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Original Article

Natural Orifice Specimen Extraction during Laparoscopic Bowel Resection for Colorectal Endometriosis: Technique and Outcome

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ABSTRACT **Study Objective:** To present a detailed description of a modified natural orifice specimen extraction (NOSE) colectomy technique. We also report the postoperative outcomes of our prospective case series when compared with conventional laparoscopic bowel resection in a relatively large series of patients.

Design: Canadian Task Force classification II-1.

Setting: A university tertiary referral center.

Patients: The last 90 consecutive patients in our care with deep infiltrating endometriosis of the bowel are presented in this study. Patients were diagnosed at the 1st Department of Obstetrics and Gynecology, Semmelweis University, Budapest, Hungary.

Interventions: We performed laparoscopic bowel resection using the transrectal NOSE technique and compared the results of the new operative method (n = 30) with traditional laparoscopic bowel resection (n = 60).

Measurements and Main Results: The median duration of surgery was 121 minutes in the control group and 96 minutes in the NOSE group (p = .005). According to the Clavien-Dindo classification, we observed a severe, grade IIIb or higher, overall complication rate of 3.3% among all 90 patients. In the control group, anastomosis insufficiency occurred in 3.3% of patients (2/60 cases), and in 1 patient with anastomotic leakage a rectovaginal fistula was observed (1.7%). There was no significant difference in the rates of severe postoperative complications (p = .55). The length of hospital stay in the control group was a median of 7 days (range, 5–13 days), whereas in the NOSE group it was 6 days (range, 3–11 days) (p < .001).

Conclusion: According to our findings, the use of NOSE colectomy offers a shorter recovery time and can eventually lead to a shorter surgery duration compared with traditional laparoscopic bowel resection. Journal of Minimally Invasive Gynecology (2018) ■■, ■■–■■

Keywords: Bowel resection; Colorectal endometriosis; Natural orifice specimen extraction

Deep infiltrating endometriosis (DIE) represents the most severe form of endometriosis and is present in 20% to 35% of all women suffering from the disease [1]. Intestinal nodules are observed in 3% to 37% of endometriosis patients [2]. In cases of colorectal DIE, adequate therapy depends on the depth of infiltration, the size of the lesion, and the woman's quality of life [2–4]. According to recently published data, the location of the lesion is the most important factor in determining optimal surgical management. Some authors suggest that conservative surgical treatment is preferred to segmental resection, particularly for low rectal lesions, because of an increased risk of potential complications [4].

Removal of the specimen after segmental bowel resection can be performed by either a conventional method (minilaparotomy) or the natural orifice specimen extraction (NOSE) technique [5–7]. The conventional method raises concerns because this could disrupt the integrity of the abdominal wall. Moreover, extraction site laparotomy is associated with higher postoperative pain scores and the occurrence of particular complications such as incisional hernias [5–12]. In order to avoid these complications, the NOSE technique has been

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introduced. During NOSE colectomy, the specimen is extracted through a natural orifice, and intracorporeal anastomosis is performed [5–7,12–14].

Herein we present a detailed description of a modified NOSE colectomy technique, which differs in many aspects from the previously published procedures. We also report the postoperative outcomes of our prospective case series when compared with conventional laparoscopic bowel resection. Finally, we provide a short overview of the relevant data from the literature.

Materials and Methods

Patients and Preoperative Workup

Between January 2015 and January 2017, 90 consecutive patients underwent segmental bowel resection because of colorectal DIE at the 1st Department of Obstetrics and Gynecology, Semmelweis University, Budapest, Hungary. The surgical plan was made individually, tailored to the signs and symptoms of our patients. Nodules larger than 3 cm causing obstructive problems and affecting more than 50% of the bowel circumference or multifocal DIE nodules (less than 2 cm from the principal lesion) or multicentric nodules more than 2 cm from the principal lesion were treated by segmental resection and anastomosis.

For bowel endometriosis, medical management was the first-line therapy because of the significant risk of postoperative complications and morbidity associated with surgical treatment. If medical management failed or in the setting of acute obstruction, surgical management was considered as the treatment of choice [4]. Apart from obstructive sequelae, medical therapy–resistant endometriosis–related severe pain (visual analog scale ≥7) qualified for surgical management as well [3].

Conventional segmental laparoscopic bowel resection was performed via laparotomy for specimen extraction up until October 2015 when we implemented the transrectal NOSE technique. From October 2015 until January 2017, NOSE colectomies with the transrectal specimen extraction method were performed in all but 3 cases. Two patients refused to undergo surgery using the new operative technique, and the third case had an ultralow nodule (lower than 5 cm from the anal verge); therefore, we performed a protective colostomy. The protective colostomy was reversed after 90 days. In this particular case, the patient had multifocal lesions in which the size of the largest distal nodule was 4 cm. There was no complication during this procedure.

