Conservative Surgery of Deep Bowel Endometriosis

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11.1 Introduction

The surgical treatment of deep bowel endometriosis is a confusing debate [1]. In the literature, variable definitions of deep endometriosis are used [2, 3]. The use of preoperative imaging is variable and varies from an indication for surgery [4], to a prediction of the type and severity of the disease [5, 6], based on the prediction of the depth of invasion into the bowel and of the degree of bowel stenosis. The aim of the surgery varies from emphasising radical excision of all endometriosis like tissue to a more conservative excision leaving at least a rim of fibrosis [3]. The surgical outcome varies from the treatment of pain and infertility, to the prevention of recurrences and the absence of complications. The debate gets even more confused since the surgical difficulty is variable and poorly defined. Variable personal skills and preferences of instruments and energy sources together with the variable local and medicolegal aspect of gynecologists performing bowel surgery further complicate the debate.

With these many variables, many of which are personal preferences, solid data resulting from a multivariate analysis with all variables do not exist and will not exist soon. A prospective study taking into account all variables would require prohibitively large numbers of interventions, with in addition the difficult to define surgeon factor—the singer or the song [7]. Moreover, techniques of surgery and our understanding of endometriosis vary over time would make a trial outdated before being finished.

A chapter or article on deep endometriosis bowel surgery will necessarily be colored by personal opinions, preferences, beliefs, and by the histories of the authors' past. We therefore will describe briefly the history of deep endometriosis surgery, our concepts of diagnostic methods and

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of outcome variables and our technical preferences before describing our concept of deep endometriosis surgery today.

11.2 Deep Endometriosis: Definition

Deep endometriosis was defined in 1992 as endometriosis infiltrating more than 5 mm under the peritoneum [8]. Realising in 1990 that 'deep endometriosis lesions' were a separate entity associated with severe pain [9] the definition of 5 mm was suggested based on two observations. First the frequency distribution of depth of endometriosis was biphasic with a nadir around 5 mm suggesting two populations. In addition, the histologic observation that the deeper lesions were more in phase with the endometrium and more active than the more superficial typical lesions seemed compatible with the concept that deeper lesions had 'escaped' from the inhibitory effect of peritoneal fluid with a high progesterone content [10]. An effect by diffusion of the hormonal content in peritoneal fluid, up to some 5 mm of depth seemed logic. Unfortunately, a full histological exploration of endometriotic glands and stroma at different depths has not been performed until today. One of the difficulties to do this is the necessity to cut lesions perpendicularly to the surface. Although the biphasic frequency distribution has been confirmed recently [2], the important overlap between the two populations has rarely been taken into account. If we would use depth of invasion as a predictive test for deep endometriosis, a depth of invasion of 6–7 mm would hardly reach an accuracy of 60% and a depth of invasion of 8–9 mm would not exceed 80% since at these depths deep endometriosis lesions are strongly contaminated with somewhat deeper typical lesions. Only depths deeper than 10 mm would achieve a higher accuracy. Searching for a better definition, adenomyosis externa was considered. However, also this definition was not considered adequate (Dan Martin, personal communication, 2019).

These comments on the definition of deep endometriosis are necessary to understand the apparent discrepancy between this chapter and the literature. In this chapter, we will discuss only the larger deep endometriosis lesions present clinically as glandular spherical lesions during excision or as half-moon glandular nodules in the bowel wall (Fig. 11.1). We will not discuss the deeper typical lesions and the larger fibrotic plaques in the pelvis and on the bowel. Although they fit the criterium of 'deeper than 5 mm' these plaque lesions are rarely deeper than 7–8 mm. They are rarely invasive in the muscularis or only in a small area. They generally can be rather easily excised.

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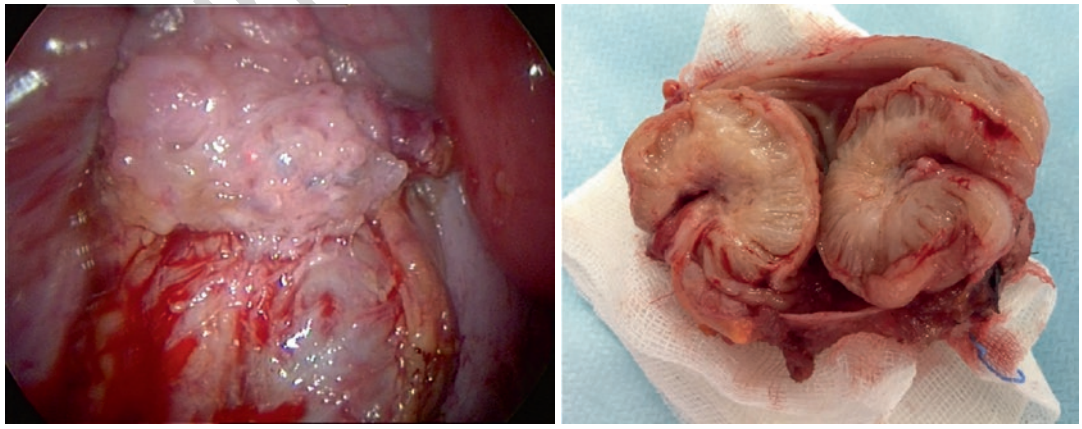

Fig. 11.1 Larger deep endometriosis lesions in the bowel present as glandular spherical lesions during excision (left) or as half-moon glandular nodules in the bowel wall (right)

11.3 History of Deep Endometriosis Surgery

Large severe deep rectovaginal endometriosis was described more than 100 years ago [11–13], even before the description of cystic ovarian endometriosis [14], and was considered a rare pathology.

Laparoscopic deep endometriosis surgery started in the early 1990s with endometriosis excision with a CO_2 laser in women with infertility [8, 9, 15, 16]. Following the borders of endometriosis lesions during excision we realised that some lesions were deeper than the usual typical lesions, that these lesions were associated with severe pain and histologically more active and different from typical lesions [9]. Over the following years we realised that some of these lesions were much bigger, that severity increased with age [16] and that some were triangular lesions, what today we would call deeper typical lesions, in contrast with others which were spherical lesions looking like adenomyosis externa [8, 17]. With excision of progressively larger bowel lesions, we were confronted with muscularis lesions and full thickness resections, which were sutured with one- or two-layer sutures. It should be understood that these were the early days of laparoscopy in abdominal surgery, and that in Leuven, gynecology and abdominal surgery were helping each other, the former teaching bowel surgery to the gynecologists and the latter teaching laparoscopic surgery to the surgeons [18]. With more extensive excisions, we encountered our first ureter lesions [19] and late bowel perforations which were initially not readily recognised [20]. In order to deal with the exponentially growing amount of work, we decided in 1996 that gynecology would continue to perform and explore the limits of conservative excisions or endometriosis with bowel suturing if necessary. The (rare) bowel resections for the very large, especially sigmoid, endometriosis lesions would be performed by abdominal surgery, since this was technically easier surgery and since the abdominal surgeons were still in their learning phase of laparoscopic surgery. During the same period, although two separate universities with little contact at that moment, a similar situation had developed at the University of Louvain with J. Donnez.

