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Original Article

Total Laparoscopic Ureteroneocystostomy for Ureteral Endometriosis: A Single-Center Experience of 160 Consecutive Patients

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Precis: Surgical nerve-sparing laparoscopy for deep infiltrating ureteral, parametrial, and bowel endometriosis is viable, safe, and successful when performed by surgeons skilled in pelvic neuroanatomy, laparoscopic nerve-sparing techniques, deep infiltrating endometriosis, and oncologic radical procedures.

ABSTRACT

Study Objective: To investigate the efficacy of laparoscopic ureteroneocystostomy in patients with deep infiltrating endometriosis (DIE) with ureteral, parametrial, and bowel involvement.

Design: Prospective study (Canadian Task Force classification II-2).

Setting: Tertiary referral center for endometriosis care.

Patients: One hundred and sixty patients with DIE underwent laparoscopic radical eradication and ureteroneocystostomy between January 2009 and December 2016.

Interventions: Laparoscopic nerve-sparing radical treatment with ureteroneocystostomy, parametrectomy, and, if necessary, segmental bowel resection.

Measurements and Main Results: Surgical eradication was radical, and ureteral endometriosis was histologically confirmed in all patients (45.6% intrinsic and 54.4% extrinsic). In 58.7% of patients, ureteroneocystostomy was performed with the psoas hitch technique. Bowel resection was performed in 121 patients (75.6%), and 115 of them had a concomitant ileostomy (71.9%). Unilateral parametrectomy was performed on the left side in 61.9% of patients and on the right side in 30% of patients, respectively, while bilateral parametrectomy was completed in 33 patients (20.6%). Postoperative complications were infrequent: 7 patients underwent reoperation (4.4%), 8 patients experienced fever (5%), 4 patients required blood transfusion (2.5%), 3 patients had intestinal fistulas (1.9%), and 24 patients experienced impaired bladder voiding (15%) after 6 months. Mean follow-up time was 20.5 months (1–60). The study reported good clinical and surgical results, with a regression of symptoms ($p < .001$) and recurrence of parametrial endometriosis of 1.2% that required opposite side ureteroneocystostomy.

Conclusion: This is the largest documented series of patients with DIE undergoing laparoscopic radical eradication and ureteroneocystostomy. The collected data show that in patients with ureteral endometriosis, this technique is feasible, effective, safe, and provides good results in terms of relapses and symptom control.

Keywords: Deep infiltrating endometriosis; Laparoscopic nerve-sparing surgery; Parametrial endometriosis; Ureter

Introduction

It has been estimated that 5% to 15% of women of reproductive age are affected by endometriosis [1]. Deep infiltrating endometriosis (DIE) in the urinary tract is the second most common affected extragenital site, with an incidence of 0.3% to 12% [2–4]. Conversely, ureteral involvement has an incidence of 0.1% to 1%, with a left predisposition in most cases, confined to the distal segment of the ureter at 3 to 4 cm above the vesicoureteric junction [4,5].

Ureteral endometriosis usually presents with nonspecific symptoms owing to secondary obstruction, lumbar pain, renal colic, and hydronephrosis [1,3,6]. There is a limited correlation between symptom severity and level of obstruction, as a severe obstruction may be asymptomatic for a long period, leaving a patient at risk of renal failure [7]. Most symptoms presented are related to DIE extended to the rectovaginal septum, the uterosacral (US) ligaments, and bowel [8].

Ureteral obstruction in most cases is caused by DIE infiltration through the posterolateral parametrium, spreading from the retrocervical region. Spreading to parametrial ligaments, it generally first involves the posterior parametrium, formed by the US ligaments, rectovaginal ligament, and lateral rectal ligament. This represents the ‘‘neural soul’’ of pelvic viscera being overcrowded by tiny fibers of the orthosympathetic and parasympathetic systems from the inferior hypogastric plexus [9]. In some cases, there is also an anterolateral spread of uterine adenomyosis, with involvement of the anterior and lateral parametria (formed by the junction of cardinal ligament, ventral and dorsal vesicouterine ligament, and paracervix), where the ureter proceeds toward the parametrial tunnel (Fig. 1). Thus, radical surgery for ureteral endometriosis could require partial or complete resection of parametrial ligaments (parametrectomy), with a surgical impact on the visceral efferent neural bundles of the inferior hypogastric plexus, as well as visceral pelvic functions.

Ureteral endometriosis can be divided in an extrinsic form, involving only the adventitia and an intrinsic form, with a full-thickness infiltration of tunica muscularis, with an inconstant ratio of 4:1, respectively, evaluated during histopathologic examination [3].

