

The impact of endometrioma and its surgical treatment
on ovarian reserve and reproductive performance

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Introduction

The endometrioma is an ovarian cyst lined by ectopic endometrial tissue and containing dark brown or chocolate-coloured fluid. It was first mentioned in the literature in 1860 by the German pathologist Carl von Rokitansky who named it “ovarial cystosarcom” [1]. Sampson in 1927 was the first to describe it as “chocolate cysts” [2]. Endometriomas are found in about 20% of patients with endometriosis and are often associated with severe disease and extensive adhesions [3]. They are more common on the left ovary than the right one [4]. Although sometimes asymptomatic, endometriomas are usually associated with distressing symptoms such as pelvic pain and infertility. Diagnosis can be achieved with pelvic ultrasound scan, which is highly accurate, sensitive and specific in detecting endometriomas. Surgery remains the only effective therapeutic option for endometriomas larger than three cm in diameter, although the optimum surgical techniques remain largely controversial. More recently, emerging evidence suggests a significant damaging effect of endometrioma surgery on ovarian reserve with a possible adverse effect on reproductive performance.

This chapter will give an overview of ovarian endometriomas with a focus on the literature data on the effect of endometrioma and its surgical treatment on ovarian reserve and reproductive performance.

Pathogenesis

Three main theories have been postulated to explain the development of endometriomas. The most widely accepted model is the invagination theory [5]. According to this theory, endometriomas start as superficial ovarian endometriosis, which becomes adherent to the adjacent peritoneum due to irritation and inflammation resulting from recurrent bleeding. As a result of ovarian adhesion to its fossa, blood and menstrual debris from the endometriotic lesions accumulate underneath the ovary leading to progressive invagination of the ovarian

cortex forming a pseudo-cyst. The second theory suggests that endometriomas start as functional ovarian cysts, which become gradually infiltrated by endometriotic implants [6]. Lastly, it has been suggested that endometriomas result from coelomic metaplasia of invaginated epithelial inclusions on the surface of the ovary. This theory is based on the observation that about 12% of endometriomas are free from adhesions and that endometriomas are often multiloculated [7].

Pathology

Initially, the newly formed endometrioma is lined by endometriotic tissue with a prominent glandular component. In long standing endometriomas, the endometriotic tissue is gradually replaced by fibrotic tissue. Eventually, the glandular components completely disappear leaving no histological evidence of endometriosis. In most cases, the cyst wall is fibrotic with foci of hypervascularized and haemorrhagic endometriotic lesions.

Unlike other types of benign ovarian cysts, the ovarian tissue surrounding the endometrioma shows abnormal histological changes including reduced follicular density, inhibited follicular maturation and impaired vascular flow. The stroma surrounding the cortex shows haemorrhages, distended capillaries, fibrosis and increased numbers of macrophages, neutrophils and lymphocytes [8,9].

Clinical presentation

As part of endometriosis, ovarian endometrioma is a disease of reproductive age, which commonly affects women aged 25 – 29 years, although it can present in early adolescents and has been reported in peri-menopausal women. It could be completely asymptomatic presenting as an incidental finding on pelvic ultrasound scan. In most cases however, endometriomas typically present with non-cyclical pelvic pain with cyclical aggravation around the time of ovulation and during menstruation. In addition, endometriomas are frequently associated with

other symptoms of severe endometriosis such as dysmenorrhoea, dyspareunia, dysuria, haematuria, dyschezia and haematochezia.

Diagnosis

Imaging

The imaging modality of choice for endometriomas is trans-vaginal ultrasound scan (TVS), which, in experienced hands, offers a diagnostic accuracy of 94% with a sensitivity of 77% and a specificity of 98% [10]. However, endometriomas can sometimes be confused with dermoid cysts, tubo-ovarian abscesses, mucinous cystadenomas or haemorrhagic cysts [55]. Typically, endometriomas appear as thick-walled, rounded structures containing diffuse low-level homogeneous internal echoes, characteristically described as “ground-glass” appearance [11]. They can be multi-loculated and are often adherent to the pelvic side wall. Together with dermoid cysts, endometriomas make up over two-thirds of persistent adnexal masses in pre-menopausal women.

Magnetic resonance (MR) can be used as a second-line diagnostic imaging modality for endometriomas with an accuracy of 90%, sensitivity of 98% and specificity of 96% [12]. It is mainly used for the diagnosis and assessment of deep infiltrating endometriosis (DIE).

