14 Ovarian Cysts: Preoperative Evaluation and Laparoscopic Approach

William Kondo, Monica Tessmann Zomer, Nicolas Bourdel, and Michel Canis

Introduction

Benign ovarian tumors remain a common gynecologic problem. It is estimated that 5–10% of women in the United States will undergo a surgical procedure for an adnexal mass sometime during their lifetime [1, 2]. The prevalence of adnexal tumors in the general population is 0.17–5.9% in asymptomatic women and 7.1–12% in symptomatic women [3].

The management of an ovarian mass depends on the nature of the tumor, urgency of the presentation (e.g., ovarian torsion requires immediate intervention), and degree of suspicion for malignancy. The gynecologist must evaluate patient's symptoms, physical examination findings, imaging exam results, and serum tumor marker tests in order to decide whether the patient is a potential candidate for surgical approach [4].

W. Kondo (✉) · M. T. Zomer
Department of Gynecology, Sugisawa Medical Center, Curitiba, PR, Brazil

Department of Gynecology, Vita Batel Hospital, Curitiba, PR, Brazil

N. Bourdel · M. Canis
Department of Gynecologic Surgery, CHU Estaing, Clermont-Ferrand, France
e-mail: nbourdel@chu-clermontferrand.fr; mcanis@chu-clermontferrand.fr

Since the majority of adnexal masses are benign, the key point is to try to determine preoperatively whether the patient is at high risk for ovarian malignancy, in order to ensure proper management [1].

Today, laparoscopic surgery is considered to be the gold standard in the management of adnexal masses [5–7]. Adhesion prevention, better postoperative recovery, and good cosmetic outcomes are some of the important advantages of this surgical approach [8]. Disadvantages of the laparoscopic approach include steep surgeon learning curves and the need for special equipment, much of which is expensive [9].

The lack of a preoperative test that can definitively exclude malignancy makes surgical management of adnexal masses more complex. Important concerns remain about intraoperative rupture of an occult malignancy and subsequent risk of cancer dissemination [9]. Therefore, the surgeon should address every patient with adnexal mass as someone who is potentially facing a malignant neoplasm [4].

Patient's treatment success is based on the adequate preoperative work-up and the systematization of the surgical procedure. In this chapter, the authors review important topics on the preoperative assessment of women with ovarian tumors and describe different laparoscopic surgical techniques, step by step, in order to make them simple, understandable, and reproducible.

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Preoperative Assessment of an Ovarian Mass

The goal of the clinical evaluation of an ovarian mass is to determine both whether the mass is more likely to be malignant or benign and whether the mass can be removed by laparoscopy without any type of harm to the patient [4]. It has already been demonstrated that ovarian cancer patients treated by gynecologic oncologists have better outcomes than those treated by general gynecologists and general surgeons [10].

Important factors that should be taken into account include patient's age, symptoms, medical history, physical examination findings, imaging studies, and laboratory test results [4]. All these information must be considered at the same time so that the surgeon can propose an operative approach or an expectant management.

Of course, it is impossible to be absolutely sure about the nature of the cyst without having the pathological examination of it. Indeed, there are different clinical-sonographic scores and mathematical models reported in the literature to try to predict the risk of malignancy/benignity of an ovarian mass in the preoperative setting. All these scores and models seem very interesting in a theoretical point of view; however, in the practical approach, their sensitivity and specificity are very good in the experience of the groups that created them or in a specific sample of patients. Whenever used in other centers, their effectiveness is widely reduced [11, 12], meaning that most of them are not very well reproducible. Even using pelvic MRI, there is no great increase in the sensitivity and specificity of the preoperative investigation [13].

In 2010, the International Ovarian Tumor Analysis (IOTA) group showed that polytomous risk prediction for the diagnosis of ovarian cancer is feasible [14]. Mathematical models were developed to predict four categories of tumors: benign, borderline, primary ovarian cancer, and secondary metastatic cancer. This work focused on comparing mathematical algorithms. Recently, the same group [15] reported the ADNEX (Assessment of Different NEoplasis in the adneXa) model (www.iotagroup/adnexmodel/) as a potential tool to estimate the probability that an adnexal tumor is benign, borderline, stage I cancer, stage II–IV cancer, or secondary metastatic cancer. Nine variables were included in the model, including age, serum Ca-125 level, type of center, maximum diameter of the lesion, proportion of solid tissue, number of papillary projection, more than ten cyst locules, acoustic shadows, and ascites, and they stated that the ADNEX model has clear potential to optimize management of women with an adnexal tumor.

Anamnesis and Physical Examination

The woman's age is an important factor to be considered in the preoperative assessment of an ovarian mass. Malignant lesions are more likely to occur in postmenopausal than premenopausal women [16]. Irrespective of age, all women presenting with an adnexal mass should have a complete history and physical examination as well as laboratories and imaging exams [9].

The clinical examination will assess the patient's general condition and predict any difficulty in the laparoscopic approach, such as previous scar, obesity, etc. On physical examination, the surgeon should pay attention to the size, mobility, and consistency of the ovarian mass. Also, the possibility of extraovarian involvement may be considered in the presence of ascites, carcinomatosis, and lymphadenopathy.

Reproductive-aged women should be questioned about recent sexual history and use of any contraceptive method. A pregnancy test must be always obtained to exclude ectopic pregnancy or concomitant intrauterine pregnancy [9].

Ultrasound

Pelvic ultrasound is still a very important imaging exam in the evaluation of gynecologic patients. It is quick to perform and does not expose the patient to ionizing radiation; however, it is operator-dependent [17]. It may be performed transvaginally and complemented transabdominally whenever the size of the mass demands. The

examination report must be complete, thoroughly analyzing the cyst for intracystic content, presence of solid and/or liquid component, thickness of the cyst wall, presence of vegetations and/or septa, and presence of inner or outer vascularization, with evaluation of the vascularization pattern with Doppler sonography [18–20].

Benign adnexal masses have typical ultrasonographic features: low echogenicity, a thin cyst wall, unilocular (or, if septated, a thin septation), and absence of internal papillary excrescences [21].

The most important morphologic features on ultrasound that are of concern for malignancy include nonfatty solid (vascularized) tissue, thick septations, and papillary projections. Color Doppler ultrasound helps in the identification of solid, vascularized components within the mass [21].

Computed Tomography (CT) and Magnetic Resonance Imaging (MRI)

The CT scan has a limited role in the primary assessment of women with an adnexal mass due to its poor soft-tissue discrimination [4, 17]. Specifically in mature cystic teratomas, it may be useful to detect calcifications or macroscopic fat [17]. Nevertheless, if ovarian malignancy is present, CT scan can help in the evaluation of the extent of disease detecting lymphadenopathy, ascites, and metastatic disease [4, 17]. The main advantage of CT scan is that it is widely available and quick to perform [21].

On the other hand, MRI provides excellent tissue contrast resolution and characterization based on magnetic resonance properties of the tissues. Different imaging patterns may be seen in cystic and solid lesions as well as in those lesions with fat, hemorrhagic, mucinous, and fibotic contents [17]. The use of gadolinium-based contrast agents also allows for the evaluation of the lesion's vascularity and enhancement [21].

However, preoperative evaluation of an ovarian mass using pelvic/abdominal MRI should not be systematic. It can be indicated in bulky lesions (or when ultrasound does not allow the evaluation of the entire ovarian mass), in young patients (to try to plan the surgical approach in the preoperative setting, to evaluate the possibility of bilateral lesions, and to enable patient counseling about all fertility-sparing possibilities), and in ovarian endometrioma (to identify concomitant deep infiltrating endometriosis lesions) [22, 23].

Tumor Biomarkers

There are currently no approved laboratory tests for early detection of ovarian cancer [4]. Cancer antigen 125 (Ca-125) is the only serological biomarker in routine use for the management of women with epithelial ovarian/fallopian tube or primary serous peritoneal cancer [24]. Elevated concentrations of serum Ca-125 may be present in several benign gynecologic conditions (healthy premenopausal women during menses, pregnancy, ovarian cysts, endometriosis, adenomyosis, uterine leiomyomas, and pelvic inflammatory disease) and in several nonmalignant nongynecological diseases (peritoneal, pleural, and musculoskeletal inflammatory disorders and liver, renal, and cardiac disease) [25].

In women with epithelial ovarian cancer, serum levels of Ca-125 are elevated in 50–60% of patients with stage I ovarian cancer, 80–90% in stage II, and greater than 90% in stages III and IV [26, 27]. However, Ca-125 is not expressed in patients with pure mucinous tumors. Carcinoembryonic antigen and Ca-19-9 are better markers in these patients [28, 29].

