients with and without postoperative hormonal therapy (data not shown). The postoperative urinary and defecation dysfunction rates are 16.2% and 27.9%, respectively. The postoperative defecation dysfunction rate was significantly higher among patients who received SRR in comparison to those with CNR (42.9% vs. 12.1%, *P*=0.007). Otherwise, the follow-up outcomes and satisfaction rates were comparable among both study groups (Table 1).

A total of 19 patients reported to have a negative postsurgical change in defecation and bowel function. Fifteen of these patients underwent segmental resection for large rectal nodules. Six patients reported a temporary dysfunction. The other 13 patients reported either a higher defecation frequency or constipation. Out of 11 patients who reported postoperative urinary dysfunction, 1 patient had a urinary infection that was successfully treated with antibiotics and 9 patients reported a temporary dysfunction that completely disappeared after a period of 3 weeks up to a maximum of 6-month. One patient reported a permanent difficulty to completely empty the bladder without the need of self-catheterisation.

The analysis revealed that the main factor affecting the occurrence of defecation dysfunction is the size of the rectal nodule and the respective choice of surgical approach. Patients with #Enzian classification C3 nodules are 8 times more likely to develop postoperative defecation dysfunction (odds ratio: 8.66, confidence interval: 1.36–55.22, *P*=0.022).

Discussion

Rectal endometriosis represents one of the most severe forms of deep endometriosis due to its possible intense symptomatology and thus negative effect on patients' quality of life.[10] Our results confirm previous findings that the surgical management of rectal endometriosis leads to a significant decrease in pain levels regardless of the used technique. While in the available literature, the term "rectal shaving" refers to different surgical procedures from simply isolating the rectum from rectovaginal endometriosis to full-thickness resection.[11] CNR indicates the complete mucosa-sparing excision of the endometriotic nodule from the rectal wall. This is in line with the definition by Roman et al.[12] and the international consensus terminology,[9] and excludes incomplete excision and distinguishes rectal shaving clearly from disc excision and segmental colorectal resection. We limited the indication for CNR to nodules of a maximum size of approximately 3 cm, as the approximation of the muscular rectal layer by a single transversal suture might be difficult and related to complications in larger

distances. However, this limitation is a non-evidence based expert opinion and should be analysed in future trials. In some cases, when CNR was not feasible due to additional bowel lesions only diagnosed during surgery, a tubular SRR has been carried out. Our data demonstrated that CNR for #Enzian C1-2 nodules and SRR for #Enzian C3 nodules are both feasible and related to a relief of symptoms and increasing patients' satisfaction. Although our data remains unable to draw definitive conclusions regarding the indication of each technique, it provides a substantial basis for standardising the surgical approach for colorectal endometriosis based on presurgical imaging by transvaginal ultrasound and/or MR imaging using the #Enzian classification.[13,14] This approach does not only allow for the choice of resection technique before surgery, but also for a detailed counselling of the patient including risk-stratification and precise preparation regarding complexity of the procedure. Avoiding intrasurgical surprises seems to be a relevant factor in decreasing complication rates. Our data contributes to the body of evidence regarding the safety of CNR and confirms the safety of SRR for rectal endometriosis. The overall Clavien-Dindo grade III/IV complication rate was 7%. We did not face any case of postoperative fistulisation or stenosis, while anastomosis leakage requiring stoma occurred in one patient of the SRR group only, which is lower than what has been previously reported.[15] One meta-analysis has shown that the rectovaginal fistula and anastomosis leakage rates are 1.5% and 1.2%, respectively.[16] Another systematic review has shown that the fistulisation and leakage rates are comparable in patients undergoing nerve-sparing segmental resection, nerve- and artery-sparing segmental resection, and conventional segmental resection.[17] Our analysis demonstrated that rectal nodule's size influences the postoperative occurrence of defecation dysfunction. SRR can be considered more invasive compared to CNR as healthy tissue along with endometriosis is resected. Large rectal nodules more frequently require SRR, which is related to higher complexity and radicality and thus to higher postoperative defecation dysfunction when compared to CNR. If feasible, the more conservative CNR could be considered as treatment of first choice in order to decrease the rate of segmental resection and thus decrease the rate of postsurgical complications and defecation dysfunction.

