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REVIEW

Role of minimally invasive surgery in complex adnexal tumours and ovarian cancer

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Abstract

Ovarian cancer is one of the most common causes of cancer-related death in women. Adnexal masses are frequently diagnosed during reproductive age and often require surgical removal. The risk of malignancy when dealing with a complex adnexal mass should be defined prior to surgery and several scoring systems may be useful for this purpose. Laparoscopic management of ovarian tumours allows a minimally invasive approach with respect to several oncological assumptions. In the last decade concerns have been raised regarding the risk of cyst rupture and tumour spillage as a consequence of the laparoscopic technique itself both in early and advanced stages of ovarian cancer. Although limited data have been reported in the literature on the use of minimally invasive techniques in ovarian cancer, the clear benefits of this approach must be balanced with the potential hazards in different clinical situations. Laparoscopic staging in borderline tumours and presumed early-stage ovarian cancer performed by a laparoscopic oncologist seems to be safe and effective when compared to laparotomy. The precise role of laparoscopy in patients with more advanced cancer is still to be defined, and the risk of suboptimal surgery should never outweigh the potential benefits of minimally invasive surgery. Thus, a tailored prediction of optimal laparoscopic debulking is mandatory in these patients.

Key words: Ovarian cancer; Laparoscopy; Borderline tumour; Adnexal masses

Core tip: The systematization of laparoscopic techniques and the improvement in technology have provided the basis for the increased use of laparoscopy in oncology in the last decade. Preoperative evaluation of complex adnexal masses and surgical planning are key factors in defining the most appropriate tailored therapy for each patient. Herein, we address the limitations and concerns regarding the use of minimally invasive techniques in the treatment of complex adnexal masses and ovarian cancer, including the clinical scenarios of borderline tumours, and both early and more advanced stages of the disease.

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INTRODUCTION

In the last two decades there has been increasing interest in the use of minimally invasive techniques in the field of gynaecological oncology. The role of laparoscopy

has been widely used in cervical and endometrial cancer due to its known clinical benefits such as magnification of the operative field, reduced intraoperative and postoperative complications, less intraoperative blood loss, and a shorter postoperative recovery. Nevertheless, the laparoscopic approach for the staging of ovarian cancer and management of suspicious adnexal masses has raised several concerns among gynaecological oncologists such as a possible reduction in radical surgical excision, an increased risk of port-site metastases or a higher recurrence rate related to more frequent intra-operative tumour cyst rupture.

Ovarian cancer is the sixth most common cause of cancer-related death among women in Europe[1] . Women have a 1 in 70 lifetime risk of developing ovarian cancer and more than 200000 women worldwide are diagnosed each year with ovarian cancer. Unfortunately, more than 65% of cases are diagnosed at advanced stages, and the five-year overall survival rate is 46%[2]. Of note, ovarian cancer is identified incidentally in up to 13% of cases after oophorectomy for a presumed benign adnexal mass[3]. Early ovarian cancer (EOC) includes cases in which the tumour is limited to the pelvis [Federation of Obstetrics and Gynecology (FIGO) stages Ⅰ-Ⅱb], whilst the term advanced ovarian cancer (AOC) is used for cases with extrapelvic disease or metastasis (FIGO stages Ⅱc or more). The five-year survival of EOC is noted to be over 90%. This figure is in sharp contrast to that of patients affected with more advanced disease, where the 5-year survival rate is poor at approximately 25%.

The laparoscopic approach for surgical staging or restaging of ovarian cancer was first reported in the mid 1990s[4]. When considering a minimally invasive approach it is of utmost importance to perform an accurate preoperative evaluation and to define the rules for surgical management of adnexal masses. As patients with EOC confined to the ovary have a good 5-year survival rate, important considerations including quality of life and fertility preservation should also be taken into account. Finally, the specific clinical features of borderline tumours raise important considerations in the laparoscopic management of these neoplasms.