Laparoscopy

Endometriomas appear as deep-seated ovarian cysts of varied sizes (typically 3 - 12cm in diameter), which could be unilateral or bilateral. They are distinguished from other cysts by the presence of pelvic adhesions and peritoneal endometriotic deposits. The adhesions are typically between the affected ovary and its fossa, utero-sacral ligament, the contralateral ovary (kissing ovaries) and/or the uterus. In about 12% of cases, the endometrioma is completely free from any adhesion (Fig 1) [7]. The surface of the affected ovary appears puckered with “powder-burn” spots. Opening of the endometrioma will reveal the characteristic chocolate-coloured fluid, which distinguishes it from simple haemorrhagic cysts. Inspection of the interior of the

endometrioma usually shows a fibrotic inner wall with foci of hypervascularized and haemorrhagic endometriotic lesions. Although, visual inspection of the cyst is remarkably sensitive (97%) and specific (95%) for the diagnosis of endometriomas, histological confirmation is always advisable to exclude any atypical or malignant changes [13,14].

Endometriomas and reproductive performance

Ovulation

Benaglia and co-workers scanned 70 women with unilateral endometriomas to assess the side of ovulation. They found that ovulation occurred from the affected ovary in 31% of the patients [15]. Although there are some limitations to this small study, the results suggest that the normal mechanisms of ovulation are impaired in ovaries containing endometriomas.

Spontaneous pregnancy

Ovarian endometriomas have been shown to be associated with increased rates of infertility, particularly if they are large (>3cm) or have ruptured [16]. In a recent longitudinal cohort study, we have found a significantly reduced spontaneous pregnancy rate (48%) in patients with untreated endometriomas seeking fertility compared with a group of healthy controls (Fig 2) [17]. As discussed above, this is thought to be due to a reduction in the amount of functional ovarian tissue available.

Endometriomas and ovarian reserve

The impact of untreated endometriomas on ovarian reserve is unclear. On one hand, some markers of ovarian reserve seem to be reduced such as follicular density on histological assessment, antral follicle count on ultrasound scan and ovarian responsiveness to exogenous stimulation. On the other hand, circulating Anti-Müllerian Hormone, which is considered an accurate marker of ovarian reserve, seems to be unaltered in the presence of endometriomas.

Follicular dynamics

As mentioned above, several studies have consistently reported reduced follicular density, inhibited follicular maturation and impaired vascular flow in the ovarian tissues surrounding the endometrioma [8,18,19]. Interestingly, these changes are not seen in other types of benign ovarian cysts [9]. Therefore, the adverse histological changes associated with endometriomas are unlikely to be due to a mechanical effect. Although, the mechanism of this damage is not well understood, it could be due to inflammatory response to the endometriosis or due to the toxic effect of the contents of the endometrioma [20,9].

Antral follicle count (AFC)

Almog and co-workers assessed the AFC in 273 women with benign unilateral cysts, of which 53 were endometriomas. They reported a significant reduction of the AFC in ovaries affected by endometriomas compared with the contra-lateral normal ovaries and with ovaries affected by other types of benign cysts including functional, dermoid and multi-loculated cysts, which showed normal AFC [21]. However, it is important to note that the accuracy of AFC assessment is significantly impaired in the presence of ovarian cysts.

Anti-Müllerian Hormone (AMH)

A recent study has compared circulating AMH in 313 women with endometriosis (including 95 with endometriomas) vs. 413 healthy controls [22]. The authors reported no differences in serum AMH levels between patients and controls (endometriosis vs. endometrioma vs. no disease).

Response to controlled ovarian hyperstimulation

The literature data on the impact of endometriomas on ovarian responsiveness to controlled ovarian hyperstimulation (COH) are conflicting. One study involving 36 patients with

unilateral endometriomas undergoing IVF reported a 25% reduction in the number of recruited follicles in the affected ovary compared to the contralateral normal ovary. The effect was more marked in women with large or multiple endometriomas [23]. However, a more recent study involving 81 women with unilateral endometriomas undergoing IVF found endometriomas to have no effect on the number of oocytes retrieved from the affected ovary [24].

