

## CLINICAL ARTICLE

## Gynecology

# Vascular- and nerve-sparing bowel resection for deep endometriosis: A retrospective single-center study

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## Abstract

**Objective:** Surgical management of bowel endometriosis is still controversial. Recently, many authors have pointed out the potential benefits of preserving the superior rectal artery, thus ensuring better perfusion of the anastomosis. The aim of this study was to evaluate the complication rate and functional outcomes of a bowel resection technique for deep endometriosis (DE) involving a nerve- and vascular-sparing approach.

**Methods:** A single-center retrospective study was conducted by enrolling patients who underwent segmental resection of the rectus sigmoid for DE in our department between September 2019 and April 2022. Intraoperative and postoperative complications were recorded for each woman, and functional outcomes relating to the pelvic organs were assessed using validated questionnaires (Knowles-Eccersley-Scott-Symptom [KESS] questionnaire and Gastro-Intestinal Quality of Life Index [GIQLI] for bowel function, Bristol Female Lower Urinary Tract Symptoms [BFLUTS] for urinary function, and Female Sexual Function Index [FSFI] for sexual function). These were evaluated preoperatively and postoperatively after 6 months from surgery.

**Results:** Sixty-one patients were enrolled. No patients had Clavien-Dindo grade 3 or 4 complications, there were no rectovaginal fistulas or ureteral lesions, and in no cases was it necessary to reoperate. Temporary bladder voiding deficits were reported in 8.2% of patients, which were treated with self-catheterizations, always resolving within 45 days of surgery. Gastrointestinal function evaluated by KESS and GIQLI improved significantly after surgery, whereas sexual function appeared to worsen, although without reaching the level of statistically significant validity.

**Conclusion:** Our vascular- and nerve-sparing segmental bowel resection technique for DE had a low intraoperative and postoperative complication rate and produced an improvement in gastrointestinal function after surgery.

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## KEYWORDS

bowel endometriosis, bowel resection, complications, deep endometriosis, functional outcomes, vascular-sparing

## 1 | INTRODUCTION

Endometriosis is a condition resulting from the presence of ectopic endometrial glands and stroma that can affect women of either reproductive age or postmenopausal status.<sup>1</sup> Deep endometriosis (DE), defined as endometrial glands and stroma infiltrating the peritoneum by at least 5 mm, is the most severe form.<sup>2</sup> Within the DE spectrum, bowel endometriosis has been estimated to affect between 5% and 12% of patients.<sup>3</sup> The rectum and sigmoid are involved in up to 90% of all intestinal lesions,<sup>4</sup> and a laparoscopic resection of the affected part of the bowel may be required in cases of either occlusive symptoms or patients with nonresponsive medical pain.<sup>5-7</sup> However, surgical management of bowel endometriosis is still controversial, with a broad variety of potential approaches applied, including rectal shaving, disc resection, and segmental resection techniques. However, no universal guideline recommends an excision technique as optimal.<sup>8</sup>

As suggested by Abrão et al., segmental resection, the most radical approach, is usually chosen for either DE lesions exceeding 3 cm in diameter or in cases of multifocal disease.<sup>7</sup> This procedure requires the dissection of the mesorectum or mesosigma. In particular, the section of the inferior mesenteric artery (IMA) distal to the left colic artery is usually performed in order to provide tension-free anastomosis.<sup>8,9</sup> In any case, besides the increasing use of nerve-sparing techniques for the treatment of DE with bowel involvement, several authors have recently pointed out the potential benefits of preserving the superior rectal artery (SRA) by preserving the IMA, thus ensuring better perfusion of the anastomosis.<sup>8,9</sup> However, data findings are still heterogeneous and not sufficient to confirm a real advantage for a nerve- and vascular-sparing technique over others.<sup>8</sup> As such, the aim of our study was to evaluate the complication rates and functional outcomes of a bowel resection technique for DE involving a nerve- and vascular-sparing approach.

