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Abdominopelvic Complications of Endometriosis

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1. Introduction

Endometriosis is a painful chronic disease occurring in 4 to 17% of menstruating women. Its aetiology is unknown, although there is a high incidence in sterile females (10-25%) (Pritts *et al.*, 2003), 60-70% in women with chronic pelvis pain as well as in those who have a family history (Bianchi *et al.*, 2007). It is characterized by the presence of functional endometrial tissue consisting of glands and/or stroma located outside the uterus.

Endometriosis can be divided into intra and extraperitoneal sites. The intraperitoneal locations are ovaries (30%), uterosacral and large ligaments (18-24%), fallopian tubes (20%), pelvic peritoneum, pouch of Douglas and gastrointestinal tract. Extraperitoneal locations include cervical portio (0.5%), vagina and rectovaginal septum, round ligament, inguinal hernia sac, abdominal scars after gynaecological surgery (1.5%) and caesarean section (0.5%). This disease rarely affects extra-abdominal organs such as the lungs, urinary system, skin and the central nervous system (Chapron *et al.*, 2003; Veeraswamy *et al.*, 2010).

Clinical manifestations of endometriosis fall into three general categories: pelvic pain, infertility and pelvis mass. The goal of therapy is to relieve these symptoms. There is no high quality evidence that one medical therapy is superior to another for managing pelvic pain due to endometriosis, or that any type of medical treatment will affect future fertility. Therefore, treatment decisions are individualized, taking into account the severity of symptoms, the extent and location of disease, desire for pregnancy, the age of the patient, medication side effects, surgical complication rates, and cost (Berlanda *et al.*, 2010; Shakiba *et al.*, 2008).

2. General indications for surgery of endometriosis

Indications for surgical management of endometriosis include:

- Symptoms that are severe, incapacitating, or acute.
- Symptoms that have failed to resolve or have worsened under medical management.
- Advanced disease: anatomic distortion of the pelvic organs, endometriotic cysts, obstruction of the bowel or urinary tract, etc.
- Patient reluctance to use hormonal/non-surgical treatments.
- Adnexal mass suspicious for malignancy.

3. Pre and postoperative medical therapy

3.1 Preoperative medical therapy

Hormonal suppression has been used prior to surgery to decrease the size of endometriotic implants (Yap *et al.*, 2004). However, there is no evidence that preoperative hormonal intervention decreases the extent of surgical dissection and recurrence rates, prolongs the duration of pain relief, or increases future pregnancy rates.

3.2 Postoperative medical therapy

The hypothetical advantages of short-term postoperative medical treatment, including resorption of residual visible foci and sterilisation of microscopic implants, should result in a reduction of postoperative lesions and symptoms recurrence rates (Vercellini *et al.*, 2003).

Progestins, danazol, estrogen-progestin pills, and GnRH agonists have been used in conjunction with laparotomy or laparoscopic conservative or definitive surgical treatment. Several trials have reported that these agents increase the duration of pain relief and delayed recurrence of symptoms (Kennedy *et al.*, 2005). However, a meta-analysis of eight trials, considered that postoperative hormonal suppression of endometriosis decreased recurrence rates, but there was no significant benefit for the outcomes of pain or pregnancy rates (Yap *et al.*, 2004). The main problem in interpreting the above data is the short-instead of long-term use of medications. In fact, the rationale for suggesting adjuvant therapy for a few months is far from clear. When this treatment is deemed opportune, oestrogen-progestogen combinations should be considered because of their tolerable side effects, limited costs, and analgesic efficacy similar to GnRH agonists and danazol (Kennedy *et al.*, 2005).

The lowest effective dose of hormone replacement should be used shortly after definitive surgery or as soon as menopausal symptoms arise. Avoidance of oestrogen-only treatment and the use of combined preparations or tibolone are suggested (Vercellini *et al.*, 2009). Oestrogen-only therapy has been associated with an increased risk of malignant transformation of ectopic foci (Modesitt *et al.*, 2002).

4. Treatment of pelvic pain and recurrent symptomatic endometriosis

Several physiopathological mechanisms might explain the relation between endometriosis and pelvic pain: (i) recurrent cyclic micro-bleeding in the endometriotic lesions responsible for hyperpressure; (ii) production of inflammatory mediators by endometriotic lesions, which can stimulate the nerves; (iii) adhesions responsible for fixed position of pelvic structures; (iv) compression and/or infiltration of the sub-peritoneal nerve fibres by deep implants (Fauconnier & Chapron, 2005).

Women with pelvic pain and suspected endometriosis may be managed with empiric medical therapy prior to establishing a definitive diagnosis by laparoscopy. It is suggested analgesics and/or combined oral estrogen-progestin contraceptives for women with no more than mild pelvic pain and a GnRH agonist for those with moderate to severe pelvic pain. Although 80 to 90% of patients will have some improvement in symptoms with medical therapy, medical interventions neither enhance fertility nor diminish

endometriomas or adhesions, and they are more appropriately managed surgically (Kennedy *et al.*, 2005). The growing popularity and widespread diffusion of operative laparoscopy has fostered a spread of surgical procedures in women with endometriosis (Vercellini *et al.*, 2009). However, due to the relapsing tendency of the disease, postoperative recurrences are very common (20-40%), and a further surgical procedure is performed in 15-20% of cases (Busacca *et al.*, 1998; Fedele *et al.*, 2006).

4.1 Repetitive conservative surgery

Conservative surgery preserves the uterus and as much ovarian tissue as possible. Very limited information is available on the effect of repetitive conservative surgery for recurrent symptomatic endometriosis in terms of postoperative pain relief (Vercellini *et al.*, 2009). Pain relief is achieved in most patients who undergo laparoscopic ablation of endometriosis and adhesiolysis. However, the long-term outcome appears suboptimal, with a cumulative probability of pain recurrence between 20% and 40% and a further surgical procedure between 15% and 20% (Fedele *et al.*, 2006; Vercellini *et al.*, 2009).

Busacca *et al.* (1998) compared surgical outcomes in patients reoperated either at laparotomy or at laparoscopy. The crude recurrence rates of moderate to severe dysmenorrhea, deep dyspareunia, and pelvic pain were, respectively, 22%, 30%, and 35% in the laparotomy group and 29%, 25%, and 32% in the laparoscopy group. The 24-month cumulative probability of recurrence of dysmenorrhea (34% and 43%, respectively) and non-cyclical pelvic pain was not significantly different in the two groups. However, in the patients operated by laparotomy, the rate of recurrence of deep dyspareunia and the number of patients requiring a third intervention was higher.