Different surgical treatments have been proposed for ureteral endometriosis [3,4,6–8,10–13]. The development of minimally invasive techniques such as ureterolysis, ureteroureterostomy, and ureteroneocystostomy can now be performed [6–8,10–18].

The purpose of this study was to investigate the efficacy of laparoscopic ureteroneocystostomy in patients radically treated for DIE and to examine short-, medium-, and long-term postoperative results.

Materials and Methods

This is a prospective study conducted on consecutive patients scheduled for laparoscopic surgery from January 2009 to December 2016 after referral to our center with a diagnosis of DIE and suspicion of ureteral involvement.

Among 9600 patients laparoscopically treated for endometriosis during this time, 179 patients had documented ureteral involvement.

Inclusion criteria for ureteroneocystostomy included ≥1 of the following: 1) mild-severe hydronephrosis (≥1 cm) with or without radiologic evidence of ureteral stricture; 2) intraoperative detection of the impossibility of performing ureterolysis owing to macroscopic infiltration of endometriosis; 3) ureteral ischemia after extensive ureterolysis. Exclusion criteria were 1) history or presence of bladder cancer or ovarian cancer related to endometriosis; 2) ureteral stricture with complete loss of renal function.

Patients were evaluated and treated radically by a multidisciplinary team comprised of gynecologists (MC, MC, RC, SS), urologists (GC and AM), and a general surgeon (GR) with extensive and specific training in laparoscopic endometriosis surgery.

Patient characteristics were recorded in a computer database. Endometriosis stage was defined according to the revised American Fertility Society classification of the American Society of Reproductive Medicine (ASRM). Patients expressed the intensity of endometriosis-related pain using the Visual Analogue Scale (VAS) for dysmenorrhea, dysuria, dyspareunia, and dyschezia at baseline, at 1 and 6 months, and then annually after treatment. Hormonal therapy was stopped one month before surgery. This study was approved by the hospital institutional review board. Before the procedure, all patients signed an informed consent.

Every patient underwent rectovaginal examination, abdominal and pelvic ultrasound, double-contrast barium enema, or magnetic resonance imaging for suspicion of bowel-related endometriosis. In case of severe hydroureteronephrosis, urologic computed tomography and renal scintigraphy were performed, and patients underwent double-J catheter placement before surgery,

or preoperative nephrostomy in case of complete ureteral stenosis. Before surgery, all patients completed bowel preparation with an oral intake of 20 mL Phospho-Lax (Sofar, Trezzano Rosa, Milan, Italy®). Antithrombotic prophylaxis with low-molecular weight heparin was initiated the evening before the operation and prophylactic antibiotic therapy with 2 g of cefazolin was administered before anesthesia induction. Operative time was calculated from umbilical incision to closure of laparoscopic wounds. Blood loss during surgery was estimated by measuring aspirated blood volume, and surgery was completed with a Foley catheter in situ.

The laparoscopic procedure started with pneumoperitoneum induction using a Veress needle, followed by the introduction of the 10-mm laparoscope in the umbilical position and three 5-mm suprapubic trocars.

Parametrial and ureteral endometriosis treatment began with both medial and lateral paravesical spaces, Retzius' retropubic space, and the Bogros space (the caudad and lateral continuation of Retzius' space) being opened starting from the anatomic landmarks (the umbilical artery, uracus, pubic symphysis, pelvic floor muscles) [19] (Fig. 2). This allowed the surgeon to work in healthy tissue and better target the portion of anterior parametrium (vesicouterine ligament) that required resection (together with the distal narrowed ureter) as well as mobilize and precisely incise the bladder achieving a tension-free ureteroneocystostomy.

As reported previously, we started to approach the "frozen pelvis" by opening the retroperitoneal avascular spaces (Lazko and Okabayashi pararectal spaces) [20]. The procedure began with 1) adhesiolysis, ovarian mobilization, and 48-hours of temporary ovarian suspension to the abdominal wall using 2/0 polypropylene non-absorbable sutures (to improve access to the posterolateral parametrium and the posterior cul-de-sac); 2) bilateral identification of ureteral courses and resection of the involved US ligaments, close to the rectovaginal nodule, if present; 3) surgical dissection of Waldeyer's presacral space and Heald's retrorectal space, thus allowing the identification and preservation of pelvic sympathetic fibers of the superior hypogastric plexus and hypogastric nerves; 4) dissection of parametrial planes, isolation of the ureteral course (Fig.1), anterolateral parametrectomy, if necessary; 5) posterior parametrectomy, deep uterine vein identification, and preservation of the parasympathetic pelvic splanchnic nerves and inferior hypogastric plexus; 6) rectal resection, if necessary; 7) ureteral resection with anterolateral or

posterolateral transected parametrial ligaments, and subsequent ureteroneocystostomy; 8) final colorectal anastomosis with temporary ileostomy.

