

Special Report

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Complications and their management in endometriosis surgery

Endometriosis is a common chronic disease mostly seen in young women. Endometriosis surgery may be considered as rather challenging in gynecology. In this article, we tried to emphasize on basic concepts of endometriosis surgery, the best surgical method that should be applied and the complications and the management of the complications.

Keywords: deep infiltrating endometriosis • endometriosis • laparoscopy • surgery • rectovaginal nodule • shaving

Endometriosis is defined as the presence of endometriotic gland and stroma outside the uterine cavity. Endometriosis is a common disease found in 10% in women of reproductive age [1]. Prevalence of the disease increases in the infertile population. Even though women may be asymptomatic, the most common symptoms are dysmenorrhea, dyspareunia, chronic pelvic pain and infertility. The localization, size, type and amount of the endometriotic lesions are correlated with the severity of the manifestations. On the contrary, the link between the severity of endometriotic lesions and infertility is controversial. In clinical practice, pelvic endometriosis may be seen as superficial implants, adhesions, ovarian cysts or deep infiltrating forms. The localization, size, amount and depth of the lesions identify the surgical strategies for the disease. The aims of the surgery for endometriosis are to demolish all visible implants, restore the pelvic anatomy by adhesiolysis, ovarian cystectomy if necessary, excision of the deep implants, prevent the recurrences, increase the conception rates and finally improve the quality of life.

Since endometriosis is one of the common gynecologic pathology in reproductive ages, a thorough classification of the disease is mandatory. Several classification systems were proposed for endometriosis, recently revised American Fertility Society is the most

preferred one [2]. However, since deep infiltrating endometriosis (DIE) is not included in revised American Fertility Society classification, ENZIAN scoring which is the most comprehensive system for DIE may be preferred [3].

Surgery for endometriosis is rather challenging for gynecologists due to the adhesive complexity of the pelvic structures caused by the impact of endometriosis. In order to perform a complete surgery and to avoid surgical complications, pre-operative assessments should be done properly and thoroughly. One or more steps for the diagnosis would be needed:

- Patient history;
- Bimanual pelvic examination and speculum assessment (especially during menstruation);
- Transvaginal/transrectal ultrasound;
- Pelvic MRI;
- Double contrast enema;
- Rectosigmoidoscopy;
- Intravenous pyelography.

Except for DIE, diagnosis of the disease is usually ascertained by patient's history, pelvic examination and transvaginal ultrasound (TVS). However, DIE is a more complicated

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entity of endometriosis that requires awareness and suspicion with additional diagnostic tools mentioned above. Despite pelvic examination is very limited in diagnosing DIE, rectovaginal examination in menstrual cycle may detect the presence, size and motility of the rectovaginal nodul. Lesions may be seen with a speculum at the posterior fornix or they may be palpated on pouch of Douglas, rectovaginal septum, uterosacral ligament or vagina.

The diagnosis of DIE by TVS is based on abnormal hypoechoic linear thickening and nodules with or without regular contours which may vary according to different localizations (uterosacral ligament, vagina, rectovaginal septum, rectum, sigmoid colon, bladder) [4]. Rectal endoscopic sonography (RES) also may be used in different localizations except the bladder. DIE is defined by the presence of hypoechoic nodule or mass with or without regular contours. MRI is one of the most accurate diagnostic tool to detect and provide a more reliable map of DIE than physical examination, TVS and RES. TVS should remain as first line diagnostic exam in chronic pelvic pain, however MRI would give better results for women with endometriosis and chronic pelvic pain before surgery.

Complications of endometriosis surgery may be divided into three categories:

- Basic laparoscopic complications (not going to be discussed in this article);
- Complications regarding the ovarian reserve and infertility;
- Complications of DIE surgery.

In order to avoid complications of endometriosis surgery, a thorough intraoperative setup is also crucial as much as the preoperative evaluation.

- Bowel preparation;
- Lithotomy position with the arms alongside the body;
- Face covered with a sterile drape;
- Legs are semiflexed;
- Shoulders and popliteal fossas are buffered with silicon pads;
- Coccyx should pass the operation table for at least 10 cm for ideal manipulation of the devices inside the vagina and rectum;
- Maximum Trendelenburg position after the insertion of Verres needle and umbilical trocars;

- Ergonomic uterine manipulator (we use two tenaculums at 3 and 9 positions with a curette inside the cavity which enables maximum ante flexion and rotation of the uterus);
- Rectal dilator if needed.

