

1 **Recommendations for Surgical Treatment of Endometriosis: Part 1: Ovarian** 2 **Endometrioma**

3 **by the European Society for Gynaecological Endoscopy (ESGE), the European Society of**
4 **Human Reproduction and Embryology (ESHRE), and the World Endometriosis Society (WES)**

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9 **Abstract**

10 Endometriomas are a commonly diagnosed form of endometriosis due to the relative ease
11 and accuracy of ultrasound diagnosis. They frequently present a clinical dilemma as to
12 whether and how to treat them when found during imaging. Previously published guidelines
13 have provided recommendations without technical details on the management of
14 endometriosis based on the best available evidence. This document provides
15 recommendations covering technical aspects of different methods of surgery for
16 endometriomas in women of reproductive age.

17 **Introduction**

18 Endometriosis is a common inflammatory condition affecting women mostly during their
19 reproductive years (Burney and Giudice, 2012). Endometriosis-associated symptoms include
20 abdominal pain, painful periods and infertility. As such, endometriosis not only has a
21 significant impact on the lives of millions of women and their families, it is also associated
22 with an enormous socioeconomic burden on society (Simoens *et al.*, 2012).

23 It is generally accepted that endometriosis presents in three different entities which are
24 frequently found together: peritoneal lesions, rectovaginal deep endometriosis and ovarian
25 endometriotic cysts (endometriomas) (Nisolle and Donnez, 1997). Endometriomas are
26 probably the most commonly diagnosed form of endometriosis due to the relative ease and
27 accuracy of ultrasound diagnosis. Although their exact prevalence and incidence are not
28 known, they have been reported to be found in 17-44% of women with endometriosis
29 (Busacca and Vignali, 2003). The presence of ovarian endometriomas has been reported a

30 marker for deep endometriosis (Redwine, 1999) and multifocal deep vaginal, intestinal, and
31 ureteric lesions (Chapron *et al.*, 2009).

32 The pathogenesis of endometriomas remains contentious with a variety of theories proffered:

- 33 • Invagination and subsequent collection of menstrual debris from endometriotic implants,
34 which are located on the ovarian surface and adherent peritoneum (Hughesdon, 1957,
35 Brosens *et al.*, 1994);
- 36 • Colonisation of functional ovarian cysts by endometriotic cells (Nezhat *et al.*, 1992);
- 37 • Coelomic metaplasia of the invaginated epithelial inclusions (Nisolle and Donnez, 1997).

38 Endometriomas frequently present a clinical dilemma as to whether and how to treat them
39 when found during imaging. Overall, currently available treatment options for all types of
40 endometriosis include oestrogen suppression, progestins and surgery (Giudice, 2010).
41 Surgical treatment is the mainstay of endometrioma management, when treatment is
42 required, aimed at the elimination of endometriotic tissue, to provide sufficient tissue for
43 histological assessment and to preserve maximum amount of normal ovarian tissue (where
44 fertility is desired and /or risk of menopause is to be avoided). It has been shown that surgical
45 treatment of endometriotic cysts is associated with the unintentional removal or destruction
46 of ovarian follicles which can be objectified by a measurable post-operative reduction in
47 serum Anti Müllerian Hormone (AMH) levels or antral follicle count on ultrasound (Somigliana
48 *et al.*, 2012, Ata and Uncu, 2015).

49 Previously published guidelines have provided recommendations on the management of
50 endometriosis based on the best available evidence (Johnson *et al.*, 2013, Dunselman *et al.*,
51 2014, Ulrich *et al.*, 2014). However, these guidelines were not intended to provide
52 recommendations on the technical details of surgical procedures. Therefore, the European
53 Society for Gynaecological Endoscopy (ESGE), the European Society of Human Reproduction
54 and Embryology (ESHRE), and the World Endometriosis Society (WES) have formed a working
55 group to provide a series of recommendations on the practical aspects of the different
56 surgical procedures for the treatment of endometriosis. Due to the scarcity of evidence, these
57 recommendations are based on expert opinion on best clinical practice. The techniques
58 described here may have different levels of efficacy in achieving individualised management
59 goals, hence background factors such as the woman's age, her symptoms (pain, fertility),

60 primary aim of the treatment (eliminating/improving pain, improving fertility, ruling out
61 malignancy), ovarian reserve, unilaterality/bilaterality, number and size(s) of the cyst(s), and
62 history of previous surgery (i.e. recurrence) will need to be taken into consideration when a
63 decision for surgery is made and the type of technique is chosen.