The surgeries were all performed by a multidisciplinary team with the participation of the same gynecologist specialist (A.B.) and colorectal surgeon (P.L.). The preoperative workup included a physical examination, transvaginal sonography, abdominal and pelvic magnetic resonance imaging, and colonoscopy.

Patients received antibiotic prophylaxis 30 minutes preoperatively (2×1.5 g cefuroxime intravenously and 2×500 mg metronidazole intravenously) and a bowel preparation (2 packs of laxatives containing sodium picosulfate and magnesium citrate) the day before surgery. Although mechanical bowel preparation is not generally recommended for laparoscopic colorectal resection, we administered bowel preparation in order to decrease the chance of contamination after viscerotomy [15].

Our study protocol was approved by the Institutional Ethical and Review Board of Semmelweis University for the protection of human subjects (no: 58723-4/2016/EKU).

Operative Technique

The goal of the surgical treatment in our group of patients was to eliminate all macroscopically visible endometriotic foci and to preserve fertility. All surgeries were performed laparoscopically in a multidisciplinary setup with the contribution of a gynecologist and colorectal surgeon and the assistance of a urologist if needed.

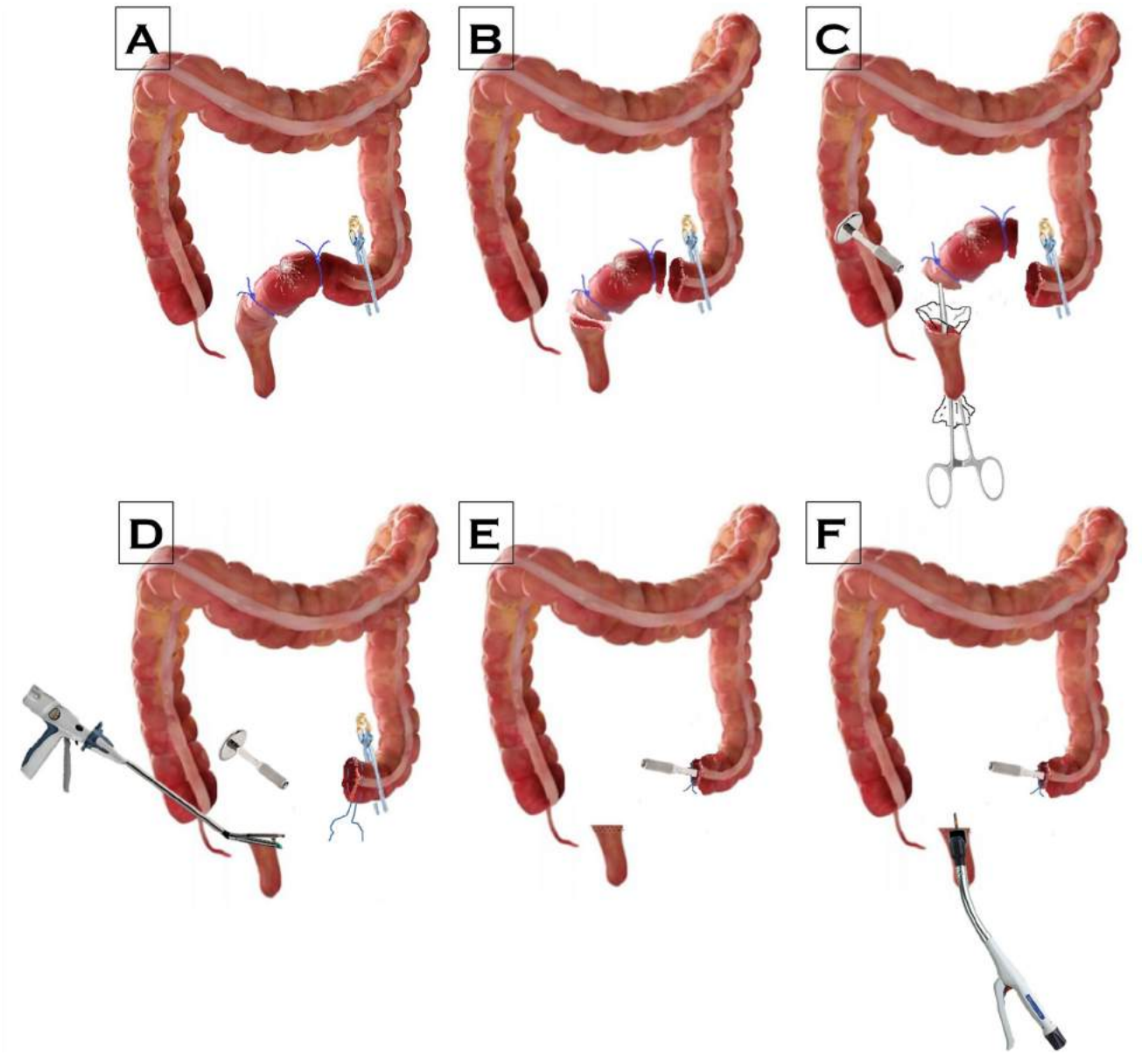
The operating room setup was the same for all procedures. Patients were placed in a modified dorsal lithotomy position. The pneumoperitoneum was created by inserting a Veress needle in the umbilicus. A 4-port approach was used; the first 10-mm port was inserted in the umbilicus. Three lower quadrant trocar sleeves were placed under direct visualization. Two 5-mm trocars and one 12-mm trocar were placed lateral to the rectus abdominis muscles 2 cm above and 2 cm medial to the anterior superior iliac spine. The third 5-mm port was placed in the midline suprapubically. The patient was then placed in the steep Trendelenburg position. In the presence of pelvic adhesions, adhesiolysis was performed in order to mobilize the rectum and sigmoid colon. The ureters were dissected until the level of the uterine arteries. A nerve-sparing approach was used at the level of the uterosacral ligaments in order to preserve the autonomic innervation of the pelvis.