The ureteral procedure typically commenced after placement of a double-J ureteral stent, if not previously positioned. Ureteroneocystostomy was then performed after isolation and resection of the narrowed ureter portion (Fig. 2). The correct surgical strategy was tailored according to length of the proximal residual ureter. If length was adequate, ureteroneocystostomy using the "Lich-Gregoir" technique was typically performed [18,21]; conversely, when the proximal segment had a limited length, a direct reimplantation was completed, with or without psoas-hitch stitches. In extreme cases, with an extremely short residual ureteral length, a cystoplasty was created in addition to the procedures already described to relieve the tension to the anastomosis. No patients required ileal ureter replacement.

The bladder was opened transversely and laterally to the bladder dome and attached to the psoas muscle (if needed) using three interrupted Vicryl Rapide (Ethicon, Sommerville, NJ) 2/0 sutures, with care to avoid the 2 genitofemoral nerve branches. Then, the ureter was passed through the bladder wall, while maintaining a linear passage during which a submucous path was created usually 3 to 5 times wider than the ureter to avoid post ureteroneocystostomy reflux. Ureterovesical anastomosis was completed using six interrupted sutures in 3/0 Monocryl (Ethicon, Sommerville, NJ), or 3 running sutures in the Lich-Gregoir technique. The bladder incision was then closed longitudinally with double sutures in 2/0 Monocryl (Ethicon, Sommerville, NJ), the first layer including the mucosa and muscular layer, the second comprised the muscular layer and the peritoneum.

When ureteroneocystostomy was performed bilaterally, the approach on the Retzius' space was the same as the unilateral procedure. After bladder mobilization, a longitudinal incision of the bladder fundus was made, to create a v-shape cystoplasty allowing bilateral psoas-hitch stitching and subsequent bilateral tension-free ureteroneocystostomy.

A drain was left in the Retzius' space or in the Douglas pouch for approximately 2 to 3 days and removed after an intravenous methylene blue test to reveal anastomosis leakage. After 7 to 10 days (14–20 days for bilateral procedures), a cystography was typically scheduled to confirm bladder and anastomosis integrity, and the bladder catheter was removed.

Clear fluids were allowed the day after surgery, and oral intake began the following day, followed by a gradual diet. Bladder function was then assessed by measurement of residual urine volume (obtained by catheterization or ultrasound) after spontaneous voiding and was considered normal if consistently lower than 100 mL in three consecutive measurements. Before discharge, an ultrasound scan of the urinary tract was performed and removal of the double-J ureteral stent was scheduled after two months (after a negative retrograde pyelography).

The grade of vesicoureteral reflux was evaluated in voiding cystourethrography and classified according to the five-grade system of the International Grading System [22].

All patients were clinically evaluated at 1 and 6 months and then annually after surgery. Follow-up consisted of pelvic examination, pelvic ultrasound, assessment of renal function, renal tract sonogram, retrograde pyelography, urologic computed tomography and mercaptoacetyltriglycine-3 radioisotope renography, if necessary.

Statistical analysis

Statistical analysis was performed with GraphPad Prism version 3.00 for Windows (GraphPad Software, San Diego, CA®). The Wilcoxon matched pairs test was used to compare the gravity of the symptoms at follow-up. The statistical significance was considered to be achieved when $p < .05$.

Results

Among the 179 patients enrolled, 160 were considered eligible for the study. Table 1 shows the preoperative patient characteristics. Eighteen patients did not meet inclusion criteria owing to exclusive laparoscopic nephrectomy and complete loss of renal function, and one patient was excluded following intraoperative finding of ovarian cancer. One hundred patients (62.5%) had previous surgery for endometriosis, and 18 patients (11.2%) had concomitant urologic and endometriosis treatments; only 38 patients (23.7%) experienced urinary symptoms.

Mild-severe hydronephrosis was present in 110 patients (68.7%) and a double-J stent was placed before surgery. Seventeen patients (10.6%) underwent ureteroneocystostomy because it was not possible to perform ureterolysis owing to macroscopic infiltration of endometriosis or secondary atony of the fibrosclerotic residual segment after ureterolysis. One hundred and fifty-one patients had unilateral stenosis (39 patients in the right ureter, 112 patients in the left), and 9

patients had bilateral stenosis.

Table 2 shows the intraoperative findings and procedures. According to ASRM classification, patients suffered from stages I/II to III/IV in 2.5% and 97.5%, respectively. In all patients, endometriosis was histologically confirmed. Histological examination of the ureter resections showed endometriosis inside the muscular ureteral layer in 45.6% of patients (intrinsic endometriosis), adventitial infiltration of the ureter in 54.4% of patients (extrinsic endometriosis).