Guidelines from the United Kingdom [30] and the United States [31] recommend that alpha-fetoprotein and hCG should be measured in all women under 40 years old with a complex ovarian mass because of the possibility of germ cell tumors. Guidelines from the United States also recommend measuring LDH in these women.

Why Is Laparoscopy the Best Surgical Approach?

The role of laparoscopic surgery in the management of adnexal masses has already been demonstrated in prospective randomized studies [6, 7].

The major concerns with this approach have been related to the rate of malignancy encountered, the risk of tumor rupture and upstaging, the incidence of port-site metastasis [4], fertility repercussions in the case of endometriomas [32], and risk of peritonitis in case of spillage in dermoid cysts [33]. Another important issue is that the learning curve for laparoscopic surgery seems to be longer than expected. Each surgeon has his own learning curve depending on his surgical experience and manual abilities. Experts in the management of adnexal masses probably have developed many tips and tricks that would help beginners, what should be reported and taught as often as possible [5].

The primary approach for an ovarian mass should be laparoscopic due to many reasons. First, preoperative work-up for an ovarian mass is generally effective in stratifying masses into those likely to be benign or malignant, but a malignant diagnosis can only be confirmed with pathology [9]. Regardless of the surgeon's experience level, when the surgeon tries to choose the type of incision for the surgery only based on the preoperative assessment, he may elect a totally inadequate surgical access route (Pfannenstiel incision) for the treatment of an ovarian cancer in up to 23% of the cases and a midline incision for the treatment of a benign ovarian cyst in up to 21% of the cases [11]. The systematic use of laparoscopy allows the surgeon to adapt the type of incision to the specific type of ovarian pathology with precision.

Second, the survival of ovarian cancer patients depends on the surgeon specialty [10, 34, 35]. Women affected by ovarian cancer should be systematically operated by gynecologic oncologists in order to achieve better outcomes [10]. However, it is not possible to refer all patients with suspicious ovarian masses to a gynecologic oncology center. In fact, all gynecologist surgeons could perform a laparoscopy to confirm or rule out malignancy if they are able to follow the basic rules to approach a suspicious mass [36]. Whenever malignancy is confirmed, the patient could be referred to a gynecologic oncologist for an early reintervention, what is completely feasible after the primary laparoscopic procedure. In the prospective study conducted in Clermont-Ferrand [37], 247 suspicious masses were managed by laparoscopy first, as long as there was no evidence of disseminated cancer. They found that 85% of the masses were benign, sparing laparotomy in 93.8% of patients with a benign mass. Among the remaining 37 malignant tumors, 18.9% were treated by laparoscopy. Using this approach, they were able to reduce the number of unnecessary laparotomies.

Third, retrospective and prospective trials have demonstrated that laparoscopy reduced intraoperative blood loss and resulted in fewer postoperative complications, shorter hospitalization, an earlier return to normal activities, less adhesions, and a better cosmetic result compared with laparotomy [6, 7, 38, 39].

For all the abovementioned arguments, we believe that all ovarian masses, even the suspicious ones, should be addressed initially by laparoscopy.

Surgical Technique

Patient Positioning, Pneumoperitoneum Creation, and Port Placement

Under general anesthesia, the patient is placed in a supine position with abduction of lower limbs and with flexion of the thighs onto the pelvis of about 20°. This position allows concomitant abdominal and vaginal access without the need to change the position of the patient. In order to avoid injuries of the brachial plexus, the two arms are positioned alongside the body. The placement of the lower limbs should avoid compression of the sciatic nerve, external popliteal nerve, and calves. The buttocks of the patient should project slightly beyond the edge of the operating table to facilitate the uterine manipulation.

Classically, pneumoperitoneum is insufflated using the Veress needle placed at the Palmer's point (left hypochondrium, 2–3 cm below the costal margin, at the midclavicular line) [40, 41]. At this level, pneumoperitoneum creation is easy even in obese patients.

After the skin incision, a 10 mm trocar is placed inside the umbilicus for the zero-degree laparoscope. Systematically, we use three ancillary trocars: two 5 mm trocars for the main surgeon and one 5 mm trocar for the assistant surgeon. The two lateral trocars are placed about 2 cm medial to the anterior-superior iliac spine (and always lateral to the inferior epigastric vessels), and the third trocar is infraumbilical, in the midline, about 8–10 cm below the umbilical trocar (Fig. 14.1).

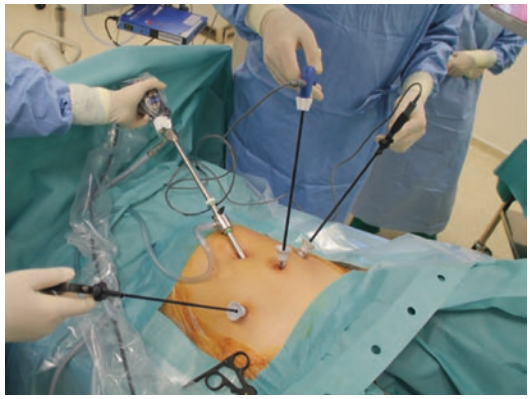

Fig. 14.1 Standard port placement: a 10 mm umbilical trocar for the laparoscope and three secondary 5 mm trocars for the instruments

The abovementioned port placement is useful for cysts up to 10 cm in diameter, in which the location of the lesion is almost exclusively within the pelvis. For ovarian masses larger than 10 cm that do not reach the navel, the Veress needle may be inserted at Palmer's point, and a 5 mm trocar is placed at the same site. A 5 mm laparoscope is then inserted through this trocar in order to define the limits of the mass and guide the correct positioning of the secondary trocars. For a very large mass (more than 20 cm) exceeding the umbilicus, but with essentially liquid component, an open laparoscopy with direct puncture of the mass using a conical trocar or a laparoscopic needle may be possible (Fig. 14.2a, b).

Always, the surgeon should not hesitate to place the trocars higher in the abdomen (more cranially) according to the volume of the mass to be operated.

Intraoperative Evaluation: Do Not Forget All the Steps!

Routinely, the throughout evaluation of the abdominal cavity must be performed [36, 42]. The surgeon has to conduct a 360-degree rotation with the laparoscope in order to evaluate the

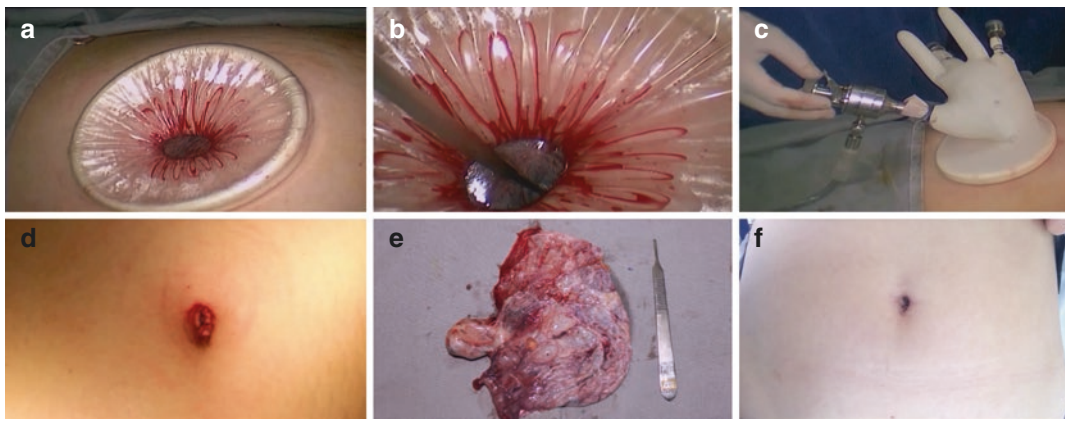

Fig. 14.2 In this case, a wound retractor was placed through the umbilicus (**a**), and the cystic lesion was punctured using a laparoscopic needle under direct visualization (**b**). The intracystic fluid was aspirated, and the puncture site was closed. An adapted single single-port approach (**c**) was used in order to perform the left adnexectomy (**e**). The good cosmetic result could be appreciated immediately at the end of the procedure (**d**) and 7 days after the surgical intervention (**f**)

entire abdominopelvic cavity: right iliac fossa, right parieto-colic gutter, ascending colon, right side of the diaphragm, liver, stomach, omentum, transverse colon, left side of the diaphragm, left parieto-colic gutter, descending colon, left iliac fossa, small bowel, mesentery, and pelvis (peritoneum, uterus, and adnexa). The laparoscope has an effect of "magnifying glass" which allows full exploration of the peritoneum looking for granulations and/or vegetations [43, 44]. This is of extreme importance in patients undergoing laparoscopy for the evaluation of resectability of advanced ovarian carcinoma [45, 46].