## 2 | MATERIALS AND METHODS

### 2.1 | Study design and population

This is a single-center, observational, retrospective study reported in accordance with the Strengthening the Reporting of Observational Studies in Epidemiology (STROBE) guidelines and checklist.<sup>10</sup> We retrieved data sets on symptomatic women who underwent laparoscopic excision of DE with segmental bowel resection using a nerve-sparing technique and with IMA preservation between September 2019 and April 2022 from the electronic databases and clinical records of the tertiary academic center for Endometriosis of the Fondazione Policlinico-Universitario Agostino Gemelli IRCCS in Rome (Italy).

### 2.2 | Ethics statement

This study received approval from the institutional review board of the "Dipartimento Universitario Scienze della Vita e di Sanità Pubblica" (protocol number DIPUSVSP-15-11-2238) and was performed in accordance with the Declaration of Helsinki. During preoperative evaluation, patients were asked in advance to sign a consent form regarding the subsequent use of their anonymized data.

### 2.3 | Variables and procedures

Segmental bowel resection was performed in patients for whom medical therapy had failed to control symptoms, in patients with simultaneous bowel obstruction or nodule residue >3 cm after a shaving technique, or in patients with multiple bowel nodules. Usually, before surgery women try at least one progestin such as dienogest norethisterone acetate, or desogestrel. All of the women had a histologically confirmed diagnosis of endometriosis. We excluded all women aged <18 years who had previous discoid or segmental bowel resection for any benign or malignant diseases, pelvic external beam radiotherapy/brachytherapy, or concomitant diagnosis of diabetic microangiopathy/vasculopathies.

Retrieved data included medical and surgical history at preoperative evaluation. Moreover, all of the women were subjected to rectovaginal examination, advanced transvaginal ultrasonography, and/or pelvic magnetic resonance imaging. In cases of subocclusive symptoms, either a colonoscopy or double-contrast barium enema was also required to evaluate stenosis. Along with the above, interviews on pain symptoms and questionnaires on pelvic organ function were also conducted.

Specifically, we focused on the main demographic, anthropometric, and clinical data (i.e. age, body mass index, and previous surgery); clinical variables (pain symptoms, urinary, and gastrointestinal and sexual function both before and after intervention); surgical findings (operating time, estimated blood loss, any intraoperative complications, length of resection, distance of the nodule from anal verge, and the need for ileostomy); and perioperative data (days of hospitalization, need for self-catheterization, and postoperative complications).

Postoperative complications, occurring within 30 days after surgery, were described using the Clavien-Dindo classification.<sup>11</sup> Six months after surgery, patients underwent rectovaginal evaluation, transvaginal, and transabdominal ultrasonography. Interviews regarding pain symptoms and questionnaires were also reassessed. The severity of pain symptoms (dysmenorrhea, dysuria, dyschezia, and dyspareunia) were assessed using visual analog scale (VAS) scores (ranging from 0 to 10, from absence of pain to most severe).

Information regarding functional outcomes was assessed using validated questionnaires: the Knowles-Eccersley-Scott Symptom (KESS) questionnaire,<sup>12</sup> the Gastro-Intestinal Quality of Life Index (GIQLI),<sup>13</sup> the Bristol Female Lower Urinary Tract Symptoms (BFLUTS) questionnaire,<sup>14</sup> and the Female Sexual Function Index (FSFI).<sup>15</sup> The KESS questionnaire was used to assess bowel function and specifically determine whether the patient experienced constipation (0 to 39 points). We used a cutoff criterion of  $\geq 10$  points in the total KESS score to define constipation.<sup>12</sup> The GIQLI was used to describe the health-related quality of life (QoL) of patients with gastrointestinal disease (0 to 144 points). The questionnaire consists of 36 items and a higher score indicates a better QoL.<sup>13</sup> The BFLUTS questionnaire was instead used to assess urinary function,<sup>14</sup> with total scores ranging from 0 to 45, where higher scores imply decreased bladder function. Finally, for the assessment of sexual function, we applied the validated Italian translation of the FSFI, i.e. 19 questions exploring all domains of sexual function. A total FSFI score  $< 26.5$  was considered to be female sexual dysfunction.<sup>15</sup> Urinary retention was defined by a postvoiding residual volume of 100 mL. In these cases, self-catheterization was recommended until the post-urinary residual volume was  $< 100$  mL at three consecutive measurements.