64 This document is the first in a series of recommendations covering technical aspects of
65 different methods of surgery for different entities of endometriosis and will focus on
66 endometriomas in women of reproductive age; recommendations dealing with other forms
67 of endometriosis will be addressed in separate subsequent publications. These
68 recommendations should be read in conjunction with the aforementioned evidence based
69 guidelines on the clinical management of endometriosis.

70 **Anatomical considerations**

71 Endometriomas are frequently densely stuck to surrounding structures such as the ipsilateral
72 pelvic side wall, the Fallopian tube, posterolateral uterus, and the bowel. As part of the pre-
73 operative planning the surgeon should consider the possibility of hydroureters and
74 asymptomatic hydronephrosis. The ureter enters the small pelvis by crossing the iliac vessels
75 and then courses anteriorly in the peritoneum of the pelvic side wall directly under the ovary.
76 Ovaries with endometriotic cysts are usually adherent to the ovarian fossa where the ureter
77 may also be involved in the disease. Occasionally, ureteric obstruction can be seen at this
78 point. This will need to be taken into account during surgery.

79 The ovary receives its blood supply from two sources: i) the ovarian artery, which arises from
80 the abdominal aorta below the renal artery and approaches the ovary through the suspensory
81 ovarian (infundibulopelvic) ligament from lateral, ii) an anastomosis between the ovarian
82 artery and the ascending branch of the uterine artery/tubal artery in the ovarian ligament.
83 Thus, the larger intra-ovarian vessels are found in the antero-lateral aspect of the ovary, the
84 hilum at the insertion of the mesovarium. The surgeon needs to be aware of this and, in
85 particular for endometrioma involving that area, has to possess the skills to avoid excessive
86 bleeding which may lead to destruction of healthy ovarian tissue through cauterisation and
87 disruption of ovarian blood supply.

88 **General recommendations**

- 89 • Assess the possible extent of disease, and the size, number and location (unilateral or
90 bilateral) of the ovarian endometriotic cysts before surgery is performed. Meticulous pre-
91 operative planning is part of the procedure and should include:
 - 92 ○ a bimanual examination to check adnexal masses and endometriotic nodules,
 - 93 ○ pelvic ultrasound (or magnetic resonance imaging (MRI)) to determine
 - 94 ■ the number, size, location (unilateral or bilateral) of the cysts,
 - 95 ■ presence of endometriotic nodules,
 - 96 ■ extent of Pouch of Douglas obliteration,
 - 97 ■ ovarian reserve tests when future fertility is a concern.
- 98 • Handle the ovarian tissue as atraumatically as possible.
- 99 • Be aware of the risk of ovarian damage in endometrioma surgery.
- 100 • Refer the woman to a centre of expertise where the necessary surgical expertise is
101 available, if the surgery cannot be performed or completed safely (Johnson *et al.*, 2013).
- 102 • Consider using anti-adhesion measures such as oxidised regenerated cellulose,
103 polytetrafluoroethylene surgical membrane, and hyaluronic acid products, as these may
104 be beneficial in reducing postoperative adhesion formation (Dunselman *et al.*, 2014,
105 Ulrich *et al.*, 2014).
- 106 • Obtain appropriate consent from the woman before surgery. She should be fully informed
107 of all possible risks associated with the surgical procedure, including general risks of
108 laparoscopic surgery, potential reduced ovarian reserve, and the, albeit small, risk of loss
109 of the ovary and consequences thereof.
- 110 • Assess serum tumour markers in case of suspicion of malignancy at imaging as may be
111 helpful to exclude malignancy. The risk of unexpected malignancy is small, but may need
112 to be taken into consideration.