The effect of repetitive laparoscopic surgery on pain is similar to that observed after first-line surgery, with a 5-year cumulative pain recurrence rate of 20% after the first surgical procedure and 17% after the second one and cumulative rates of retreatment of 19% and 17%, respectively. This fact confirms the effectiveness of repeat conservative surgery in the treatment of recurrent pain, which is more likely to be associated with severe disease, adhesions and deep intraovarian or multilocular cysts (Fedele *et al.*, 2006).

High recurrence rate is the demonstration that surgery alone is a suboptimal treatment for a chronic disease such as endometriosis. In order to possibly reduce recurrences of endometriosis, it is important that all surgical procedures including primary surgery are performed by experienced surgeons and that prolonged ovarian suppression is established postoperatively (Vercellini *et al.*, 2009).

4.2 Pelvic denervating procedures

In these conditions, one of the clinical dilemmas regards the indication for and the potential benefit of reoperation. In women wishing for conception, uterine denervation may be performed in addition to repetitive ablation of endometriotic lesion to improve long-term analgesic results. Laparotomy or laparoscopy plus presacral neurectomy has better results than surgery only in regard to: recurrence of dysmenorrhea at 1-year follow-up (17% and 25%, respectively), dysmenorrhea relief at 6 and 12 month follow-up (87% vs 60%, and 86% vs 57%, respectively), severity of dysmenorrhea, dyspareunia, non-menstrual pelvic pain

and health-related quality of life at 24-month follow-up (Zullo *et al.*, 2004). However, this technique presents limitations that must be taken into account: first, it is effective in reducing midline pain only, whereas lateral, adnexal pain is not influenced; second, denervation of bowel and bladder cause *de-novo* constipation (15%) and urinary urgency (5%) (Latthe *et al.*, 2007; Zullo *et al.*, 2004); third, great care must be taken to avoid damaging the right ureter and major and midsacral vessels (Berlanda *et al.*, 2010). Systematic performance of presacral neurectomy cannot be recommended, only in patients with central, hypo-gastric pain (Latthe *et al.*, 2007; Vercellini *et al.*, 2009).

The addition of uterosacral ligament resection (i.e., laparoscopic uterosacral nerve ablation) to laparoscopic surgical treatment of endometriosis was not associated with a significant difference in any pain outcomes (Latthe *et al.*, 2007).

4.3 Definitive surgery

Definitive surgery in women with chronic pain is a controversial procedure, especially in young women. However, this factor should be carefully evaluated in order to offer a reliable prognosis to women affected by an oestrogen-responsive disease (Vercellini *et al.*, 2009). The surgical solution in women with recurrent symptoms after previous conservative procedures for endometriosis should be based on the desire for conception, and the pre-operative patient assessment must be complete, including testing for bowel dysmotility, urologic disorders, musculoskeletal lesions, and psycho-socio-environmental factors (Berlanda *et al.*, 2010). The risk of depressive symptoms after definitive procedures must be taken into account, particularly in young patients (Vercellini *et al.*, 2009). The definitive therapy for endometriosis is represented by total hysterectomy, bilateral salpingo-oophorectomy and removal of all endometriotic lesions, in particular deep lesions involving the pouch of Douglas, the anterior pouch or the ureter. The operation mimics radical hysterectomy (Berlanda *et al.*, 2010).

When pregnancy is no longer an issue and the woman reveals good psychological stability, hysterectomy with or without bilateral salpingo-oophorectomy may be considered and offers the best outcome. The presence of multiple pelvic symptoms, previous use of a GnRH agonist, and absence of pain resolution predict the likelihood of subsequent hysterectomy (Learman *et al.*, 2007). Few studies address the advantages of hysterectomy for severe pelvic pain associated with endometriosis. Standard extrafascial hysterectomy is associated with increased recurrence of pain than radical hysterectomy with removal of deep endometriotic lesions (31% vs 0%) (Fedele *et al.*, 2005a).

The decision to preserve or remove the ovaries should be based on patient's age and intraoperative gonadal conditions. Bilateral oophorectomy substantially reduces the risk of recurrent symptoms and reoperation due to pelvic pain over the ovarian-preserving surgery (10% vs 62%, and 3.7-8% vs 19.2-31%, respectively). Preservation of both ovaries at hysterectomy for symptomatic endometriosis increased the risk of reoperation by 2.4 to 8.1 (Shakiba *et al.*, 2008). Nonetheless, whenever possible at least one gonad should be preserved in young women, especially in those with objections to the use of oestrogen-progestogens (Shakiba *et al.*, 2008). The effect of postoperative medical treatment on the probability of pain relapse should be taken into account after both conservative and definitive procedures.

5. Deep infiltrating endometriosis

The term deep infiltrating endometriosis (DIE) is used to describe infiltrative forms of the disease that involve the uterosacral ligaments, rectovaginal septum, bowel, bladder, or ureters, but is histologically defined in arbitrary manner when endometriotic lesions extending more than 5 mm beneath the peritoneal surface (Chapron *et al.*, 2009) suggest, regardless of location (bladder, intestine, ureter, etc.) that endometriosis is only considered to be DIE when the muscularis is involved (Yantiss *et al.*, 2001). This entity is responsible for refractory pelvic pain, of which the intensity is correlated with the depth of infiltration, and occurs in 30%-40% of the patients with endometriosis (Chapron *et al.*, 2003).

DIE is thought to arise from several possible mechanisms: (i) The Sampson's retrograde menstruation theory: during menstruation, endometrial tissue refluxes through the fallopian tubes, implanting and growing on the serosal surface of abdominal and pelvic organs, influenced by local hormones and immune, genetic and environmental factors. This results in peritoneal and ovarian endometrial deposits. (ii) The coelomic metaplasia theory proposes that endometriosis develops from metaplasia of the cells that line the pelvic peritoneum. These cells share a common embryological origin with the germinal endometrium of the ovary and the müllerian ducts. Infectious, hormonal or inflammatory stimuli could result in metaplasia of these cells and endometriosis. This theory is supported by the rare occurrence of endometriosis in men and in prepubertal girls. (iii) The embryonic rest theory proposes that metaplasia of müllerian duct remnants in the rectovaginal septum could result in the rectovaginal nodules. (iv) Another theory implies the migration of cells through the lymphatic system or via hematogenous spread. (v) The neurologic hypothesis is a new concept in the pathogenesis of endometriosis: the lesions seem to infiltrate the large bowel wall along the nerves, at a distance from the primary lesion (Anaf *et al.*, 2004). It is thought that the growth and invasion of endometrial tissue at ectopic sites is due to a process of neovascularization mediated by pro-angiogenic factors such as vascular endothelial growth factor (VEGF) (Taylor *et al.*, 2009). Histologically, endometrial nodules are composed of hypertrophic smooth muscle and endometrial glands, similar in appearance to adenomyosis in the uterus (Brouwer & Woods, 2007).