Psoas-hitch was performed in 94 patients (58.7%) because of the need for tension-free anastomosis. Laparoscopic radical excision of the macroscopic localization of endometriosis was performed in all patients. Sixty-five patients (41.4%) underwent Argon beam coagulation of the posterofundal superficial adenomyosis.

Bowel resection was performed in 121 patients (75.6%) and 115 of them had a concomitant ileostomy. The most common endometriosis lesions were in the rectosigmoid region (73.1%) and left (anterolateral or posterolateral) parametrium (61.9%). Bilateral parametrectomy was performed in 33 patients (20.6%).

Cystography on Day 7 to 10 confirmed the integrity of the anastomosis in 147 cases (91.8%); 12 patients needed to maintain the bladder catheter owing to minimal anastomosis leakage for another 7 to 10 days; after that another cystography showed restoration of normal integrity. A Foley catheter was left for 50 days in one patient and removed after a negative cystography. Positive postoperative bladder capacity (>200 mL) was observed in all patients.

Vesicoureteral reflux was detected in 26 patients at the side of ureteroneocystostomy, all classified as stage I [22].

The median time to resume voiding function was 3 days (range, 1–18). Median length of hospital stay was 8 days (range, 7–18), and median follow-up time was 20.5 months (range, 1–60). Eleven patients were lost to long-term follow-up. Postoperative complications were classified according to Clavien-Dindo (Table 3) [23]. During the first month, there were 7 reoperations (4.4%), 3 for bladder suture leakages (one with an associated pelvic abscess, one with associated hemoperitoneum), one vaginal-cuff dehiscence, one hemoperitoneum, and 2 ileostomy related complications. No patient presented with bowel anastomosis leakage. Anemia caused by blood loss occurred in 6 patients (3.7%), 4 of whom received blood transfusion (2.5%). Eight patients

experienced postoperative fever and were successfully treated with antibiotic therapy (5%), while 2 patients had transient hematuria (1.2%).

In the first postoperative month, 3 patients experienced complications with rectovaginal fistulas (1.9%), 6 urinary tract infections (3.7%); 26 patients experienced impaired bladder voiding evaluated by urodynamic testing (16.2%), with 33% positive postvoiding residual urine volume requiring temporary intermittent self-catheterization.

At 6 months follow-up, 11 patients reported urinary tract infections detected by urine culture (6.9%). At the second urodynamic evaluation, 24 patients confirmed bladder dyskinesia (15%), 79.2% of them with reduced bladder visceral sensitivity and 70.8% with urethral hypertonia. Two patients revealed minimum stable hydronephrosis and 2 patients an intestinal obstruction with concomitant subocclusion. One patient underwent laparoscopic reoperation for intestinal obstruction from adhesions bridle, the other patient was treated for anastomotic stenosis with endoscopic dilation. At 24 months, endometriosis recurrence rate was 3.1%, with 5 ovarian endometriomas confirmed by transvaginal ultrasound. Two patients with relapsed parametrial endometriosis (1.2%) underwent a second opposite-side laparoscopic ureteroneocystostomy 36 to 48 months after the first procedure. Six patients underwent sacral neuromodulation therapy, with substantial improvement of bladder dyskinesia (3.7%). One hundred and nineteen patients underwent postoperative hormone therapy with oral progestin or combined estrogen-progestin (74.4%). An improvement in pain symptoms was noted after surgery ($p < .0001$; Table 4). Sixty-one surgically treated patients expressed interest in future pregnancy (38.8%); 12 pregnancies were spontaneously obtained with 7 vaginal deliveries, 5 Caesarean sections, and a pregnancy rate of 19.7% after DIE excision.

Discussion

The optimal surgical approach to ureteral endometriosis has yet to be defined. Different surgical treatments have been proposed, but low prevalence diminishes the possibility for prospective randomized trials to demonstrate optimal treatment, leaving only the most recent retrospective surgical series to help determine appropriate disease management.

A review by Cavaco-Gomes et al [24] suggests that ureterolysis should be limited to patients with minimal ureteral involvement and notes reimplantation to be the preferred treatment for ureteral obstruction. Data from more recent series [10–12] indicate that recurrence rates after ureterolysis are not negligible, with reported persistence of ureteral stenosis of 12% and 20% of patients who underwent ureteroureterostomy and ureterolysis, respectively [13]. Recent studies have investigated the technique and feasibility of laparoscopic ureteroneocystostomy in patients with severe ureteral endometriosis [3,6–8,15–18].

As it is impossible to differentiate intrinsic and extrinsic ureteral endometriosis preoperatively, the indication for ureteroneocystostomy should be the presence of moderate/severe hydronephrosis owing to posterolateral parametrium involvement that causes ureteral stenosis. When ureteral endometriosis does not cause stenosis and hydronephrosis, ureterolysis with or without ureteral shaving may be considered [24]. Conversely, in case of intrinsic endometriosis it is generally established that ureteral resection is necessary because it seems to evade persistence of disease and renal failure [25].