In cases of low rectum (5–8 cm from the anal verge) and vaginal nodules, special care was taken in order to preserve the branches of the inferior hypogastric plexus. In cases of a central DIE nodule, preservation of the vegetative nerve fibers was not very difficult. We used a nerve-avoiding technique with gentle pulling of the fibers laterally along with surgical instruments possessing minor lateral thermal effects. In addition, we performed a limited tubular resection in a meso-sparing manner close to the bowel in order to preserve the branches of the inferior hypogastric plexus. When we encountered large nodules with extensive lateral fibrosis, we enabled visualization of the branches of the inferior hypogastric plexus and the parasympathetic splanchnic nerves according to the technique reported by Kavallaris et al [16].

During our procedures, the bilateral development of the "Heald space," the rectovaginal septum, and the Latzko pararectal space was needed for the identification of uterosacral, lateral rectal, and rectovaginal ligaments. By using these anatomic landmarks, it was possible to avoid injury to autonomic visceral nerves in most cases.

Fig. 1

(A) The rectum is tied off distally and proximally to the DIE nodule and then a laparoscopic atraumatic temporary intestinal clamp is placed proximally to the resection line. (B) A transverse colotomy is performed using a harmonic scalpel. (C) A laparoscopic camera sleeve is used for anvil introduction into the abdominal cavity. (D) The oral part of the anastomosis was performed by suturing the anvil in place with a purse-string laparoscopic suture. (E) The distal rectum was closed using a 45-/60-mm endoscopic linear stapler, and the anvil is sutured in place after the removal of the atraumatic clamp. (F) End-to-end anastomosis was created with a circular stapler.



Severe neurogenic complications seem to occur only in cases of bilateral involvement [17,18]. In cases when R0 resection was not possible without major neural damage, we decided to leave a minimal amount of fibrotic tissue. The residual fibrotic tissue was never in the proximity of the ureters.

The endometriotic lesions were excised and then extracted with the help of the modified transrectal NOSE technique (Video 1 and Fig. 1). The proximal rectum was freed from the mesorectum using a vessel-sealing device (Harmonic Scalpel ACE; Ethicon Endo-Surgery, Cincinnati, OH); therefore, in case of sigmoid resection, the ampulla recti's reservoir function could be preserved. In case of a low anterior resection in which the preservation of ampulla recti was not possible, a transanal NOSE colectomy was performed.

In cases when transrectal/transanal NOSE colectomy was performed, the standard procedure was modified as follows. The sigmoid/rectum was isolated, and both the proximal sigmoid colon and the proximal rectum were tied off

Fig. 2

The application of the atraumatic intestinal clamp.

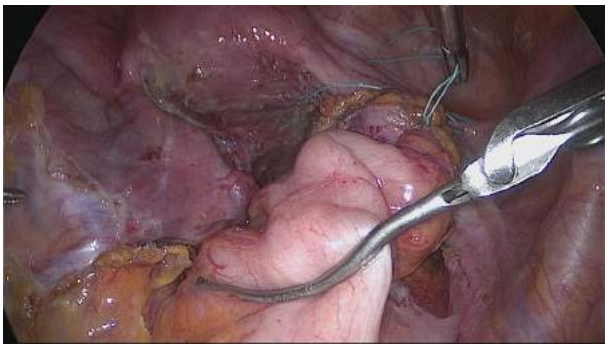
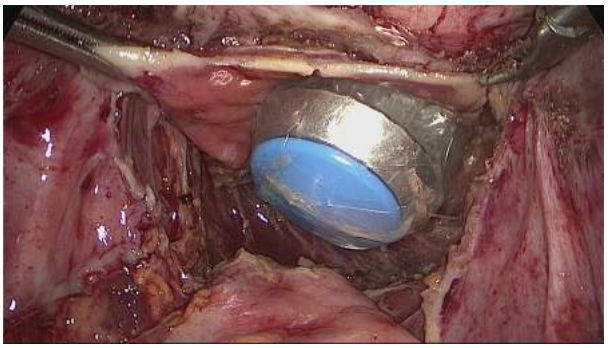