Management of ovarian endometrioma

Management strategy

The natural history of untreated endometriomas remains largely unknown due to lack of any longitudinal studies following up untreated endometriomas. Management of endometriomas should be individualised depending on each patient's circumstances [25]. Treatment options include expectant management, non-hormonal (pain killers) therapy, hormonal suppression and surgery.

Asymptomatic endometriomas smaller than 8 cm in young women not seeking fertility could be managed expectantly. On the other hand, endometriomas larger than 8 cm and/or those in older (≥ 45 years) or post-menopausal women should be removed surgically due to the known risk of malignant transformation [80].

Symptomatic endometriomas smaller than 3 cm, could be offered hormonal or surgical treatment. On the other hand, surgery remains the only effective treatment for symptomatic endometriomas > 3 cm in diameter [26,27].. Currently, there are no published data on the effect of medical treatment, either hormonal suppression or pain killers, on symptomatic endometriomas.

Hormonal therapy

Endometriomas smaller than 3cm in diameter may temporarily shrink by up to 50% in

response to hormonal suppression using danazol or Gonadotrophin Releasing Hormone (GnRH) analogues [28]. However, the endometrioma usually re-grows shortly after discontinuation of therapy [29]. In addition, hormonal suppression seems to offer no benefit as an adjuvant therapy with surgery for endometriomas either pre-operatively (to shrink the endometrioma) or post-operatively (to prevent recurrence) [30]. Furthermore, pre-operative GnRH analogue therapy seems to result in fibrosis of the endometrioma capsule, thereby increasing the difficulty of surgery [31].

Surgical treatment

Surgery is widely accepted as the only effective treatment for symptomatic endometriomas with high rates of pain improvement [27, 29, 32]. It is usually performed to alleviate pain, prepare for fertility treatment or to avoid cyst complications such as rupture, torsion or rarely malignant transformation [33,34]. Recurrence of endometriomas after surgery remains a significant concern for patients and clinicians [35-37].

Management of endometriomas in sub-fertile patients

Surgery for endometriomas ≤ 8 cm with minimal or no symptoms prior to IVF is controversial. Whilst some Gynaecologists offer surgery, others prefer the expectant approach. Advocates of surgery claim that excision or ablation of the cyst improves ovarian responsiveness to COH, facilitates access to the follicles during oocyte retrieval and avoids inadvertent insertion of the needle into an endometrioma with possible subsequent abscess formation [38-44]. On the other hand, advocates of expectant management claim that surgery could cause damage to ovarian function, which could compromise the outcome of IVF. Furthermore, the risk of abscess formation in patients with untreated endometriomas seems negligible. This is supported by Benaglia and co-workers who reported 0% infection rate in 119 patients with endometrioma undergoing 189 oocyte retrieval cycles from the affected ovary [45].

In 2005, ESHRE issued guidelines for the management of endometriosis recommending laparoscopic ovarian cystectomy for patients with endometriomas ≥ 4 cm who are scheduled for IVF. However, in 2013 with the emergence of new evidence, ESHRE published a new set of guidelines recommending clinicians only to consider cystectomy for endometriomas > 3 cm prior to IVF if necessary to improve pelvic pain or to facilitate access to the follicles during oocyte retrieval. In both sets of guidelines, ESHRE recommends that clinicians counsel women with endometrioma regarding the risks of reduced ovarian function after surgery and the possible loss of the ovary. The decision to proceed with surgery should be considered carefully if the woman has had previous ovarian surgery.

A survey amongst 107 ESHRE members in 2010 showed the majority (79%) to adhere to the 2005 guidelines, with cystectomy being the preferred procedure for endometriomas prior to IVF [46]. More recently, we have conducted a national survey focused on current UK practice in women with endometriomas undergoing IVF. A total of 388 UK gynaecologists completed the survey. We found that 95% of surgeons offer surgery for endometriomas in women undergoing ART, either on the basis of the size of the endometrioma (51.4%), the presence of symptoms (16.2%), the presence of multiple/bilateral endometriomas (1.7%), regardless of the size and symptoms (18.8%) or only to women undergoing IVF (6.1%) (Fig 3). Excision was the most common surgical modality (68%), followed by ablation (25%) [47].

From these two surveys, it seems that surgery for endometriomas is widely practiced despite the lack of good evidence of benefits to IVF treatment. Furthermore, new emerging evidence suggests that surgical treatment of endometriomas prior to ART does not seem to improve treatment outcomes and may compromise ovarian reserve (see below).