Ureteral layers consist of a mucosal stratum coated by transitional epithelium, a double smooth muscle layer (circular and longitudinal), and an adventitia tunica, where all vascular ureteral supplies merge, arising from the aorta, gonadal artery, and common and internal iliac system; this allows ureteral mobilization during surgeries over a long distance, without endangering blood supply. As shown in Fig. 3, Waldeyer described another layer and called it the ureteral “sheath” that is formed by an encircling fibromuscular layer around the distal ureteral segment entering the bladder, mixing with the detrusor muscle [26,27]. Conversely, if ureterolysis requires ureteral adventitia invasion, compromising its vascularization and altering the Waldeyer sheath, a residual ischemic ureter could result in a subsequent ureteral fistula. Moreover, an involved parametrium can impact external ureteral layers without causing stenosis. In the current experience, parametrectomy with resection of the involved ligaments and ureterolysis is always the best surgical option, including the shaving of the adventitial involved ureteral layer. After that, a final decision regarding ureteroneocystostomy must be considered after a meticulous evaluation of the ureteral course, caliber, peristalsis, and its residual vascularization. In fact, 54.4% of the current patients revealed an extrinsic endometriosis on histopathologic specimens, but

ureteroneocystostomy after extensive ureterolysis was found to be necessary. These data show how ureteral stricture cannot be considered alone as the only factor influencing surgical management. The real surgical challenge is to unroof the ureter, removing the surrounding parametrial endometriosis without compromising its vascularization.

Ureteroneocystostomy modifies the anatomy of the urinary tract but does not seem to change urodynamic parameters [14]. Postoperative bladder dysfunctions seem unrelated to ureteroneocystostomy itself, but is associated with neuroablative damage during parametrectomy, often overlapping the effects of multiple previous surgeries [9,20]. This clinical aspect was partially confirmed in the current study. In fact, 15% of current patients were found to suffer from bladder dyskinesia, but this was associated with massive parametrial involvement that was recorded in the study, with consequent infiltration of parametrial bladder branches and the need for radical parametrectomy, which was done bilaterally in 33 women (20.6%). Moreover, the percentage of patients requiring urodynamic follow-up has declined since 2013, and this appears to be related to improved control of parametrial surgical anatomy and the nerve-sparing technique introduced and performed by our team [20].

To the best of our knowledge, this is the largest series of patients who underwent laparoscopic ureteroneocystostomy for DIE and has the strength of a single-center study with a systematic follow-up. In the current study, the reported recurrence rate was 1.2% with a complete regression of symptoms ($p < .0001$; Table 4). No major complications were reported both postoperatively and at long-term follow-up, and bowel complications (3.1%) were comparable to a previous study [28].

More than 95% were classified as stage III/IV according to ASRM classification, with 62.5% having undergone previous surgery for endometriosis.

In our experience ureteral endometriosis, both intrinsic or extrinsic, is a direct consequence of a posterolateral and/or anterolateral parametrial involvement. In the majority of patients, endometriosis impacts the parametrial ligaments, spreading from an involved/obliterated anterior and/or posterior cul-de-sac and arising from adenomyosis.

When there is a clear indication for surgery, such as with the oncomimetic growth-pattern of endometriosis, radical removal of disease is essential (together with parametrial and bowel surgery) and must be balanced with a fertility- and nerve-sparing approach.

Conclusion

The current manuscript shows that laparoscopic ureteroneocystostomy for ureteral endometriosis is safe, feasible, and effective. The primary goal is to provide minimally invasive techniques, laparoscopic or robotic-assisted, to achieve better surgical outcomes than the open technique.

This technique is crucial in distal ureteral obstruction with a risk of subsequent renal failure. On the other hand, when surgery is indicated (after medical treatment failure), ureteroneocystostomy may be considered necessary as well, for wide parametrial involvement and external ureteral infiltration, noting the primary goal to be complete surgical endometriosis excision.

In the treatment of DIE with multiple-organ involvement, the standard protocol at our institution is a multidisciplinary team approach (gynecologist, urologist, general surgeon) to achieve optimal treatment preoperatively, intraoperatively, and postoperatively. Surgery should be performed by experienced gynecologic surgeons skilled in pelvic neuroanatomy, laparoscopic nerve-sparing techniques, DIE, and oncologic radical procedures.