Fig. 4

Transrectal anvil introduction using a camera sleeve.



laparoscopically with a nonabsorbable suture (Dafilon 0; B Braun AG, Meslungen, Germany). Cephalad to the resection line, a laparoscopic atraumatic temporary intestinal clamp (Aesculap, Tuttlingen, Germany) was placed in order to decrease the chance of fecal spillage (Fig. 2). A transverse colotomy was performed in healthy tissue using a harmonic scalpel (Fig. 3) to deliver the anvil from a circular stapler (Proximatew ILS CDH 29, Ethicon Endo-Surgery) introduced through the anus using a sterile laparoscopic camera sleeve (folded laparoscopic camera sleeve; 3M, St Paul, MN). The use of the camera sleeve for anvil introduction into the abdominal cavity reduces the possibility of contamination of the peritoneal cavity (Fig. 4).

Because the rectum/sigmoid colon is transected completely, the specimen can be extracted transrectally through the camera sleeve in a specimen retrieval bag (Fig. 5). The proximal part of the anastomosis was completed by suturing the anvil in place with a purse string of a monofilament laparoscopic suture (PDS 2.0; Ethicon, Inc, Cincinnati, OH) (Fig. 6). The intestinal clamp was then removed. The distal rectum was closed using a 45-/60-mm endoscopic linear stapler (Echelon Flex Endopath, Ethicon Endo-Surgery) (Fig. 7).

Extensive saline irrigation was performed in which the suture of the distal rectum was checked by the Michelin test. End-to-end anastomosis was made using the circular stapler (Proximatew ILS CDH 29) (Fig. 8). At the end of the operation, a second irrigation was performed using a total of 6 L saline solution. The Michelin test was repeated, and a drain

Fig. 5

Transrectal specimen extraction using a laparoscopic specimen retrieval bag.

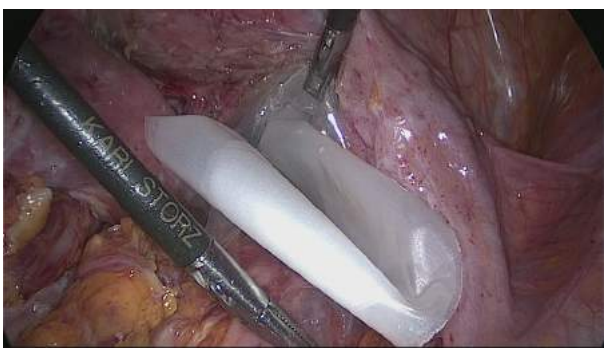


Fig. 3

A transverse colotomy was performed in healthy tissue, orally and caudally from the nodule, using a harmonic scalpel,.

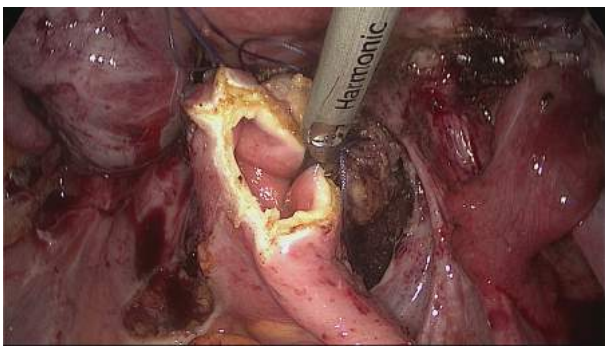


Fig. 6

Anvil fixation after a purse-string suture in the proximal colonic end.

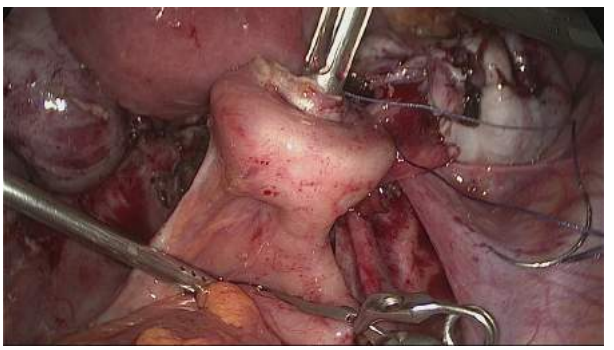
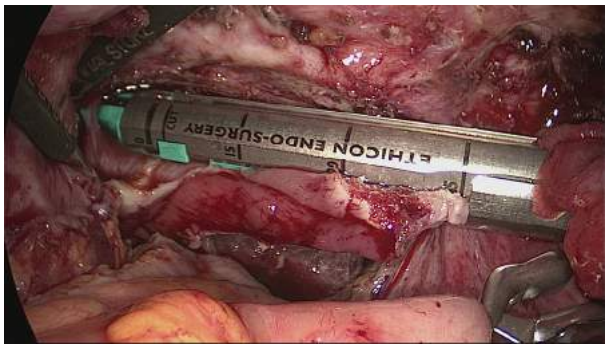


Fig. 7

The use of a linear stapler for closing the distal rectal stump.



was placed in the pouch of Douglas. When feasible, a tension-free omental flap was placed on the anastomosis in order to prevent rectovaginal fistula formation.