113 **Initial stages of laparoscopic surgery for ovarian endometriomas**

- 114 • Inspect the pelvic organs, upper abdomen, and the appendix.
- 115 • Obtain peritoneal washings and biopsies before mobilising the ovary with endometrioma in the
116 presence of clinically relevant ascites, suspicious peritoneal lesions, or ovarian cysts of abnormal

117 appearance. However, for a presumed endometrioma, peritoneal washing is not routinely
118 recommended.

- 119 • Consider using three laparoscopic working ports as these may facilitate surgery.
- 120 • Separate the ovary with endometrioma from the pelvic side wall, where it is usually
121 adherent to, by adhesiolysis. This usually results in drainage of endometrioma. It is
122 important to visualise the ureter at this stage to avoid damage, as the ovary may be
123 adherent to it. In the presence of dense adherence, start the surgery by dissecting the
124 ureter from the healthy tissue proximal to the adherence point. Endometriotic tissue on
125 the pelvic side wall will need to be removed as well (this will be covered in the
126 recommendation on the treatment of peritoneal endometriosis).
- 127 • Where the cyst ruptures, extend the opening in the cyst wall adequately to expose the
128 cyst cavity. Multiple incisions and excessive opening should be avoided to prevent
129 damaging the ovarian cortex, functional ovarian tissue, and the hilum. Where feasible, the
130 cyst may be turned inside out to facilitate further treatment.
- 131 • When the ovary is not adherent, the incision should ideally be over the thinnest part of
132 the ovarian endometriotic surface or, if this is not visible, on the antimesenteric border.
- 133 • Irrigate and inspect the cyst cavity to rule out malignancy. Any suspicious area should be
134 biopsied for histological confirmation of any diagnosis.
- 135 • If suspicious for malignancy, local guidelines for further management should be followed.
- 136 • Irrigate and aspirate thoroughly to check for haemostasis and to remove any remaining
137 cyst fluid or blood clots from the abdominal-pelvic cavity.

138 The following options are available for surgical treatment of ovarian endometrioma:

- 139 ○ cystectomy
- 140 ○ ablation by laser or by plasma energy, or
- 141 ○ electrocoagulation.

142 These methods, the combined technique and the two or three step approach are described
143 below (Dunselman *et al.*, 2014, Ulrich *et al.*, 2014).

144 **Principles of electrosurgery for endometrioma**

145 Electrosurgery is widely used for the treatment of ovarian endometriomas. Coagulation
146 modes with different techniques and electrodes lead to different voltage levels, including
147 modulation of high frequency (HF) current with soft coagulation, forced coagulation or spray
148 coagulation. These various application modes result in different effects on the target tissue
149 and cause different degree of tissue damage.

150 **Electrosurgery application**

151 The thickness of the capsule of an ovarian cyst can be up to 3.0 mm. It varies between cysts
152 but may also change within the same cyst. During the application of HF energy for destruction
153 of endometriotic lesion by thermal effect, it is difficult to assess the changes in the tissue.
154 Whilst the impact on superficial tissue may be visible by change of colour and vaporisation,
155 coagulation of deeper structures is more difficult to observe. Deep coagulation may destroy
156 primordial follicles and/or blood supply of the ovary, resulting in severe ovarian damage.

157 The surgeon needs to be aware of the exact HF effect of each instrument and various
158 application forms. Coagulation or vaporisation of the ovarian cyst should inactivate
159 endometriotic lesions superficially and respect the underlying tissue. Uncontrolled
160 application of heat may result in destruction of healthy tissue with severe consequences for
161 the ovarian function.

162 **Monopolar energy**

163 *Cutting current* is unmodulated alternating current and vaporizes or cuts the tissue for
164 superficial ablation and deeper coagulation effect. *Coagulation current* is modulated
165 alternating high voltage current and has a higher thermal spread, which leads to deeper
166 coagulation of the tissue. *Blended current* is a mixture of cutting and coagulation currents and
167 is generated by altering the time that the current is applied.