Ovarian endometriosis

One of the most common and unfavorable complication of endometriosis surgery is diminished ovarian reserve leading to iatrogenic infertility or premenopause. There are several surgical techniques to treat ovarian endometriomas; ultrasound-guided aspiration, excision or stripping and coagulation or vaporization.

USG-guided aspiration may solely be an alternative to repeat endometrioma surgery since the operation itself is not so innocent. High recurrence rates have been reported (60–90%) [5,6]. In order to diminish the recurrence rate some authors have proposed sclerotherapy; however, leakage of the endometriotic fluid or sclerotherapeutic medium may lead to adhesion formation [7,8]. Moreover, since the old blood is a perfect bacterial culture media, USG-guided approaches may increase the risk of ovarian abscess which eventually necessitates oophorectomy. USG-guided aspiration and/or sclerotherapy should be limited to patients who do not will to undergo surgery, increased anesthetic risk or women with severe adhesions.

Laparoscopic drainage and coagulation/vaporization technique may be another alternative; however, there is an increased recurrence rate of endometrioma and has a disadvantage in terms of conceiving when compared with excision methods [9,10]. In the past, three stage techniques for ovarian endometrioma have been proposed. Drainage in the first laparoscopy followed by 3 month GnRH agonist administration and vaporization of the cyst wall by CO₂ laser in the second laparoscopy [11]; however, the costs and risks of two separate laparoscopic surgeries do not justify these approaches for endometriosis surgery. When cystectomy is technically difficult or if the ovarian reserve is diminished then aspiration and vaporization may be an alternative to cystectomy.

Laparoscopic cystectomy still remains the first-line therapy for ovarian endometriomas [12]. On the other hand most of the complications related to ovarian reserve occurs proceeding the cystectomy techniques. Debates are mainly focusing on whom and when cystectomy should be performed. Prior and after endometrioma surgery, it would be wiser to evaluate antral follicle count (AFC), FSH and AMH levels. We strongly recommend to obtain especially the laboratory findings prior to surgery to establish an already set premenopausal status and inform the patient in order to prevent

yourself for medicolegal conditions. Streuli *et al.* [13] showed that AMH levels were not diminished in women with uni-bilateral endometriomas unless they had had previous endometrioma surgery. It has been shown that laparoscopic removal of endometriomas by excision/stripping techniques may cause a decrease in ovarian reserve detected by AMH levels. This effect was seen particularly when endometriomas were ≥ 5 cm or bilateral [14].

There is a controversy whether endometrioma surgery affects ovarian reserve or not. It has been shown that normal ovarian tissue was present in cystectomy specimens in 97% of cases [15]. This is mainly due to the inadvertent removal of healthy ovarian tissue while stripping. Moreover electrosurgical coagulation or postsurgical inflammation may also jeopardize the normal ovarian function. Somigliana *et al.* [16] evaluated several studies comparing ovarian responsiveness during *in vitro* fertilization in affected and normal ovaries and concluded that the presence of endometrioma did not affect the ovarian reserve and responsiveness to hyperstimulation in unoperated ovaries, excision techniques might reduce the ovarian responsiveness in operated gonads by 50% and finally CO₂ laser vaporization of the cyst wall might be less harmful to the follicular reserve. Severe ovarian damage following endometrioma surgery, especially in bilateral cases is not uncommon [17,18], therefore special attention should be paid and the best choice of surgical method should be performed.

In a recent study, Donnez *et al.* [19] described a new combined technique of excision (cystectomy) and CO₂ laser ablation of endometriomas laparoscopically. A total of 52 women under 35 years of age with endometriomas larger than 3 cm were enrolled to the study and the endometrioma wall was first excised in the first step and then the remaining 10–20% of the endometrioma wall close to the hilus was vaporized by CO₂ laser in the second step. The operated ovaries, unoperated normal ovaries and the control infertile group (male factor infertility) were compared by means of ovarian volume and AFC. Ovarian volume and AFC were found to be similar in all subgroups. Histopathologic evaluation of the excised part of the endometrioma wall revealed presence of follicle in only one case (2%). The recurrence rate was 2% (only one case) and the pregnancy rate was 41% with a mean follow-up of 8 months. They concluded that combined technique (stripping and ablation) has no deleterious effect to the ovary.