## 2.4 | End points and outcome assessment

The primary end point of the study was to evaluate surgical outcomes, such as intraoperative, perioperative and postoperative complications in women who underwent vascular- and nerve-sparing bowel resection. As secondary end points, we looked at functional outcomes related to pelvic organs (bowel, urinary, and sexual function), assessed using validated questionnaires, and pain symptoms both at baseline and at 6-month follow-up, in order to highlight potential improvement after the intervention. Furthermore, we evaluated the correlation between functional outcomes at follow-up, by means of KESS, GIQLI, FSFI, and BFLUTS questionnaires, and surgical, anthropometric, and intraoperative findings.

## 2.5 | Surgical technique and postoperative care

When preparing for surgery, all patients followed a 5-day residue-free diet and received mechanical bowel preparation in the form of a 4-L split dose of Macrogol 2L 2 days before surgery and 2L the day before surgery. Intravenous cefuroxime and metronidazole were administered intraoperatively as antibiotic prophylaxis.

All patients were operated on by a multidisciplinary surgical team highly experienced in the laparoscopic surgical excision of bowel endometriosis, including a gynecologist and a colorectal surgeon. The severity of the disease was intraoperatively classified using the revised American Society for Reproductive Medicine (r-ASRM) score<sup>16</sup> and the Enzian classification.<sup>17</sup>

In all cases, a laparoscopic surgical approach for posterior DE using a nerve-sparing approach was conducted, as previously

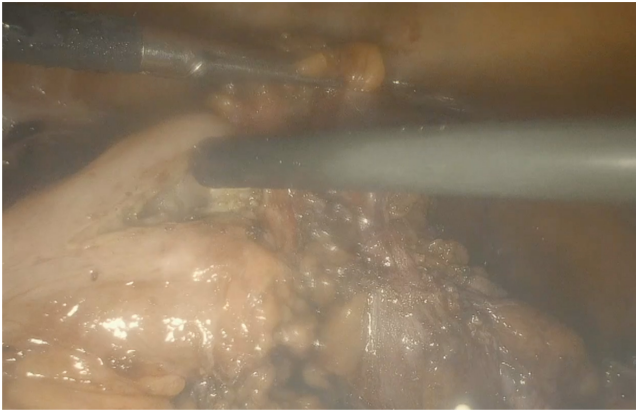


**FIGURE 1** Anvil, prepared with a 0 vicryl suture, bound at the hole of the tip.

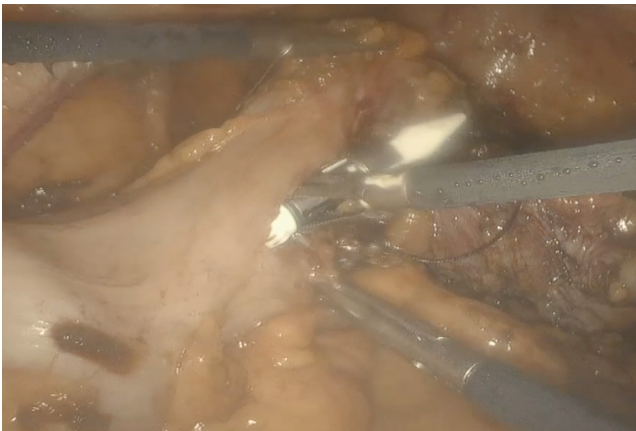
published.<sup>18–20</sup> When DE involved the lateral and/or posterior parametrium, a nerve-sparing parametrectomy was performed, as previously described.<sup>2,21</sup> In the case of further ureteral involvement due to the disease, ureterolysis was performed first and, if this failed to solve ureteral infiltration, ureteroneocystostomy was performed.<sup>22</sup>

Segmental bowel resection was performed following the same steps, i.e. a 5-mm trocar was added in the right hypochondrium. Then, the peritoneum of the mesosigma was opened above the root of the IMA, as close to the bowel wall as possible. Sigmoid vessels, which supply the bowel segment to resect, were progressively identified and selectively coagulated. The dissection was performed until the rectal wall below the endometriotic nodule was reached, and then the rectum was transected with a linear stapler (Echelon Flex Endopath Stapler 60mm; Ethicon). Colorectal anastomosis was performed by extracting the segment of bowel to be resected through a suprapubic mini-Pfannenstiel incision (4–5 cm) and following the classic steps,<sup>18,23</sup> or with a totally intracorporeal anastomosis (TICA).<sup>24</sup> See Video S1 in the supplementary material. The choice of a totally intracorporeal anastomosis (introduced to our institution in 2021) or of a mini-Pfannenstiel incision was made at the discretion of the gynecologist and colorectal surgeon.