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Figure Legends

Fig. 1 Different surgical steps for ureterolysis of a left ureter with endometriosis involvement. (**A**) Overview of a “frozen pelvis”, with the dilated ureter that runs into the posterolateral left pathologic parametrium attached to the retrocervical and rectovaginal septum infiltrated by endometriosis. (**B**) Left ureterolysis and development of lateral and medial pararectal spaces (Latzko’s and Okabayashi’s) and transection of the cardinal ligament. (**C–D**) Left narrowed ureter after posterolateral parametrectomy with cranial dilation and the required left ureteroneocystostomy. E = endometriosis nodule; LP = lateral pararectal space; MP = medial pararectal space; OV = ovarian vessels; R = rectum; U = ureter.

Fig. 2 Surgical steps of a left ureteroneocystostomy. (**A**) Dissection and preparation of the retropubic and lateral retropubic (Retzius' and Bogros’) spaces with complete bladder mobilization. (**B**) Proximal left ureteral segment preparation for the ureteroneocystostomy with the double J ureteral stent. (**C**) Left ureteroneocystostomy according to the Lich-Gregoire technique, beginning with Monocryl 3/0 (Ethicon, Sommerville, NJ) for the second running suture. (**D**) Final overview of the left ureteroneocystostomy. B = bladder; BS = Bogros space; IPR = ischiopubic ramus; R = Retzius space; U = ureter; UA = umbilical artery; UT = uterus.

Fig. 3 Ureteral wall layers and intrinsic vascularization. (**A**) Anatomic drawing showing ureteral layers and the Waldeyer’s sheath enveloping the periadventitial ureteral vascularization. (**B**) Waldeyer’s fibromuscular sheath enveloping the terminal ureteral inner vascularization (drawn in white). (**C**) Final view of a de-vascularized ureter after ureterolysis and removal of an extrinsic endometriosic nodule infiltrating through the Waldeyer’s Sheath (Drawings by Francesca Ceccarello inspired from Hinman F Jr. Atlas of Urologic Surgery, 2nd Ed. Philadelphia, PA: WB Saunders Company. 1998 [26,27].

Table 1

Patient characteristics

Patient enrolled, N	160
Age, years	36.1
Body mass index, kg/m^2	22.1
Previous hormonal therapy, n	73 (45.6%)
Previous surgery for endometriosis, n	100 (62.5%)
Previous surgeries per patient, mean number (range)	1 (1–5)
Previous urologic surgery	18 (11.2%)
Dyspareunia, n (%)	76 (47.5%)
VAS score ≥5, n	53
VAS score (range)	3.8 (1–10)
Dysuria, n (%)	38 (23.7%)
VAS score ≥5, n	21
VAS score (range)	1.7 (1–10)
Dysmenorrhea, n (%)	127 (79.3%)
VAS score ≥5, n	102
VAS score (range)	6.7 (1–10)
Dyschezia, n (%)	76 (47.5%)
VAS score ≥5, n	52
VAS score (range)	4 (1–10)
Renal colic, n (%)	11 (6.9%)
Recurrent cystitis, n (%)	2 (1.2%)
Preoperative double J stent, n (%)	114 (71.2%)

Values are reported as mean or (%). VAS = Visual Analogue Scale.

442 Table 2

443 Intraoperative findings and procedures (N = 160)

Duration of surgery, minutes (range)	364.3 (120–600)
Duration of ureteroneocystostomy, minutes (range)	92.3 (30–180)
Blood loss, mL (range)	291.4 (50–1250)
Stage of disease, n (%)	
I	0
II	4 (2.5%)
III	11 (6.9%)
IV	145 (90.6%)
Ureteroneocystostomy, n (%)	
Right	39 (24.4%)
Left	112 (70%)
Bilateral	9 (5.6%)
Psoas hitch, n (%)	94 (58.7%)
Bilateral	4 (2.5%)
Concomitant urological procedures, n (%)	
Nephrectomy	1 (0.6%)
Termino-terminal anastomosis	1 (0.6%)
Concomitant endometriosis sides, n (%)	
Vesicouterine pouch	37 (23.1%)
Rectosigmoid	117 (73.1%)
Pouch of Douglas	58 (36.2%)
Right fallopian tube	13 (8.1%)
Left fallopian tube	10 (6.2%)
Right parametrium	48 (30%)
Left parametrium	99 (61.9%)
Bilateral parametrium	33 (20.6%)
Right ovary	41 (25.6%)
Left ovary	58 (36.2%)
Right wide ligament	75 (46.9%)
Left wide ligament	81 (50.6%)
Right uterosacral ligament	76 (47.4%)
Left uterosacral ligament	93 (58.1%)
Rectovaginal septum	86 (53.7%)
Vaginal posterior fornix	47 (29.4%)
Right round ligament	5 (3.1%)

Left round ligament	11 (6.8%)
Ileum/Caecum	12 (7.5%)
Appendix	6 (3.7%)
Associated procedures, n (%)	
Excision of endometriomas	96 (60%)
Unilateral/bilateral salpingo-oophorectomy	8 (5%) / 3 (1.9%)
Unilateral/bilateral salpingectomy	20 (12.5%) / 3 (1.9%)
Total hysterectomy	3 (1.9%)
Excision of uterosacral ligaments	126 (78.7%)
Excision of rectovaginal nodule	86 (53.7%)
Bowel resection	121 (75.6%)
Bladder resection	16 (10%)
Excision of vaginal posterior fornix nodule	47 (29.4%)
Ileostomy	115 (71.9%)

Values are reported as mean or (%).