In this review, we will address the limitations and concerns of the use of minimally invasive techniques in the treatment of complex adnexal masses and ovarian cancer.

EVALUATION AND MANAGEMENT OF COMPLEX ADNEXAL MASSES

Adnexal masses are a worrisome issue for gynaecologists worldwide. They may be symptomatic or incidentally discovered and can be found in females of all ages, even in fetuses. The prevalence of adnexal masses in the premenopausal asymptomatic population is about 8%, and decreases to 2.5% in postmenopausal women. The diagnostic evaluation of the mass is guided by the anatomic location, symptoms, age and reproductive status of the patient. The expertise of the multidisciplinary team in charge of the patient is essential in women with adnexal masses at high risk of malignancy, and therefore, they should be referred to specialized centres, whereas patients at low-risk can be managed at general hospitals[5]. The American College of Obstetricians and Gynecologists has proposed guidelines for the management of adnexal masses and the detection of EOC[6].

Serum markers, such as CA125 or CA 19.9 have been widely used in the diagnostic evaluation of adnexal masses. Unfortunately, the positive predictive value (PPV) for malignancy of these glycoproteins has been shown to be lower than 20% in the best scenarios of postmenopausal asymptomatic women[7]. Another emerging tumour marker that deserves special mention is the human epididymis secretory protein 4 (HE4)[8,9], a protein overexpressed in ovarian and endometrial cancers. That was the rationale for including HE4 in addition to CA125 in the Risk of Ovarian Malignancy Algorithm (ROMA), which has been used over the last five years yielding an improved PPV for the detection of high-risk patients when compared with previous decision-making strategies[10,11]. Another model widely used over the past two decades is the Risk of Malignancy Index (RMI), which is calculated using several ultrasound variables, the menopausal status and the CA125 level. Its relative simplicity makes it easy to use[12,13]. Recently, Van Gorp *et al*[14] compared the diagnostic accuracy of ROMA with the RMI and subjective assessment by ultrasound in 432 women with a pelvic mass who were scheduled to undergo surgery in a single-centre prospective cohort study. Surprisingly, the subjective assessment proved to be more accurate than the other two methods, suggesting that the addition of plasma biomarkers did not only further improve the usefulness of ultrasonography, but in contrast, worsened the diagnostic value.

Laparotomy is still the most widely used approach, particularly in patients with complex masses at ultrasound. In order to increase the rate of the minimally invasive approach in these patients, Canis *et al*[15,16] suggested a reasonable approach for managing adnexal masses under suspicion in specialized centres. Laparoscopy should be the first indication in both premenopausal and postmenopausal patients, excluding tumours exceeding 12 cm or in the presence of obvious advanced disease. In cases in which malignancy is histologically diagnosed intraoperatively, a complete surgical staging should be performed either by laparotomy or laparoscopy, according to the extent of the disease and the surgeon's experience. Under these conditions the need for laparotomy to treat benign neoplasms could be reduced from 42% to 14%. Ghezzi *et al*[17], showed that the availability of a precise diagnosis from a frozen section might favour a laparoscopic approach independently of clinical or ultrasound characteristics or level of tumour markers. They demonstrated that frozen section analysis was 100% sensitive enabling optimal staging in 16.9% of postmenopausal women with a diagnosis of ovarian cancer.

The laparoscopic approach to complex adnexal masses must always maintain the principle that the specimen

Table 1 Operative evaluation of macroscopic characteristics predicting the potential of malignancy in adnexal masses

Multiloculation
Aberrant neovascularization at ovarian surface
Thick cystic wall
Papillary excrescences
Firm adhesions
Ascites
Bilaterallity
Infiltration of surrounding structures

could be malignant. Therefore, special care should be taken while establishing the pneumoperitoneum, in order to avoid rupture of the cystic wall. Systematic examination of the abdominal cavity should be performed and reported after surgery. Peritoneal washings and biopsies of any suspicious areas are also mandatory.