Following the TICA technique, before anastomosis, the anvil of the circular stapling device (EEA circular stapler with Tri-Staple technology, 28 or 31 mm Medium/Thick; Covidien) was prepared with a 0 vicryl suture, bound at the hole of the tip (Figure 1). The anvil was brought into the abdominal cavity through the opening for the 12-mm port in the right abdominal flank. A colotomy was performed at the colonic wall just proximal to the endometriotic nodule (Figure 2), and then the anvil was introduced into the colon through the colotomy (Figure 3). The linear stapler was arranged to include the whole colostomy. The suture attached to the rod of the anvil needed to be taken from the superior edge of the colotomy, keeping the vicryl suture out of the linear stapler. The colon was then transected with a linear stapler (Figure 4) and the anvil extracted through the colon next to the suture line, pulling on the thread tied to it (Figure 5). Then, the circular stapler was introduced in the rectum and end-to-end anastomosis was performed. The specimen was extracted through the 12-mm port on the right flank



**FIGURE 2** Colotomy, performed cranially and proximally to the endometriotic.



**FIGURE 3** Anvil, introduced into the colon through the colotomy, leaving the thread tied to the anvil out of the colon.



**FIGURE 4** The colon is transected with a linear stapler including the colotomy in the suture.

or through the vagina in cases of hysterectomy. At the end of the procedure, an air leak test was performed to evaluate anastomosis integrity. One drainage was left in place. In the postoperative period, at 3 and 5 postoperative days, white cell count and C-reactive



**FIGURE 5** The anvil is extracted through the colon next to the suture line, pulling on the thread tied to it.

protein measurements were performed to look at potential early postoperative septic complications. Fast-track diet resumption was followed for nutrition.

## 2.6 | Statistical analysis

Only a few studies have investigated vascular- and nerve-sparing bowel resection for DE. Given the exploratory nature of the end points, there was no need for a formal sample size calculation. Consequently, we enrolled a convenience sample of 61 women in the study, following the time-window chosen for enrollment.

The sample was described regarding its clinical and demographic characteristics using descriptive statistical techniques. Specifically, qualitative data sets were expressed as absolute and relative percentage frequencies, whereas quantitative variables were expressed as either mean and standard deviations or median and interquartile ranges (IQRs), as appropriate. To verify the Gaussian distribution of quantitative variables, a Shapiro–Wilk test was applied. Missing values in quantitative data (all <5%) were treated using the *imputeR* package (R Project for Statistical Computing), with multiple imputations using Lasso regression methods centered on the mean.<sup>25</sup> Pre- versus post-differences in the overall VAS scales and in the four questionnaires on sexual function and quality of life were analyzed by Student *t* test or Wilcoxon rank sum test for paired data, as appropriate. These changes over time were further shown by “violin plots” drawn with R packages “*ggpubr*”, “*ggplot2*”, and “*ggstatsplot*”.<sup>26–28</sup> Statistical significance was set at a *P* value <0.05. Suggestive *P* values were further reported ( $0.05 \leq P < 0.10$ ). All analyses were conducted using R software version 4.2.0 (CRAN, R Core 2022).<sup>29</sup>

## 3 | RESULTS

In the end, we included 61 women in the study, with a mean age of  $38.4 \pm 5.9$  years and a median body mass index of  $22.9 \text{ kg/m}^2$  (IQR, 20.4–24.6). A total of 39 (67.2%) women had not had any previous

surgery for endometriosis. Furthermore, 44 patients (72.1%) had undergone previous hormone therapy at least 3 months before surgery. All patients were classified as having stage III or IV disease according to American Society for Reproductive Medicine (ASRM) (27 [44.3%] and 34 [55.7%] patients, respectively). There were no conversions to laparotomy.