Surgical techniques

A laparoscopic approach, with its well established advantages, should be the preferred choice rather than laparotomy for endometrioma surgery whenever possible. Compared to laparotomy, laparoscopy gives a magnified view of the disease, improves precision of treatment, minimises blood loss, allows quicker recovery and reduces postoperative adhesion formation [48-50].

The optimal surgery for endometriomas is controversial. The initial step invariably includes complete mobilization of the affected ovary by lysis of the peri-ovarian adhesions. The endometrioma is then widely opened, drained and irrigated to clear all the chocolate material. The interior wall is inspected for evidence of endometriosis and to exclude any suspicious looking areas. Whilst some surgeons take a more conservative approach by just ablating the visible endometriotic tissue (using diathermy or laser) on the interior of the endometrioma, others (including the author of this chapter) prefer to strip off the cyst wall from the ovarian tissue [51,52]. After removal of the cyst wall, the ovary is carefully inspected and bleeding points are secured with bipolar electrocoagulation until good homeostasis is achieved. There is usually no need to reconstruct the ovary after either treatment. Whichever approach is taken, a biopsy has to be taken from the endometrioma to exclude malignancy. There is a consensus that just draining and irrigating the endometrioma (cystectomy) is not enough and reformation of the chocolate cyst is almost inevitable [53-55].

Recurrence of endometrioma after surgery

Recurrence rates of 10-30% have been reported at 12-48 months after excision of endometriomas [56-61]. A recent Cochrane review [62], based on two RCTs [63,64] reported a significantly lower recurrence rate at 12-24 months follow-up after excision compared to ablation surgery. However, a recent long-term follow-up study showed similar recurrence rates for the two modalities at five-year follow up [65]. Interestingly, it appears that pregnancy after

endometrioma surgery is protective against recurrence of the cysts [37,59].

Ablation versus excision

Although, the debate over ablation *vs.* cystectomy remains unresolved, recent national and European surveys have revealed that the majority of gynaecologists seem to favour the excision approach [46,47]. Advocates of cystectomy argue that it minimizes the risk of recurrence and may result in higher spontaneous pregnancy rates [62]. Advocates of the conservative approach claim that the cyst wall consists of normal ovarian tissue, which if removed could potentially compromise the ovarian reserve due to the significant loss of follicles. Furthermore, cystectomy has been associated with concomitant excision of normal ovarian tissue resulting in further loss of ovarian reserve [8,66,67]. They also claim that ablation offers several other advantages such as reduction of operative time, minimisation of blood loss and reduction of the risk of postoperative adhesion formation. On the other hand, advocates of excision argue that ablation is associated with higher recurrence rates. In addition, ablation could cause significant thermal damage to normal surrounding ovarian tissues, with subsequent loss of ovarian reserve [68, 69].

Surgery for endometriomas and ovarian reserve

Impact of surgery on circulating AMH

Short- to medium- term effects on AMH

Several prospective cohort studies involving patients undergoing surgery for endometriomas have consistently reported a significant postoperative fall in serum AMH levels. Circulating AMH has also been shown to fall after surgery for other types of benign ovarian cysts, but to a much less extent compared to surgery for endometriomas [70,71].

We have recently published a systematic review and meta-analysis of eight prospective cohort studies investigating changes of circulating AMH in 237 patients undergoing surgery for endometriomas [72]. The results showed a statistically significant fall in serum AMH concentration after ovarian cystectomy (weighted mean difference [WMD] 1.13 ng/ml; 95% confidence interval (CI), 0.37-1.88), but heterogeneity was high. The significant fall in circulating AMH persisted (WMD, 1.52 ng/ml, 95% CI, 1.04 – 2.0) after improvement of heterogeneity by sensitivity analysis of studies involving patients with normal preoperative circulating AMH (≥ 3.1 ng/ml). We have therefore concluded that excision of endometrioma seems to cause about 25% reduction of circulating AMH. It is important to note that all the studies included in the analyses had a short follow-up period, typically one to three months after surgery.

Long- term effect

Until recently, there have been no studies addressing the long-term impact of surgery for endometriomas on ovarian reserve. One of the short-term follow-up studies reported a 65% recovery in serum AMH levels three months after laparoscopic ovarian cystectomy. However, the findings of this study were not specific to endometriomas as other types of benign ovarian cysts were also included.