This experience of a fast-increasing severity and number of deep endometriosis lesions in Leuven, was repeated in Radcliffe, Oxford UK after 1996 and in Gemelli, Rome, Italy after 2003. We therefore consider this increase a recognition and referral bias, much more than a real epidemiologic increase in severity and incidence [21]. As a consequence of the increasing numbers and with the fast adoption of laparoscopy in abdominal surgery, endometriosis surgery was rapidly introduced in all major hospitals in Belgium and France and by the beginning of the twenty-first century bowel resections performed by abdominal surgeons had become the most frequently performed intervention for larger deep endometriosis lesions. Indeed, without the blessing of the local abdominal surgeon, conservative excision, a more difficult and time-consuming procedure, could not be developed by the gynecologists. Only when deep endometriosis surgery had been initiated before the introduction of laparoscopy in abdominal surgery conservative excisions continued to be performed. After 2000 the concept of the pelvic surgeon resulted at the international level in a revival of conservative excisions and a progressive decrease in bowel resections [22], especially after the introduction of the circular [23, 24] and linear staplers [25, 26] to perform full thickness discoid resections.

11.4 Radicality of Deep Endometriosis Surgery

In the beginning, excision of deep endometriosis was guided by the principle of complete eradication of all endometriotic cells, a rule derived from cancer surgery. However this concept was challenged by the observation that subtle endometriosis which was not necessarily a disease but a normal physiologic phenomenon occurring intermittently in all women [27], and by microscopical endometriosis which was found in over 10% of normal looking peritoneum [28, 29]. Also the observation that endometriosis was found in the

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lymph nodes of the bowel in over 15% of women with a bowel resection for deep endometriosis [30], raised the question whether all endometrium-like tissue outside the uterus was pathologic. More recently it was demonstrated that bowel deep endometriosis had clusters of endometrium like cells in the bowel wall at least up to 5 cm from the lesions [31, 32].

"The proof of the pudding is in the eating" and radicality of endometriosis surgery should be judged by recurrence rates. Discussing the completeness of deep endometriosis surgery at the mixed surgery-gynecology meetings in Deauville, France and after reviewing mutual videos of surgery, we realised as early as 1998 that the radicality of conservative excisional surgery varied from very complete (with more bowel openings) to much less complete with a rim of endometriosis/fibrosis remaining on the bowel. However, as suggested back then, until today recurrence rates seem not to be obviously different between very complete and less complete excisions [33], between conservative excisions and segmental bowel resections and between small and large bowel resections.

These observations can be explained by the genetic-epigenetic pathophysiology of endometriosis [2] (Fig. 11.2). As suggested in 1999 by the endometriotic disease theory [34], subtle lesions are considered normal endometrium implanted outside the uterus [35], whereas typical, cystic and deep endometriosis, then called endometriotic disease, developed when a threshold of genetic and epigenetic incidents had been reached. This explains that each endometriotic disease lesion is clonal [36, 37], different and originated from a specific incident in adult or neonatal endometrial or stem or bone marrow cells. This explains the heterogeneity of lesions [38], and the association with cancer [39]. The menstrual bleedings in the lesions moreover, risk causing additional incidents and thus influence the growth and severity of the lesions [40].

Whereas genetic mutations are clearly permanent and transmissible, this is much less clear for epigenetic changes. It is unclear which and when epigenetic changes become irreversible and although it is easily understood that they are transmitted by cell cleavage it is unclear whether they are transmissible between generations. A similar confusion exists for histologically observed metaplastic changes. We are unable to distinguish normal endometrial cells from cells with reversible epigenetic changes and cells with irreversible genetic-epigenetic changes. As discussed for subtle lesions [35] we are unable to distinguish a normal implanted endometrium, from metaplastic endometrium like cells following mesenchymal–mesothelial transition and cells with irreversible genetic-epigenetic changes on their way to develop more severe endometriosis lesions. It seems likely that reversible metaplastic changes are caused by reversible epigenetic changes [41–43]. Tumor cells, similarly, can cause metaplastic changes in the surrounding cells which acquire a tumor looking aspect through cell-cell interaction.

In order to explain the similar low recurrence rates of deep endometriosis after a less complete nodulectomy than after a (large) bowel resection for deep endometriosis, our hypothesis today is that the periphery of endometriosis lesions and the fibrosis around these lesions are reversible metaplastic changes without irreversible epigenetic incidents, but induced by the central endometriotic cells with G-E incidents. Although consistent with clinical observations, this hypothesis is speculative today and needs biological confirmation.

Surgically, however, this hypothesis is fundamental since it also can explain that the nests of endometriotic looking cells in the bowel at distance from a nodule and in the lymph nodes do not develop clinically into a symptomatic disease. We even wonder whether following surgical excision of deep endometriosis these endometriotic looking cell at distance return to normal. Unfortunately, this cannot be investigated for obvious ethical reasons. Clinically important is the thickness of these metaplastic changes surrounding the core of deep endometriosis lesions. For surgery, it is important to know whether the metaplastic zone is thin, whether it comprises the

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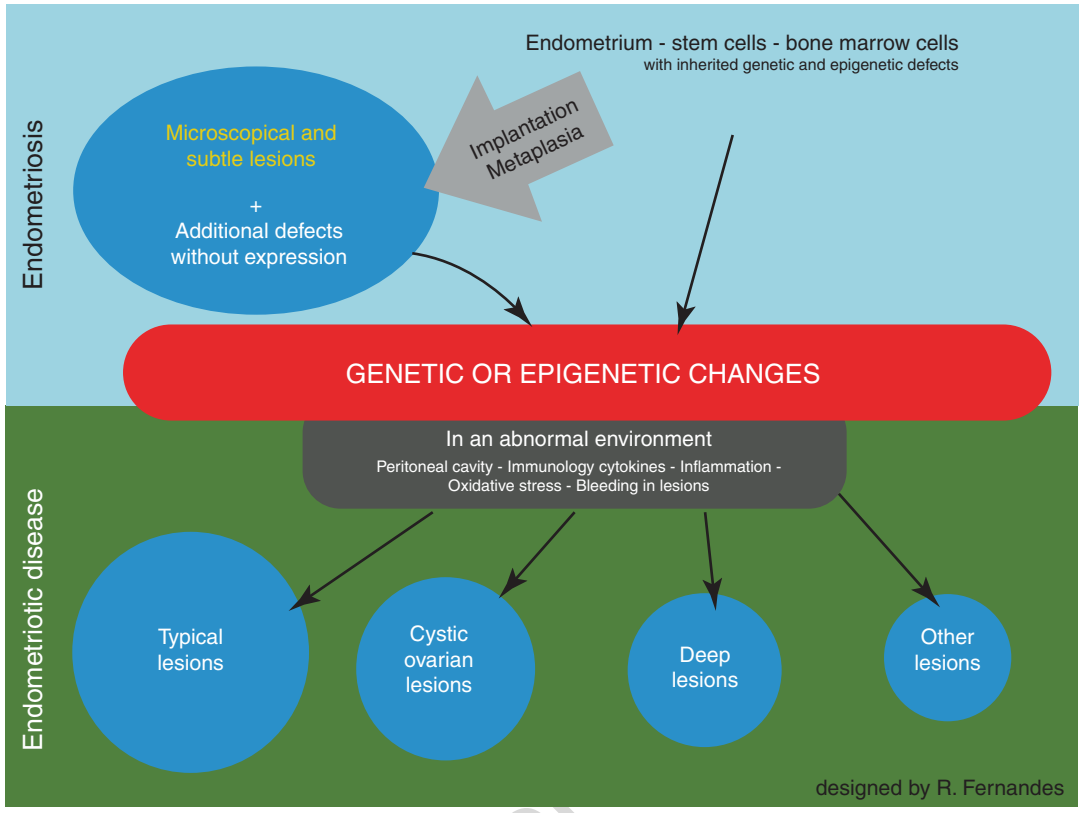