Laparoscopic examination is essential to identify adnexal masses at high-risk of malignancy. Several macroscopic findings must be borne in mind and included in the operative report (Table 1). In the presence of a high-risk suspicious mass at the preoperative evaluation the mass should be mobilized bluntly with gentle traction of the ligamentary structures that support it, therefore, avoiding the possibility that the small and sharp laparoscopic instruments could damage the mass. Laparoscopic trocars should be secured to the abdominal wall to avoid any leakage of CO_2 and gas evacuation must be carried out at the end of the procedure through the trocar sheave and never directly through the wall incision. Under these conditions, the only limitation for the laparoscopic management of adnexal masses is the size of the endoscopic bag, as the whole mass should be contained in this device to permit its safe extraction through the abdominal wall without risk of contamination (Figure 1). To facilitate the manoeuvre of exteriorization, the fascia and the skin incision may be increased to 2-3 cm. As the tumour is being removed, morcellation of large specimens is allowed always inside the bag. Once the extraction has been successfully completed, the trocar can be replaced in its orifice and easily secured using a fascial closure instrument, thus permitting continuation of the procedure if necessary.

BORDERLINE OVARIAN TUMOURS

Borderline ovarian tumours (BOTs) form a separate entity within the group of epithelial ovarian tumours recognized by the World Health Organization (WHO). Three terms are used to clasify these tumours: borderline tumour, tumour of low malignant potential, and atypical proliferative tumour. They represent about 15%-20% of all epithelial ovarian malignancies and have a worldwide incidence of 1.8-4.8 per 100000 women per year. In comparison with ovarian carcinomas, BOTs are diagnosed at a lower FIGO stage, tend to appear in younger women (average 10 years younger), have a higher infertility rate and they are not usually associated with other neoplasms. Although prognosis for patients with BOTs is, in general,

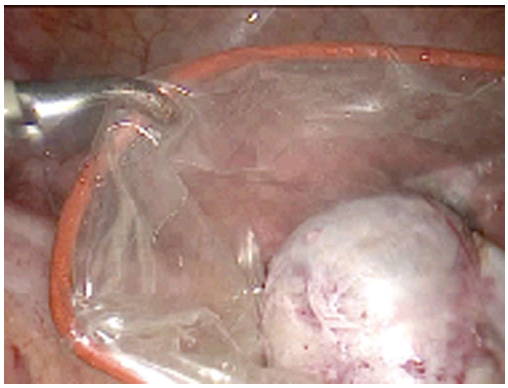

Figure 1 Specimen retrieval.

excellent, a minority will have a more aggressive form and may have long-term recurrence with a global 10-year recurrence rate of 10%-20%[18]. Therefore, the correct management and follow up is essential in these patients.

BOTs are characterized by increased epithelial proliferation accompanied by nuclear atypia (usually mild to moderate) and mildly increased mitotic activity with no stromal invasion. In typical serous BOTs, approximately 35% of patients have implants, which are either invasive (25%) or non-invasive (75%), and an invasive peritoneal implant is an adverse prognostic factor. When a BOT is identified at surgery by intraoperative histology, the recommended treatment is laparoscopic salpingo-oophorectomy (Figure 2). The correct staging surgery includes exploration of the entire abdominal cavity, peritoneal washings, omentectomy, multiple peritoneal biopsies, and complete resection of all macroscopic suspected lesions. For resection of the primary tumour, bilateral salpingo-oophorectomy in combination with hysterectomy is recommended, although some authors suggest that hysterectomy may cause more morbidity without a clear role in overall prognosis. Lymphadenectomy is not indicated. If a mucinous tumour is suspected or intraoperative histologic consultation leads to this diagnosis, appendectomy should be performed.