We have recently conducted a longitudinal long-term follow up study investigating the serum AMH levels up to nine years after endometrioma surgery (unpublished data). The study included 50 patients with previous endometrioma surgery and 50 age- and weight-matched healthy controls without any previous ovarian surgery. Serum AMH levels were compared between the study and control groups as well as between subgroups of study patients undergoing different types of surgery. We found a significantly ($p=0.044$) lower median [quartile] serum AMH concentration (0.31 [0.00-0.77]) in patients (aged ≤ 42) with previous

endometrioma surgery compared to that (0.52 [0.26-1.54] ng/ml) of the control group. Further sub-analysis revealed that neither the type of surgery (excision, ablation, oophorectomy or drainage) nor the number of surgical episodes seems to influence the long-term changes in serum AMH levels.

Impact of surgery on AFC

Data on the impact of endometrioma surgery on AFC are conflicting. Whilst, several short-term studies have reported a significant post-operative reduction of AFC [73-76], others have revealed either no change [77] or an increase in the AFC [78].

Impact of surgery on ovarian response to COH

Ovarian response to COH during IVF is widely used as the best marker for ovarian reserve. However, the accuracy of this method may be compromised by several factors e.g. the operator's skill, variation in stimulation protocols and the threshold follicle size for ovum retrieval [79].

A plethora of published studies have looked at ovarian responsiveness to COH in ART cycles following surgery for endometriomas. Overall, the data from these studies are conflicting, although, the majority have reported a negative effect of surgery (mainly excision). These studies can be divided into three groups according to the control subjects used for comparison as detailed below.

The first group of studies compared ovarian response to COH in patients with surgically treated endometriomas vs. a control group of patients with untreated endometriomas. The majority of these studies reported longer stimulation periods, greater FSH requirements, lower serum oestradiol concentrations and fewer mature oocytes retrieved in the surgically treated group [80-82]. However, one study reported no difference in length of stimulation and FSH

requirements and showed that higher levels of oestradiol were obtained in the treated group [83]. A recent meta-analysis [84] summarising the results of five retrospective studies revealed no significant effect of endometrioma surgery on peak serum E2 levels, number of retrieved oocytes, number of utilised gonadotrophin ampoules and number of embryos available for transfer.

The second group of studies have compared ovarian response in the surgically treated ovaries *vs.* the contra-lateral normal ovaries. The majority of these studies have shown a reduced number of recruited follicles and retrieved oocytes in the treated ovary [85-91]. However, a few other reports have shown no difference in response to ovarian stimulation between the operated and contra-lateral normal ovary [92-94].

Finally, a third group of studies compared women with excised endometriomas *vs.* a control group of women without endometriomas. The majority of these studies reported higher requirement for FSH, lower peak serum E2 levels, reduced number of recruited follicles and number of retrieved oocytes/embryos in the patients with surgically treated endometriomas [83,91,95-101]. Some other studies have shown no difference in the two groups with regards to the above parameters [93,103,104-107].

Premature ovarian failure

One study involving 103 patients undergoing surgery for unilateral endometrioma reported an incidence of 0.9 % for premature ovarian failure [108], which is similar to general population (POF) [109]. Two studies reported a POF incidence of 2.4% and 2.5% in patients with previous surgery for bilateral endometriomas [108,110]. These figures, which seem significantly higher than a background incidence of 1% [109] in the general population, suggest that surgery for bilateral endometriomas increase the risk of POF.

Surgery for endometriomas and the onset of menopause

Currently, there are limited data on impact of endometrioma surgery on the age of menopause. In a recent longitudinal study, Coccia and co-workers followed up 239 patients for up to 14 years after excision of endometriomas (unilateral in 155 cases and bilateral in 84) [108]. They reported a significantly ($p=0.0001$) lower age at menopause for women ($n=32$) with previous endometrioma surgery (45.3 ± 4.3 years, range 32–52) compared to that of the reference population (51.2 ± 3.8 years, range 45–56) [111]. They also reported that women with previous bilateral cystectomy ($n=11$) were significantly ($p=0.003$) younger (42.1 ± 5.1 years) at menopause than patients ($n=21$) with history of unilateral endometrioma excision (47.1 ± 3.5 years). Interestingly, there was no statistically significant difference in the age of menopause between patients with previous excision of bilateral endometriomas (42.1 ± 5.1 years) compared to endometriosis patients who had no ovarian disease (45.1 ± 3.0 years).