The multifocal distribution of DIE lesions indeed prompted us to cease considering this disease as a single organ pathology but rather, to see it as an "abdomino-pelvic multifocal pathology" (Chapron *et al.*, 2010). The pre-operative work-up (questioning, clinical examination and imaging information) aims to clarify the exact location and likely extension of DIE lesions. This is essential in order to: (i) Specify the surgical procedures required to achieve complete excision of symptomatic DIE lesions, the only way to prevent the recurrence. (ii) Thoroughly describe the surgical risks to the patient. (iii) Obtain the patient's full informed consent, as necessary prior to surgery for a benign pathology responsible for painful symptoms (Chapron *et al.*, 2010). It must take into account that the discovery of a DIE nodule during clinical and/or imaging investigations is not always followed by surgery. Only lesions that give rise to symptoms should be operated on.

Although medical treatment may be effective in some DIE patients, the treatment of choice is surgical excision. The multifocal nature of DIE lesions must be taken into account when defining the surgical strategy (Chapron *et al.*, 2003). Generally, DIE is presented as a pathology with a high risk of recurrence, estimated at around 30%. Often, however, recurrence corresponds to persistence of DIE lesions that were left in place as the result of an incomplete initial surgical removal (Vignali *et al.*, 2005).

6. Bowel endometriosis

Endometriosis affects the gastrointestinal tract of 5-12% of women with this condition (Wills *et al.*, 2009). The rectum and the rectosigmoid junction are the most common sites of bowel endometriosis (70-93% of all bowel lesions). The rectovaginal septum, appendix, caecum and distal ileum may also be affected, with a lower incidences (12%, 3-18%, 2-5% and 2-20%, respectively). (Chapron *et al.*, 2003; De Cicco *et al.*, 2011). In most cases, intestinal endometriosis is associated to genital endometriosis. Rectal involvement is associated with DIE and adnexal endometriosis in 70% and 80% of the patients, respectively (Chapron *et al.*, 2003).

Bowel endometriosis is considered an infiltration or invasion phenomenon, found that there is a histological continuity between the superficial and underlying deep lesions originating from the serosa progressively invade the muscularis propria (Anaf *et al.*, 2004). Endometriosis infiltrating the muscularis propria may lead to localized fibrosis, strictures, and small or large bowel obstruction (Yantiss *et al.*, 2001).

Bowel endometriosis is difficult to diagnose because of the lack of characteristic symptoms. The patients present with relapsing bouts of abdominal pain, abdominal distention, tenesmus, constipation, diarrhoea, rectal bleeding and pain during defecation (Brouwer & Woods, 2007). Colicky abdominal pain is the most common symptom. Rectal bleeding may be caused by mucosal injury during the passage of stools through a stenosed colon with the intramural endometriotic tissue increased at the time of menses if it occurs. Bowel endometriosis can mimic other abdominal pathologies such as malignancy, inflammatory bowel disease, ischaemic colitis, infectious diseases and irritable bowel syndrome (Bianchi *et al.*, 2007). Hematochezia is an uncommon symptom due to low incidence of mucosal involvement. Endometriosis of the small bowel should be suspected in young, nulliparous patients with abdominal pain, in conjunction with signs of obstruction (Del Rey-Moreno *et al.*, 2008).

Clinical examination has been shown to have a low sensitivity and moderate specificity for uterosacral, high rectovaginal and rectal involvement. The presence of a large, palpable rectovaginal nodule identifies the patient at risk of rectal involvement. The low percentage of rectal endometriosis extending to the mucosa means colonoscopy has too low a sensitivity to be a reliable test for rectal involvement. Preoperative colonoscopy should be performed on an individualised basis to exclude other pathology and suspicious mucosal lesions should be biopsied to exclude malignancy (Wills *et al.*, 2009). Endorectal ultrasound has shown a sensitivity of more than 90% for rectovaginal septum endometriosis and a lower specificity for rectal wall invasion. Transvaginal ultrasound may be as effective as endorectal ultrasound (Chapron *et al.*, 2004). Magnetic resonance imaging of cul-de-sac obliteration, deep pelvic nodules and rectal involvement have an accuracy of 72-90% in predicting disease when measured against findings at surgery (Kataoka *et al.*, 2005). Currently, MRI is the best imaging modality for enteric endometriosis with a sensitivity of between 77-93% (Bianchi *et al.*, 2007). When endoscopic and radiologic examinations (computed tomography, endorectal ultrasound, magnetic resonance imaging) are performed, an extrinsic process is revealed and nearly all patients undergo a diagnostic laparoscopy as part of their investigations their symptoms (De Cicco *et al.*, 2011). This is often the first test that identifies rectal involvement. Brouwer & Woods (2007) have proposed a preoperative approach that minimizes the use of endorectal ultrasound and

magnetic resonance imaging and focuses on assessing the possibility of rectal involvement on laparoscopy and clinical examination under anaesthetic. A significant number of patients have more than one laparoscopy and the number of laparoscopies has been shown to correlate to extent of rectal involvement.

Treatment consists of surgical excision, or segmental resection. Excision should be complete in order to achieve maximal pain relief and minimal recurrences (De Cicco *et al.*, 2011). When the rectum is involved there are several approaches to be considered. The choice of technique depends on the size, location, degree and depth of involvement of the endometriotic implant. As a general rule, less is better when it comes to removal of rectal endometriosis as long as the implant can be completely excised. The nodule can be shaved off the rectal wall leaving it intact if superficial serosal deposits are present, alternatively if there is a solitary penetrating nodule there may be the opportunity to perform a full-thickness disc resection of the rectal wall, or it may be necessary to consider a segmental resection of the rectum and/or sigmoid colon (Brouwer & Woods, 2007; Wills *et al.*, 2009). All these procedures can be carried out by either a laparoscopic, combined or open approach (Brouwer & Woods, 2007; Dousset *et al.*, 2010; Wills *et al.*, 2009). Robotic assistance may allow more bowel resections to be carried out by laparoscopy (Veeraswamy *et al.*, 2010). An initial laparoscopy is carried out unless the preoperative assessment mandate a laparotomy. It appears that most authors decide to perform a bowel resection before surgery, based on preoperative examinations. This approach seems to result in a very high incidence of bowel resection. The indication reported is based on dimensions of the nodule >2 cm or 3 cm, and/or on muscularis involvement and/or occupation of more than one-third of the rectal circumference (Brouwer & Woods, 2007). The other approach is to decide during surgery based on findings such as the size, localisation and extension of the disease. Laparoscopic conversion rates is from 0% to 13%, due to extent of disease, dense adhesions, bowel perforation, difficulty stapling a bowel anastomosis, bleeding and poor visualisation (Wills *et al.*, 2009).