At baseline, VAS pain scales disclosed a remarkably high perception of dysmenorrhea (median, 8 [IQR, 5–9]) and dyschezia (median, 8 [IQR 5–9]), whereas pain due to dysuria was low overall. Moreover, there was a mean KESS score of  $18.7 \pm 7.6$ , thus highlighting an overall index of constipation. QoL was scarce, expressed by a mean GIQLI of  $57.6 \pm 22.1$ . Urinary function was instead good overall, with a median BFLUTS of 9 (IQR, 4–13), but there was an overall indication of sexual dysfunction, as shown by a mean FSFI of  $17.5 \pm 9.3$ . All data sets are reported in Table 1. Endometriosis was further mapped by the Enzian classification system, as reported in Table 2.

### 3.1 | Intervention and complications rate

All of the women had surgery performed in laparoscopy. More specifically, intestinal nodules were mainly 43 single (73.8%) versus 16 multiple (26.2%), with a mean size of  $3.6 \pm 0.8$  cm. The median resected intestinal tract was 8 cm (IQR, 6–9 cm) and was mainly referred to the rectum ( $n=56$ ; 91.8%).

TICA was performed in 20 (32.8%) women, while bowel anastomosis was mainly a classic double stapling technique (Knight and Griffen) (47 women; 77.0%). No patients had colostomy performed, and protective ileostomy was needed in 19 (31.1%) cases. Only in a few cases was salpingo-oophorectomy performed (nine cases: 14.8% monolateral; and six cases: 9.8% bilateral). In addition, ureterolysis was performed in 45 patients (73.8%). The mean operative time was  $350.3 \pm 77.9$  min and a median of 6 days of hospitalization were required overall. Moreover, during intervention, the median estimated blood loss was 200 mL (IQR, 150–300 mL). Ureteral resection or reimplantation was needed in three cases (4.9%). Of note, posterolateral parametrectomy was needed in 48 cases (78.7%), compared with only three cases (4.9%) of anterior parametrectomy, while 23 patients (37.7%) required total hysterectomy. All data sets are reported in Table 3.

### 3.2 | Complications rate

The rate of intraoperative complications was extremely low ( $n=2$ ; 3.3%). Fever was observed in 11 cases (18%). Notably, none of the patients experienced rectovaginal, vesicovaginal, ureteral or vesical fistula, or ureteral stenosis and both uroperitoneum and hemoperitoneum. No cases of reintervention were recorded, while bladder voiding deficit was observed in five patients (8.3%) and urinary tract infections were seen in six (9.8%). Data sets are shown in Table 4.

**TABLE 1** General characteristics of the study sample at baseline ( $N=61$ ).<sup>a</sup>

Age, years	38.4 (5.9)
BMI, kg/m <sup>2</sup>	22.9 (20.4–24.6)
Previous surgery for endometriosis	20 (32.8)
Previous hormonal therapy 3 months before surgery	44 (72.1)
ASRM endometriosis stage	
I	0 (0)
II	0 (0)
III	27 (44.3)
IV	34 (55.7)
VAS pain scales	
Dysuria	0 (0–2)
Dysmenorrhea	8 (5–9)
Dyspareunia	6 (3–7)
Dyschezia	8 (5–9)
Questionnaires	
KESS	18.7 (7.6)
GIQLI	57.6 (22.1)
FSFI	17.5 (9.3)
BFLUTS	9 (4–13)

Abbreviations: ASRM, American Society for Reproductive Medicine; BFLUTS, Bristol Female Lower Urinary Tract Symptoms; BMI, body mass index; FSFI, Female Sexual Function Index; GIQLI, Gastro-Intestinal Quality of Life Index; KESS, Knowles-Eccersley-Scott Symptom; VAS, visual analog scale.

<sup>a</sup>Descriptive statistics are expressed as mean (standard deviation) or median (interquartile range) for quantitative variables and as absolute and relative percentage frequencies for qualitative variables.