Generally when assisted reproductive techniques are necessary in women with asymptomatic endometriomas, there are insufficient data to suggest that surgery will improve IVF success rates. However, the rule of not operating prior to IVF has some exceptions [20]:

- If the endometrioma is larger than 4 cm;
- To confirm the histological diagnosis;
- Improve access to follicles during oocyte pick-up;
- To diminish the risk of infection after oocyte pick-up.

Deep infiltrating endometriosis

The aims of surgical management for DIE are to increase the quality of life, preserve the fertility, reduce the recurrence rates and minimize the complication rates. Hormonal therapy has been used for DIE to suppress the estrogen synthesis and cause atrophic changes in the ectopic endometrial tissue; however, the recurrence rates were high. Although pelvic pain relieves significantly with hormonal therapy, endometriotic nodule volume reduces very little. Endometriotic nodules decrease only up to 30% even with several months of therapeutic amenorrhea [21,22]. Smooth muscle fibers and fibrosis constitutes more than 60% of the nodule histologically which do not respond to hormonal therapy while 20–30% is reductable endometrial epithelium [23]. However, suppression of intranodular microhemorrhagia may cause relief in pain [24]. Moreover, hormonal therapy may be used to reduce recurrences preceding surgical excisions of macroscopic endometriotic lesions. Also medical therapy may prevent formation of endometriotic lesions from a different localization after complete surgical excision and lowers the recurrence of pain symptoms [25].

For a complete surgical excision of DIE; preoperative work up should be done properly, surgical techniques should be identified and risks and benefits should be evaluated. DIE lesions are usually multifocal and associated with other forms of endometriosis, hence vaginal or rectal approach solely are insufficient and not applicable in most of the cases. Laparoscopic or Robotic techniques may be considered with a multidisciplinary and well-trained surgical team.

Surgical options for nodular DIE lesions:

- Only nodular excision;
- Shaving (if only superficial muscular involvement of the intestines is present, without opening the rectum);
- Discoid resection (muscular invasion with nodule <3 cm);
- Segmental sigmoid resection (bifocal involvement, nodule >3 cm, sigmoid lumen restriction >50%, muscular or mucosal involvement of sigmoid colon);

- Partial bladder excision (nodule with muscular bladder invasion);
- Ureterolysis (nodule surrounding ureter);
- Ureteral anastomosis or ureterocystostomy (nodule invading the ureter).

There are limited number of studies on which technique is more effective in colorectal endometriosis. Segmental colorectal resection is used widely in symptomatic patients. Authors advocating this technique, indicate that segmental resection is the most effective procedure in terms of pain relief, better life quality and decreased recurrence rates by radical excisions of endometriotic lesions [26–28]. Besides, several other studies have shown that microscopic endometriotic lesions around the rectal nodule might not be excised completely by discoid resection [29,30]. Moreover, since the active glandular epithelial and stromal components are located deeply in the rectum, some note that shaving technique is insufficient [31]. On the contrary, there are some experienced surgeons advocating that the first choice should be rectal nodule excision solely [25,32–35]. High postoperative complication rates, urinary and intestinal dysfunctions were reported after segmental resections [36,37]. Also, cyclic intestinal symptoms seen after segmental resection techniques support that even with radical approaches microscopic endometriotic lesions may not be excised completely [38,39].

In a study by Fanfani *et al.* [40], a comparison of laparoscopic discoid (48 patients) or segmental (88 patients) resection for DIE was conducted. Median operation time was 200 and 300 min, respectively, for discoid (study group) and segmental (control group) resection patients ($p = 0.02$). Median blood loss, length of hospital stay and intraoperative complication rates were similar. Temporary ileostomy was reported in eight patients (9.1%) in the control group and only one patient (2.1%) in the study group ($p = 0.04$). Re-operation rates were similar. In the discoid resection group no complications regarding the urinary system was noted, whereas there were one vesicovaginal and one ureterovaginal fistulas in the control group. No late bladder dysfunction and a low rate of rectal dysfunction (2.1%) was observed in the study group, whereas in the control group rates were 14.7 and 4.5%, respectively. Leakage on the anastomosis site has been reported in one case in the segmental resection group. Overall, with an approximately 3 years of follow-up, there were no significant difference in terms of patient's satisfaction and recurrence rate.

In another study, a total of 41 cases have undergone colorectal segmental resection (25 patients and nodule excision (16 patients) [36]. After the follow-up, pelvic pain and recurrence rate was similar, however,

colorectal segmental resection was associated with several unpleasant functional intestinal symptoms when compared with nodule excision.