Mechanism of damage to ovarian reserve

As discussed above, the presence of untreated endometriomas seems to cause some damage to ovarian reserve. Surgery appears to further damage the already compromised ovarian reserve as evidenced by the postoperative fall of circulating AMH. This is likely to be either due to inadvertent removal of normal ovarian tissue during cystectomy or to thermal destruction to surrounding ovarian tissue during ablation surgery. The extent of surgical contribution to the loss of ovarian reserve remains uncertain.

Surgery for endometriomas and reproductive function

Short term effects

Spontaneous ovulation

Few studies have reported a marked reduction in spontaneous ovulation rates after surgery for ovarian endometriomas. Loh and co-workers monitored ovulation in 11 natural cycles after

excision of unilateral endometriomas in women under the age of 35. They reported that ovulation occurred only in the untreated ovaries [94]. Another study reported a significant ($p=0.01$) reduction of ovulation rate from $34.3\pm6.6\%$ before excision of a unilateral endometrioma to $16.9\pm4.5\%$ postoperatively [112].

Spontaneous pregnancy

Pregnancy rates of 23-67% have been reported during follow-up periods of 24 – 48 months after laparoscopic surgery for endometriomas [35, 37, 48-50,, 56, 63, 64, 112-115]. Elsheikh and Co-workers analysed cumulative pregnancy rates at different times after excision of endometriomas ($\geq 3\text{cm}$) [114]. They reported pregnancy rates of 25%, 40%, 50% and 53% at 6, 12, 18 and 24 months after surgery respectively. All the above data should, however, be interpreted with caution as most of these studies are retrospective with significant selection and publication bias. Furthermore, many studies had high rates of loss to follow-up and did not analyse important data such as the number and laterality of the endometriomas.

A recent review summarising published studies reported similar pregnancy rates following different surgical techniques for endometriomas (excision or ablation) using different energy modalities [116]. For untreated endometriomas, the review reported a 10% cumulative pregnancy rate at 24 months, which was increased to ~50% after laser ablation, with the majority of the pregnancies occurring within the first ten months. However, the authors of the review pointed out that there was a wide variation in the criteria used to select patients and in the way results were reported.

A Cochrane systematic review including two randomised trials comparing laparoscopic excision *vs.* ablation of endometriomas reported higher spontaneous pregnancy rates after excision (OR 5.12, CI 2.04-13.29) [62].

Long-term effects

In a recent long-term follow-up study involving 38 women seeking fertility after endometrioma surgery, we have reported a spontaneous pregnancy rate of 50% during a nine-year follow-up period [17] (Fig 2). This was not significantly different from a pre-operative spontaneous pregnancy rate of 48% in the same group of patients. These rates were significantly lower ($p = 0.0001$) than the 98% long-term spontaneous pregnancy rate in a control group of age- and weight-matched healthy controls. We have therefore concluded that endometriomas per se appear to be the main cause of the compromised reproductive performance, with little or no contribution from surgery. These results are consistent with a previous study by Shimizu and co-workers who reported a long-term spontaneous pregnancy rate of 49% amongst 45 subfertile women who underwent KTP laser ablation of endometriomas [117].

ART outcome

Several studies have consistently reported that surgical treatment of endometriomas before ART neither improves nor worsens the pregnancy rates. In a meta-analysis by Tsoumpou and co-workers, no differences were found in pregnancy rates following IVF between patients who had ovarian cystectomy/ablation vs. women with untreated endometriomas [84]. These findings are supported by a recent Cochrane systematic review, which reported that aspiration/excision of endometrioma did not improve the pregnancy rates during IVF [118].

Gupta and co-workers reviewed all studies published between 1985 and 2005 investigating the outcomes of ART after surgery (aspiration/excision) for ovarian endometriomas [119]. They reported that although there was a reduction in the number of growing follicles and retrieved oocytes following endometrioma surgery, the pregnancy rates were no different from patients with untreated endometriomas. A study by Ragni and co-workers reported a marked reduction (~50%) in the number of dominant follicles, retrieved oocytes and created embryos from the surgically treated ovary compared to the normal contra-lateral ovary. However, there was no

difference in fertilisation rates between oocytes from the two ovaries. They explained that these results suggest that the damage to ovarian reserve is quantitative rather than qualitative [89].

