Review Article

Application of Laparoscopic Surgery in Gynecological Oncology

Wen-Chun Chang,1 Long-Chien Lee,2 Su-Cheng Huang,1 Bor-Ching Sheu1*

The role of laparoscopic surgery in the management of gynecological cancers continues to expand. For early-stage cervical cancer, laparoscopically assisted radical vaginal hysterectomy is feasible, and radical vaginal trachelectomy with laparoscopic pelvic lymphadenectomy has emerged as a safe option for women who desire fertility preservation. In the treatment of early-stage endometrial cancer, the surgical staging of laparoscopic hysterectomy, peritoneal washings and pelvic lymph node dissection is effective and safe when compared with the same surgery performed via laparotomy. In ovarian malignancies, laparoscopic surgery has been incorporated to manage early-stage cancers.

Key Words: cervical cancer, endometrial cancer, laparoscopy, lymphadenectomy, ovarian cancer

The use of laparoscopy in oncological procedures, whether alone or in combination with other approaches, is growing. Technical advances have made modern-day laparoscopy more widely applicable, and it is now possible to perform laparoscopically all of the International Federation of Gynecology and Obstetrics (FIGO) standard surgical staging procedures for early-stage gynecological cancer.1–4 The advantages of laparoscopic staging are smaller incisions and thus lower postoperative morbidity, faster postoperative recovery,5 and quicker commencement of adjuvant radiotherapy or chemotherapy.6 However, laparoscopic surgery (LS) technically hampers the removal of large tumors, and has a potential risk of trocar site metastasis. In this paper, the application of LS in endometrial, cervical and ovarian cancer is discussed.

Laparoscopic Lymphadenectomy

Currently, advanced laparoscopic techniques are used to evaluate and treat cervical, endometrial and ovarian malignancies. Assessment of the invasion of the pelvic lymph nodes is part of the staging process for these gynecological cancers. In most cases, imaging techniques cannot reliably evaluate lymphatic spread. Endoscopy offers a satisfactory means of determining the surgical stage

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of the disease. Pelvic lymphadenectomy can influence the therapeutic strategy, especially when a combination of treatments is proposed. Specifically, transperitoneal laparoscopic lymphadenectomy that includes the pelvic and para-aortic nodes is a feasible and efficacious procedure in the management of certain gynecological malignancies. Figure 1 depicts the typical patterns of lymphatic dissemination of gynecological cancer. The pelvic lymph nodes include the common iliac, external iliac, internal iliac (hypogastric), and obturator nodes. The para-aortic lymph nodes are sampled bilaterally to the level of the inferior mesenteric artery. The level of dissection that is considered adequate is controversial. Some authors have suggested that the periaortic dissection should extend to the renal vessels.

Tables 1–3 show that laparoscopy provides an equivalent lymph node yield compared with laparotomy in gynecological cancer. Some investigators have reported their experience with 650 pelvic and periaortic lymphadenectomies performed for gynecological malignancies; 396 of which were for cervical cancer, 112 for endometrial cancer, and 44 for ovarian cancer. After a learning period of approximately 20 procedures, a constant number of pelvic lymph nodes (16.9–21.9) were removed. Pelvic lymphadenectomy took 28 minutes, and para-aortic lymphadenectomy took 36–62 minutes. The number of para-aortic lymph nodes removed has increased continuously from 5.5 to 18.5. The number of lymph nodes removed and the duration of pelvic lymphadenectomy were independent from the body mass index of the patient. The overall complication rate was 8.7%, with 2.9% intraoperative (vessel or bowel injury) and 5.8% postoperative complications. Figure 2 shows the operative procedures of laparoscopic pelvic lymphadenectomy.

**Endometrial Cancer**

The risk factors of endometrial cancer, such as diabetes, hypertension and obesity, have been well documented to increase surgical risk and confer a higher perioperative morbidity and mortality. Therefore, the adoption and utilization of LS to treat this patient population is an attractive option. However, there are some limitations associated with LS, and women with a uterine size that exceeds a transversal diameter of 8 cm, clinically advanced disease, or other important health problems are not candidates for LS. The surgical approach includes washing cytology, hysterectomy, bilateral salpingo-oophorectomy, and lymphadenectomy. In women with endometrial cancer, the operating time, number of lymph glands resected, complication rate, recurrence rate, and survival outcome were the same with laparoscopic and open surgery (Table 1). In addition, LS was associated with a shorter hospital stay and a better postoperative quality of life. These data demonstrate that the laparoscopic surgical approach for the treatment of patients with clinical early-stage endometrial cancer is effective and safe.