Fig. 11.2 The genetic-epigenetic theory of endometriosis [2]

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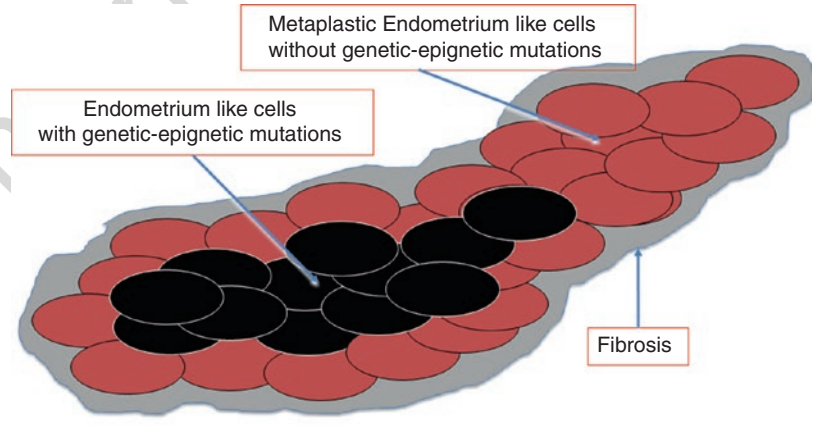
Fig. 11.3 A deep endometriosis nodule: our hypothesis. The periphery of an endometriotic nodule is composed of metaplastic endometrium like cells without genetic and epigenetic changes. After excision of the core with genetic and epigenetic changes, the metaplastic cells will return to normal



growing columns of cells or whether this layer is much thicker. This indeed will determine the necessary radicality of excision, since after excision of the core, these peripheral metaplastic cells will return to normality—"after cutting the head the snake dies" (Fig. 11.3).

11.5 What Is the Place of Diagnostic Tests Before Surgery?

A correct diagnosis is the cornerstone of surgery. A diagnosis is ideally made before surgery. However, if only suspected, the diagnosis can be confirmed during surgery. Understanding the value of a diagnostic test is important to understand why the treatment of deep endometriosis by nodulectomy or by bowel resection remains debated.

The accuracy of any preoperative test is judged by its sensitivity and its specificity. Sensitivity is the percentage of women with the disease that are detected; specificity is the percentage of women without the disease that are correctly diagnosed as negative. The former thus express the missed diagnoses and the latter the false positives. In addition, when a test is used for a rare condition specificity should be very high in order to prevent too many false positives. This can best be illustrated with an example, of a disease occurring in 1% of the population, or 100 women with the disease in a group of 10,000. A test with 99% sensitivity will find 99 of the 100 women with the disease. A 99% specificity means that 9801 women out of the 9900 will be diagnosed correctly as not having the disease. However, this also means that 99 women will be diagnosed erroneously as having the disease. The test thus will result in 99 true positive and 99 false positive diagnoses. A test with 99% specificity and 99% sensitivity thus will result in as many true positives as false positives for a disease with a prevalence of 1%. This is the well-known reason why screening tests, e.g., for breast cancer, need to be very accurate in order to prevent finding too many false positives.

The clinical usefulness of a test is a clinical decision. For deep endometriosis, a preoperative diagnostic test could help to make the decision to perform surgery and to make the decision which type of surgery should be performed. A full discussion of the clinical usefulness of imaging of deep endometriosis before surgery is beyond the scope of this chapter. However, we invite the readers to check in the other chapters of this book the sensitivities and specificities of imaging before surgery. The reader should decide whether sensitivity and specificity of small nodules, e.g., smaller than 1 cm, and whether the lower detection limit are good enough to overrule the clinical decision to do or not to do surgery. The reader should also decide whether the accuracy of depth of bowel invasion is good enough to decide about a bowel resection without attempting a nodulectomy.

Although imaging before surgery is of great value to discuss with the patient the probable severity of the disease and the type of surgery that will probably be performed, the results should be used with caution. Indeed, with sensitivities and specificities below 99%, and prevalences around 1%, the risk of missing disease and of false positives is high when used as an absolute indication to do surgery or to perform a bowel resection without trying a nodulectomy.

11.6 Outcome of Surgery

A full discussion of the outcome of surgery is far beyond the scope of this chapter. However, the readers are invited to check in the other chapters the results for pelvic pain, for infertility, for recurrence rates, for the quality of life and to check the risks for early and late postoperative complications and functional outcomes [44]. It is not surprising, that because of the complexity, outcomes are invariably given selectively, with a preference of results after a short time. In addition, it is difficult to compare outcomes which are so different. The reader should also realise that describing one outcome while ignoring all the other outcomes can be misleading, something described as "lying with statistics" [45, 46].

Rare events are difficult to judge since solid data are missing, especially for deep endometriosis surgery. A 1% complication, however serious, needs 1000 surgeries to collect ten cases. Any trial thus requires prohibitively large numbers for meaningful conclusions. This is the reason why careful reporting, permitting meta-analysis is important. This has permitted the conclusion (Fig. 11.4) that the incidence of anastomotic

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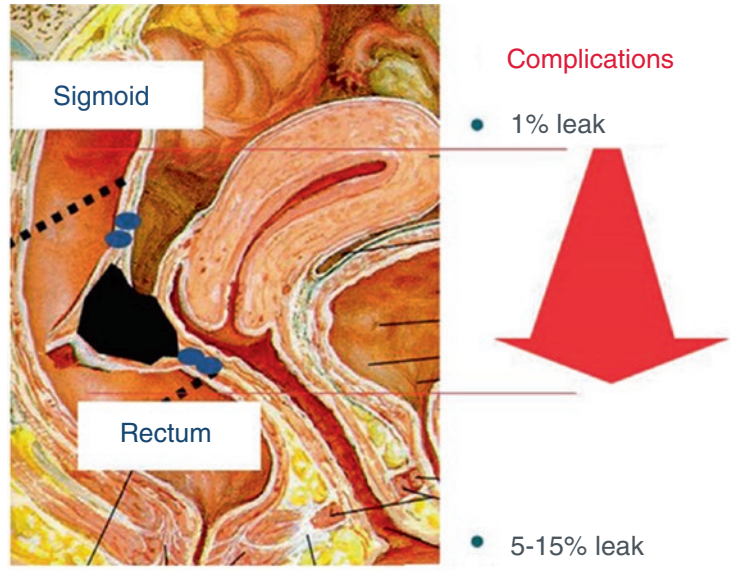

Fig. 11.4 Complications after bowel resection [47]. (L Ret Davalos, de Cicco, D'Hoore, P Koninckx J Min Invas Surg a review of all cases since 1990 ≥10,000)

leaks was some 1% for the sigmoid and increased to over 10% for the low rectum [47], with some 30% lifelong bladder, bowel, and 40% sexual problems [47]. It is unfortunate that notwithstanding almost 2000 reported bowel resections for deep endometriosis, solid data on these complications especially sexual problems are not available [48]. A fortiori comparisons between bowel resection versus discoid resection are missing. However, although rarely considered, common sense suggests that sexual problems and anorgasmia are serious complications.