BOTs are usually diagnosed in women during reproductive age, which implies that therapeutic decisions regarding fertility-sparing surgery, treatment of infertility or premature hormonal deprivation, intra and postoperative morbidity, and adjuvant chemotherapeutic treatments are particularly pertinent. Nevertheless, the risk of recurrence and the risk of progression to invasive disease, which accounts for up to 2%-4% should be taken into consideration. The fertility-sparing options can range from cystectomy to adnexectomy, however, patients who undergo a conservative ovarian cystectomy should be informed that there is a substantial risk of relapse, and recurrence can even develop many years later, therefore, a long-term follow up must be agreed[19].

Laparoscopy is an attractive approach for BOTs supported by lower morbidity and fewer adhesions than laparotomy (both important for fertility). However, in many studies, laparoscopic management of BOTs was

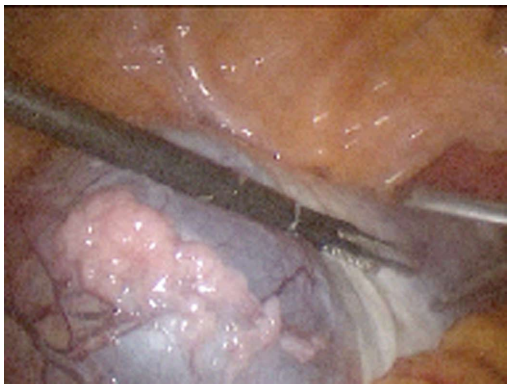

Figure 2 Macroscopic findings in borderline tumour.

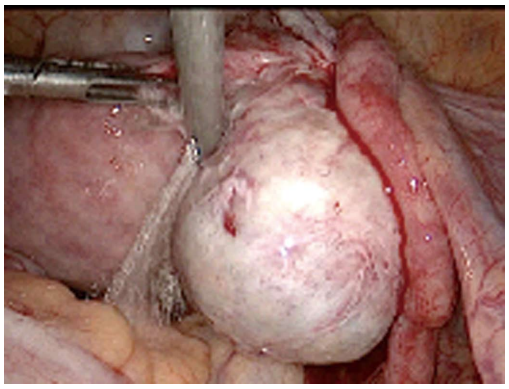

Figure 3 Laparoscopic cystectomy technique.

associated with a higher rate of cyst rupture and incomplete staging, probably due to low experienced surgeons[18,19]. Therefore, a laparoscopic approach for BOTs should always be performed by oncologic surgeons with expertise in extensive laparoscopic procedures in order to obtain both an optimal surgical staging and an optimal prognosis (Figure 3). In each patient affected by a suspicious adnexal mass it is essential to perform a careful and systematic examination of the abdominal cavity in order to detect possible peritoneal invasive implants. Ghezzi *et al*[17] reported a statistically significant difference in the rate of minor postoperative complications, with 6.7% of patients in the laparoscopy group experiencing such an event compared to 42.1% of patients in the laparotomy group. Fanfani *et al*[20] tested the accuracy of narrow band imaging in BOTs in order to increase the sensitivity of laparoscopy in the detection of peritoneal implants. This technology processes the spectral characteristics of the narrow-bind light aiming to enhance visualisation of the subperitoneal vessels. This allows significant improvements in the detection of tumoral implants in the peritoneum, as well as occult lesions, by revealing their characteristic surface staining or vascular pattern. This method has introduced the concept of "optical biopsy", and this principle of precise detection of malignancy has more recently been used in the laparoscopic management of recurrent platinum sensitive ovarian cancer[21] (Figure 4).

Intraoperative rupture is one of the main concerns

Figure 4 Narrow binding imaging in advanced ovarian cancer.

during the laparoscopic management of adnexal masses. Although the rupture rate is regarded to be higher for laparoscopy than for laparotomy in several studies, it did not affect the recurrence risk of BOTs[22-24]. Moreover, ovarian cyst rupture was not related to the surgical route, but to the implementation of cystectomy instead of adnexectomy[22]. Since the recurrence rate after cystectomy is high, it has been suggested that laparoscopic cystectomy should be considered only in women with one ovary or with bilateral tumours who wish to preserve their childbearing potential[22,23]. Nowadays, there is no evidence that adjuvant treatments improve prognosis or survival, as these tumours have poor response rates to traditional cytotoxic agents[24]. Some studies have shown that treatment with adjuvant platinum-based chemotherapy for invasive serous BOTs improves the prognosis with a relapse rate of less than 22%[25].