During the postoperative course, on the first postoperative day, only oral fluid intake was allowed. The time to resume a normal diet was 3 days to a maximum of 6 days.

Evidence shows that fast-track programs or enhanced recovery after surgery protocols improve the surgical stress response and postoperative outcomes [19–21].

However, there are no data regarding the use of fast-track programs in combination with NOSE procedures. Therefore, because we are routinely not creating a diverting ileostomy, to increase the safety of our procedures, we administered a combination of fast-track and standard postoperative care. Similar to the enhanced recovery after surgery protocols, we advise oral carbohydrate fluid intake on the first day after surgery. On the second and third day, we started a low-fiber diet.

The criteria for hospital discharge in all cases were tolerance of a solid diet and passage of flatus and stool. Patients were asked to present for a postoperative checkup 4 weeks and 6 months after surgery. In the postoperative period, all of our patients who did not wish to conceive were advised to start ovarian suppression therapy either with oral contraceptives (OCs) or dienogest [22].

We administer OCs or dienogest because they have an acceptable side effect profile [22,23]. In addition, dienogest exhibits antiproliferation activity by growth suppression of endometrial cells, and its uterotropic index is high, similar to natural progesterone [24,25]. Furthermore, dienogest exerts direct effects on the endometrium, which serve as the basis for the proven efficacy in endometriosis [26].

The first-line therapy is the use of OCs; in cases of OC intolerance, we switched to dienogest treatment. In those women scheduled for surgery and not desiring fertility, we administered the same medical therapy in both groups [23] (Table 1). All of our procedures were video

Fig. 8

An end-to-end anastomosis was created with a circular stapler.

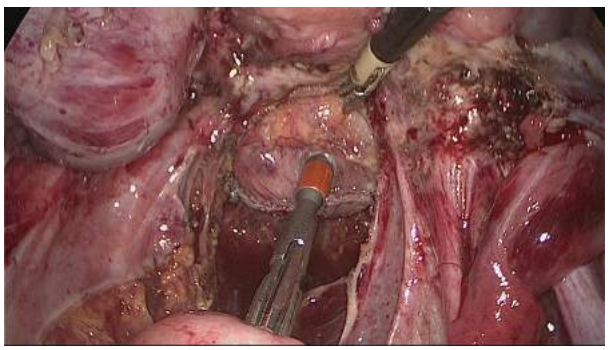


Table 1

Characteristics and demographic data of patients undergoing a conventional laparoscopic anterior resection or laparoscopic colectomy with transrectal specimen extraction

Total Number of Surgical Procedures (N = 90)

	Conventional (n = 60)	NOSE (n = 30)
Age, median (range)	32 (24–48)	33 (25–45)
BMI (kg/m^2), median (range)	21 (19–29)	21 (18–27)
ASA score, n (%)		
ASA I	50 (83)	24 (80)
ASA II	10 (17)	6 (20)
ASA III	0 (0)	0 (0)
rAFS stage, n (%)		
I	0 (0)	0 (0)
II	1 (1.7)	0 (0)
III	9 (15)	3 (10)
IV	50 (83.3)	27 (90)
rAFS score, median (range)	75 (12–112)	73 (16–125)
Previous medical treatment, n (%)		
Dienogest containing OAC	24 (40)	17 (57)
Other OAC	3 (5)	0 (0)
Dienogest only pills	30 (50)	13 (43)
Desogestrel containing OAC	3 (5)	0 (0)
Previous surgical treatment, n (%)		
Laparotomy		
1	3 (5)	0 (0)
2	1 (1.7)	1 (3)
Laparoscopy		
1	25 (42)	10 (33)
2	3 (5)	4 (13)
3	1 (1.7)	1 (3)
4	1 (1.7)	2 (7)
5	0 (0)	0 (0)
6	1 (1.7)	0 (0)
TUR	1 (1.7)	0 (0)

ASA = American Society of Anesthesiologists; BMI = body mass index; NOSE = natural orifice specimen extraction; OAC = oral anti contraceptive; rAFS = revised American Fertility Society; TUR = transurethral resection.