168 The more concentrated the energy, the greater is the thermodynamic effect. The density of
169 the current depends on the size of the electrode (a smaller electrode may require lower
170 power setting). Use of monopolar diathermy with low power setting and small contact surface
171 provides better control of the tissue effect.

172

173 **Argon beam coagulation (ABC)**

174 With this instrument ionized argon gas carries electrons from the electrode to the tissue. The
175 gas stream produces a monopolar tissue effect depending on the diameter of the beam and
176 the distance between the beam and the target. The tissue effect is similar to that achieved by
177 monopolar coagulation but allows treating wider superficial areas.

178 **Bipolar energy**

179 Bipolar diathermy is a very useful technique to coagulate endometriosis in a safer way than
180 monopolar diathermy. The current passes across the tissue between the two jaws of the
181 instrument. The tissue temperature could be up to 300 – 400°C at the point of maximum
182 current flow. The penetration into the tissue can be up to 10-12 mm depending on the power
183 setting and the application time.

184 **Cystectomy**

- 185 • After mobilisation of the ovary and drainage of the cyst, make an incision to reveal the
186 cleavage plane; this may be either on the edge of the cyst opening or a central incision,
187 which divides the cyst into two halves. With both types, the incision should be away from
188 the blood vessels in the hilum/meso-ovarium.
- 189 • To aid dissection and identification of the cyst wall, saline or diluted synthetic vasopressin
190 solution (0.1-1 unit/ml) may be injected under the cyst capsule. The diluted synthetic
191 vasopressin injection has the additional advantage of reduced bleeding during cyst
192 removal. Synthetic vasopressin is not available in all countries, and while rare, may cause
193 intraoperative cardiovascular complications including bradycardia and hypertension.
- 194 • In some cases, a cleavage plane may not be easily identified after the ovarian incision. In
195 such cases, it may be better to take a small part of the cyst wall for histological diagnosis
196 then use an ablation method rather than risking damage the ovary from persistent
197 attempt to perform cystectomy.
- 198 • Once the cleavage plane is identified, use gentle traction and counter-traction to dissect
199 the cyst capsule from the ovarian parenchyma. Traction and counter-traction may be
200 effective during the initial part of the dissection. Avoid use of excessive force to separate
201 a highly adherent cyst from the ovary as this will likely cause tearing of ovarian tissue,

202 excessive bleeding, need for coagulation or diathermy and thus further damage to normal
203 ovarian tissue.

- 204 • Careful identification of the cleavage plane and precise spot bipolar coagulation is the key
205 to achieve haemostasis, prevent unnecessary damage to healthy tissue and to avoid blind
206 or excessive diathermy.
- 207 • Ensure final haemostasis after complete removal of the cyst capsule. Bipolar coagulation,
208 suturing, or intraovarian haemostatic sealant agents may be used for this purpose. It is
209 important to avoid damaging major blood supply at the hilum coming in from the ovarian
210 and infundibulopelvic ligaments at this stage.
- 211 • After removal of large endometriomas, it may be necessary to reconstruct the ovary and
212 achieve haemostasis with monofilament sutures. For small endometriomas, suturing is
213 often not required as the ovarian opening usually approximates spontaneously. If a suture
214 is used, it should ideally be placed inside the ovary, as the exposed suture may be prone
215 to adhesion formation.
- 216 • Small cyst walls may be divided and retrieved directly through a port. Large cyst walls can
217 be removed in a specimen retrieval bag. Posterior colpotomy is very rarely used for
218 retrieval of endometriomas.

219 **Laser ablation**

- 220 • Ablate the entire inner surface of the cyst wall using the laser beam. The power setting
221 of 30-55 W for CO₂ laser beam and 6-10 W for CO₂ fibre (based on animal data) is usually
222 used. The laser should be on the ablate function to widen the beam (defocus or surgiscan).
223 The laser should be applied in a mode so that it can ablate the tissue while preserving the
224 underlying healthy tissue.
- 225 • Aim to vaporise the endometriotic cyst lining only until haemosiderin pigment stained
226 tissue is no longer visible (until the colour changes from reddish to yellow-white). The
227 entire depth of the cyst capsule does not need vaporisation, as endometriotic tissue is
228 present only superficially.
- 229 • Use intermittent irrigation to maintain good visibility and to remove carbon debris.
- 230 • Ensure the border of the cyst opening is completely vaporised.