Fertility-preserving treatments are often desirable for women of reproductive age who are diagnosed with BOTs. When conservative surgery is indicated, the uterus and at least part of an ovary are preserved. Although data suggest that the rate of recurrence is higher after conservative surgery, this possibility could be offered to those women who wish fertility-sparing surgery due to their personal interests. It should be noted that conservative management should be limited to selected patients with complete resection in the absence of invasive peritoneal implants. Cystectomy should be considered only in bilateral tumours or in patients with one ovary, as oophorectomy has resulted in a lower recurrence rate in the contralateral ovary in comparison to cystectomy. If a relapse in the remaining ovary occurs conservative management may be offered, but this should be reserved for patients without invasive implants who are young (age < 40 years), desire fertility preservation, and engage in long-term follow-up (Figure 5). Cystectomy is not safe in patients undergoing conservative management for mucinous borderline tumours due to an increased risk of recurrence as invasive carcinoma. If the relapse occurs as invasive disease, complete debulking should be performed. If no relapse occurs after childbearing, there is no need to perform restaging surgery as long as the patient accepts a long-term follow up[26-29].

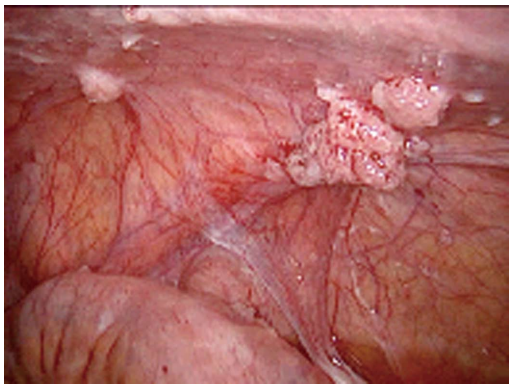

Figure 5 Peritoneal invasive implants in mucinous borderline tumours.

The impact of conservative fertility-sparing surgeries has been compared with more extensive surgical approaches. Yinon *et al*[30] studied the recurrence rate in 40 patients who underwent unilateral salpingo-oophorectomy *vs* 22 patients who were managed conservatively with ovarian cystectomy. Recurrence rates were found to be similar between the two groups (27.5% *vs* 22.7%, respectively, $P = 0.8$). Park *et al*[31] confirmed these results in a group of 360 women with BOT. A radical approach was associated with a similar recurrence rate (5.1%) to conservative management (4.2%), with no differences in disease-free survival rates. Patterns of recurrence also seem to differ between the fertility-sparing and the radical surgery group, where isolated recurrence in the remaining ovary was the most frequent form of relapse in the former and recurrence in the contralateral ovary in the latter. Therefore, a systematic follow-up should be planned in order to detect recurrences and complementary surgery after fulfilling childbearing desires can be agreed with the patient.

EARLY-STAGE OVARIAN CANCER

The extended approach for surgical staging of EOC is usually performed by exploratory laparotomy including hysterectomy and salpingo-oophorectomy, pelvic and paraaortic lymph node dissections, omentectomy, peritoneal washings, and peritoneal biopsies following the recommendations of the International FIGO[32]. Reich published the first report on laparoscopic staging in EOC in the early 1990s[33]. Two decades ago Querleu *et al*[4] published the first report on laparoscopic complete restaging of nine patients with EOC. After these initial reports there has been a progressive improvement in the instrumentation and imaging quality, which has led to more groups considering this approach in selected patients.