Table 2

Surgical data

Operative Data (N = 90)

	Conventional (n = 60)	NOSE (n = 30)	p Value (Conventional vs NOSE)
Duration of surgeries (min), median (range)	121 (85–250)	96 (60–190)	.005
Intraoperative blood loss (mL), median (range)	35 (0–150)	15 (0–30)	.82
Conversion rate, n (%)	0 (0)	0 (0)	1.00
Need for transfusion, n (%)	1 (1.7)	0 (0)	1.00
Number of DIE lesions of the bowel, n (%)			
1	35 (58)	17 (57)	.88
2: Sigmoid and rectum	4 (7)	1 (3)	.66
Multilocular			
Sigmoid colon and rectum	17 (28.3)	8 (26)	.87
Coecum and sigmoid/rectum	2 (3.3)	2 (7)	.6
Appendix and sigmoid/rectum	2 (3.3)	2 (7)	.6
Length of the resected bowel (cm), median (range)	10 (5–29)	7 (5–17)	.31
Low rectum resection, n (%)	31 (52)	17 (57)	.65
Other localizations of endometriosis, n (%)			
Endometrioma: unilateral	17 (28)	13 (43)	.15
Bilateral	5 (8)	2 (7)	1.00
Peritoneal	53 (88)	26 (86)	1.00
Bladder	11 (18)	6 (20)	.85
Ureter: unilateral	10 (17)	2 (7)	.32
Bilateral	1 (1.7)	1 (3)	1.00
Rectovaginal septum	53 (88)	25 (83)	.52
Vagina (transmural involvement)	8 (13)	2 (7)	.28
Diaphragm	1 (1.7)	2 (7)	.26
Cecum/ileum	2 (3.3)	0 (0)	.55
Nervus ischiadicus	1 (1.7)	0 (0)	1.00
Liver	1 (1.7)	0 (0)	1.00
Umbilicus	1 (1.7)	0 (0)	1.00
Chromopertubation, n (%)			
Bilateral patency	22 (37)	6 (20)	.11
Unilateral patency	22 (37)	3 (10)	.011
Bilateral occlusion	16 (26)	21 (70)	<.0001
Infertility, n (%)	20 (33)	17 (57)	.034
Mean hospital stay, median (range)	7 (5–13)	6 (3–11)	<.001

DIE = deep infiltrating endometriosis.

recorded and analyzed after the operation by the surgical team.

Statistical Analysis

The study data were evaluated by descriptive statistical methods, such as median, range frequency, and distribution. Variables were tested for normality using the Kolmogorov-Smirnov, Lilliefors, and Shapiro-Wilk tests. Groups of values without normal distribution were compared using the Mann-Whitney *U* test. The Fisher exact test was used in case of small cell counts.

All tests are 2-sided, and $p < .05$ was accepted as a significant difference. Statistical analysis was undertaken using GraphPad Prism software (version 5.0a; GraphPad Software, San Diego, CA).

Fertility

At the time of admission, patients filled out questionnaires (i.e., the Endometriosis Health Profile-30 and a validated questionnaire for pain catastrophizing) regarding their symptoms and fertility [27]. Fifty-seven percent of the patients in the transrectal NOSE group claimed infertility and 33% in the control group. The intraoperative chromopertubation results are noted in Table 2.

Results

In this study, we included patients operated on for colorectal endometriosis between January 2015 and January 2017. During this period, we had a total number of 1240 patients operated on for endometriosis. Of the 1240 patients, there were

256 diagnosed with colorectal DIE, and 90 required segmental anterior resection. The rest of the patients were treated either with rectal shaving or full-thickness discoid resection. From our series, 90 consecutive patients who underwent laparoscopic segmental bowel resection are presented in this study. Patients were consulted and diagnosed at our department's endometriosis clinic.

Because we wanted to introduce a new surgical technique to our daily practice, we designed this study with the aim of critically analyzing the outcomes of the NOSE technique compared with conventional laparoscopic bowel resection. After 30 cases of NOSE colectomy, we found the procedure safe, offering shorter recovery and operative times compared with the conventional method.

At this point, we decided to share our experience with the new technique. Accordingly, to the best of our knowledge, we report the highest number of consecutive NOSE colectomies performed for the treatment of colorectal endometriosis.

The NOSE group consisted of 30 transrectal specimen extraction cases (the transrectal group [TRG]), whereas the control group (CG) had 60 patients who underwent conventional laparoscopic colorectal resection.

At the time of surgery, the median age of the patients was 32 years in the CG and 33 years in the TRG. The median body mass index of these patients showed no difference between the 2 groups. All of our patients received hormonal treatment (either OC or dienogest) before surgery. In the conventional group, 10% of patients had undergone previous laparotomies, whereas in the NOSE group this rate was 6%. For detailed data, see Table 1.