Surgery is only indicated in enteric endometriosis in acute or subacute small bowel obstruction that fails to resolve, in endometriotic tumours or when it is impossible to exclude malignancy. In an emergency setting, the main aim of surgery should be to relieve the obstruction, and if the disease is suspected intra-operatively, then as many ectopic deposits as possible should be excised (Bianchi *et al.*, 2007; Del Rey-Moreno *et al.*, 2008). It can be difficult to exclude a malignancy intra-operatively, in such case is appropriate to carry out an oncological resection.

Appendiceal endometriosis may present as an incidental finding with or without pelvic disease. Acute symptoms are similar to those of appendicitis. The appendix should be inspected in all patients undergoing surgery for endometriosis and appendectomy is recommended if it seems abnormal (Veeraswamy *et al.*, 2010).

The overall complication rate after surgery is 22.2%. Major complications occur in 7%-12.6% of women: colorectal anastomotic leakage (3.7%-11%), recto-vaginal fistula (4%-8.5%), severe obstruction (2.7%), haemorrhage (2.5%), pelvic abscess (1-4.2%), delayed ureteral ischemic necrosis (2%). Minor complications occur in 14.7% of women: temporary bowel dysfunction (4%), bladder dysfunction (8%-17%) (De Cicco *et al.*, 2011; Dousset *et al.*, 2010). The combination of systematic diverting ileostomy, interposition of omentoplasty and

nonjuxtaposed vaginal and colorectal sutures are major factors in preventing and facilitating the conservative treatment of anastomotic leaks, and the increased use of preoperative endoscopic ureteral double pig-tail stenting may help to prevent delayed ureteral ischemic necrosis related to extensive ureterolysis. The most frequent specific complication of compete surgery for low rectal endometriosis is transient peripheral neurogenic bladder. The inferior hypogastric nerves are recognized and preserved during surgery but may require resection in cases with lateral pelvic wall invasion (Dousset *et al.*, 2010).

The recurrence of symptoms for follow-up periods of 2-5 years varies between 4% and 54%. The recurrence of pain requiring surgery is 0% to 34%. Proven bowel endometriosis recurrence is 0-25% (De Cicco *et al.*, 2011; Dousset *et al.*, 2010), and is higher for dissection off the rectal wall (22.2%) than anterior rectal wall excision (5.2%) and segmental rectal resection (0-4.7%) (Brouwer & Woods, 2007; Dousset *et al.*, 2010). Recurrence of endometriosis can be explained by the significant proportion of rectal lesions that extend into the submucosa (36%) (Brouwer & Woods, 2007). The overall improvement in pain-related symptoms is of 87%-94% and in quality of life assessment of 90% (Dousset *et al.*, 2010). Dousset y cols (2010) believe that the very low recurrence in rectal endometriosis is related to a "carcinologic" surgical approach: (i) all additional extrarectal sites of endometriosis were removed, (ii) total mesorectal excision and en-bloc resection of the rectal nodule together with posterior vaginal fornix and uterosacral to ensure free anterior and circumferential resection margins, (iii) rectal section at least 2-cm below the endometriotic nodule, and (iv) all additional intestinal and urologic endometriotic deposits were resected with 2-cm-free surgical margins.

The results of several series show that with a multidisciplinary approach (gynaecologic, gastrointestinal and urologist surgeons, radiologist) to the management of endometriosis involving the rectum and radical surgery to excise the disease as completely as possible at one operation, excellent results can be achieved with low morbidity and recurrence (Brouwer & Woods, 2007; De Cicco *et al.*, 2011; Dousset *et al.*, 2010).

7. Abdominal wall endometriosis

Abdominal wall endometriosis is defined as endometrial tissue within the abdominal wall, superficial to the peritoneum. This entity occurs in 0.03 to 1.08% of women with previous history of obstetric or gynaecologic procedures, particularly after hysterotomy. The time from surgery to the onset of symptoms ranges from months to 17.5 years, with an average of 30 months. The association between abdominal wall endometriosis and pelvic endometriosis is found in 2.5% - 25% of the cases (Bektas *et al.*, 2010; Horton *et al.*, 2008).

The pathogenesis of abdominal wall endometriosis is explained by a combination of theories: (i) Iatrogenic direct implantation during the surgical procedure, endometrial tissue is seeded into the wound; this theory alone is not enough to completely explain the physiopathology, given the low incidence of this disease and the reports of endometriosis without previous surgery, (ii) endometrial cells may reach a caesarean section via lymphatic or hematogenous routes, (iii) coelomic metaplasia and, (iv) cell immunity change theory (Bektas *et al.*, 2010). Malignant transformation of abdominal wall endometriosis is a rare complication (1%).

It should always be considered when a mass appears in or near a caesarean section scar or other gynaecologic operative procedure sites, in the umbilicus or in the inguinal region, more so when pain accompanying the patient's menstrual cycle. The diagnosis may become difficult if cyclical pain is not present (43%). Also be diagnosed in patients without previous surgery. Moreover, abdominal wall endometriosis patients are often referred to the general surgeons and were diagnosed after surgical techniques such as appendectomy, inguinal hernia repair, or laparoscopic procedures. Accurate preoperative diagnosis varies between 20% and 50% (Bektas *et al.*, 2010; Horton *et al.*, 2008).