Our data shows that the presence of #Enzian C3 lesions is not only related to a higher rate of dyschezia, but also to a higher rate of additional large rectovaginal and vaginal lesions (#Enzian A3). The available literature describes the posterior nodules as rectovaginal lesions and the infiltration of rectum and vagina as two sides of the same nodule.[18,19] The significant correlation between lesion size in #Enzian compartment C and A in our study is a new aspect in the understanding of rectovaginal endometriosis. Our data also showed that #Enzian C3 lesions are related to a higher rate of additional intestinal lesions of appendix, coecum, sigmoid or small bowel (#Enzian FI). This could be relevant in light of the three mechanisms of bowel-related pain and dysfunction in patients with colorectal endometriosis: rectal lateral or anterior fixation, rectal stenosis, and cyclic inflammation.[20] While surgery can restore the normal anatomy and remove the mechanical barrier imposed by the rectal nodule, it remains unable to revoke the prolonged effect of cyclic inflammation and the resulting bowel hypersensitivity.[21] However, the meticulous intrasurgical examination of the appendix, coecum, sigmoid and small bowel is of importance, as occult lesions might contribute to ongoing postsurgical bowel symptoms.[22] In contrast to our results, Pashkunova et al.[23] reported significantly improved low anterior resection syndrome (LARS) symptoms in patients treated with SRR and full-thickness discoid excision. However, patients with preoperative LARS-like symptoms of the full-thickness discoid excision group exhibited aggravated LARS scores during their postoperative follow-up.[23] Alternatively, Roman et al.[24] indicated that the risk of defecation dysfunction in endometriosis patients undergoing rectal surgery is as high as 40%. In another study, the same group demonstrated that the surgical management of rectal endometriosis does not mandatorily relieve the digestive complaints,[25] but that the improvement of other endometriosis-related pain symptoms overweighted the persistence of bowel symptoms, which was also evident in our study.

Although we did not use protective stoma in this cohort, the leakage rate was 0.87% and there was no case of fistulisation. Similarly, Collinet et al.[26] in their recent study reported a complication rate of 14% among 97 patients who were operated for colorectal endometriosis without preventive stoma, with 1 case of fistulisation and 2 cases of anastomosis dehiscence. This strongly indicates that a protective stoma should not be performed on a standard basis. On the contrary, protective stomas for rectal endometriosis could be considered as "over-treatment" as they may lead to increased morbidity and higher costs of endometriosis management.

In their systematic review, Bendifallah et al.[27] demonstrated that the recurrence rate of rectal endometriosis was higher among patients who underwent conservative bowel surgery in comparison to those who underwent SRR and discoid excision. On the other hand, the recurrence did not differ significantly between SRR and discoid excision. Our study did not assess the histologically proven recurrence rate, but we hypothesize that CNR technique shares the same principle of the complete disease removal and thus comparable recurrence rates as discoid excision. A prospective randomized trial comparing CNR and disc excision could analyse possible differences.

Study Limitations

Our study has several limitations. This is a non-randomised retrospective single-center study, which makes it prone to selection bias. We followed up with the patients through phone calls using an unvalidated questionnaire. This might limit the strength of long-term functional outcome conclusions for bowel and urinary dysfunction. Although it is useful, the application of the PGI-I scale could be problematic since, to the best of our knowledge, it has not been applied in the field of rectal endometriosis. The follow-up rate is relatively low, and the number of followed patients in each study group is low, which makes it harder to detect significant differences between the groups. Urinary and defecation dysfunction were defined as impairment compared to the preoperative situation. However, we did not access presurgical bladder and bowel dysfunction in detail. Thus, we are not able to completely differentiate between already existing dysfunction from surgery-related dysfunction. Important anatomical variables such as number of nodules, exact distance of endometriosis nodules from the anal verge and circumferential bowel involvement are missing, although these parameters might influence the choice of surgical approach. A more detailed prospective data analysis including disc resection should include these parameters in a future trial.

Conclusion

CNR and SRR are safe, equally effective in improving pain symptoms of deep rectal endometriosis, and associated with high postoperative satisfaction rates. CNR seems to be a feasible mucosa-sparing approach in lesions up to 3 cm, related to lower postoperative defecation dysfunction rates and CRP levels when compared to segmental resection. Large rectal nodules are related to a higher rate of additional intestinal deep endometriosis.

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Data sharing: All the data are available from the corresponding author on a reasonable request.

Transparency: The authors affirm that this manuscript is an honest, accurate, and transparent account of the study being reported; that no important aspects of the study have been omitted; and that any discrepancies from the study as planned have been explained.

Supplementary Table: https://d2v96fxpocvxx.cloudfront.net/bfe6b059-1982-481c-8e2f-073cbc0b054a/content-images/0b1e1a56-4be5-46e0-a767-2b6abe012c39.pdf

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