Peritoneal Cytology

The next step is to get a sample for peritoneal cytology, what can be done by simple aspiration of the peritoneal fluid spontaneously present in the pouch of Douglas (Fig. 14.3) or after instillation of saline solution at the level of parieto-colic gutters, pelvis, and adnexa.

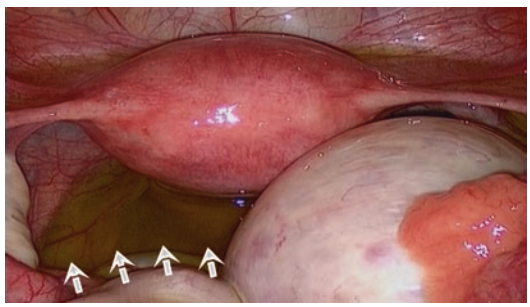

Fig. 14.3 Peritoneal fluid at the posterior cul-de-sac (arrows). The left ovary is normal, and the right ovary is enlarged

Intraoperative Assessment of the Ovarian Mass

Extracystic Evaluation

The surgeon must know the semiology of an ovarian mass. The semiology begins with the recognition of any suspicious signs of malignancy, which may have already been identified at the time of inspection of the abdominopelvic cavity: ascites, peritoneal vegetations, extracystic vegetations, intracystic vegetations, and anarchic vascularization of the cyst wall. The volume of peritoneal fluid becomes suspicious when it fills in completely the pouch of Douglas. Extracystic vegetations are often obvious, but its interpretation is often difficult and systematically requires a biopsy with frozen section examination. The intracystic vegetations are often diagnosed during the preoperative ultrasound, but they can also be visible through the ovary wall and the cyst wall, requiring caution during surgery if present. The irregular vascularization may sometimes confuse the surgeon, but its presence is a factor that speaks in favor of malignancy.

A more accurate semilogy must be known to allow differentiation of functional and organic cysts (Table 14.1).

Intracystic Evaluation

The intracystic assessment [48] should include the inner cyst wall and the fluid. Usually, the ultrasonography already gives the surgeon some arguments in favor of the presence or absence of suspicious vegetations but also about the liquid content (pure anechoic cysts, hemorrhagic cysts, dermoid, mucinous, etc.). The perfect assessment can be made during surgery in three different moments:

Table 14.1 Laparoscopic findings to differentiate functional and organic cysts [47]

	Organic cysts	Functional cysts
Utero-ovarian ligament	Lengthened	Normal
Cyst wall	Thick	Thin
Ovarian vessels	Numerous and regular starting from the mesovarium	More scanty, coral-like
Cyst fluid	Variable (depending on the type of cyst)	Saffron yellow
Inner cyst wall	Smooth of fibrotic with areas of hypervascularization	Retina-like aspect
Ovarian cystectomy	Feasible	Impossible/difficult

- Before the treatment of the cyst: in this situation, the surgeon is going to puncture the cyst, aspirate the cyst fluid, and perform an ovarian cystoscopy.
- After the treatment of the cyst and before specimen extraction: in this case, the surgeon is going to perform first the ovarian cystectomy or the adnexectomy, and then the cyst will be punctured and widely opened. Then, ovarian cystoscopy is going to be performed.
- After the treatment of the cyst and after specimen extraction: in this situation, the cyst will be opened outside the abdomen, after being retrieved from the abdominal cavity.

The liquid within the cyst must always be evaluated during the laparoscopic procedure. The surgeon should think about malignant nature of the cyst in the presence of cloudy, dark-colored, and/or stringy fluid. After analyzing the fluid (intracystic content), the inner surface of the cyst must be evaluated [36, 42]. The presence of intracystic vegetations is frequently identified on the preoperative work-up during the transvaginal ultrasound. Suspicious findings are great number and volume of vegetations and also irregular and grayish papillary projections. During laparoscopy, the presence of intracystic vegetations may also be suspected by the external aspect of the cyst wall and the presence of a visible whitish thickening of the cyst wall.

Whenever the surgeon decides to puncture the cyst, the puncture technique must be as perfect as possible. It is important to try to prevent spillage of intracystic fluid into the peritoneal cavity. For cysts smaller than 8 cm, which represent the majority of cases, the cyst must be placed within an endoscopic bag before puncture. The puncture should be performed under visual control, perpendicularly to the surface of the cyst with the use of an endoscopic needle (Fig. 14.4) or a 5 mm conical trocar (Fig. 14.5), at the opposite side of the ovarian vascularization. The cyst content is aspirated with a syringe in the case of using the laparoscopic needle or directly with an aspiration cannula in the case of using a 5 mm trocar. During aspiration, the surgeon must ensure there is no leakage of intracystic content using one or two grasping forceps around the puncture site, allowing occlusion of the cyst at the puncture site (Fig. 14.5c, d). These grasping forceps should elevate the lateral walls of the cyst in order to prevent the flow of fluid out of the cyst. After aspiration of the cyst fluid, the puncture site will be enlarged with scissors, allowing the performance of an ovarian cystoscopy (Fig. 14.6d) to evaluate the inner cyst wall and check for the presence of any vegetations.

If the cyst was punctured in order to reduce its volume, especially in the case of a large ovarian cyst that does not fit within the endoscopic bag, the puncture site may be closed without perform-

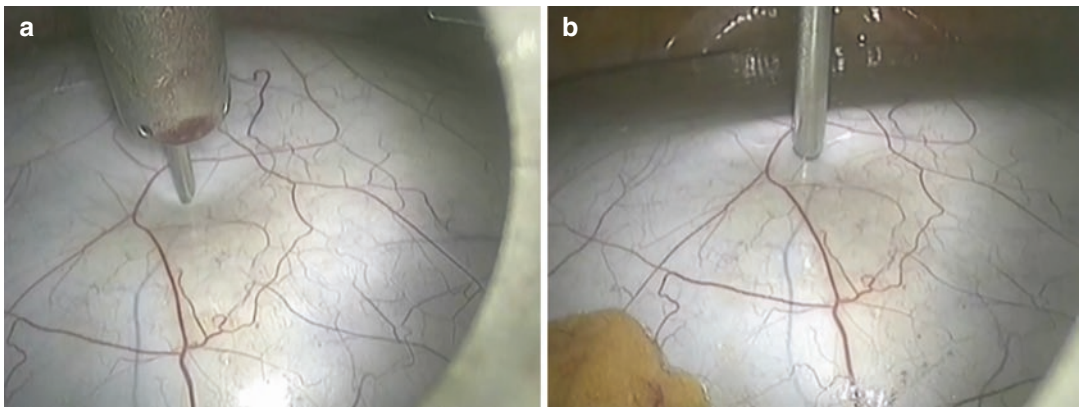

Fig. 14.4 Puncture of a presumed benign ovarian tumor using a laparoscopic needle

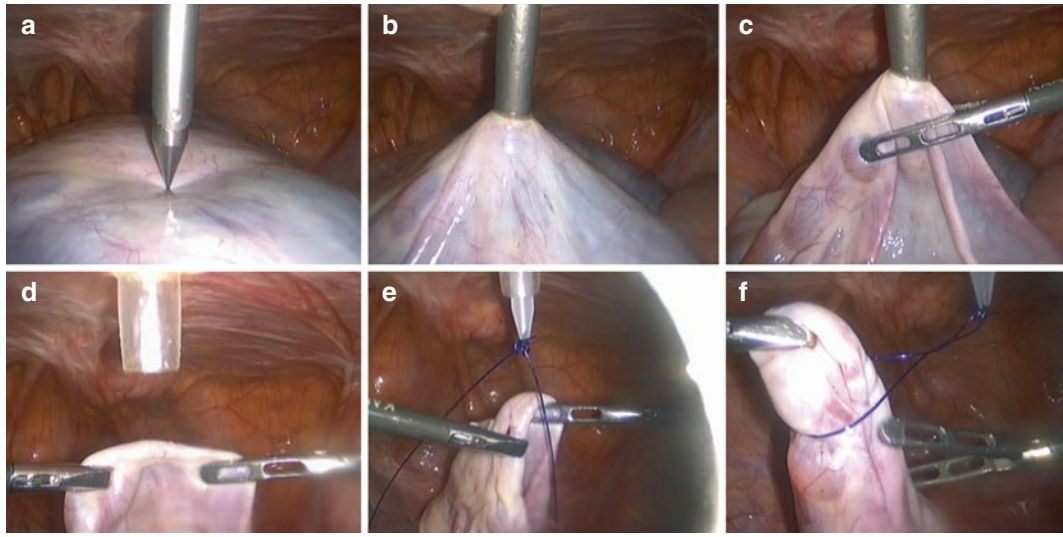

Fig. 14.5 (**a**–**c**) Puncture of a presumed benign ovarian cyst under visual control using a 5 mm conical trocar. After the puncture, the edges of the cyst are held on (**d**), and the puncture site is closed using an endoloop (**e**, **f**)

ing an ovarian cystoscopy using an endoloop (Fig. 14.5e, f).