Table 3

Complications (Clavien-Dindo grading system for surgical complications)

	Postoperative	Clavien-Dindo	After 1 month	After ≥6 months
Reinterventions, n (%)	7 (4.4%)	IIIb	–	–
Blood loss with anemia, n (%)	6 (3.7%)	I	–	–
Blood transfusion, n (%)	4 (2.5%)	II	–	–
Postoperative fever, n (%)	8 (5%)	II	–	–
Hematuria, n (%)	2 (1.2%)	–	–	–
Urinary infection, n (%)	–	–	6 (3.7%)	11 (6.9%)
Rectovaginal fistula, n (%)	–	–	3 (1.9%)	–
Bladder voiding deficit, n (%)	–	–	26 (16.2%)	24 (15%)

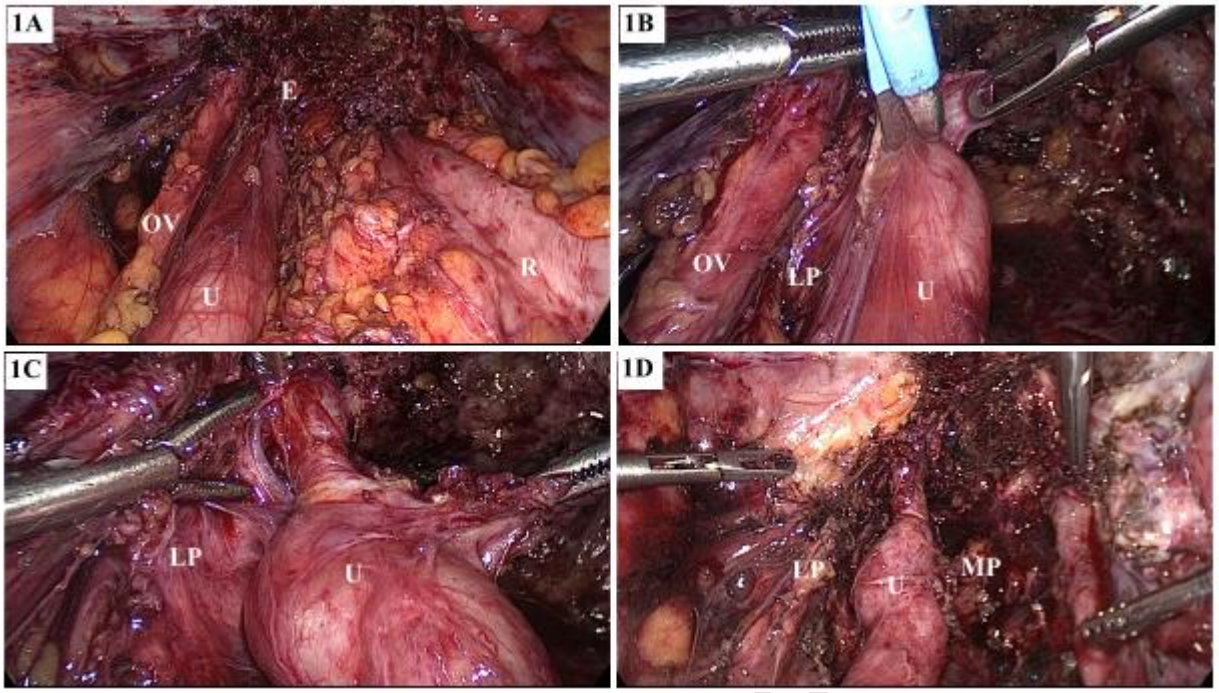
Table 4

Symptom improvement after surgery (N = 160)

	Preoperative symptoms		Postoperative symptoms	
	Mean	SD	Mean	SD
Dysmenorrhea	6.6	3.14	1.1	1.42
Dysuria	1.7	2.57	0.8	1.42
Dyschezia	4	3.71	0.8	0.76
Dyspareunia	3.8	3.62	0.9	1.19

Values are mean ± standard deviation (SD) with $p < .0001$ (Wilcoxon test).