The Cochrane Collaboration recently performed a systematic review to evaluate the benefits and risks of laparoscopy compared with laparotomy for the surgical treatment of FIGO stage I ovarian cancer[34]. This meta-analysis did not find any publications that met the inclusion criteria to address this subject. Even with the lack of well-established evidence and the low quality of available survival data, several studies address important issues concerning the role of laparoscopy in this type of tumour. Three different studies[35-37] have analysed the differences in survival rates between patients undergoing laparoscopy *vs* laparotomy for EOC. No statistical difference was observed in survival rates or other oncological parameters. Laparoscopy showed less blood loss and better recovery with a significantly higher operative time, which could be explained by the learning curve in this type of procedure. Other authors[38] found, in short series, that the laparoscopic approach in EOC resulted in significantly worse overall survival in comparison to laparotomy. However, these results are questionable as comprehensive staging was not the purpose of laparoscopy in most of these women. A shorter interval to chemotherapy was demonstrated by Park and colleagues in patients staged by laparoscopy than in patients staged by laparotomy (12.8 ± 4.9 d *vs* 17.6 ± 8.3 d), confirming that a minimally invasive approach does not delay important adjuvant treatment, and may avoid delays due to surgical complications more frequently associated with laparotomy[39].

Laparoscopy also seems to have more advantages when fertility-sparing treatment is indicated in well-differentiated FIGO I a stages in women wishing to conceive. In these cases, laparoscopic staging should include a complete pelvic and paraaortic lymph node dissection, omentectomy, and unilateral salpingo-oophorectomy with preservation of the uterus as well as the contralateral ovary and tube after careful checking for the absence of suspicious areas, and if detected, directed biopsies should be performed. Patients should be advised that several studies have reported an increased recurrence rate with fertility-sparing techniques[40,41]. Therefore, it is advisable to proceed with a strict follow-up and complete restaging, which can be performed also by laparoscopy after delivery. Muzii *et al*[42] reported two pregnancies with term deliveries and two miscarriages out of 27 unexpected ovarian cancer patients who underwent fertility-saving laparoscopy and a follow up of 20 mo.

Port-site metastasis is one of the main concerns among gynaecological oncologists while managing ovarian cancer in either early or advanced stages. The positive CO_2 pressure with changes in peritoneal ambient pressure and the possible facilitation of tumoral cell implantation at the trocar sites due to gas leakage are considered to be the possible mechanisms of this complication. Initial reports showed a very high rate up to 20% in patients with ascites, affected by recurrent or advanced disease or undergoing multiple laparoscopic procedures. More recent series have shown a prevalence of port-site metastasis lower than 2%, which is similar to traditional laparotomy[43,44]. There are several manoeuvres that can be adopted in order to prevent this complication, although none have been clearly demonstrated to be effective in well-designed trials[45,46] (Table 2). The laparoscopic surgeon has to take into account this possible complication in cancer managed by laparoscopy irrespective of the dis-

Table 2 Surgical manoeuvres in order to decrease port-site metastasis in the laparoscopic management of complex adnexal masses

Using wound protectors
Minimizing tumour manipulation
Anchoring ports to prevent dislodgment
Avoiding carbon dioxide leakage and sudden desufflations
Using gasless laparoscopy
Irrigating and suctioning the abdomen, instruments and ports before removal
Using heparin or 0.25%-1% povidone-iodine solution to irrigate wounds and the abdomen
Excising trocar sites and deliberate closure of all abdominal layers including the peritoneum after laparoscopy; or postoperative port-site radiation
Resuming definitive surgery or chemotherapy early
Using 5-fluorouracil, topical taurolidine or intraperitoneal endotoxin

ease stage.

Another concern with the laparoscopic approach is the feared possibility of an increase in the risk of rupture of malignant masses in comparison to laparotomy. However, various studies have shown that this risk is similar to that observed following laparotomy, which ranges from 11.4%-30.3%[47-51]. Vergote *et al*[48] performed a review of a large series of 1545 patients with different stages of ovarian cancer in which reduced progression-free survival was associated with increased cystic rupture. In contrast, Sjövall and colleagues[52] showed that tumour rupture during surgery did not have an impact on survival in 394 patients.