If the ovarian cystectomy or the adnexectomy was performed without previous puncture, the cyst is going to be punctured before extraction, within the endoscopic bag using an endoscopic needle or after extraction of part of the endoscopic bag, under direct visualization. In the latter situation, the surgeon should enlarge the skin/aponeurosis incision to obtain a better visual control, if needed.

Different Surgical Approaches: Step by Step

Cystectomy After Puncture

This is the classical surgical approach for pure anechoic serous and mucinous adenomas or for ovarian cysts containing a single vegetation with low suspicious for malignancy. Six steps should be taken:

1. Puncture of the ovarian cyst followed by enlargement of this opening using scissors. The opening of the ovarian cyst wall should be wide and should start exactly at the level of the puncture site (Fig. 14.6b, c).
2. Inspection of the cyst lining (in situ ovarian cystoscopy) should be systematically performed. At this moment, it is possible to wash the cyst with saline solution in order to better expose the entire inner cyst wall.
3. Identification of the cleavage plane. It is necessary to follow the opening of the cyst wall in order to find the exact cleavage plane between normal ovarian parenchyma and cyst wall (Fig. 14.6d). If the plane is not exposed spontaneously, the surgeon should not hesitate to increase the opening of the cyst to find a better cleavage plane.
4. The surgeon should start the dissection using two forceps, one grasping the ovarian cyst and the other one grasping the ovarian parenchyma, exactly at the cleavage plane (Fig. 14.6e).
5. Once identified, the plane between ovarian cyst and normal ovarian cortex is developed further by application of divergent forces at the edge of the ovarian cortex and the cyst wall. Traction-countertraction and blunt dissection should be done gently, with brief gestures, in order to progressively peel the cyst wall from the underlying ovarian bed. For this purpose, it is necessary to frequently exchange the position of the graspers, so that they are always as close as possible to the cleavage plane (Fig. 14.6e). The systematic use

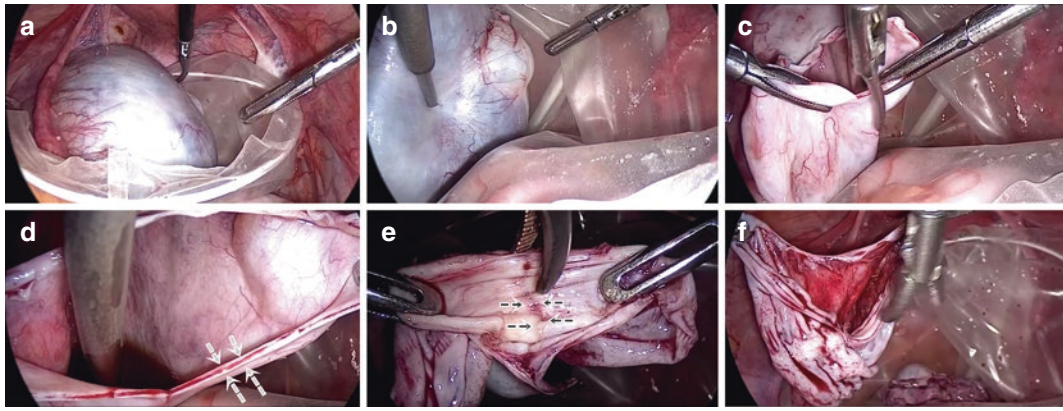

Fig. 14.6 The ovary is placed inside the endoscopic bag (**a**). The puncture is performed using a laparoscopic needle (**b**), and the puncture site is enlarged using scissors (**c**). The cleavage plane is identified (**d**), and the cyst is progressively separated from the ovarian cortex (**e**). At the end of the cystectomy, hemostasis must be checked (**f**)

of three graspers allows for a constant and satisfactory exposure. This is imperative to be sure that the dissection progresses within the correct plane. The exposure is maintained by two graspers, and the third forceps grasps the tissue close to the plane of dissection and so on, without ever releasing the cyst and the ovary. If the dissection becomes more difficult, the surgeon should change the position of the graspers in order to be close to the cleavage plane again. The surgeon must avoid tissue slippage and tearing in order not to damage normal ovarian parenchyma. Extreme caution must be taken when working near the hilar vessels of the ovary. Small shots of bipolar energy may be useful at this moment to avoid inadvertent bleeding;

6. Hemostasis must be meticulous. However, the surgeon should be aware that ovarian cystectomy usually has little bleeding whenever the cleavage plane is respected. The surface of the cyst should be white, without reddish fibers (Fig. 14.6e). When this is not the case, the dissection is probably being done far from the cyst wall, and the surgeon must reidentify the plane of dissection close to the cyst wall. The use of three secondary trocars during the operative laparoscopy is the only possible way of installation that enables the surgeon to maintain the exposure, allow for coagulation/hemostasis of the remaining ovary and use the washing system at the same time, with no need for a constant instrument change. At the end of the cystectomy, hemostasis should be checked (Fig. 14.6f). The surgeon should use the washing system in the right hand and the bipolar forceps in the left hand. The assistant surgeon should keep the exposition of the ovarian cyst bed using his grasping forceps.

Cystectomy Without Puncture

This is the classic treatment for dermoid cysts and is composed of six steps:

1. Positioning the ovary within an endoscopic bag (Fig. 14.7a) in order to prevent the risk of spillage during the procedure, which may lead to a serious complication called granulomatous peritonitis [33, 49].
2. Opening the ovary exactly at the opposite edge to the hilar vessels. Usually, the ovarian parenchyma may be grasped, and this opening is conducted using cold scissors. Whenever grasping the ovary is not possible, the surgeon may open the ovarian parenchyma using a small shot of monopolar energy setup on pure cut mode. The opening is widened/extended using scissors to about 50% of the circumference of the ovarian parenchyma in order to facilitate the enucleation of the dermoid cyst (Fig. 14.7b, c). Identification of the correct cleavage plane is essential (Fig. 14.7d). The surface of the cyst is yellowish-white (no red

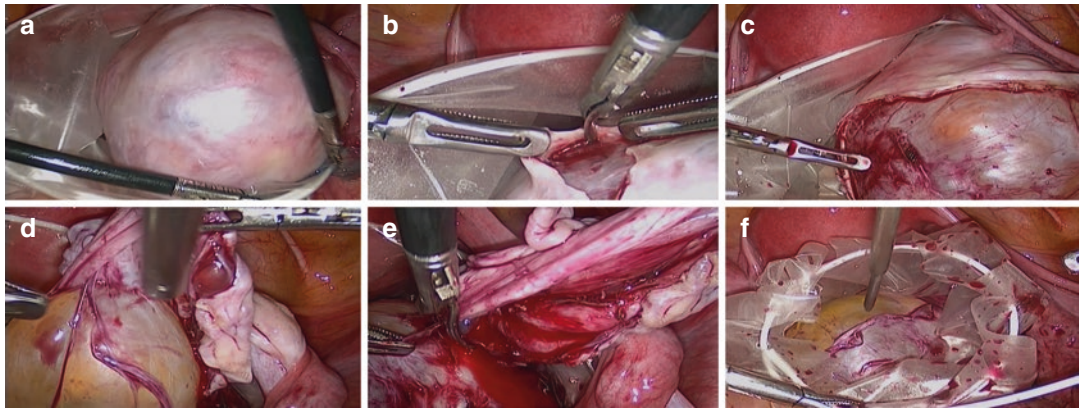

Fig. 14.7 The ovary is positioned within the endoscopic bag (**a**). The ovarian parenchyma is opened using scissors (**b**), and the cleavage plane is identified (**c**, **d**). A small bleeding may occur during the enucleation close to the ovarian vessels (**e**). At the end, the cyst may be punctured in order to evacuate the intracystic contents to facilitate extraction (**f**)

fibers), and the cleavage plane should be avascular.

3. Two forceps grasp the edges of the ovarian parenchyma, and the surgeon must perform a movement as if he was "wearing" the cyst, supporting the bottom of the cyst on the ipsilateral pelvic wall or on the uterus. The enucleation of the cyst requires that the instruments work tangentially to the cyst. If the dissection is not easy, the surgeon may perform the dissection on one side and then on the other side of the cyst, using grasping forceps, bipolar forceps, and scissors.
4. When more than 50% of the cyst surface is dissected, the surgeon may raise the ovarian parenchyma and use the weight of the cyst to help in the dissection, what is going to act as a divergent force. Dissection may be completed using traction, focal coagulation, and section. Usually, some bleeding may occur close to the pelvic infundibulum (Fig. 14.7e), where bipolar coagulation is recommended before finalizing the freeing of the cyst from the ovarian parenchyma.
5. Hemostasis of the cyst bed allows the ovary to resume its normal shape. Suturing the ovary is rarely necessary.
6. Extraction should be performed by puncturing/aspirating the cyst within the endoscopic bag (Fig. 14.7f).