### 3.3 | Postoperative improvement of symptoms and quality of life

Finally, concerning pain symptoms at 6-month follow-up evaluations, all VAS scales related to dysuria, dysmenorrhea, dyspareunia, and dyschezia were significantly reduced, with an overall disappearance of symptoms perception. Moreover, a significant improvement was observed on the constipation index, i.e. the KESS score (mean  $18.7 \pm 7.6$  vs.  $13.5 \pm 7.5$  at 6 months;  $P < 0.001$ ), and for overall QoL (mean GIQLI  $57.6 \pm 22.1$  vs.  $82.8 \pm 20.5$ ;  $P < 0.001$ ), but urinary function (i.e. the BFLUTS score) did not significantly improve. Furthermore, sexual function worsened in general, although without reaching statistical significance. All data sets are reported in Table 5.

## 4 | DISCUSSION

To our knowledge, our study is one of the few in the literature that aims to investigate complication rates and functional outcomes in segmental bowel resection for DE, focusing on the simultaneous use of

TABLE 2 Enzian classification system (N = 61).<sup>a</sup>

Enzian classification system	
Peritoneum	16 (26.2)
Ovaries	
Absent	34 (55.7)
O1	10 (16.4)
O2	14 (23.0)
O3	3 (4.9)
Tubes	
Absent	34 (55.7)
T1	5 (8.2)
T2	11 (18.0)
T3	11 (18.0)
Compartments	
A (rectovaginal septum and vagina)	
Absent	34 (55.7)
A1	3 (4.9)
A2	16 (26.2)
A3	8 (13.1)
B (uterosacral/cardinal ligaments, parametrium, pelvic sidewalls)	
Absent	24 (39.3)
B1	13 (21.3)
B2	18 (29.5)
B3	6 (9.8)
C (rectum)	
Absent	4 (6.6)
C1	1 (1.6)
C2	21 (34.4)
C3	35 (57.4)
Fa (adenomyosis)	43 (70.5)
Fb (urinary bladder involvement)	4 (6.6)
Fi (other intestinal locations)	60 (98.4)
Fu (ureteric involvement with signs of obstruction)	6 (9.8)

<sup>a</sup>Descriptive statistics are expressed as absolute and relative percentage frequencies.

vascular- and nerve-sparing techniques.<sup>8</sup> Feasibility and, in particular, good functional gastrointestinal outcomes were further confirmed for these techniques, and for the first time to our knowledge they were evaluated using well-recognized questionnaires. Nonetheless, urinary function did not significantly improve, and we also found nonsignificant postoperative worsening of sexual function.

The preservation of the main vascular arch of the rectum and the performance of a nerve-sparing dissection of the mesorectal and parametrial planes allowed us to obtain a low rate of intraoperative and postoperative complications, with anastomosis leakage, especially, occurring in only 1.6% of cases (only one patient who had previously undergone surgery for DE). Consistent with previous studies focused on the use of nerve- and vascular-sparing techniques for

TABLE 3 Intervention data for the study population (N = 61).<sup>a</sup>

Surgery	
Laparoscopy	61 (100)
Nodules	
Single	45 (73.8)
Multiple	16 (26.2)
Intestinal nodule size, cm	3.6 (0.8)
Resected intestinal tract, cm	8 (6–9)
Rectum	33 (54.1)
Sigmoid	1 (1.6)
Rectum + sigmoid	23 (37.7)
Rectum + ileum	2 (3.3)
Rectum + ileocecal	2 (3.3)
TICA	20 (32.8)
Bowel anastomosis	
L-L	5 (8.2)
L-T	9 (14.8)
T-T	47 (77.0)
Distance from the anal verge, cm	7 (6–8)
Ileostomy	19 (31.1)
Colostomy	-
MSO	9 (14.8)
BSO	6 (9.8)
Ureterolysis	45 (73.8)
Neurolysis	6 (9.8)
Duration of intervention, minutes	350.3 (77.9)
Days of hospitalization	6 (6–8)
Estimated blood loss, cc/mL	200 (150–300)
Other data	
Ureteral resection/reimplantation	3 (4.9)
Partial resection of the bladder	4 (6.6)
Partial vaginal resection	12 (19.7)
Conversion to laparotomy	-
Total hysterectomy	23 (37.7)
Posterolateral parametrectomy	48 (78.7)
Anterior parametrectomy	3 (4.9)

Abbreviations: BSO, bilateral salpingo-oophorectomy; MSO, monolateral salpingo-oophorectomy; TICA, totally intracorporeal anastomosis.