Finally, a recent systematic review of 11 observational studies[53] showed that the laparoscopic approach for EOC had less blood loss with an overall conversion to laparotomy of 3.7%. The overall rate of recurrence in studies with a median follow-up period of 19 mo was 9.9% concluding that the operative outcomes of the laparoscopic approach in patients with EOC was comparable with those of laparotomy.

Taking into consideration the lack of high-grade evidence, the laparoscopic approach in the early stages of ovarian cancer seems safe and effective in terms of oncologic outcomes. In addition, early recovery and initiation of adjuvant therapy may be beneficial for patient outcome, however, oncological manoeuvres adopted during surgery should be similar to those performed during laparotomy.

ADVANCED-STAGE OVARIAN CANCER

The standard treatment of AOC includes upfront surgery with intent to accurately diagnose and stage the disease and to perform maximal cytoreduction, followed by chemotherapy in most cases. Rosenoff *et al*[54] reported the use peritoneoscopy for pretreatment evaluation in ovarian cancer four decades ago. In the early 1990s, pioneers in laparoscopic surgery used minimally invasive techniques to treat gynaecologic cancers, including laparoscopic staging of EOC and primary and secondary cytoreduction in advanced and recurrent disease in selected cases[55,56]. The potential role of minimally invasive surgery in the treatment of AOC is warranted for the following: (1) laparoscopic assessment of the feasibility of upfront surgical cytoreduction by laparotomy in patients with advanced ovarian cancer; (2) laparoscopic debulking of advanced disease; (3) laparoscopic reassessment in patients with complete remission after primary treatment; and (4) laparoscopic assessment and cytoreduction of recurrent disease[55].

Different indications for the laparoscopic approach in advanced ovarian cancer have been described including triage for resectability, second-look assessment, and in select cases, primary or secondary cytoreduction (Figures 6 and 7). Laparoscopy offers multiple advantages over traditional laparotomy including smaller incisions, improved visualization, less blood loss, reduction in the need for analgesics, decreased morbidity and a more rapid recovery. An additional advantage for patients with ovarian cancer requiring adjuvant therapy includes a shorter interval before initiation of adjuvant therapy[56].

Gallotta *et al*[57] reported the outcome of laparoscopic secondary cytoreduction in patients with localized recurrence of ovarian cancer. Twenty-nine patients with localized recurrent ovarian cancer were selected for laparoscopic cytoreduction. A complete debulking was achieved in 96.2% of cases with a median disease-free survival time of 14 mo. The median operating time was 188 min with a median estimated blood loss of 150 mL and a median hospital stay of 4 d. No intraoperative complications occurred and two conversions to laparotomy occurred due to technical difficulties.

Fagotti *et al*[58] retrospectively evaluated ovarian cancer patients with isolated platinum sensitive relapse, defined as the presence of a single nodule in a single anatomic site. In every case the presence of isolated relapse was assessed at preoperative positron emission tomography-computed tomography (PET/CT) scan and confirmed by cytoreductive laparoscopy followed by Hyperthermic Intraperitoneal Chemotherapy (HIPEC). Out of 84 women with platinum sensitive relapse, 10 cases showed isolated relapse and were treated with laparoscopic/robotic cytoreduction and HIPEC. In all cases, a complete debulking was achieved. The median operative time was 122 min (95-140 min), with an estimated blood loss of 50 cm^3 (50-100 cm^3) and a median length of hospital stay of 4 d (3-7 d). The interval from surgery to adjuvant chemotherapy was 21 d (19-32 d). No grade 3/4 surgical, metabolic, or haematologic complications occurred. In all cases, postoperative PET/CT scan was negative and no recurrence was observed after a median time of 10 mo.