Cystectomy for Paraovarian/Paratubal Cyst

The surgical approach consists of six steps:

1. Placement of the cystic lesion within an endoscopic bag (Fig. 14.8a). It is important to remember that they are not always benign (2% are malignant lesions). The cyst content appears bluish when only liquid is present, and the cyst is covered only by the peritoneum (mesosalpinx). If the cyst wall appears whitish, probably there must be any intracystic vegetation within the cyst.
2. Incision of the peritoneum far from the fimbriae and tube (Fig. 14.8b).
3. Enlargement of the opening as described for the dermoid cyst (Fig. 14.8c, d).
4. Dissection is conducted according to the description of the dermoid cyst. When the dissection approaches the ovary, it is important to coagulate and cut the vascular and fibrous attachments (Fig. 14.8e).
5. Check the hemostasis and the good anatomical positioning of the fimbriae at the end of the dissection.
6. Extraction of the endoscopic bag after puncturing the cyst within the endoscopic bag (Figs. 14.8f and 14.9), as performed for the dermoid cyst.

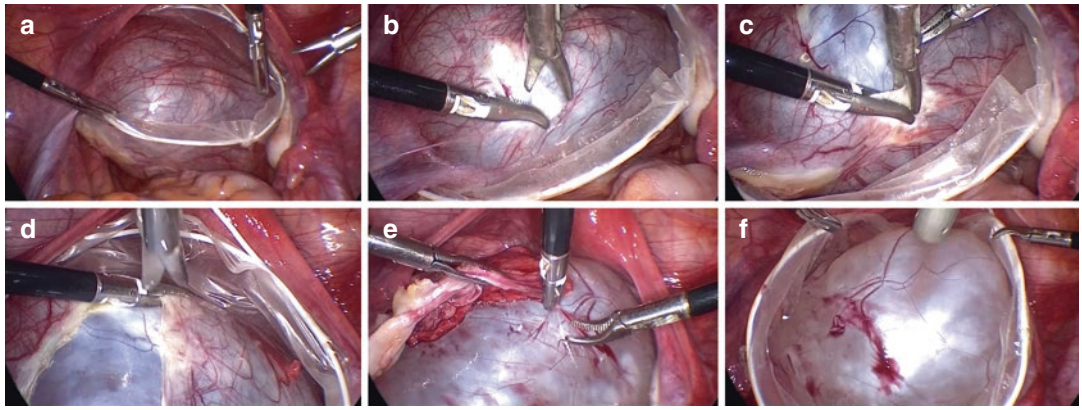

Fig. 14.8 The left paratubal cyst is placed inside the endoscopic bag (**a**). The mesosalpinx is opened using bipolar and scissors (**b**–**d**), and the cyst is progressively separated from the mesosalpinx, taking care with the distal part of the tube (**e**). At the end of the procedure, the cyst may be punctured within the endoscopic bag before extraction (**f**)

Cystectomy of Ovarian Endometrioma

The ovarian endometrioma contains three different zones [50]:

1. Zone of adhesion between the ovarian endometrioma and the posterior leaf of the broad ligament or the uterosacral ligament.
2. Zone of active tissue with a small amount of fibrosis, where dissection is easily performed.
3. Zone of intense fibrosis, where the cleavage plane is difficult to find. It is usually close to the hilar vessels.

The surgical procedure consists of seven steps:

1. Ovariolysis is performed with an aspiration cannula, separating the ovary from the attachments at the pelvic sidewall or at the uterosacral ligament. This maneuver must start at the level of the most dependent part of the ovarian adhesion to the pelvic sidewall and continues toward the utero-ovarian ligament (Fig. 14.10a). In this way, the ovary is released from the pelvic wall. In most cases, this maneuver ruptures the cyst, and the surgeon may see the typical chocolate fluid coming from the inner aspect of the cyst.
2. The pelvic cavity is washed, and the cystic contents are aspirated in order to clean the cavity. The inner cystic wall is inspected for vegetations or irregularities to exclude any signs of malignancy.
3. The cyst opening is enlarged using scissors, starting at the area where the cyst was ruptured (Fig. 14.10b). It is important not to perform a new opening in the ovarian parenchyma! The incision is widely enlarged until the surgeon can perfectly identify the cleavage plane (Fig. 14.10c).
4. The cleavage plane is dissected further by grasping the edge of the ovarian parenchyma and the cyst wall separately. Divergent traction movements should be slow, smooth, and limited in range to open the cleavage plane without tearing the cyst or the ovarian cortex. The surface of the cyst is whitish, the plane is avascular, and the bleeding must be minimal. This first step of the dissection is very easy and corresponds to 10–90% of the cyst wall, depending on the chronicity of the endometrioma (Fig. 14.10d).
5. In the second step of the dissection, divergent traction becomes less effective. The cyst wall is not uniformly whitish anymore, and some reddish fibers start appearing (Fig. 14.10e). At this moment, the surgeon should stop simple divergent traction maneuvers. Fibrosis is always stronger than the ovarian parenchyma. The red fibers, often triangular in shape,

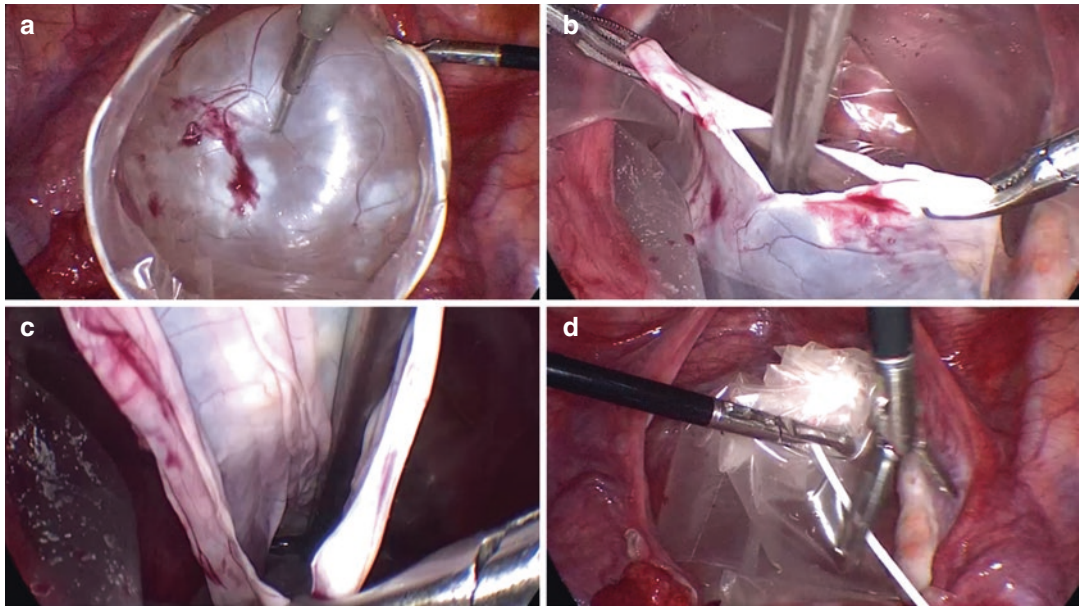

Fig. 14.9 The cyst is punctured inside the endoscopic bag (**a**), and the cyst fluid is aspirated (**b**). A cystoscopy is performed (**c**) in order to evaluate the inner cyst wall. The endoscopic bag is closed using the traction wire (**d**)

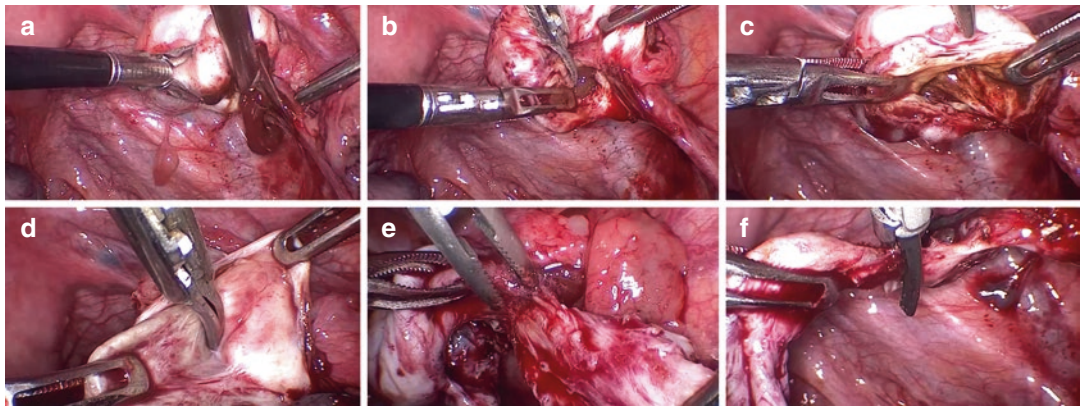

Fig. 14.10 Detachment of the ovarian adhesions (**a**) leading to the spontaneous rupture of the endometriosis cyst. Enlargement of the ruptured area using scissors (**b**) to find the exact cleavage plane (**c**). Separation of the ovarian endometrioma from the ovarian cortex (**d**) in the active area (easy dissection). When the surgeon approaches the area close to the hilar vessels, some precise hemostasis using bipolar energy (**e**) or ultrasonic energy (**f**) may be carefully used

should be coagulated on the surface of the cyst, at the level of the triangle apex, and cut to find the exact cleavage plane close to the cyst.