The many different aspects of outcome, the rare events, the inherent variability of the surgery performed in deep endometriosis, and the inherent variability of the skills of the surgeon all contribute to deep endometriosis surgery remaining debated after 30 years.

11.7 Technical Choices

The importance of dissection and of coagulation before cutting, and the choice of energy devices as electrosurgery, sealing devices, CO_2 laser, or ultrasonic devices are highly individual. In addition, few surgeons are equally skilled with all devices.

Deep endometriosis excision from the bowel started in the early 1990s as an extension of CO_2 laser excision of superficial endometriosis. With intermittent pulses at high-power density, CO_2 laser is a precise, fast, cutting instrument through vaporisation of the superficial layers with less than 100 µm tissue damage. "What you see is what you do." The use of the CO_2 laser through the operative laparoscope had the advantage of the surgeon holding the camera. However, the use of the CO_2 laser also has several disadvantages. The CO_2 laser is used at short distance decreasing the overview of the surgical field. Its use requires a high and continuous flow insufflation for smoke evacuation [49], with desiccation and probably adhesion formation as side effects [50]. The CO_2 laser is not suited for dissection and has poor coagulation properties. This requires a specifically well-trained assistant, capable of the immediate coagulation of bleedings. Being not suited for dissection together with the fast cutting, a CO_2 laser is highly suited for fast excision of a deep endometriosis nodule until safety requires dissection. It has some advantages for the excision from the bowel muscularis but not from the mucosa. Other disadvantages are the weight of the coupler and the lower image quality of operative laparoscopes.

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Bipolar forceps, cold scissors and electrosurgery are the most versatile instruments for dissection and coagulation of vessels before cutting. However, fat is a poor conductor of electricity and bipolar coagulation is less suited for well irrigated fat, such as bowel fat or omentum. For these tissues sealing and ultrasonic devices are more appropriate.

These comments should explain our personal choices. In Leuven endometriosis surgery was started with CO_2 laser excision assisted with bipolar coagulation and cold scissors dissection before cutting. This combined use of an 80-W CO_2 laser together with bipolar/cold scissors dissection continued to be the basic setting. Whereas the surgeon holding the telescope with the camera and the laser, was considered an advantage in the early years, the increasingly severe endometriosis and the importance of specifically trained assistants resulted in the gradual replacement of registrars by dedicated fellows. In most other centers, dissection surgery was progressively developed since necessary for oncologic and pelvic floor surgery and the CO_2 laser was rarely used. In addition, the introduction of the new generation of telescopes had a much better image quality than the older operative endoscopes. For these reasons, the CO_2 laser has become rarely used for deep endometriosis surgery. It remains however, the preferred instrument for the treatment of superficial endometriosis.

Over the years we have tried many other instruments. With bipolar scissors we had difficulty to follow the plane of cleavage between endometriosis and healthy tissue because of the coagulated tissue. For ultracision and sealing devices we concluded that notwithstanding being superior for transecting bowel fat and epiploon, the dissecting capacities were insufficiently precise for the excision of endometriosis from the bowel wall or the ureter.

11.8 Excision of Deep Endometriosis of the Bowel

Our excision of deep endometriosis of the bowel has been guided by four principles. *First*, we always perform a one bloc resection, without leaving endometriosis to be excised later. This is done, since the traction by the central endometriosis nodule fixes the tissues and facilitates the judgment of cleaving plane between the endometriosis and the healthy tissue. Leaving endometriosis tissue to be excised later is more difficult when tissues are more mobile. Therefore, *the second principle* is that all lateral endometriosis (ureter, ischial spine, uterosacrals) should be excised first up to the pararectal spaces before starting the excision of the bowel endometriosis. For the same reason, *the third principle* is to keep the bowel attached to the uterus and to dissect the bowel from the endometriosis. This keeps traction on the plane between the nodule and the bowel and permits manipulation by moving the uterus. It avoids the much more difficult dissection of a nodule from a mobile bowel. *Fourth*, we consider the accuracy and predictive value of the estimation of the depth of invasion insufficient to permit the decision that excision of a bowel nodule cannot be done. For this reason, we use the 'try and see' principle and decide during surgery whether excision is feasible. The few exceptions are a bowel obstruction of more than 50% over more than 2 cm diagnosed by contrast enema. Experience has taught us that this is an absolute indication for a (sigmoid) bowel resection. Until today we did not see a single woman with a rectum obstruction fitting these criteria. However, confronted with a very large spherical nodule of more than 4–5 cm diameter, we learned to be prudent since excision could be long and difficult with the risk that a reception anyway would be necessary.

11.8.1 The Rectum and Low Rectum

With the principles outlined above, we needed to perform in Leuven over 20 years 5–6 bowel resections only, in more than 1500 deep endometriosis nodules of variable sizes a shown in Fig. 11.5.

According to our principles, before starting the excision of endometriosis from the bowel wall, all lateral endometriosis around ureter, uterosacrals and ischial spine has been taken care