Intraoperative Findings

Stage of Endometriosis and Localization of the Nodules

The average median and range of the revised American Fertility Society scores of the patients are presented in Table 1. The anatomic distribution and the number of endometriotic nodules were similar in both groups. In more than 50% of cases, we performed a low rectum (5–8 cm from the anal verge) resection in both groups (p = .65).

A single nodule was detected during histologic examination in 56% in the NOSE group and 58% in the CG (p = .88). Multifocal (2 or more) lesions were diagnosed in 44% of the specimens from the NOSE colectomy group and 42% in the CG (p = .66, Table 2).

The length of the resected bowel section varied from 5 to 29 cm; the average length was 10 cm in the CG and 7 cm in the transrectal NOSE group (p = .31).

Endometriosis was present in areas other than the colorectal region in most cases. The frequency of extracolonic localization of endometriotic lesions was similar in the NOSE group and the CG. Most commonly, these were found in the rectovaginal septum, pelvic peritoneum, and the ovaries (Table 2).

Eight patients in the CG (13%) and 2 in the TRG (7%) required vaginal resection because of transmural vaginal involvement. DIE of the bladder was found in 18% of the CG and 20% of the TRG (p = .85). Ureteral endometriosis was present in 18.7% of the TRG and 10% of the CG (p = .32, Table 2).

Duration of Operations

There was a statistically significant difference between the duration of surgeries in the CG when compared with the TRG (CG: median = 121 minutes [range, 85–205 minutes] and TRG: median = 96 minutes [range, 60–190 minutes); p = .005).

Postoperative Complications

According to the Clavien-Dindo classification, we observed a severe (grade IIIb or higher) overall complication rate of 3.3% among our 90 patients [15]. Anastomosis insufficiency occurred in 2 cases (3.3% of patients from the CG and none in the TRG, p = .55). Among the 2 patients with anastomotic insufficiency, a rectovaginal fistula appeared in 1 case (1.7% of all patients, 1/60 cases) after conventional laparoscopic colectomy (p = 1.00). The patient with a rectovaginal fistula had a full-thickness vaginal resection because of transmural vaginal vault infiltration. When comparing the CG and TRG with regard to the rates of severe postoperative complications, we found no statistically significant difference (p = .55). When the rectovaginal fistula was diagnosed, an immediate second laparoscopy was done, and sigmoidostomy was performed. The fistula was closed, and the sigmoidostoma was repaired after 3 months.

It is well-known that concomitant vaginal resection and anterior colorectal resection notably increase the chance of rectovaginal fistula formation. However, performing a limited segmental resection and using a surgical technique that maintains the vascularization of a tension-free anastomosis lowers the chance of this complication [1,3,4]. The other patient with anastomotic insufficiency underwent laparoscopic suture of the leak, and a subsequent sigmoidostomy was performed.

In 1 patient from the CG (1.7%), clinical recurrence was diagnosed. She underwent a second laparoscopy and had a rectal nodule situated 5 cm proximally to the resection line completely removed by full-thickness discoid resection. The resection margins were negative at the time of the first surgery. The recurrence occurred despite postoperative ovarian suppression therapy with combined continuous OCs. From the NOSE group, there was no clinical recurrence of the disease so far.

Postoperative bleeding from the umbilical port site occurred in 1 patient from the CG. A compression dressing was administered.

Transient bladder dysfunction (urinary retention) was present in 2 (3.3%) of our patients from the CG and 1 (3%) from the TRG (p = 1.00). The voiding problems were medically treated with oral pyridostigmine (3 × 60 mg/d) and lasted for a maximum of 7 days in all cases. In all other cases, we successfully used the nerve-sparing technique in order to avoid

Table 3

The Short-term outcome of conventional laparoscopic rectum/sigmoid resections and natural orifice specimen extraction (NOSE) colectomies performed for colorectal deep infiltrating endometriosis

	Conventional (n = 60), n (%)	NOSE (n = 30), n (%)	p Value (Conventional vs NOSE)
Recurrence	1 (1.7)	0 (0)	1.00
Anastomosis insufficiency	2 (3.3)	0 (0)	.55
Rectovaginal fistula	1 (1.7)	0 (0)	1.00
Postoperative bleeding	1 (1.7)	0 (0)	1.00
Injury of the ureter	0 (0)	0 (0)	1.00
Rectal bleeding	1 (1.7)	2 (6)	.26
Gastrointestinal infection	2 (3.3)	0 (0)	.55
Incisional hernia	0 (0)	0 (0)	1.00
Hematoma in the wound	0 (0)	0 (0)	1.00
Subileus	0 (0)	1 (3)	1.00
Neurogenic bladder dysfunction (maximum of 7 days)	2 (3.3)	1 (3)	1.00

vegetative neural dysfunction. The complication rates are summarized in Table 3.