Complete excision of the microscopic endometriotic lesions may not be always possible with shaving or discoid resection. Hence, the probability that patients suffering from cyclic pain after surgery is higher. However, since the postoperative cyclic symptoms may be controlled successfully with hormonal agents (oral contraceptives, progestins), more radical surgeries associated with high mortality and morbidity rates are debatable nowadays. Recently favorable results were reported with shaving technique in rectovaginal deep endometriosis. Postoperative complications such as urinary retention, rectovaginal fistula or rectal stenosis were noted to be very low. Postoperative continuous use of progestins or immediate pregnancy after discontinuation of progestins revealed low recurrence rates, whereas patients who could not conceive and did not use progestins, the recurrence rates were about 20% [25]. Especially in young women treated for DIE, in order to decrease postoperative morbidity rates, symptom-based surgical methods would be appropriate, instead of radical segmental resections, nodular excisions may be preferred. Segmental resections may be considered only if the intestinal lumen is restricted more than 50% or if the involvement of the muscular layer of the intestine is more than 7–8 cm [41]. Nodular excision is recommended to patients who accept postoperative medical amenorrhea until menopause. To patients who wish to conceive, radical segmental resection is not recommended, however, since the duration of the hormonal therapy will be limited in these patients postoperatively, in case of a rapid recurrence assisted reproductive techniques would be considered [35,36].

Laparoscopic excision of deep infiltrating endometriotic nodule:

- Lateral edges of the nodule are dissected in order to free the nodule;
- Free the nodule from the ureter, uterine artery and/or sacrospinous ligament;
- Posterior aspect of the nodule is dissected from the rectum, until the rectum is completely liberated;
- Liberation of the nodule from posterior vagina and cervix;
- Extirpation of the nodule;
- Repair of the posterior vaginal wall and rectum if necessary;
- Rectal perforation test (intrarectal methylene blue injection).

Duration of laparoscopic nodule excision may prolong if:

- Nodule is >3 cm;
- In case of pelvic adhesions;
- Nodule is on the sigmoid colon;
- Adhesive to the ischial spine.

If the rectum and vagina needs to be sutured, the sutures should not be placed in the same direction in order to prevent a fistula formation. If the rectum is sutured sagittally, then the vaginal sutures must be placed vertically. Liberal prophylactic suturing of the rectum may be needed if the nodule has extended into the muscularis layer.

Donnez *et al.* [25] have analyzed complication, pregnancy and recurrence rates after deep endometriotic nodule excision by shaving surgery in a total of 500 cases with a mean lesion size of 3.4 cm. Mean duration of operation was noted as 78 min. Laparoscopic nodule resection was performed successfully in all cases, no conversion to laparotomy was needed. Rectal perforation was seen in 1.4% of the cases which were repaired successfully by laparoscopy. Ureter damage (three of them thermal damage) was reported in four patients (0.8%). They have stated that endometriotic nodule surgery for DIE was controversial, however, complications after rectosigmoid resection were significantly higher than shaving technique. The surgeon should also keep in mind to spare the autonomic pelvic nerves which control rectal, bladder and sexual functions during the nodule surgery. Damage on the nerve fibers is very limited in shaving method which do not require deep lateral rectal dissection unlike rectosigmoid resection. These young patients are especially seeking normal bladder, intestinal and sexual activity proceeding the surgery. Therefore, since DIE is not a malignant state, it is debatable whether we should increase postoperative complication rate by radical surgery or not.

A combined transanal and laparoscopic rectal disk excision technique was described by Bridoux *et al.* [42]. Although the limited number of cases, they reported total relief in postoperative intestinal symptoms, and rectal stenosis might be avoided. They used Contour Transtar stapler with direct laparoscopic visualization. This technique may only be used in lesions that are at least 10 cm distal to anus and not exceeding 5 cm.

In a comparison of laparoscopic anterior discoid resection and laparoscopic low anterior resection for deep infiltrating rectosigmoid endometriosis, it was shown that anterior discoid resection was associated with decreased operative time, blood loss, hospital stay and low anastomotic strictures. Two of three anastomosis strictures

required rectal dilation [43]. Anastomotic dehiscence and leakage are the most important life threatening complications especially in low rectal anterior resection and anastomosis surgery. These patients may require transient or permanent colostomy [44]. Perineal abscesses and rectovaginal fistulas have also been reported after bowel resection operations [45,46]. To minimize the risk of rectovaginal fistula formation, an omental flap would be used when a vaginal defect is present close to the rectal anastomosis [47].