More recently, another report[59] evaluated the prognostic impact of routine use of staging laparoscopy (S-LPS) in patients with AOC. All women were submitted to S-LPS before primary debulking surgery (PDS) or neoadjuvant treatment (NACT) and interval debulking surgery (IDS). The surgical and survival outcomes were evaluated in 300 consecutive patients submitted to S-LPS. One hundred forty-eight (49.3%) women were considered suitable for PDS and the remaining 152 (50.7%)

Figure 6 Extensive bowel infiltration in advanced-stage ovarian cancer.

Figure 7 Liver and diaphragmatic infiltration in stage III ovarian cancer.

received NACT. The percentages of complete (residual tumour, RT = 0) and optimal (RT < 1 cm) cytoreduction following PDS and IDS were 62.1% and 57.5%, 22.5% and 27.7%, respectively. The number of post-operative complications in the NACT/IDS group were lower than that in the PDS group with a median disease-free survival interval in women with RT = 0 at PDS of 25 mo (95%CI: 15.1-34.8), which was longer than that in all other patients, irrespective of the type of treatment they received. At multivariate analysis, residual disease and performance status maintained an independent association with PFS (60).

Nezhat *et al*[60] described their preliminary experience with laparoscopic total primary or interval cytoreduction in 32 women with presumed advanced (FIGO stage ⅡC or greater) ovarian, fallopian tube, or primary peritoneal cancers. Seventeen patients underwent total laparoscopic primary or interval cytoreduction, and 88.2% had optimal cytoreduction. Eleven underwent diagnostic laparoscopy and conversion to laparotomy for cytoreduction, and 72.7% had optimal cytoreduction. Four patients had biopsies, limited cytoreduction or both. In the laparoscopy group, 9 patients have no evidence of disease (NED), 6 are alive with disease (AWD), and 2 have died of disease (DOD), with a mean follow-up time of 19.7 mo. In the laparotomy group, 3 patients have NED, 5 are AWD, and 3 have DOD, with a mean follow-up of 25.8 mo. Estimated blood loss and length of hospital stay were less for the laparoscopy group, while operating time and complication rates were not different. Median time to recurrence was 31.7 mo in the laparoscopy group and 21.5 mo in the laparotomy group. The authors concluded that laparoscopy is an effective tool in advanced ovarian cancer in order to predict optimal debulking.

Interestingly, a prospective study[61] reported the accuracy of laparoscopy performed to describe intraabdominal extent of the disease in AOC. One hundred sixty-eight cases were considered eligible for the study. A per-protocol analysis was performed on 120 cases. The worst laparoscopic assessable feature was mesenteric retraction, whereas the remaining variables ranged from 99.2% (peritoneal carcinomatosis) to 90% (bowel infiltration). The accuracy rate was over 80% for both single parameters and overall score. The parameters used to predict the resectability of the tumour by laparoscopy should be chosen according to the experience of the surgical team in order to minimize the rate of suboptimal surgery (Table 2).

There is still controversy in defining the exact role of laparoscopy in advanced disease. Prediction of resectability is one of the most valuable tools in patient management and might facilitate a better selection of patient candidates for neoadjuvant chemotherapy.

CONCLUSION

In conclusion, although limited data has been reported on the use of minimally invasive techniques in ovarian cancer, the clear benefits of this approach must be balanced with the potential hazards in different situations. Laparoscopic staging in borderline tumours and presumed early-stage ovarian cancer should be performed by a trained laparoscopic oncologist and seems to be safe and effective in comparison to laparotomy. Early recovery and reduced intraoperative complications and blood loss leads to a short period before initiation of adjuvant therapy. In addition, fertility-sparing management in well selected patients managed by laparoscopy could have additional benefits in terms of pregnancy rates. There is still insufficient data supporting the role of laparoscopy for advanced ovarian cancer, but the minimally invasive approach permits selection of candidates for primary optimal cytoreduction resulting in a lower rate of suboptimal surgeries.

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