Histologic Examination

Histologic examination confirmed bowel endometriosis infiltrating the muscularis in 81 of 90 cases, and in 9 cases the mucosal layer was also involved.

Hospital Stay

The median length of hospital stay in the CG was 7 days (95% confidence interval [CI], 5–13) days, whereas in the TRG it was 6 days (95% CI, 3–11). Patients in the NOSE group had a shorter time of hospitalization compared with the CG ($p < .001$).

Intraoperative Blood Loss

We found no statistically significant difference with regard to the intraoperative blood loss between the CG and TRG ($p = .82$).

Discussion

To the best of our knowledge, there are few multidisciplinary teams [28,29] active in the surgical management of colorectal DIE by NOSE colectomy using laparoscopic intracorporeal anastomosis. Our new technique differs in many ways from the one used by the groups in Leuven, Belgium, and Strassbourg, France. First, we perform our procedure from the classic gynecologic port sites, thus avoiding additional abdominal incisions after the end of the initial gynecologic part of the operation. Second, during our method, we fix the anvil using a hand-sewn purse-string suture; hence, fewer linear staplers are used, which makes our procedure faster and less expensive. On the other hand, the complete transection of the colon presented in our method potentially increases the chance of contamination. Therfore, to mitigate this, we introduced the use of a laparoscopic intestinal clamp and a camera sleeve for the anvil introduction as previously described. In addition, meticulous bowel preparation, antibiotic prophylaxis, and extensive lavage were performed. Third, our method allows one to perform a more physiological end-to-end anastomosis, avoiding negative consequences such as fecolith formation.

The limitation of our study is the relatively low number of patients in our cohort who underwent bowel resection combined with the modified transrectal technique. In addition, because of the recent introduction of the transrectal NOSE technique at our institution, the median follow-up period is shorter than 1.5 years. Therefore, an accurate postoperative assessment of the quality of life and reproductive outcome was not possible.

Prior studies provided initial evidence that the use of NOSE during laparoscopic colectomy offers several benefits to patients [12,14,28,30]. We have provided further evidence that our novel modified technique is feasible and offers a shorter recovery and operative duration when compared with conventional laparoscopic segmental resection.

The method has attracted attention as a technique to minimize the negative consequences of conventional laparoscopic surgery by avoiding a minilaparotomy [6,7,12,31–34]. In their fundamental randomized clinical trial, Wolthuis et al [28] used a standardized surgical technique and reported lower postoperative pain scores and a decreased need of analgetics in favor of the NOSE procedure. However, inflammatory responses (C-reactive protein levels and white blood cell counts) were greater in the NOSE colectomy group. Postoperative anorectal function, complications, and hospital stay were similar for the 2 groups [28].

Recently, Ma et al [12] conducted a meta-analysis to investigate if laparoscopic resection with NOSE has better

postoperative outcomes. They revealed that the NOSE group showed faster convalescence, less postoperative pain, and a lower prevalence of postoperative complications but experienced a longer operation time.

In our series, the overall rate of severe surgical complications (Clavien-Dindo stage IIIb or higher) was 3.3% (2 cases). This is comparable with the results of other groups, which ranged from 2.4% to 13.2 % [12]. In order to decrease the chance of rectovaginal fistula formation, we performed omentoplasty in all cases when full-thickness vaginal excision was done simultaneously.

The radicality of surgeries and the use of a nerve-sparing technique can affect the incidence of complications [3,4,17,18]. In our practice, all surgeries were performed with a nerve-sparing intention. Neurogenic bladder disorder occurred in 2 of the CG patients and in 1 patient from the TRG. Urinary dysfunction improved within 7 days. None of our patients experienced long-term postoperative urinary dysfunction.

There are conflicting results in the literature concerning the operative times. According to Zhang et al [9], the NOSE technique is associated with shorter times than conservative operative laparoscopy. Conversely, Wolthuis et al [14] reported a significantly longer duration of NOSE surgeries, which may be reduced with experience. Comparing our 60 cases of conventional laparoscopy and 30 cases of transrectal NOSE colectomy procedures, we detected a statistically significant difference between the duration of the operation (121 vs 96 minutes, $p = .005$). Our data show that by applying the transrectal NOSE technique, the operating time was shorter when compared with traditional laparoscopy.

According to the previously published data, after NOSE procedures, the length of the hospital stay is shortened, with faster recovery and better cosmetic results [14]. In our study, we did not assess the cosmetic outcomes. However, the statistically significantly shorter hospital stay observed in our cohort of women favors the transrectal NOSE technique ($p < .001$).

Conclusion

According to our findings, the use of NOSE colectomy is safe, offers a shorter recovery time, and can eventually lead to a quicker surgery compared with traditional laparoscopic bowel resection.

Supplementary Data

Supplementary data related to this article can be found at https://doi.org/10.1016/j.jmig.2018.02.006.

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