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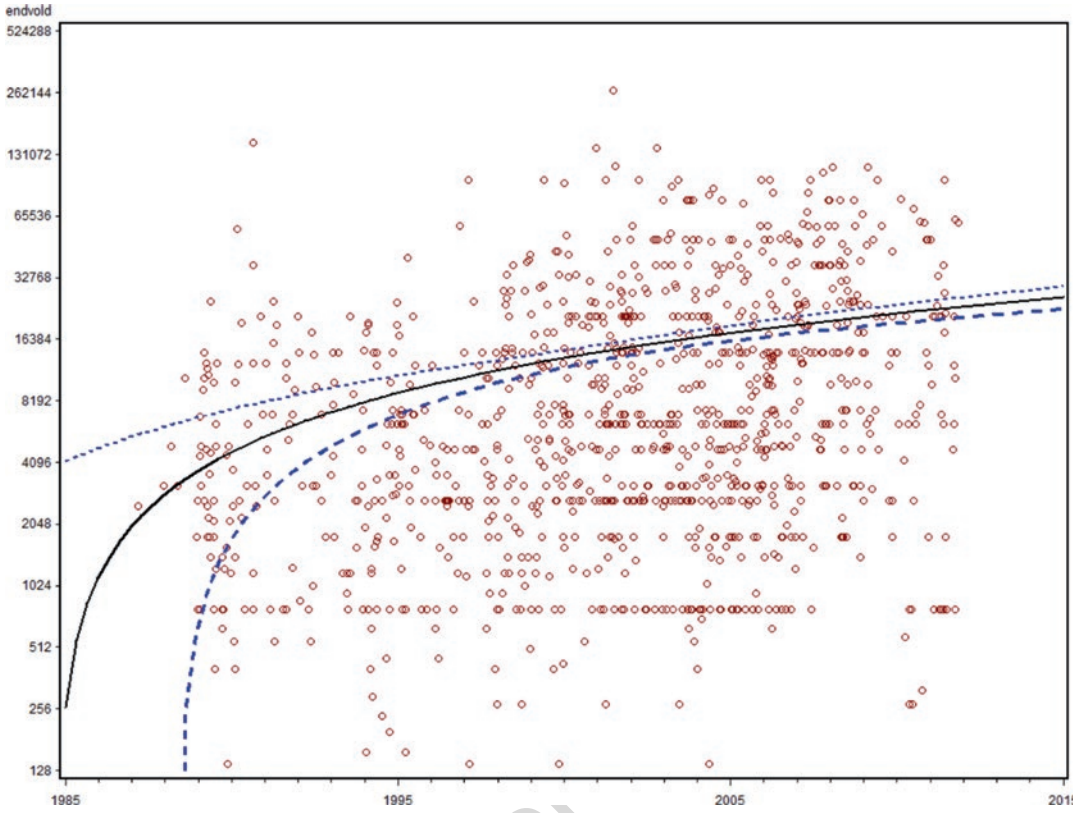

Fig. 11.5 Volume of deep endometriosis nodules in mm^3 managed by conservative excision in Leuven between 1989 and 2011. A quadratic regression with 95% confidence limits is shown AU6

of. In addition, both ureters and both pararectal spaces should be clearly identified.

When starting the excision, the endometriosis nodule should remain attached to the uterus/cervix in the central part only (Fig. 11.6). This implies that all lateral dissection up to the uterine arteries must be performed first. This surgery should respect the sympathetic nerves and it comprises the dissection of the lateral vagina and lateral cervix and the insertion of the uterosacrals. Important in this step is to emphasise the central traction between cervix, nodule and bowel in order to facilitate the visualisation of cleavage plans.

After this, still before starting the dissection between the nodule and the rectum, all bowel fat lateral from the nodule and the bowel is dissected. This can be done with little risks since this fat can be clearly identified, coagulated, and cut. Important is to do this as extensively and as deep as possible since it will increase the central traction between cervix, the nodule, and the bowel.

Only thereafter, dissection between the nodule and the bowel wall is started. Opening the peritoneum overlying the bowel is without risks. The difficulty starts when entering and cutting the muscularis. Important is always to do this progressively always after the lateral dissection of the fat in order to keep the central traction identify the plane of cleavage. Whereas 20 years ago, we excised all endometriosis including the surrounding fibrosis we became more conservative over the years and left some fibrosis on the bowel. Smaller arteries coagulated but capillary bleeding did not. The plane of cleavage is dissected with sharp scissors, after the plane of cleave is aligned with the plane of the scissors through uterine manipulation and/or a rectal probe. Only after complete dissection of the bowel from the nodule, the nodule is dissected from the cervix and the vagina. In doubt the posterior fornix of AU7

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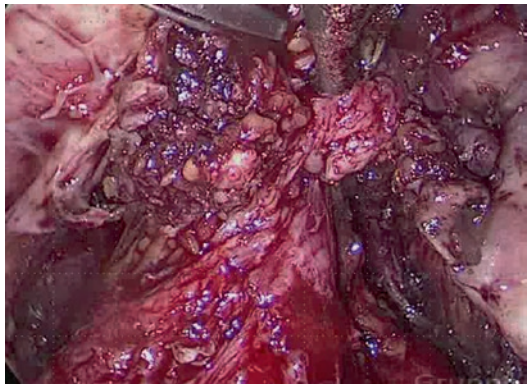

Fig. 11.6 Conservative excision of a 3 × 3 × 3 cm endometriosis nodule from the rectum. Notice the rectum attached centrally to the cervix and the partial dissection of the damaged muscularis which has to be sutured

the vagina is resected since all recurrences we have seen were all at in the vaginal cuff.

With this technique over 95% of bowel endometriosis nodules were excised without the need to perform a bowel resection. An eventual small mucosa lesion, occurring in some 10% is sutured immediately in order to prevent prolonged leakage. Although the mucosa is rarely involved, it becomes tricky when the bowel is entered repetitively, and a wedge resection of the bowel is necessary. After excision of the nodule, the bowel is sutured in one layer for muscularis lesions only and in two layers for full thickness resections. It is unclear whether interrupted or running sutures should be preferred. Important is to suture healthy muscularis to healthy muscularis and it is unclear which distance of damaged muscularis can be bridged. Considering the semilunar configuration of bowel nodules (Fig. 11.1), distances up to 5–6 cm seem acceptable.

Today we think that for larger nodules the technique as described can be simplified by leaving some endometriosis on the bowel wall and to use a circular stapler to excise the remaining anterior bowel wall with the remaining endometriosis. However, the technique as described keeps its full importance since it permits a maximal reduction of the nodule volume prior to excision with a circular stapler. Although we never should say never in medicine, today the large majority of rectum endometriosis nodules can be excised conservatively without the need to perform a bowel resection. When nodules are very big and a lengthy excision over a long distance is anticipated, a much faster small bowel resection should be considered.

11.8.2 The Sigmoid

Endometriosis nodules in the sigmoid (Fig. 11.7) are generally much larger than their macroscopic appearance during laparoscopy. Often the strongly distorted anatomy is the only indication of a severe deep endometriosis together with a solid harder mass on palpation.

After been dissected from its physiologic adhesions to the side wall, the sigmoid becomes very mobile. This together with the localisation almost vertically under the umbilicus makes excision of a sigmoid nodule and the suturing of the frequent muscularis defect, or of a full thickness resection technically difficult.

Over the last 30 years we have explored the technical feasibility of excision of sigmoid nodules. The sigmoid was sutured to the round ligaments of the uterus permitting to pull the sigmoid down. This in addition, stabilised the sigmoid somewhat and facilitated the angle of surgery. Fairly rapidly, it was evident that excision of lesions with an occlusion of more than 50% over more than 2 cm on contrast enema almost systematically ended with a bowel resection with end-to-end anastomosis. Therefore the 5% nodules with ‘more than 50% occlusion over more than 2 cm on contrast enema’ became around 1996 an indication for elective bowel resection. For all other nodules, we started excision but another 5% ended with a bowel resection. It should be noticed that adhesions and spasms can mimic severe bowel stenosis over a short distance, as experienced in 5–10 cases over 30 years.

To the best of our knowledge there are no comparative studies which permit to judge the degree of bowel obstruction with other imaging methods than a contrast enema. The exact predictive value of ultrasound, virtual colonoscopy, and MRI with contrast remains to be established.