231 Plasma energy ablation

- 232 • Ablate the entire inner surface of the cyst wall using plasma energy in coagulation mode
233 set at 10 to 40 , at a distance averaging 5 mm from the tip of the hand piece (Roman *et al.*,
234 2013).
- 235 • Aim to vaporise the endometriotic cyst lining only until haemosiderin pigment stained
236 tissue is no longer visible (until the colour changes from reddish to yellow-white). The
237 entire depth of the cyst capsule does not need vaporisation, as endometriotic tissue is
238 present only superficially.
- 239 • Take care to treat all areas and to ablate the edges of the invagination site.
- 240 • When cyst eversion is not feasible, the surgeon progressively exposes the cyst interior to
241 apply the plasma at an angle perpendicular to the inner surface of the cyst.

242 Electrocoagulation

- 243 • Coagulate the cyst lining systematically using bipolar forceps. The power setting depends
244 on the generator and type of forceps used, but 25-40W setting is frequently used. It is
245 advisable to start at a lower power setting and adjust it depending on the effectiveness of
246 coagulation achieved. The key point is to use very short coagulation times to minimise
247 ovarian tissue damage, as the depth of the destruction can be difficult to judge.
- 248 • Monopolar energy may be used in selected areas where there is fibrotic endometriotic
249 tissue located at the hilum. The power setting of 15-20W is frequently used.
- 250 • Tissue damage tends to be deeper than with laser and plasma energy ablation, hence the
251 ovary should be cooled frequently with irrigation fluid.

252 Combined technique

- 253 A combined technique using both excision and ablation can be used to prevent excessive
254 bleeding and ovarian tissue removal/damage from the ovarian hilum, particularly for larger
255 endometriomas.
- 256 • Open and drain the cyst followed by identification of the cleavage plane as described
257 before.

- 258 • Strip 80 to 90% of the cyst wall and perform a partial cystectomy, as described above, up
259 to the ovarian hilum. Laser, plasma energy, or bipolar can then be applied to treat the
260 remaining endometriotic tissue (10 to 20%).
- 261 • Suturing of the ovary may be considered to restore anatomy.

262 **Two or three step approach**

263 For large endometriomas, a two or three step procedure can be considered.

- 264 • The first step involves opening and draining the endometrioma as described in the initial
265 stages section.
- 266 • Inspect the cyst cavity and take a biopsy.
- 267 • Following this initial step, administer gonadotrophin releasing hormone agonist (GnRHa)
268 therapy for 3 months during which time the thickness of the cyst wall significantly
269 decreases, with atrophy and reduction in stromal vascularization of the cyst (Donnez *et*
270 *al.*, 1996).
- 271 • Complete the surgery with a second laparoscopy in the form of either cystectomy, CO₂
272 vaporisation, bipolar diathermy, or plasma ablation of the cyst wall lining.

273 Although women have to undergo two invasive procedures, the potential benefit is that this
274 may facilitate the management of larger ovarian endometriomas, reduce recurrence rates,
275 and limit decrease in ovarian reserve rates.

276 **Further considerations**

277 Laparotomy is rarely indicated for benign ovarian endometriomas, whatever the diameter of
278 the cyst and/or the associated adhesions (Johnson *et al.*, 2013). If the procedure is too difficult
279 to perform by laparoscopy, it is better to stop the procedure after the drainage of
280 endometriomas, prescribe GnRHa for 3 months, and re-operate 3 to 6 months later.
281 Alternatively, the woman may be referred to a centre with the necessary surgical expertise
282 (Johnson *et al.*, 2013).

283 Oophorectomy may be considered after careful discussion with the woman, particularly in
284 the presence of recurrent or large unilateral endometriomas, or suspicion of potential
285 malignancy. Informed consent, as described above, needs to be obtained in these cases.

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