Data on the impact of surgery for bilateral ovarian endometrioma on pregnancy rates during IVF are very limited and conflicting. Esinler and co-workers reported that although the number of oocytes obtained was much lower following bilateral ovarian surgery group compared to unilateral surgery, the number of embryos obtained and the clinical pregnancy rates were similar [96]. On the other hand, another study found significantly impaired IVF pregnancy rates in women with previous bilateral endometrioma surgery compared to women without previous ovarian surgery [97].

Conclusions

Endometriomas, which are commonly encountered in women presenting with subfertility, usually represent a dilemma to the Reproductive Specialist. Surgery remains the only effective treatment for endometriomas larger than three cm in diameter. National and international surveys have revealed that the majority of Gynaecologists and Reproductive specialists offer surgery for endometriomas in subfertile patients before fertility treatment. This is despite evidence that endometrioma surgery does not improve success rates of IVF. Furthermore, increasing evidence suggests that surgery for endometriomas significantly damages ovarian reserve and compromises ovarian responsiveness to COH during IVF. It is therefore reasonable to recommend that endometrioma surgery before IVF should only be considered in patients with marked symptoms or with vary large endometriomas, which could interfere with oocyte retrieval.

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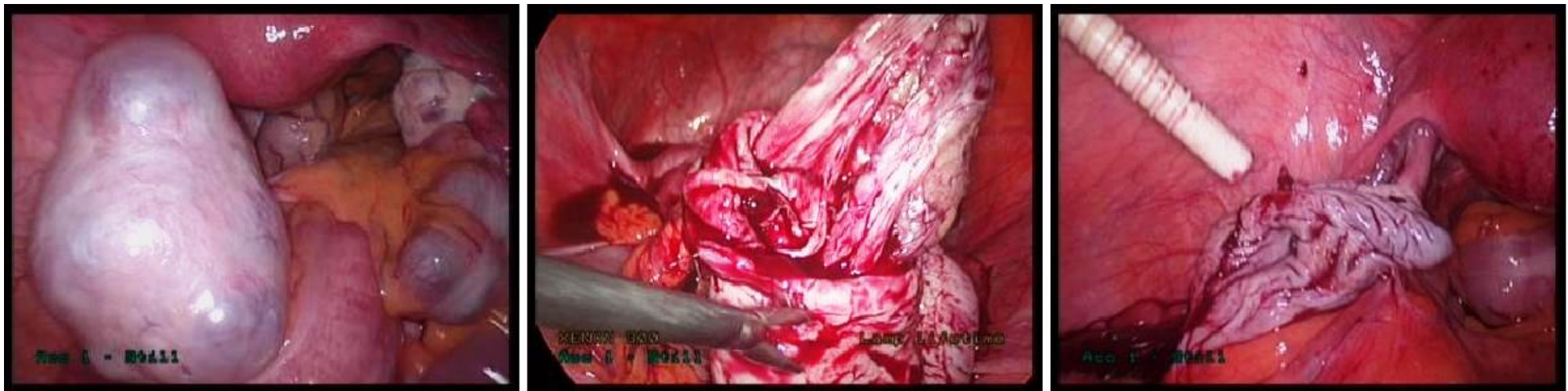
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Figure captions