Early or late onset intestinal perforations and leakage on the suture or anastomosis site are the most serious complications of DIE surgery. When the resection involves the lower part of the bowel, leakage rate increases. Leakage may occur in 1% of the cases with sigmoid resection, whereas it is about 15% after low anterior resections [41]. Most of the intestinal perforations (>90%) occur in the first 48 h following surgery. Early diagnosis and rapid relaparoscopy is crucial. In the first 24 h, perforations may be managed with double-layer suture and abundant lavage and antibiotherapy. After 24 h, prophylactic colostomy may be needed. CRP may be a good indicator for a possible perforation; if CRP is >200 there is a great chance of perforation and relaparoscopy may be considered.

Urinary tract endometriosis may be found in 6% of women presenting with pelvic endometriosis. Either ureters or bladder may be involved [48]. For ureteral lesions; ureterolysis, ureteral resection and end-to-end anastomosis or ureterocystostomy are considerable. Ureteral involvement is usually secondary to uterosacral or rectovaginal spread of DIE [49]. For bladder lesions; full thickness excision of the endometriotic nodule and suturing may be performed. Bladder atony may occur after parasympathetic nerve damage during pararectal fossa dissections. Atony usually ameliorates spontaneously by catheterization, however, duration of bladder catheterization may last several months.

Rozsnyai *et al.* [49] reported surgical complications after removal of ureteral and bladder endometriosis. They have reported four complications in 16 women treated for ureteral endometriosis and two complications in 15 women treated for bladder endometriosis:

- (Ureterolysis with harmonic scalpel) led to ureteric fistula due to thermal necrosis and treated by pig tail ureteric stent followed by ureterocystostomy;
- (Segmental ureteric resection) caused pyelonephritis 7 days after surgery and treated successfully with antibiotherapy;
- (Removal of DIE of both rectum and ureter) bladder atony required five bladder catheterizations per day over 6 months;

- (Enlarged hysterectomy, rectal shaving and segmental ureteric resection with end to end anastomosis) because the double J catheter was inserted 6 months prior to surgery, calcified crust developed and microlithiasis spread above the anastomosis leading to postoperative obliteration of the stent and fistula of the anastomosis requiring ureterocystostomy;
- (Full thickness bladder excision) led to fistula formation between bladder and anterior vaginal wall, required re-intervention 5 weeks later;
- (Full thickness bladder excision on the trigone) caused bladder atony requiring four- to five-times bladder catheterization per day over a 15-month period.

Conclusion & future perspective

In conclusion, endometriosis is a very common disease affecting women mostly in reproductive age varying

from simple superficial implants to deep infiltrating forms. Awareness and suspicion with an experienced surgical team is mandatory to diagnose and treat the disease. The aim is to demolish all implants and varying forms of endometriosis and finally improve the quality of life of the patients.

In future, more studies will be held on molecular basis and medical treatment of endometriosis which may replace surgical interventions that still have controversies and consist severe complications.

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Executive summary

- The aims of the surgery for endometriosis are to demolish all visible implants, restore the pelvic anatomy by adhesiolysis, perform ovarian cystectomy if necessary, excise the deep implants, prevent the recurrences, increase the conception rates and finally improve the quality of life.
- In order to perform a complete surgery and to avoid surgical complications, preoperative assessments should be done properly and thoroughly.
- Deep infiltrating endometriosis (DIE) is a more complicated entity of endometriosis that requires awareness and suspicion with additional diagnostic tools.
- One of the most common and unfavorable complication of endometriosis surgery is diminished ovarian reserve leading to iatrogenic infertility or premenopause.
- Laparoscopic cystectomy still remains the first-line therapy for ovarian endometriomas.
- Special attention should be paid particularly when endometriomas are ≥ 5 cm or bilateral.
- The aims of surgical management for DIE are to increase the quality of life, preserve the fertility, reduce the recurrence rates and minimize the complication rates.
- Colorectal segmental resection is associated with several unpleasant functional intestinal symptoms when compared with nodule excision.
- Especially in young women treated for DIE, in order to decrease postoperative morbidity rates, symptom-based surgical methods would be appropriate. Instead of radical segmental resections, nodular excisions may be preferred.
- Since DIE is not a malignant state, it is debatable whether we should increase postoperative complication rate by radical surgery or not.

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