<sup>a</sup>Descriptive statistics are expressed as mean (standard deviation) or median (interquartile range) for quantitative variables and as absolute and relative percentage frequencies for qualitative variables.

segmental bowel resection, the leakage rate was substantially superimposable, varying between 0% and 3%.<sup>8</sup>

Hypothetically, the preservation of the SRA makes it possible to reduce the risk that potentially arises from hypoperfusion of the proximal stump of the rectum, due to a marginal artery of Drummond (anastomosis between the sigmoid arteries and the SRA) that is, for example, insufficient for the anastomosis requirement.<sup>9</sup>

**TABLE 4** Intraoperative and postoperative complication rates (N = 61).<sup>a</sup>

Complications	
Intraoperative complications	2 (3.3)
Transfusion	3 (4.9)
Fever	11 (18.0)
Subcutaneous hematoma	-
Pelvic abscess	3 (4.9)
Uroperitoneum	-
Hemoperitoneum	-
Urinary tract infections	6 (9.8)
Bladder voiding deficit	5 (8.2)
Intestinal anastomosis leakage	1 (1.6)
Anastomosis stenosis	-
Rectovaginal fistula	-
Vesicovaginal fistula	-
Ureteral fistula	-
Ureteral stenosis	-
Vesical fistula	-
Reintervention	-
Clavien-Dindo maximum grade	0 (0-2)
Days of catheterization	6 (4-45)
Time from surgery to flatus passage	2 (1-4)

<sup>a</sup>Descriptive statistics are expressed as median (interquartile range) for quantitative variables and as absolute and relative percentage frequencies for qualitative variables.

However, there is no adequate evidence to establish its superiority compared with the classic technique.<sup>8</sup>

In our series, there were no major Clavien-Dindo complications 3 or 4. More specifically, no rectovaginal, ureteral, or vesicovaginal fistulas were reported, nor was there ureteral or colorectal anastomosis stenosis. These data findings are consistent with what was reported in a recent review by Darici et al.,<sup>8</sup> which showed a rate between 0% and 3.6% for rectovaginal fistulas and between 0% and 6.1% for ureteral fistulas in the group of patients undergoing segmental resection using nerve- and vascular-sparing techniques. Anastomotic strictures, instead, ranged from 0% to 1.2%. Similarly, rates of postoperative pelvic abscesses (4.9%, three patients) and postoperative hemorrhages requiring transfusions (4.9%, three patients) were similar to those reported by Darici et al., i.e. 0.6% and 4.6%, respectively.<sup>8</sup>

We did not observe any cases of reintervention, as the only anastomotic leak occurred in a patient for whom a temporary ileostomy had previously been performed due to an anastomosis <5 cm from the anal margin. As such, the patient was treated conservatively, maintaining the stoma for 70 days, and it then closed without complications after performing a barium enema, which confirmed the healing of the millimetric colorectal dehiscence.

Although the most frequent postoperative complication was bladder voiding deficit (8.6%), which was resolved through the use

**TABLE 5** Pain VAS scale and questionnaires evaluation before intervention and at 6-month follow-up (N = 61).<sup>a</sup>

	Baseline	6-month follow-up	P value
VAS			
Dysuria	0 (0-2)	0 (0-0)	0.015
Dysmenorrhea	8 (5-9)	0 (0-0)	<0.001
Dyspareunia	6 (3-7)	0 (0-1)	<0.001
Dyschezia	8 (5-9)	0 (0-0)	<0.001
Questionnaires			
KESS	18.7 (7.6)	13.5 (7.2)	<0.001
GIQLI	57.6 (22.1)	82.8 (20.5)	<0.001
FSFI <sup>b</sup>	17.4 (11.7-23.8)	21.5 (10.6-29.9)	0.402
BFLUTS	9 (4-13)	6 (3-14)	0.369

Abbreviations: BFLUTS, Bristol Female Lower Urinary Tract Symptoms; FSFI, Female Sexual Function Index; GIQLI, Gastro-Intestinal Quality of Life Index; KESS, Knowles-Eccersley-Scott Symptom; VAS, visual analog scale.