6. Most small surface bleeding stops spontaneously. Therefore, precise hemostasis is performed taking care not to be excessive (Fig. 14.10e, f). If the final ovarian shape is not satisfactory, the surgeon may place some sutures inside the ovary.
7. Extraction is carried out in the conventional manner using an endoscopic bag.

Adnexectomy

There are two major risks during adnexectomy: ureteral injury and incomplete removal of the ovary. In a classic situation, where there

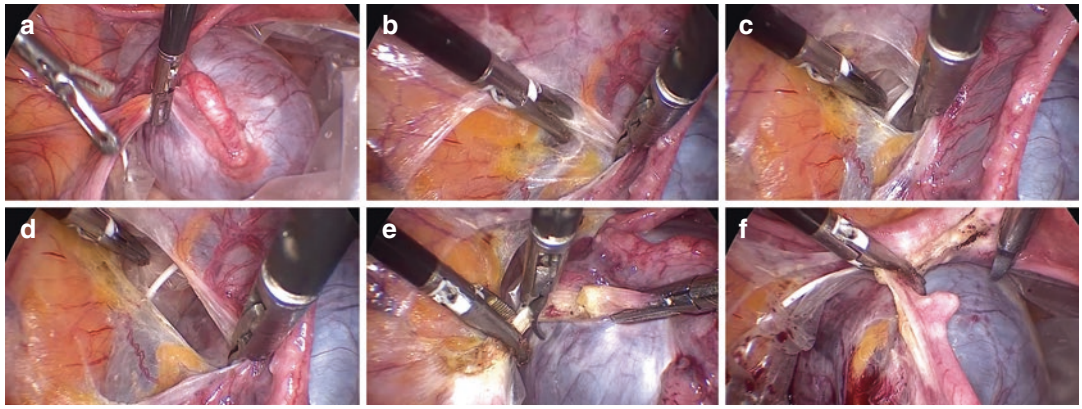

Fig. 14.11 Left adnexectomy. Medial traction of the adnexa is applied by the assistant (**a**), and the surgeon is going to fenestrate the broad ligament (**b**–**d**). Coagulation and section of the ovarian vessels (**e**) and the tube/utero-ovarian ligament (**f**) are progressively performed using bipolar forceps and scissors

is no adhesion to the posterior leaf of the broad ligament and to the ureter, it consists of six steps:

1. Medial traction of the adnexa (Fig. 14.11a).
2. Coagulation and section of the peritoneum lateral to the ovarian pedicle (Fig. 14.11b).
3. Fenestration of the broad ligament (Fig. 14.11c, d). The surgeon should coagulate and cut the anterior and the posterior leaf of the broad ligament creating a window. If the surgeon places his two instruments inside this window and gently applies divergent forces in a cranial-caudal direction, he is able to widely open this window. In this manner, the ovarian pedicle is isolated coming medially to the window, and the ureter stays lateral to the window, thus avoiding the risk of ureteral injury during the next steps of the surgical procedure.
4. Progressive coagulation and section of the ovarian pedicle are performed (Fig. 14.11e). The surgeon must coagulate and cut the peritoneum around the lumbar-ovarian ligament before this vascular control because it increases the effectiveness of bipolar coagulation (the peritoneum around the vessels increases the tissue impedance).
5. Coagulation and section of the utero-ovarian ligament and the fallopian tube close to the uterus (Fig. 14.11f).
6. Placement and extraction of the specimen within an endoscopic bag.

There are some difficult situations in which the ovary is firmly attached to the posterior leaf of the broad ligament. In these situations, it is necessary to excise the peritoneum of the ovarian fossa in order to be complete in the oophorectomy; otherwise, the surgeon may leave some ovarian tissue behind attached to the peritoneum and there is a possibility of further development of an ovarian remnant syndrome. This intervention requires some degree of ureterolysis, depending on the specific situation. This ureteral dissection always starts cranial, identifying the ureter after the opening of the peritoneum in a healthy tissue. The main objective of the dissection is to lateralize the ureter in order to allow for a safe resection of the peritoneum involved by the disease. If necessary, this dissection must be carried out until the level of the uterine vessels.

Extraction of the Specimen Within the Endoscopic Bag

Extraction of the surgical specimen should always be performed in a protected manner, usually using an endoscopic bag.

The surgical specimen must be placed inside the endoscopic bag, and it can be completely closed using the traction wire. Extraction of the bag may be carried out through a trocar incision (Fig. 14.12) or by vaginal route (colpotomy)

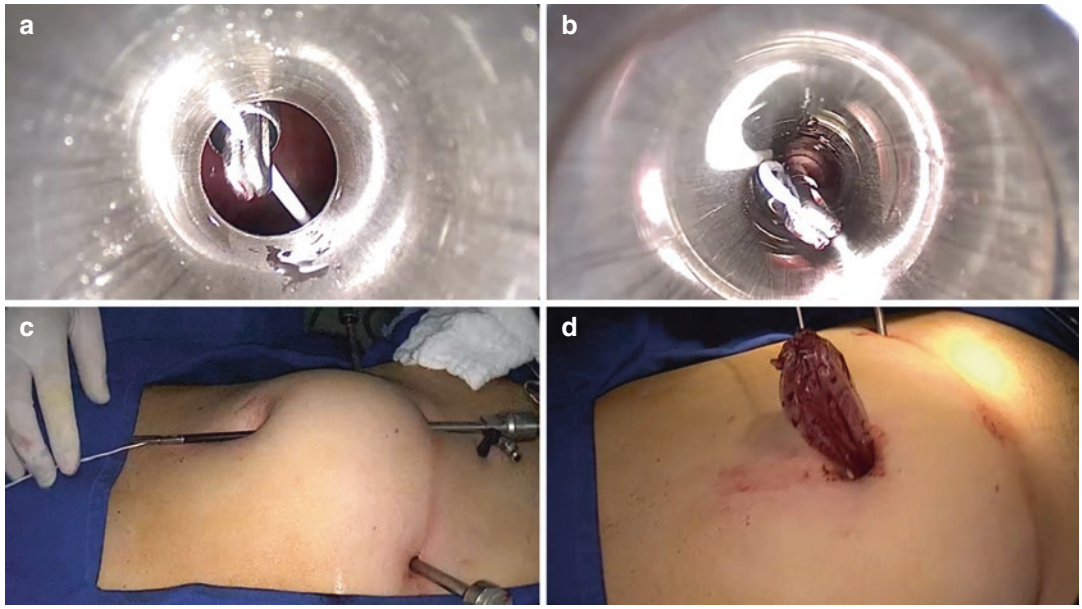

Fig. 14.12 The traction wire is grasped by the surgeon using the suprapubic trocar (**a**), and the forceps is moved forward through the umbilical trocar (**b**). The umbilical trocar is removed, and the traction wire is grasped outside the abdominal cavity (**c**). The endoscopic bag is exteriorized with the cyst inside (**d**)