Additional studies such as ultrasound, CT scan, MRI, or fine-needle aspiration may be obtained if the lesion is very large, there is concern for fascial involvement, or if the diagnosis is in doubt. This information may assist with surgical planning especially when an abdominal wall reconstruction is anticipated (Veeraswamy *et al.*, 2010). Ultrasonography is the most commonly used investigational procedure for abdominal masses; the mass may appear hypoechoic and heterogeneous with scattered internal echoes, solid, or with cystic changes. The findings on computed tomography scan depend on the phase of the menstrual cycle, the proportions of stromal and glandular elements, the amount of bleeding, and the degree of surrounding and fibrotic response, without pathognomonic findings. Owing to the relatively vascular nature of these lesions, enhancement often occurs when intravenous contrast material is used. Magnetic resonance imaging enables very small lesions to be detected and can distinguish the hemorrhagic signal of endometriotic lesions. Fine needle aspiration cytology can confirm the diagnosis and eliminate the possibility of malignancy. This is justified only in cases of large masses, doubtful diagnosis and atypical clinical manifestations. However, its use is still controversial of the risk of causing new implants at the puncture site (Bektas *et al.*, 2010; Horton *et al.*, 2008).

The treatment of choice is surgical excision with at least 1 cm margin, even for recurrent cases and, if necessary, placement of mesh for fascia defects. A combination of surgical re-excision with hormonal therapy is also recommended (Bektas *et al.*, 2010; Horton *et al.*, 2008).

During violation of endometrial cavity, inoculum of endometrial tissue spill and implant on the abdominal wound. Thus, it is strongly recommended that the abdominal wound be cleaned at the conclusion of the cesarean section. Other recommendations are delivering the uterus outside the abdomen to repair, not using the same suture material to close the abdomen as used for uterine closure, not swabbing out the uterine cavity following the delivery of the placenta or discarding the swab used to clean the endometrial cavity after delivery of placenta, or using wound edge protector to separate the edges of the incision from contact with the patient's abdominal contents, instruments, and gloves during the procedure (Bektas *et al.*, 2010; Horton *et al.*, 2008).

8. Urinary tract endometriosis

Endometriosis expanding and invading the urinary tract is a rare occurrence found in 0.3%-5% of all endometriotic patients (Chapron *et al.*, 2003; Mereu *et al.*, 2010). The bladder is the most frequently involved organ, followed by the ureters and the kidneys with a proportion of 40:5:1. The endometriosis that comprises the urinary tract cannot be considered to be primary lesions from these organs (Abrao *et al.*, 2009).

8.1 Bladder endometriosis

Bladder is the most frequent location in cases of urinary endometriosis. Amongst women suffering from DIE, 11% present lesions that affect the bladder. According to the three major etiopathogenic theories proposed, vesical endometriosis may develop from mullerian remnants in the vesicouterine septum, or as an extension of an adenomyotic nodule of the anterior uterine wall, or from implantation of regurgitated endometrium (Chapron *et al.*, 2003).

Patients may present with variable urinary symptoms (cystalgia 43%-58.3%, dysuria 21%-25%, urinary frequency 16.6%-71%, macroscopic hematuria 12.5%-19%) (Le Tohic *et al.*, 2009) and/or symptoms related to endometriosis (dysmenorrhea 70.8%, dyspareunia 21%-50%, chronic pelvic pain 43%-75%); these symptoms may be cyclic (34.6%-100%) (Abrao *et al.*, 2009; Le Tohic *et al.*, 2009). This entity should also be considered in postmenopausal patients receiving hormonal replacement therapy who report voiding symptoms and who are unsuccessfully treated for interstitial cystitis. During pelvic examination an anterior nodule is palpated in 41.7% to 97.5% of the patients. When a bladder nodule is diagnosed, it has to be differentiated from bladder carcinoma, varices, papillomas or angiomas (Chapron *et al.*, 2010; Le Tohic *et al.*, 2009).

The diagnosis of bladder endometriosis is often difficult to make and it is based on ultrasound, MRI, and cystoscopy. Generally, pelvic ultrasound is the first imaging test performed and allows the bladder nodule DIE in the 38%-100% of patients (Le Tohic *et al.*, 2009). Transvaginal ultrasound is capable of diagnosing bladder nodules in 58.3% of patients. Cystoscopy may reveal typical red and/or bluish lesions (30%-38.4%), extrinsic compression (38.4%), or may be normal (Chapron *et al.*, 2010; Le Tohic *et al.*, 2009); and also helps to rule out vesical epithelial malignancy, to ascertain the precise location of bladder DIE nodule (distance with the ureteral meata and the lower endometriotic margin) and to define the ureteral status (Chapron *et al.*, 2010). The presentation of endometriosis varies over the menstrual cycle; the lesions are more obvious and congestive during menstruation (Pang *et al.*, 2008). MRI shows the presence of a nodule in 77.2%-100% of patients. Generally, the bladder DIE nodule is unifocal in the bladder wall (posterior wall 62.5%-74.7%, vesical dome 25.3%-37.5%). The mean size of the bladder nodule at pathological examination is 23.6 mm (range 8-50 mm). Bladder DIE is isolated in 36% of the cases, and 64% of the patients is associated with posterior DIE lesions (intestinal 32%, ureteral 9.3%, unilateral or bilateral ovarian endometriomas 24%, uterosacral ligament 33.3%, vagina 26.7%); therefore, should not be considered as an independent form of the disease (Chapron *et al.*, 2010; Fedele *et al.*, 2005b, Le Tohic *et al.*, 2009).

Treatment of bladder endometriosis can be medical therapy with antiestrogenic agents or surgical excision. Medical therapy often results in temporary improvement of the symptoms, but relapse may occur. Most clinicians agree that surgery is the best option and resection should be complete. This can be carried out by laparotomy or laparoscopy depending on the lesion, skill, and experience of the surgeon (Chapron *et al.*, 2010; Fedele *et al.*, 2005b; Le Tohic *et al.*, 2009). Cystoscopic transillumination was used to better define the edges of the lesion and to maximize sparing of unaffected mucosa (Fedele *et al.*, 2005b). During the surgical procedure complete excision of all associated symptomatic posterior DIE lesions are performed (uterosacral resection, colpectomy, intestinal resection).

Transurethral resection is not an optimal treatment because it does not permit complete excision of the disease –the disease originates outside (from the peritoneum) the bladder- (Chapron *et al.*, 2010; Le Tohic *et al.*, 2009), radicality would imply bladder perforation, and the patients have a high recurrence (11.5 %) (Le Tohic *et al.*, 2009). Pang *et al.* (2008) have reported a case treated with combined transurethral and laparoscopic excision followed by laparoscopic bladder reconstruction, taking advantage of both approaches.