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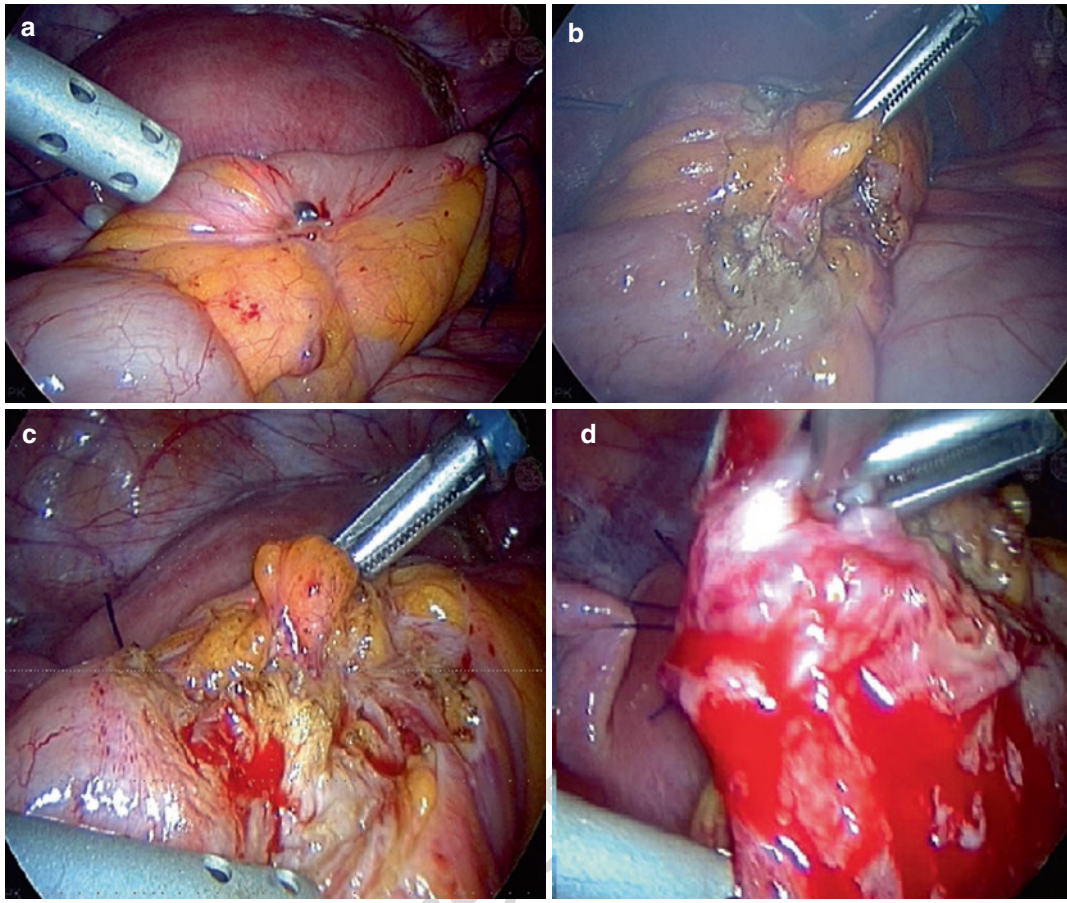

Fig. 11.7 Conservative excision of deep endometriosis from the sigmoid is feasible although no longer recommended. The nodule is more important than judged by inspection (**a**). A CO_2 laser is used up to the muscularis (**b**). Sharp dissection is used thereafter (**c** and **d**)

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11.9 Conclusions and Discussion

11.9.1 Conclusions

Looking back at the historical evolution of deep endometriosis bowel surgery and considering newer techniques as (double) discoid excision with a circular or linear stapler, and the short 'economic' bowel resections as developed by A Wattiez (we conclude that (short) segmental bowel resections should be used liberally for sigmoid nodules, whereas conservative excision without bowel resection is the preferred technique for the large majority of deep endometriosis nodules of the rectum. A segmental resection of the sigmoid has a low risk of postoperative leaks and of long-term functional problems of bladder, bowel and sexuality. On the other hand, a conservative excision of a sigmoid nodule is long and technically difficult surgery with frequent muscularis lesions, full thickness resections and at least 5% bowel resections. Therefore, although feasible, excision of sigmoid endometriosis lesions should be reserved for small nodules with a liberal conversion to a bowel resection. Low rectum deep endometriosis nodules can be excised conservatively in most women. In order to do so, it is mandatory to identify the ureters, the pararectal spaces, to free the lateral attachment of the nodule from the cervix up to the vagina, to keep the central attachment to the cervix permitting mobilisation and traction on

the nodule and to dissect the bowel from the nodule. If the aim is to suture the muscularis defect or an eventual full thickness defect, we suggest leaving a rim of fibrosis on the bowel wall since this will reduce the risk of opening the bowel without increasing the recurrence risk. If the aim is to use a circular stapler to perform a full thickness resection of the bowel wall excision of the nodule can even be less complete. It is unclear whether the outcome of a conservative excision with discoid resection with a circular stapler is superior to suturing. However, a discoid excision with a circular stapler has the advantages of being technically easier and faster, permitting a more superficial and less complete dissection of the nodule from the bowel. It is unclear until which size the feasibility of conservative excision should be tried. We suggest that when nodules are very big, i.e., more than 4 cm in all directions or a volume of more than 20 ml, a small bowel resection should be considered, given the difficulty and duration of a conservative excision. It is also unclear whether the rare women with two deep endometriosis nodules, one in the sigmoid and another one in the rectum should be treated with a long segmental bowel resection and a high risk of persisting functional disturbances or whether the rectum nodule should be conservatively excised in a first procedure followed later by a small sigmoid resection.

The liberal use of low bowel resections can no longer be recommended. First it is no longer necessary, since conservative excision can be done for most nodules with postoperative complications which are similar to rectum resections [1, 48]. Second, rectum resections are associated with the long-term functional complications of the bladder, bowel, and sexuality. Until proven otherwise this is a major argument to avoid low rectum resections and to prefer conservative excision. Anorgasmia indeed should be considered a serious complication.

Technical considerations suggest that the use of a CO_2 laser belongs to the past. Important is that the CO_2 laser is less suited for the precise dissection of a deep endometriosis nodule from the muscularis and mucosa of the bowel. The proper use of a CO_2 laser moreover requires a continuous flow to prevent blooming of the laser beam in the telescope and for smoke evacuation, and a trocar with a large side opening [51]. The use of a CO_2 laser needs additional training to learn the technique of the surgeon holding the telescope, working at short distance and relying on a trained assistant for coagulation. Finally, the image quality of the operating telescopes is less than for straight telescopes whereas 4K operative telescopes even do not exist today.