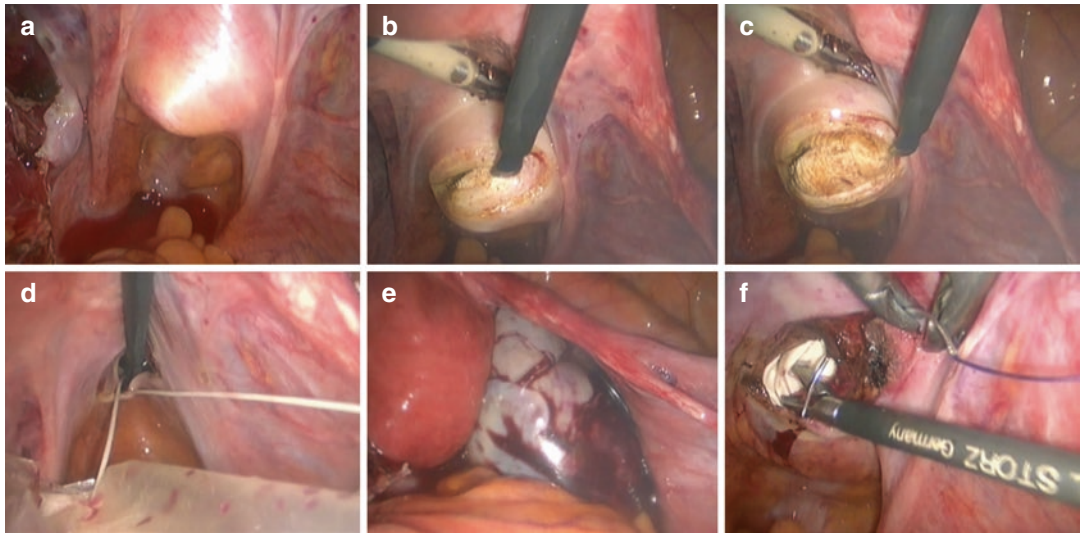

Fig. 14.13 A gauze is placed inside the vaginal cavity, exactly at the posterior vaginal fornix (**a**). The vagina is opened over the gauze using monopolar energy in pure cut mode (**b**, **c**). The endoscopic bag is extracted vaginally (**d**, **e**), and the vagina is closed laparoscopically (**f**)

(Fig. 14.13). In the former situation, the traction wire is simply pushed through the trocar and retrieved from the abdominal cavity. The skin/aponeurosis incision is enlarged according to the size of the cyst.

How to Approach the Ovarian Mass? Puncture? Conversion? Cystectomy? Adnexectomy?

The management of a patient with an ovarian mass must be individualized. The underlying management rationale is to minimize patient morbidity, trying to be conservative when possible, use laparoscopic techniques if appropriate (avoiding laparotomy when possible), and refer to a gynecologic oncologist if necessary.

Puncture

Based on the preoperative work-up, the surgeon must always think about the possibility or not to puncture the ovarian mass. It should not be systematic!

Whenever adnexal conservation is not considered, there is no indication for ovarian puncture before the surgical procedure:

1. Strong suspicion of malignancy (multiple intracystic vegetations on preoperative assessment, solid tumor, extracystic signs of malignancy)
2. Menopausal or climacteric women

Puncture of the ovarian mass should be considered in young women, when the puncture will help to diagnose the nature of the cyst and allow or not for an adnexal conservation. The presence of one small non-vascularized intracystic vegetation is not a contraindication to puncture the cyst. If there is any doubt in a young woman, the surgeon should not hesitate to carry out the ovarian puncture. Another indication for ovarian puncture is the presence of a large ovarian mass with pure cystic content with no index of suspicion for malignancy. In this case, the size of the mass prevents or hinders any laparoscopic approach of this mass most likely benign. Figure 14.2 demonstrates an adapted laparoscopic single-port approach in such cases, which may also be managed using the conventional laparoscopic port placement (Fig. 14.1) after the puncture.

Laparotomy

Conversion to laparotomy should be systematic if:

1. Peritoneal carcinomatosis is confirmed and cytoreductive surgery is possible. If the surgeon is not able to completely perform the surgery, biopsies are taken, and the patient should be referred to an oncology center in order to be reoperated as soon as possible.
2. There is a major risk of rupture or spread of a suspected mass: a laparotomy is always preferable to a laparoscopic dissemination of an ovarian tumor.

Of course, selected patients may undergo a complete cytoreductive surgery by laparoscopic approach in experienced hands.

Adnexectomy

Adnexectomy should always be performed if:

1. The patient is menopausal (probably the patient will undergo a bilateral adnexectomy).
2. The patient is more than 45 years old and does not want to preserve her fertility (unilateral adnexectomy).
3. The ovarian mass is very suspicious (extra- and/or intracystic evaluation).

Cystectomy

Cystectomy should be performed in all other cases! The surgical technique should be adapted for each specific type of ovarian cyst, as discussed above.

Conclusions

Laparoscopy is currently the gold standard for the management of ovarian masses. It has proven advantages compared with laparotomy and is feasible, safe, and efficient after the surgeon's learning curve. A meticulous preoperative evaluation is recommended in order to try to exclude malignancy. During laparoscopy, systematization of the procedure is essential. The surgical technique must be adapted to the characteristics of the cyst and the patient. Experts should try to teach young surgeons the proper surgical technique in order to make it easier and reproducible.

References

1. National Institutes of Health Consensus Development Conference Statement. Ovarian cancer: screening, treatment, and follow-up. Gynecol Oncol. 1994;55(3 Pt 2):S4–14.
2. NIH consensus conference. Ovarian cancer. Screening, treatment, and follow-up. NIH consensus development panel on ovarian cancer. JAMA. 1995;273(6):491–7.
3. Padilla LA, Radosevich DM, Milad MP. Accuracy of the pelvic examination in detecting adnexal masses. Obstet Gynecol. 2000;96(4):593–8.
4. Hilger WS, Magrina JF, Magtibay PM. Laparoscopic management of the adnexal mass. Clin Obstet Gynecol. 2006;49(3):535–48.
5. Canis M, Rabischong B, Houlle C, Botchorishvili R, Jardon K, Safi A, Wattiez A, Mage G, Pouly JL, Bruhat MA. Laparoscopic management of adnexal masses: a gold standard? Curr Opin Obstet Gynecol. 2002;14(4):423–8.
6. Mais V, Ajossa S, Piras B, Marongiu D, Guerriero S, Melis GB. Treatment of nonendometriotic benign adnexal cysts: a randomized comparison of laparoscopy and laparotomy. Obstet Gynecol. 1995;86(5):770–4.
7. Yuen PM, Yu KM, Yip SK, Lau WC, Rogers MS, Chang A. A randomized prospective study of laparoscopy and laparotomy in the management of benign ovarian masses. Am J Obstet Gynecol. 1997;177(1):109–14.
8. Canis M, Mage G, Pouly JL, Wattiez A, Manhes H, Bruhat MA. Laparoscopic diagnosis of adnexal cystic masses: a 12-year experience with long-term follow-up. Obstet Gynecol. 1994;83(5 Pt 1):707–12.
9. Sisodia RM, Del Carmen MG, Boruta DM. Role of minimally invasive surgery in the management of adnexal masses. Clin Obstet Gynecol. 2015;58(1):66–75.
10. Earle CC, Schrag D, Neville BA, Yabroff KR, Topor M, Fahey A, Trimble EL, Bodurka DC, Bristow RE, Carney M, Warren JL. Effect of surgeon specialty on processes of care and outcomes for ovarian cancer patients. J Natl Cancer Inst. 2006;98(3):172–80.
11. Boll D, Geomini PM, Brölmann HA, Sijmons EA, Heintz PM, Mol BW. The pre-operative assessment of the adnexal mass: the accuracy of clinical estimates versus clinical prediction rules. BJOG. 2003;110(5):519–23.
12. Mol BW, Boll D, De Kanter M, Heintz AP, Sijmons EA, Oei SG, Bal H, Brölmann HA. Distinguishing the benign and malignant adnexal mass: an external validation of prognostic models. Gynecol Oncol. 2001;80(2):162–7.
13. Bouic-Pagès E, Perrochia H, Mérigeaud S, Giacalone PY, Taourel P. MR imaging of primary ovarian tumors with pathologic correlation. J Radiol. 2009;90(7–8 Pt 1):787–802.
14. Van Calster B, Valentin L, Van Holsbeke C, Testa AC, Bourne T, Van Huffel S, Timmerman D. Polytomous diagnosis of ovarian tumors as benign, borderline, primary invasive or metastatic: development and validation of standard and kernel-based risk prediction models. BMC Med Res Methodol. 2010;10:96. https://doi.org/10.1186/1471-2288-10-96.
15. Van Calster B, Van Hoorde K, Valentin L, Testa AC, Fischerova D, Van Holsbeke C, Savelli L, Franchi D, Epstein E, Kaijser J, Van Belle V, Czekierdowski A, Guerriero S, Fruscio R, Lanzani C, Scala F, Bourne T, Timmerman D, International Ovarian Tumour Analysis Group. Evaluating the risk of ovarian cancer before surgery using the ADNEX model to differentiate between benign, borderline, early and advanced stage invasive, and secondary metastatic tumours: prospective multicentre diagnostic study. BMJ. 2014;349:g5920. https://doi.org/10.1136/bmj.g5920.
16. Yancik R, Ries LG, Yates JW. Ovarian cancer in the elderly: an analysis of surveillance, epidemiology, and end results program data. Am J Obstet Gynecol. 1986;154(3):639–47.
17. Perera DS, Prabhakar HB. Imaging of the adnexal mass. Clin Obstet Gynecol. 2015;58(1):28–46.
18. Schneider VL, Schneider A, Reed KL, Hatch KD. Comparison of Doppler with two-dimensional sonography and CA 125 for prediction of malignancy of pelvic masses. Obstet Gynecol. 1993;81(6):983–8.
19. Timor-Tritsch LE, Lerner JP, Monteagudo A, Santos R. Transvaginal ultrasonographic characterization of ovarian masses by means of color flow-directed Doppler measurements and a morphologic scoring system. Am J Obstet Gynecol. 1993;168(3 Pt 1):909–13.
20. Weiner Z, Beck D, Shteiner M, Borovik R, Ben-Shachar M, Robinzon E, Brandes JM. Screening for ovarian cancer in women with breast cancer with transvaginal sonography and color flow imaging. J Ultrasound Med. 1993;12(7):387–93.
21. Jeong YY, Outwater EK, Kang HK. Imaging evaluation of ovarian masses. Radiographics. 2000;20(5):1445–70.