Major complications can occur in 2.7% of patients, such as vesico-uterine or vesico-digestive fistula, intravesical or pelvic hematoma (Chapron *et al.*, 2010; Le Tohic *et al.*, 2009). The painful symptoms improved in 100% of the patients (Chapron *et al.*, 2010). The recurrence rate of clinical-instrumental evidence can range between 0% (Chapron *et al.*, 2010) and 10.9% (Fedele *et al.*, 2005b). The factors influencing rate of recurrence is the extent of surgical excision and the vesical base involvement. When the resection include both the vesical lesion and a 0.5-1 cm deep portion of the adjacent myometrium, recurrence is significantly less frequent compared to the removal of the bladder lesion only (0% vs 26%, respectively) (Fedele *et al.*, 2005b).

8.2 Ureteral endometriosis

Ureteral endometriosis is a rare but serious localization of the disease (<0.3%) (Li *et al.*, 2008) because it may cause silent loss for renal function (Abrao *et al.*, 2009; Li *et al.*, 2008; Mereu *et al.*, 2010). Disease is predominantly unilateral, with the left ureter affected more commonly than the right, although bilateral disease does occur (Li *et al.*, 2008). The lesions are localized in the lower third of the ureter (Abrao *et al.*, 2009), and associated with endometriosis elsewhere in the pelvis (Li *et al.*, 2008; Mereu *et al.*, 2010). There are two major pathologic types of ureteral endometriosis: intrinsic and extrinsic, occurring, respectively with a 1:4 ratio. In the intrinsic disease, ectopic endometrial tissue infiltrates the muscularis mucosa and the uroepithelium. In the extrinsic disease, the endometrial tissue invades only the ureteral adventitia or surrounding connective tissue. These pathologic types can coexist. Indeed, both entities can lead to ureteral obstruction with subsequent hydronephrosis and dilatation of the renal pelvis that can be also asymptomatic (Li *et al.*, 2008). Generally, bladder is not affected for endometriosis in the patients with ureteral endometriosis. This observations confirms that, although ureter and bladder are both part of the urinary tract, endometriotic lesions affecting these sites have a different behavior (Abrao *et al.*, 2009).

The patients have symptoms predominantly related to pelvic endometriosis (dysmenorrhea, dyspareunia, chronic pelvic pain [75%-100%]) and lower frequency patients have urologic symptoms such as renal colic or urinary frequency (3.6%-50%). Because of the absence urologic symptoms (56.5%) and the risk for subsequent loss of renal function (20%), checking the integrity of the urinary tract of patients with endometriosis not only before surgery and after surgery but also during medical therapy is recommended (Li *et al.*, 2008; Mereu *et al.*, 2010). Rectal or vaginal infiltration by the posterior DIE is present in 74% of these patients, and extensiveness of adnexal adhesion are factors related to dysmenorrhea severity (Abrao *et al.*, 2009). The presence of retrocervical and rectum-sigmoid involvement in most patients with ureteral endometriosis suggest that the origin of ureteral endometriosis is extrinsic (Abrao *et al.*, 2009; Mereu *et al.*, 2010).

The diagnostic exams include ureteroscopy with intraluminal ultrasound, computerized tomography, abdominal ultrasound, intravenous pyelography and laparoscopy. Ultrasound as a screening tool to rule out urinary tract obstruction in patients with pelvic endometriosis is routinely used, whereas intravenous pyelography and cystoscopy are used only for patients with urologic symptoms or positive ultrasound for ureteral or bladder involvement. When ureteral involvement and cortical atrophy are revealed, renal function should be checked by kidney scintigraphy (Camanni *et al.*, 2010). Patients with renal compromise may benefit from percutaneous nephrostomy for urinary diversion before definitive surgery. The pelvic spread of the disease and its involvement of the other pelvic organs are evaluated by CT and/or MRI (Li *et al.*, 2008).

The treatment of ureteral endometriosis should be tailored to relieve urinary tract obstruction, eliminate symptoms, preserve renal function, and to avoid disease recurrence and any morbidity associated with radical surgery (Li *et al.*, 2008). Hormonal therapy has been proposed by some authors for the treatment, but others have noted that drugs are unlikely to relieve ureteral obstruction once dense fibrosis has occurred. Hormonal therapy is an appropriate option for patients with normal renal function or minimal obstructions. Surgical treatment remains the gold standard in severe forms of endometriosis: ureterolysis, segmental resection and anastomosis, or ureteroneocystostomy; taking into account that ureteral endometriosis and pelvic disease should be treated at the same time when they coexist (Li *et al.*, 2008). Minimally access procedures are equally effective as the open techniques (Camanni *et al.*, 2010; Mereu *et al.*, 2010). Ureterolysis could be used as the initial surgical step for patients if the extension of ureteral involvement is limited in length and there is no residual ureteral damage or dilatation (Camanni *et al.*, 2010; Mereu *et al.*, 2010). Preoperative endoscopic ureteral double pig-tail stenting may help to prevent delayed ureteral ischemic necrosis related to extensive ureterolysis. In cases of intrinsic ureteral endometriosis, it is necessary to perform a ureteral dissection. When the localization of the stricture is far from the bladder, an uretero-ureterostomy has to be considered. When the ureteral stenosis is reasonably close to the vesicoureteral junction the best choice is the ureteroneocystostomy. In some cases, when the localization of the stricture is halfway or in which resection of a long segment of the ureter is required, ureteroneocystostomy with a psoas bladder hitch must be carried out (Mereu *et al.*, 2010).

Ureterolysis has demonstrated to be effective as the first-line surgical approach in patients with deep endometriosis despite the rate of recurrence reported (0-15.8%) (Camanni *et al.*, 2010; Li *et al.*, 2008; Mereu *et al.*, 2010). Reintervention during hospitalization and follow-up is more frequent in patients undergoing ureterolysis than in those treated with ureteroureterostomy (33% vs 11.7%) (Mereu *et al.*, 2010).

8.3 Renal endometriosis

Renal endometriosis is a rare condition. Presenting symptoms and signs include flank or back pain, hematuria, hydronephrosis, or a renal mass (Dirim *et al.*, 2009). Additional studies are necessary to help determine its etiology (intravenous pyelography, computerized tomography scan or MRI). Unfortunately, in the absence of a biopsy there is no accurate preoperative method to exclude malignancy, so a majority of patients are treated with nephrectomy (Veeraswamy *et al.*, 2010).