<sup>a</sup>Descriptive statistics are expressed as mean (standard deviation) or median (interquartile range). P values were computed using either Student t test or Wilcoxon rank sum test for paired data. Significant findings (P < 0.05) are in bold.

<sup>b</sup>Test computed net of the five patients who did not have sexual activities after intervention and consequently did not fill out the questionnaire.

of intermittent self-catheterization within 45 days in each of the five patients, its rate was lower than in other studies on nerve-sparing techniques (0%-22%).<sup>8</sup> However, this comparison is not reliable because only a few studies specified parametrectomy, which is in itself considered a risk factor for postoperative urinary retention.<sup>2,18</sup> The number of preventive ileostomies, although seemingly high (31.9%), is comparable to the previous literature<sup>18,30</sup> and attributable to our center's choice to perform them in all cases of ultra-low resections, as well as in simultaneous ureteral resection/reimplantation.

Bowel function, on the other hand, improved significantly in our casuistic, as confirmed by the considerable enhancement of both KESS (P < 0.001) and GIQLI (P < 0.001) after surgery for bowel endometriosis, as also previously reported in a recent multicenter study by our group.<sup>2</sup> Conversely, other studies have not shown any relief from digestive complaints after segmental bowel resection for DE.<sup>31,32</sup> In addition, in a recent study on discoid resection for bowel DE, Roman et al. reported a significant improvement in gastrointestinal function only regarding the GIQLI but not with all validated questionnaires used before and after surgery (KESS, Wexner score, and Bristol scale), though their findings are not reliably comparable due to the absence of segmental resections in his series.<sup>33</sup>

Although surgery was generally associated with an improvement in dyspareunia, as already reported by several authors,<sup>34-36</sup> we observed an overall worsening of sexual function, even though it was not statistically significant. This finding might depend on the high number of posterolateral parametrectomies performed in association with segmental bowel resection (78.7% of patients) and on the

median distance of resection from the anal margin (6 cm). Both of these factors can lead to the lesion of a number of autonomic nerves responsible for decreasing blood flow to the vagina and aiding lubrication, as previously reported.<sup>2</sup> These data sets, in fact, are consistent with other findings from authors who reported that segmental resection can be linked to either lower sexual quality of life<sup>37</sup> or reduction of sexual pleasure.<sup>18</sup>

The main strength of our study is that, despite several other articles having investigated the role of surgery for bowel endometriosis, to our knowledge this is the first scientific report focused on complications and functional outcomes, evaluated using well-recognized questionnaires, resulting from a surgical technique based on the preservation of the vascular branch of the IMA, as well as the pelvic orthosympathetic and parasympathetic innervation.

Obviously, our study is not without limitations. First, its retrospective nature and, second, its relatively small sample size did not allow us to fully assess complication rates. Furthermore, the short follow-up period may also constitute a limitation, even though we designed the study to focus on complications and functional outcomes directly connected to the surgical technique of vascular- and nerve-sparing bowel resection, without dwelling on the risk of endometriosis relapse.

## 5 | CONCLUSIONS

This study should be considered an initial observation that needs further confirmation through larger-scale and prospective longitudinal studies. Nonetheless, the low rate of complications and the good gastrointestinal outcomes we observed support a more widespread use of surgical techniques that enhance the sparing of the SRA, as well as pelvic orthosympathetic and parasympathetic innervation, in rectus-sigmoid DE surgery.

### AUTHOR CONTRIBUTIONS

Manuel Maria Ianieri and Francesco Santullo were responsible for study conception and design and manuscript drafting. Pia Clara Pafundi was responsible for statistical analysis and manuscript drafting. Alessandra De Cicco Nardone contributed to the study design. Greta Benvenga, Pierfrancesco Greco, Maria Vittoria Alesi, and Federica Campolo contributed to data acquisition. Claudio Lodoli and Carlo Abatini contributed to data analysis and interpretation. Giovanni Scambia and Fabio Pacelli supervised the project. All authors have read and approved the final manuscript.

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### CONFLICT OF INTEREST STATEMENT

The authors declare that they have no conflicts of interest and nothing to disclose.

### DATA AVAILABILITY STATEMENT

Research data are not shared.

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## SUPPORTING INFORMATION

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

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