Figure 1

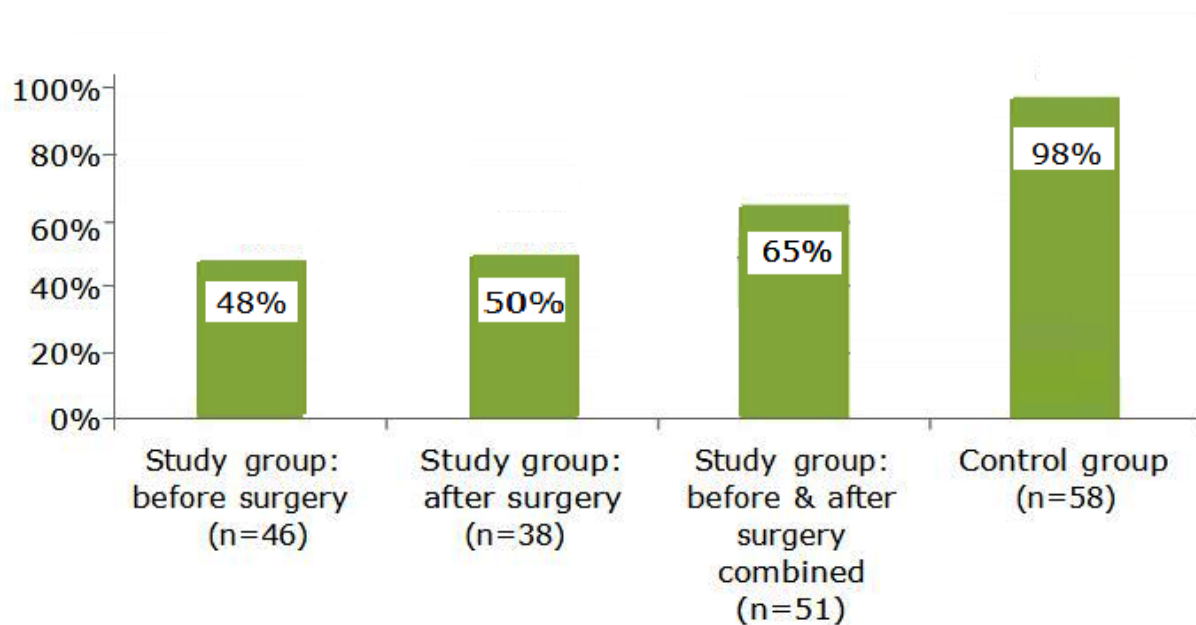
Excision of large ovarian endometrioma



Intact ovarian endometrioma (left), stripping off the cyst wall (middle), separated cyst wall (right)

Figure 2

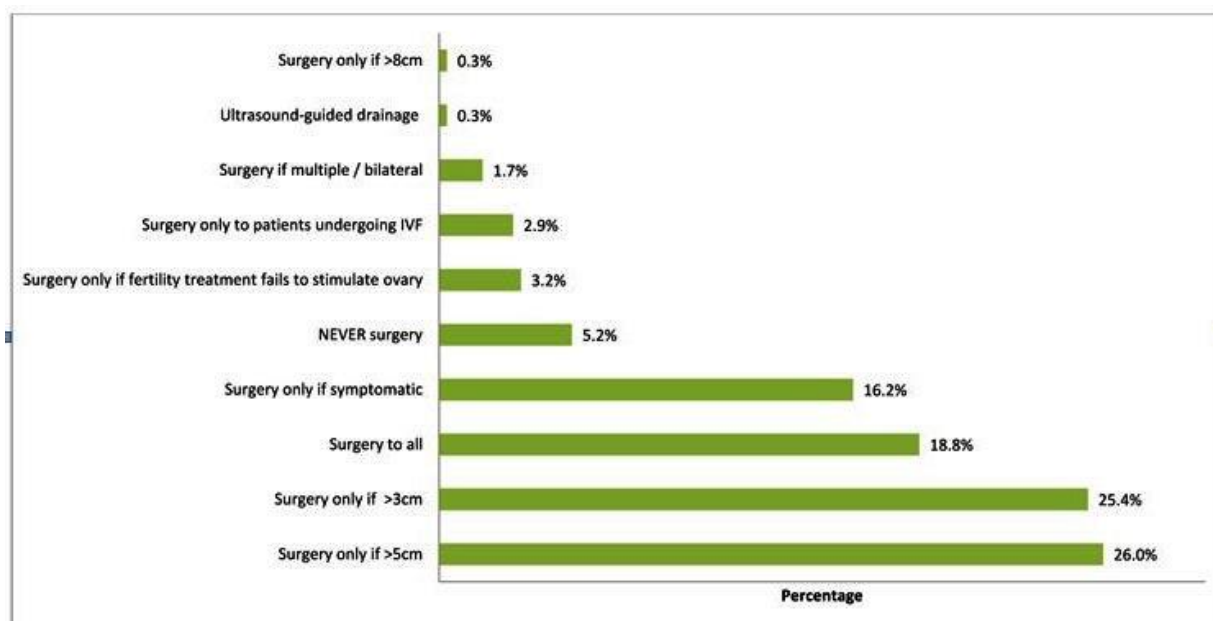
Spontaneous pregnancy rates in women surgery for endometriomas



Pregnancy rates before and after surgery compared with a control group of age- and weight-matched healthy women

Figure 3

National survey of UK practice in subfertile women with ovarian endometriomas undergoing IVF



Percentages of gynaecologists offering different types of surgery for endometriomas