9. Other sites of intra-abdominal endometriosis

9.1 Liver endometriosis

Hepatic endometriosis is rarely seen. Malignancy must be excluded when endometriosis is discovered in unusual sites like the liver. The majority of patients are symptomatic, generally with epigastric or right upper quadrant abdominal pain. Catamenial epigastric pain is characteristic, although rarely seen. Other possible presentations are malaise, nausea, vomiting, obstructive jaundice, portal vein thrombosis, hepatomegaly (Nezhat *et al.*, 2005; Schuld *et al.*, 2011) and biliopytosis, which is intermittent bile-stained sputum (Schuld *et al.*, 2011). Generally, liver involvement is superficial. The lesion size ranged from 3 to 20 cm. The principal diagnostic method is CT scan or MRI, showing a heterogeneous mass containing septated, thick-walled cystic lesions, implying complex pathophysiology (Veeraswamy *et al.*, 2010). Because of the wide range of possible morphologic features of endometriosis, there are no characteristic imaging findings that can distinguish either pelvic or extrapelvic endometriosis from other processes. Final diagnosis can only be made by pathologic evaluation. The treatment is surgical resection with adequate margins (Nezhat *et al.*, 2005).

9.2 Pancreatic endometriosis

Endometriosis involving the pancreas is an extremely rare condition. The patients have pain abdominal in the left upper quadrant and/or abdominal mass. In a woman of childbearing age with intermittent abdominal pain and a cystic lesion in the pancreas on imaging studies, endometriosis must be considered in the differential diagnosis. Partial pancreatectomy and resection of the adjacent viscera affected is the treatment of choice (Tunuguntla *et al.*, 2004).

9.3 Omentum endometriosis

Involvement of the omentum by endometriosis is not rare. Probably occur by transmission through peritoneal fluid or lymphatics. The commonest clinical features are abdominal distension, dysmenorrhoea and brown or bloody ascites. Laparoscopy and biopsy may still be necessary to exclude malignancy. Treatment is by excision of endometriotic nodule and/or ovarian suppression (Naraynsingh *et al.*, 1985).

9.4 Nervous system endometriosis

The most common site of endometriosis involving the nervous system has been within nerves in or near the pelvis. Sciatic nerve endometriosis presents as sciatic pain, muscle weakness, sensory deficits, and pelvic pain. Cyclic sciatica related to menses should be considered suggestive of endometriosis. Similarly, endometriosis involving obturator nerve, produces pain and proximal muscle weakness. These patients are treated by excision of endometriosis and associated fibrosis surrounding the nerve. Although the direct spread of pelvic endometriosis to and along nerves coursing through the pelvis seems logical, not all patients have been found to have pelvic disease (Veeraswamy *et al.*, 2010).

10. Massive ascites and endometriosis

The association of endometriosis with massive bloody ascites is extremely rare and represent a diagnostic dilemma for gynecologists, owing to their rarity and to the fact that

these cases mimic malignant ovarian neoplasms. In these cases the endometriosis involves mainly the peritoneum, with multiple adhesions and ovarian endometriomas. Ascites is detected in large volumes (4254 mL on average) and is bloody or brown (Sait, 2008).

Ectopic endometrial tissue is influenced by hormonal levels of the uterine cycle, so it flakes off with the drop of the hormonal peak as normal endometrium. This mechanism causes an inflammatory reaction in the site of interest and possible ascites in the case of peritoneal endometriosis. The rapid production of fluid by inflamed tissue and the obstruction of subdiaphragmatic lymph vessels, which impair its reabsorption, may be responsible for the large volumes detected (Zeppa *et al.*, 2004).

Fine-needle cytology has been successfully used to diagnose endometriosis by demonstrating the presence of epithelial and stromal cells in the smears, but usually their cytological features are not specific enough to allow a definite cytological diagnosis of endometriosis, nor to exclude even a neoplastic process (Zeppa *et al.*, 2004). Endometriosis-associated ascites is commonly mistaken for ascites caused by ovarian neoplasms, especially when associated with an elevated CA-125 level (Sait, 2008), and laparoscopy and microscopic examination of tissue are generally required for diagnosis. Nonetheless, the cytological diagnosis of endometriosis in effusions, avoid more invasive diagnostic procedures (Zeppa *et al.*, 2004).

Although there is no established treatment is usually performed conservative surgical resection and suppression of ovulation with a GnRH agonist (Sait, 2008).

11. Spontaneous hemoperitoneum in pregnancy and endometriosis

Spontaneous hemoperitoneum in pregnancy is an uncommon yet dramatic cause of hemoperitoneum, associated with high perinatal mortality (31%) and 44% of these deaths attributable to maternal shock. No maternal deaths have been reported in the last 20 years. The condition is most common during the third trimester of pregnancy. Endometriosis is considered a major risk factor (Brosens *et al.*, 2009).

The cause of this condition is not fully clarified. Inoue *et al.* (1992) have suggested two possible explanations for the involvement of endometriosis: (i) chronic inflammation due to endometriosis may make utero-ovarian vessels more friable; (ii) the resultant adhesions may give further tension to these vessels when the uterus is enlarged during pregnancy. Invasiveness of severe endometriosis has been suggested as a reason for this entity, but Brosens *et al.* (2009) found no apparent correlation between spontaneous hemoperitoneum in pregnancy and stage of endometriosis.

The typical presentation of spontaneous utero-ovarian vessel rupture consists of a sudden onset of abdominal pain without vaginal bleeding, associated with signs of acute abdomen and hypovolemia. Fetal distress is an uncommon finding unless there is severe hemodynamic instability. Abdominal ultrasound examination does not reveal signs of placental abruption and fail to diagnose intraperitoneal bleeding as cause of acute pain. Transvaginal ultrasound and computerized tomography scans sometimes indicate the presence of intraperitoneal free fluid, but in most cases the diagnosis is only established at laparotomy (Brosens *et al.*, 2009). Preoperatively other potential diagnoses are placental abruption, uterine rupture, HELLP syndrome, abdominal pregnancy or rupture of the liver or spleen (Grunewald & Jördens, 2010).

At laparotomy, a substantial amount of hemoperitoneum is found (range: 500 to 4000 mL). The bleeding is not arterial but arise from superficial veins or varicosities on the posterior surface of the uterus or parametria. Treatment of bleeding is variable: thermal coagulation, hemostatic sutures or clips, or hysterectomy after caesarean section (Brossens 2009).

Since endometriosis may cause infertility, and assisted reproduction technology is increasingly used to enable patients to conceive, it is likely that there will be more cases with unprovoked hemoperitoneum in the near future (Grunewald & Jördens, 2010).