458 Fig. 1



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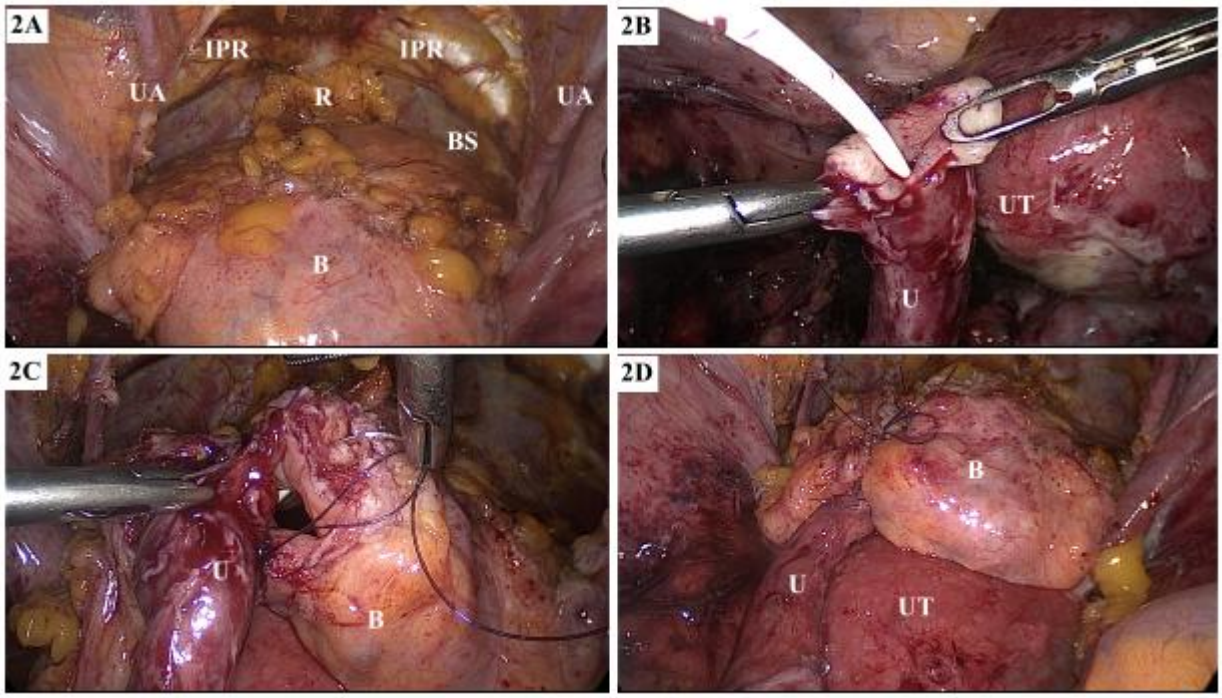
460 Fig. 2



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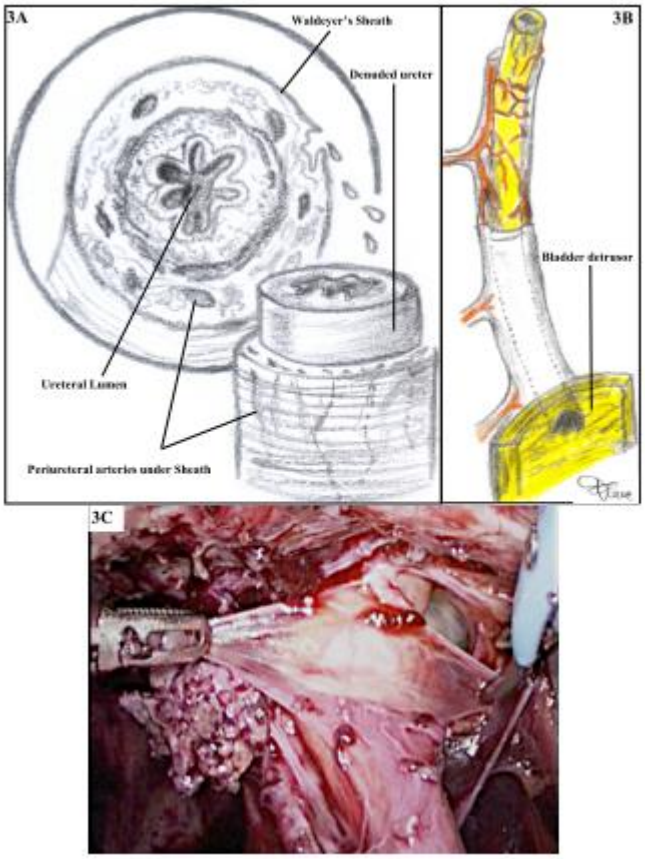
463 Fig. 3



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