Considering the similar tissue effects of superficial vaporisation with limited tissue damage of a CO_2 laser and of pure cutting current electrosurgery when used with intermitted pulses, both techniques can advantageously be used to speed up the lateral dissection of the nodules up to the muscularis. Looking back, it is surprising to realise that in the early 1990s I used this type of electrosurgery when resecting deep endometriosis nodules when a CO_2 laser was not available, and that over the subsequent years bipolar coagulation and cold scissors dissection became used exclusively. Only recently observing the Brazilian use of electrosurgical hook [52] we think that this technique should be considered to speed up the lateral dissection of the nodule up to the muscularis, in a similar fashion as done with the CO_2 laser previously.

11.9.2 Discussion

We limited our discussion to the larger lesions which seem spherical and glandular during resection of which have the typical semilunar retractive aspect after bowel resection (Fig. 11.1). We excluded slightly deeper typical lesions and larger fibrotic plaques which seem a different pathology although fitting the diagnosis of 'more than 5 mm under the peritoneum'.

Understanding the accuracy and clinical usefulness of diagnostic methods is important to judge whether decisions as an elective bowel resection can be taken before surgery. This has organisational advantages when the presence of an abdominal surgeon has to be planned. The risk however is that bowel resections are too frequently used. Much of the confusion stems from the pitfalls and the poor understanding of the diagnostic accuracy of a diagnostic method.

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A first pitfall is that for rare diseases the sensitivities and specificities need to be much higher. Indeed, for a disease with a prevalence of 1%, 99% specificity, and 99% sensitivity will result in unacceptable 50% false positives. A second pitfall is the confusion resulting from extrapolating statistically significant differences as a diagnostic test. Although men are significantly taller than women, height is a poor predictor of gender. The third pitfall is that the clinical usefulness of a diagnostic test is a clinical judgment and that the required accuracy will vary with the pathology. The acceptable risk of missing the diagnosis (sensitivity) of a cancer, and the risk of a false diagnosis of cancer (specificity) with severe consequences of surgery and chemotherapy, should obviously be less than for conditions which are not life-threatening. A fourth pitfall is circular conclusions. The conclusion that this size or the circumference of a nodule is an indication for a bowel resection requires that conservative resection has been tried. A fifth last pitfall is the absence of diagnostic sensitivity and specificity stratified for nodules of different sizes.

Surgery should be judged by its results, which should comprise postoperative complications, permanent bladder, bowel and sexual complications, and improvement of pain, infertility, quality of life, and absence of adhesion formation. With that many variables a comprehensive multivariate analysis does not exist. Moreover, many variables as postoperative complications are rare events requiring prohibitively large groups for meaningful conclusions. Unfortunately, lifelong bladder, bowel and sexual problems are poorly investigated since considered 'unavoidable' and minor side effects.

Confusion is fuelled in addition by the varying interpretation of words. It is unclear when metaplasia, and by extension epigenetic changes, are reversible or irreversible. 'Shaving' sounds as a progressive removal layer by layer which is not what is done during deep endometriosis excision. For this reason, we prefer excision.

It was beyond the aim of this chapter to discuss nerve sparing in deep endometriosis bowel surgery. However, the livelong bowel bladder and sexual problems after traditional rectum resections, and the dissection required to do a bowel resection strongly suggest that a nodulectomy should be preferred if possible and to perform the smallest bowel resection possible if necessary.

In conclusion, to discuss the management of deep endometriosis of the bowel we need a clear understanding and definition of deep endometriosis, we need to understand the accuracy and pitfalls of a diagnostic test and a comprehensive understanding of complications and results. Considering the available evidence today we suggest a liberal use of bowel resection for sigmoid endometriosis. Provided a correct technique, almost all rectal deep endometriosis lesions can be treated conservatively by excision, eventually by discoid excision. Low rectum bowel resections should progressively become obsolete except for the very large lesions, and if performed a short or minimal resection should be performed.

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References

1. Donnez O, Roman H. Choosing the right surgical technique for deep endometriosis: shaving, disc excision, or bowel resection? Fertil Steril. 2017;108:931–42.
2. Koninckx PR, Ussia A, Adamyan L, Wattiez A, Gomel V, Martin DC. Pathogenesis of endometriosis: the genetic/epigenetic theory. Fertil Steril. 2019;111:327–39.
3. Koninckx PR, Ussia A, Adamyan L, Wattiez A, Donnez J. Deep endometriosis: definition, diagnosis, and treatment. Fertil Steril. 2012;98:564–71.
4. Di Giovanni A, Casarella L, Coppola M, Iuzzolino D, Rasile M, Malzoni M. Combined transvaginal/transabdominal pelvic ultrasonography accurately predicts the 3 dimensions of deep infiltrating bowel endometriosis measured after surgery: a prospective study in a specialized center. J Minim Invasive Gynecol. 2018;25:1231–40.