12. Malignancy

Malignant transformation is an infrequent complication of endometriosis and has been reported in 0.7-1% of patients and 62%-78.7% of the cases occur in the ovary, whereas extragonadal sites represent 21.3%-38% of tumors. The rectovaginal septum, rectosigmoid colon, vagina, and pelvic peritoneum represented the majority of extragonadal sites. Other locations include: bowel, umbilicus, lymph node, urinary tract, pleura, diaphragm, lung, etc (Slavin *et al.*, 2000; Van Gorp *et al.*, 2004; Yantiss *et al.*, 2001). Two possible explanations for the relation-ship between endometriosis and intraperitoneal cancer have been proposed: (i) endometriotic implants undergo malignant transformation secondary to genetic defects (p53 mutations) (Akahane *et al.*, 2007) that also serve to enable the endometriosis to thrive, or (ii) women with endometriosis have a defect in their immune system that enables the endometriosis to flourish, and this baseline defect leaves them more susceptible to subsequent malignant transformation (Modesitt *et al.*, 2002). It has been seen a direct transition from clearly benign epithelium through atypical endometriosis to carcinoma. This association suggest that atypical endometriosis can act as a precancerous lesion, as seen in atypical hyperplasia of the endometrium (Van Gorp *et al.*, 2004).

Among malignancies arising from endometriosis of the ovaries, endometrioid adenocarcinoma is the most common histologic type (23%-69.1%), followed by clear-cell carcinomas (13.5%-23%), sarcomas (11.6%), and rare cell types (6%) (Modesitt *et al.*, 2002). Extragonadal lesions are mostly endometrioid tumors (66%) and sarcomas (25%); clear cell histology is seen in only 4.5% of extragonadal malignancies. Tumors arising in endometriosis are predominantly low grade and confined to the site of origin (Slavin *et al.*, 2000; Van Gorp *et al.*, 2004). The histopathological criteria to classify a malignancy as arising from endometriosis include the demonstration of cancer arising in the tissue and not invading it from another source, and the presence of tissue resembling endometrial stroma surrounding the epithelial glands (Slavin *et al.*, 2000).

The risk factors for malignant transformation in endometriosis are poorly defined. An association has been noted between unopposed estrogen therapy and the development of endometrioid or clear cell epithelial ovarian tumors (Modesitt *et al.*, 2002). Increasing parity, and hormonal contraceptive use for ≥ 5 years, decreases the risks of both subtypes. Breast feeding and tubal ligation are inversely associated, but significantly so only for the endometrioid tumor (Nagle *et al.*, 2008; Van Gorp *et al.*, 2004). Obesity is associated only with clear cell cancers, with a two-fold increased risk. Also a significant trend of decreasing risk with increasing intensity (not duration) of smoking and education beyond high school

is associated with decreased development of clear cell cancers only (Nagle *et al.*, 2008). The decreased risk of clear cell ovarian cancer amongst users of combined oestrogen and progestin hormone replacement therapy is interesting given the role of progestin as a potential chemopreventive agent in ovarian cancer (Nagle *et al.*, 2008). 86% of the patients with an extraovarian cancer had undergone a prior hysterectomy and bilateral salpingo-oophorectomy (Modessit *et al.*, 2002).

Pelvic pain or pelvic mass in a postmenopausal woman with a previous history of endometriosis should raise suspicions of reactivation or malignant transformation of endometriosis. Vaginal bleeding may signify the presence of a vaginal or rectovaginal septum lesion. Malignant transformation of colorectal endometriosis may produce gastrointestinal dysfunction and/or bleeding. Urinary symptoms may herald urinary tract involvement with this disease (Slavin *et al.*, 2000; Van Gorp *et al.*, 2004).

The differential histological diagnosis of endometrioid and colonic adenocarcinoma is difficult because colonic adenocarcinoma has a significant mucosal component, while endometrioid adenocarcinoma usually involves the outer layers of the colon (30% are intramural) and endoscopic biopsies usually yield insufficient tissue for a definitive pathologic diagnosis (Slavin *et al.*, 2000; Yantiss *et al.*, 2001). Immunohistochemical staining seems to be useful in differentiating colonic endometrioid adenocarcinoma. The endometrioid tumor expresses cytokeratin 7 and CA-125, whereas cytokeratin 20 and carcinoembryonic antigen decorate colonic adenocarcinoma (Slavin *et al.*, 2000).

Primary surgical treatment with complete resection of pelvic tumors should be performed when feasible. Appropriate staging biopsies of lymph nodes and tissues in the upper abdomen should be performed when macroscopic disease is confined to pelvis. After surgical resection, is recommended the progestin therapy. Although postoperative treatment has not been clearly defined, 70% of these patients have been reported to receive chemotherapy or radiotherapy (Modesitt *et al.*, 2002).

Malignant transformation within endometriomas or within extragonadal endometriosis confined to the genital tract carries a much better prognosis, with a 67% 5-year survival for those with disease confined to the ovary and 100% 5-year survival for those with extragonadal disease confined to the site of the origin. Disseminated intraperitoneal disease had a poor prognosis, with a 12% 5-year survival (Van Gorp *et al.*, 2004).

13. Conclusion

The specialist approach to deep endometriosis has now evolved into a collaborative one, much like the multidisciplinary management of colorectal cancer. Preoperative assessment involves radiologist, gynaecologist, colorectal surgeon and in cases where bladder or ureteric involvement are suspected, a urologist. This approach results in the ability to achieve complete excision of all the endometriosis at the one operation.

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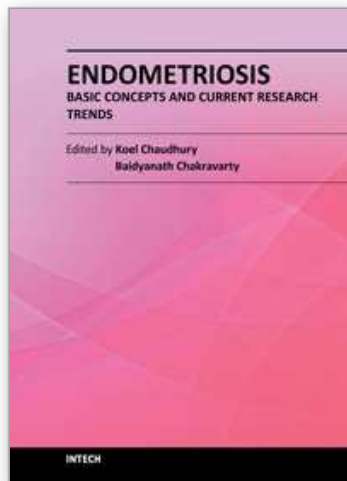
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This book provides an insight into the emerging trends in pathogenesis, diagnosis and management of endometriosis. Key features of the book include overviews of endometriosis; endometrial angiogenesis, stem cells involvement, immunological and hormonal aspects related to the disease pathogenesis; recent research reports on infertility, endometrial receptivity, ovarian cancer and altered gene expression associated with endometriosis; various predictive markers, and imaging modalities including MRI and ultrasound for efficient diagnosis; as well as current non-hormonal and hormonal treatment strategies. This book is expected to be a valuable resource for clinicians, scientists and students who would like to have an improved understanding of endometriosis and also appreciate recent research trends associated with this disease.

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