22. Kondo W, Zomer MT, Pinto EP, Ribeiro R, Ribeiro MFC, Trippia CR, Trippia CH. Deep infiltrating endometriosis: imaging features and laparoscopic correlation. J Endometr. 2011;3(4):197–212.
23. Trippia CH, Zomer MT, Terazaki CRT, Martin RLS, Ribeiro R, Kondo W. Relevance of imaging examinations in the surgical planning of patients with bowel endometriosis. Clin Med Insights Reprod Health. 2016;10:1–8.
24. Bast RC Jr, Klug TL, St John E, Jenison E, Niloff JM, Lazarus H, Berkowitz RS, Leavitt T, Griffiths CT, Parker L, Zurawski VR Jr, Knapp RC. A radioimmunoassay using a monoclonal antibody to monitor the course of epithelial ovarian cancer. N Engl J Med. 1983;309(15):883–7.
25. Sölétormos G, Duffy MJ, Othman Abu Hassan S, Verheijen RH, Tholander B, Bast RC Jr, Gaarenstroom KN, Sturgeon CM, Bonfrer JM, Petersen PH, Troonen H, CarloTorre G, Kanty Kulpa J, Tuxen MK, Molina R. Clinical use of cancer biomarkers in epithelial ovarian cancer: updated guidelines from the European Group on Tumor Markers. Int J Gynecol Cancer. 2016;26(1):43–51.
26. Duffy MJ, Bonfrer JM, Kulpa J, Rustin GJ, Soletormos G, Torre GC, Tuxen MK, Zwirner M. CA125 in ovarian cancer: European Group on Tumor Markers guidelines for clinical use. Int J Gynecol Cancer. 2005;15(5):679–91.
27. Liu J, Matulonis UA. Anti-angiogenic agents in ovarian cancer: dawn of a new era? Curr Oncol Rep. 2011;13(6):450–8.
28. Høgdall EV, Christensen L, Kjaer SK, Blaakaer J, Jarle Christensen I, Gayther S, Jacobs IJ, Høgdall CK. Protein expression levels of carcinoembryonic antigen (CEA) in Danish ovarian cancer patients: from the Danish 'MALOVA' ovarian cancer study. Pathology. 2008;40(5):487–92.
29. Kelly PJ, Archbold P, Price JH, Cardwell C, McCluggage WG. Serum CA19.9 levels are commonly elevated in primary ovarian mucinous tumours but cannot be used to predict the histological subtype. J Clin Pathol. 2010;63(2):169–73.
30. National Institute for Health and Clinical Excellence. Ovarian cancer: the recognition and initial management of ovarian cancer. NICE clinical guideline 122. London: NICE; 2011.
31. American College of Obstetricians and Gynecologists. Management of adnexal masses. ACOG Practice Bulletin No. 83. Washington DC: ACOG; 2007.
32. Goodman LR, Goldberg JM, Flyckt RL, Gupta M, Harwalker MJ, Falcone T. Effect of surgery on ovarian reserve in women with endometriomas, endometriosis and controls. Am J Obstet Gynecol. 2016;215(5):589.e1–6.
33. Kondo W, Bourdel N, Cotte B, Tran X, Botchorishvili R, Jardon K, Rabischong B, Pouly JL, Mage G, Canis M. Does prevention of intraperitoneal spillage when removing a dermoid cyst prevent granulomatous peritonitis? BJOG. 2010;117(8):1027–30.
34. Bristow RE, Berek JS. Surgery for ovarian cancer: how to improve survival. Lancet. 2006;367(9522):1558–60.
35. Bristow RE, Nugent AC, Zahurak ML, Khouzhami V, Fox HE. Impact of surgeon specialty on ovarian-conserving surgery in young females with an adnexal mass. J Adolesc Health. 2006;39(3):411–6.
36. Canis M, Jardon K, Rabischong B, Bourdel N, Mage G. Advanced ovarian cancer, an optimal surgical treatment is possible to all patients owing to laparoscopy. Ann Chir. 2006;131(8):423–5.
37. Canis M, Pouly JL, Wattiez A, Mage G, Manhes H, Bruhat MA. Laparoscopic management of adnexal masses suspicious at ultrasound. Obstet Gynecol. 1997;89(5 Pt 1):679–83.
38. Hidlebaugh DA, Vulgaropulos S, Orr RK. Treating adnexal masses. Operative laparoscopy vs. laparotomy. J Reprod Med. 1997;42(9):551–8.
39. Pittaway DE, Takacs P, Bauguess P. Laparoscopic adnexectomy: a comparison with laparotomy. Am J Obstet Gynecol. 1994;171(2):385–9; discussion 389–91.
40. Delabaere A, Bourdel N, Botchorishvili R, Tran X, Jardon K, Rabischong B, Canis M, Mage G. How I do... laparoscopy with previous laparotomy. Gynecol Obstet Fertil. 2009;37(4):346–8.
41. Dubuisson J, Botchorishvili R, Perrette S, Bourdel N, Jardon K, Rabischong B, Canis M, Mage G. Incidence of intraabdominal adhesions in a continuous series of 1000 laparoscopic procedures. Am J Obstet Gynecol. 2010;203(2):111.e1–3.
42. Canis M, Jardon K, Niro J, Rabischong B, Bourdel N, Botchorishvili R, Pouly JL, Mage G. Endoscopic management of gynecological malignancies: an update. 2007. Bull Acad Natl Med. 2007;191(7):1357–65; discussion 1365–6.
43. Possover M, Morawski A, Hettenbach A. Laparoscopic treatment of ovarian tumors in menopausal women. J Gynecol Obstet Biol Reprod (Paris). 1994;23(7):784–9.
44. Possover M, Mader M, Zielinski J, Pietrzak K, Hettenbach A. Is laparotomy for staging early ovarian cancer an absolute necessity? J Am Assoc Gynecol Laparosc. 1995;2(3):285–8.
45. Chéreau E, Ballester M, Rouzier R, Coutant C, Daraï E. Advanced ovarian cancer: criteria of resectability. Bull Cancer. 2009;96(12):1189–97. https://doi.org/10.1684/bdc.2009.0985.
46. Fagotti A, Ferrandina G, Fanfani F, Ercoli A, Lorusso D, Rossi M, Scambia G. A laparoscopy-based score to predict surgical outcome in patients with advanced ovarian carcinoma: a pilot study. Ann Surg Oncol. 2006;13(8):1156–61.
47. Mage G, Canis M, Manhes H, Pouly JL, Bruhat MA. Ovarian cysts and celioscopy. Apropos 226 cases. J Gynecol Obstet Biol Reprod (Paris). 1987;16(8):1053–61.
48. Blanc B, D'Ercole C, Nicoloso E, Boubli L. Laparoscopic management of malignant ovarian cysts: a 78-case

national survey. Part 2: follow-up and final treatment. Eur J Obstet Gynecol Reprod Biol. 1995;61(2):147–50.
49. Zomer MT, Ribeiro R, Branco AW, Branco Filho AJ, Kondo W. How do I treat ovarian dermoid cyst by laparoscopy? Bras J Video-Surg. 2011;4(2):84–90.
50. Kondo W, Bourdel N, Zomer MT, Slim K, Rabischong B, Pouly JL, Mage G, Canis M. Laparoscopic cystectomy for ovarian endometrioma—a simple stripping technique should not be used. J Endometr. 2011;3(3):125–34.