Uncorrected Proof

5. Exacoustos C, Zupi E, Piccione E. Ultrasound imaging for ovarian and deep infiltrating endometriosis. Semin Reprod Med. 2017;35:5–24.
6. Abrao MS, Andres MP, Barbosa RN, Bassi MA, Kho RM. Optimizing perioperative outcomes with selective bowel resection following algorithm based on pre-operative imaging for bowel endometriosis. J Minim Invasive Gynecol. 2020;27(4):883–91.
7. Muzii L, Miller CE. The singer, not the song. J Minim Invasive Gynecol. 2011;18:666–7.
8. Koninckx PR, Martin DC. Deep endometriosis: a consequence of infiltration or retraction or possibly adenomyosis externa? Fertil Steril. 1992;58:924–8.
9. Cornillie FJ, Oosterlynck D, Lauweryns JM, Koninckx PR. Deeply infiltrating pelvic endometriosis: histology and clinical significance. Fertil Steril. 1990;53:978–83.
10. Koninckx PR, Heyns W, Verhoeven G, Van BH, Lissens WD, De MP, et al. Biochemical characterization of peritoneal fluid in women during the menstrual cycle. J Clin Endocrinol Metab. 1980;51:1239–44.
11. Cullen TS. Adenoma-myoma uteri diffusum benignum. J Hopkins Hosp Bull. 1896;6:133–7.
12. Lockyer C. Adenomyoma in the recto-uterine and recto-vaginal septa. Proc R Soc Med. 1913;6: 112–20.
13. Cullen TS. The distribution of adenomyomata containing uterine mucosa. Am J Obstet Gynecol. 1919;80:130–8.
14. Sampson JA. Perforating hemorrhagic (chocolate) cysts of the ovary. Their importance and especially their relation to pelvic adenomas of the endometrial type. Arch Surg. 1921;3:245–323.
15. Cornillie FJ, Koninckx PR. Morphologic aspects of endometriosis. In: Martin D, editor. Appearances of endometriosis. London: Gower Medical Publishing; 1992. p. 1–6.
16. Koninckx PR, Meuleman C, Demeyere S, Lesaffre E, Cornillie FJ. Suggestive evidence that pelvic endometriosis is a progressive disease, whereas deeply infiltrating endometriosis is associated with pelvic pain. Fertil Steril. 1991;55:759–65.
17. Koninckx PR, Martin D. Treatment of deeply infiltrating endometriosis. Curr Opin Obstet Gynecol. 1994;6:231–41.
18. Penninckx F, Aerts R, Kerremans R, Koninckx PR. Laparoscopic cholecystectomy: some advantages or just an artifice of new technology? HPB Surg. 1991;3:291–4.
19. Neven P, vandeursen H, Baert L, Koninckx PR. Ureteric injury at laparoscopic surgery : the endoscopic management. Case review. Gynaecol Endosc. 1993;2:45–6.
20. Koninckx PR, Timmermans B, Meuleman C, Penninckx F. Complications of CO_2-laser endoscopic excision of deep endometriosis. Hum Reprod. 1996;11:2263–8.
21. Koninckx PR, Ussia A, Keckstein J, Wattiez A, Adamyan L. Epidemiology of subtle, typical, cystic, and deep endometriosis: a systematic review. Gynaecol Surg. 2016;13:457–67.
22. Nassif J, Trompoukis P, Barata S, Furtado A, Gabriel B, Wattiez A. Management of deep endometriosis. Reprod Biomed Online. 2011;23:25–33.
23. Kondo W, Ribeiro R, Zomer MT, Hayashi R, Ferreira LR, Martin RL. Double discoid resection in deep intestinal endometriosis. J Minim Invasive Gynecol. 2015;22:S140.
24. Kondo W, Ribeiro R, Zomer MT, Hayashi R, Ferreira L, Martin R. Surgical techniques for the treatment of bowel endometriosis. J Minim Invasive Gynecol. 2015;22:S131.
25. Ribeiro PA, Rodrigues FC, Kehdi IP, Rossini L, Abdalla HS, Donadio N, et al. Laparoscopic resection of intestinal endometriosis: a 5-year experience. J Minim Invasive Gynecol. 2006;13:442–6.
26. Ohara F, Abdala-Ribeiro HS, Rodrigues FC, Aldrighi JM, Ribeiro PA. Outcomes of laparoscopic treatment of rectosigmoid endometriosis: the linear nodulectomy and the segmental resection. J Minim Invasive Gynecol. 2015;22:S95.
27. Koninckx PR. Is mild endometriosis a condition occurring intermittently in all women? Hum Reprod. 1994;9:2202–5.
28. Nisolle M, Paindaveine B, Bourdon A, Casanas F, Donnez J. Peritoneal endometriosis: typical aspect and subtle appearance. Acta Endosc. 1992;22:15–23.
29. Schenken RS. Microscopic endometriosis. Contrib Gynecol Obstet. 1987;16:7–12.
30. Rossini R, Monsellato D, Bertolaccini L, Pesci A, Zamboni G, Ceccaroni M, et al. Lymph nodes involvement in deep infiltrating intestinal endometriosis: does it really mean anything? J Minim Invasive Gynecol. 2016;23:787–92.
31. Roman H, Hennetier C, Darwish B, Badescu A, Csanyi M, Aziz M, et al. Bowel occult microscopic endometriosis in resection margins in deep colorectal endometriosis specimens has no impact on short-term postoperative outcomes. Fertil Steril. 2016;105:423–9.
32. Badescu A, Roman H, Aziz M, Puscasiu L, Molnar C, Huet E, et al. Mapping of bowel occult microscopic endometriosis implants surrounding deep endometriosis nodules infiltrating the bowel. Fertil Steril. 2016;105:430–4.
33. Koninckx P. Recurrence rate of deep endometriosis. In: Lemay A, Maheux R, editors. Understanding and managing endometriosis: advances in research and practice. New York: Parthenon; 1999. p. 251–9.
34. Koninckx PR, Kennedy SH, Barlow DH. Pathogenesis of endometriosis: the role of peritoneal fluid. Gynecol Obstet Investig. 1999;47(Suppl 1):23–33.
35. Koninckx PR, Donnez J, Brosens I. Microscopic endometriosis: impact on our understanding of the disease and its surgery. Fertil Steril. 2016;105: 305–6.
36. Wu Y, Basir Z, Kajdacsy-Balla A, Strawn E, Macias V, Montgomery K, et al. Resolution of clonal origins for endometriotic lesions using laser capture microdissection and the human androgen receptor (HUMARA) assay. Fertil Steril. 2003;79(Suppl 1):710–7.

Uncorrected Proof

37. Mayr D, Amann G, Siefert C, Diebold J, Anderegg B. Does endometriosis really have premalignant potential? A clonal analysis of laser-microdissected tissue. FASEB J. 2003;17:693–5.
38. Koninckx PR, Ussia A, Adamyan L, Wattiez A, Gomel V, Martin DC. Heterogeneity of endometriosis lesions requires new approaches to research, diagnosis and treatment. Facts Views Vis Obgyn. 2019;11(1):57–61.
39. Guo SW. Cancer driver mutations in endometriosis: variations on the major theme of fibrogenesis. Reprod Med Biol. 2018;17(4):369–97.
40. Guo SW. Fibrogenesis resulting from cyclic bleeding: the Holy Grail of the natural history of ectopic endometrium. Hum Reprod. 2018;33:353.
41. Eelen G, de Zeeuw P, Treps L, Harjes U, Wong BW, Carmeliet P. Endothelial cell metabolism. Physiol Rev. 2018;98:3–58.
42. Scutiero G, Iannone P, Bernardi G, Bonaccorsi G, Spadaro S, Volta CA, et al. Oxidative stress and endometriosis: a systematic review of the literature. Oxidative Med Cell Longev. 2017;2017:7265238.
43. Giroux V, Rustgi AK. Metaplasia: tissue injury adaptation and a precursor to the dysplasia-cancer sequence. Nat Rev Cancer. 2017;17:594–604.
44. Roman H, Milles M, Vassilieff M, Resch B, Tuech JJ, Huet E, et al. Long-term functional outcomes following colorectal resection versus shaving for rectal endometriosis. Am J Obstet Gynecol. 2016;215:762.
45. Connor J. How to lie with statistics. Lenexa, KS: Unlimited Press Works LLC; 2015.
46. Huff D. How to lie with statistics. New York: WW Norton & Company; 1982.
47. Ret Davalos ML, De Cicco C, D'Hoore A, De DB, Koninckx PR. Outcome after rectum or sigmoid resection: a review for gynecologists. J Minim Invasive Gynecol. 2007;14:33–8.
48. De Cicco C, Corona R, Schonman R, Mailova K, Ussia A, Koninckx PR. Bowel resection for deep endometriosis: a systematic review. BJOG. 2011;118:285–91.
49. Koninckx PR, Vandermeersch E. The persufflator: an insufflation device for laparoscopy and especially for CO_2-laser-endoscopic surgery. Hum Reprod. 1991;6:1288–90.
50. Koninckx PR, Gomel V, Ussia A, Adamyan L. Role of the peritoneal cavity in the prevention of postoperative adhesions, pain, and fatigue. Fertil Steril. 2016;106:998–1010.
51. Koninckx P, Vandermeersch E. Gas insufflation system for use in endoscopy and a surgical endoscope therefor. Google Patents; 1992.
52. Fernandes LF, Bassi MA, Abrao MS. Surgical principles for disc resection of deep bowel endometriosis. J Minim Invasive Gynecol. 2020;27(2):262.

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