Cancer cell dissemination caused by the uterine manipulator during LS is an issue of concern, and several studies have noted a higher vaginal cuff recurrent rate in LS patients. As far as we are aware, there have been no studies that were adequately powered to detect a difference in vaginal cuff recurrence between patients who were treated with LS and laparotomy. However, some authors have suggested that efforts should...
### Table 1. Comparison of laparoscopic and laparotomic staging surgery of endometrial cancer in the literatures

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<td>F/U (mon)</td>
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<tr>
<td>Recurrence (%)</td>
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<td>8.5</td>
<td>5.3</td>
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<tr>
<td>Survival (%)</td>
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<td>82.7</td>
<td>86.5</td>
<td>89.5</td>
<td>91.9</td>
<td>93</td>
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*LS = laparoscopic; LT = laparotomic; LN = lymph node; EBL = estimated blood loss.*

### Table 2. Comparison of laparoscopic and laparotomic radical hysterectomy of cervical cancer in the literatures

<table>
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<td>206</td>
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<td>EBL (mL)</td>
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<td>Blood transfusion (%)</td>
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<td>5.7</td>
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<td>Complication (%)</td>
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<td>13</td>
<td>4</td>
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<td>6</td>
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<td>Postoperative adjuvant chemoradiation (%)</td>
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<td>33</td>
<td>22</td>
<td>21</td>
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<tr>
<td>F/U (mon)</td>
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<td>17</td>
<td>21</td>
<td>52</td>
<td>49</td>
<td>26</td>
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<tr>
<td>Recurrence (%)</td>
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<td>0</td>
<td>5.6</td>
<td>5.6</td>
<td>4</td>
<td>4</td>
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<tr>
<td>Survival (%)</td>
<td>100</td>
<td>100</td>
<td>100</td>
<td>100</td>
<td>94</td>
<td>96</td>
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</table>

*LS = laparoscopic; LT = laparotomic; LN = lymph node; EBL = estimated blood loss.*
be made during LS to minimize the risk of vaginal recurrence, such as using a 1-0 Vicryl suture to close the cervix as the first step during LS, and avoiding manipulator use.29

**Cervical Cancer**

In recent years, vaginal radical surgery combined with laparoscopic pelvic lymphadenectomy for early-stage cervical cancer has gained recognition in the field of oncology. Dargent30 was the first to use the combined approach in 1987, and since then, gynecological oncologists have used LS more frequently in the management of cervical cancer, and have concluded that it is feasible and effective.31–37 Patients with tumors less than 4 cm, negative lymph nodes, and the absence of combined angiovascular and lymphovascular space involvement can be identified by LS, and are ideal candidates for laparoscopic-assisted radical hysterectomy.38 Studies that have compared LS and laparotomy for radical hysterectomy are listed in Table 2. This demonstrates that early cervical cancer can be treated successfully with LS with similar efficacy and recurrence rates to those of laparotomy. The major benefits are less intraoperative blood loss and shorter hospital stay.

In cervical cancer, one of the most important prognostic factors is the status of the lymph nodes. Approximately 7–15% of all patients with early invasive cervical carcinoma are found to have lymphatic spread, and removing pelvic and para-aortic lymph nodes is an important part of the staging procedure. LS has been used to perform pelvic and para-aortic lymphadenectomy, along with laparoscopic-assisted radical vaginal hysterectomy,39 total laparoscopic radical hysterectomy,40,41 or laparoscopic-assisted radical vaginal trachelectomy.42,43 Magrina et al44 compared three groups: robotic-assisted laparoscopy, traditional laparoscopy, and laparotomy, and concluded that the robotic and laparoscopic groups were very similar in their surgical outcomes, and that both were preferable to laparotomy.

As a result of effective screening, an increasing number of women are being diagnosed with cervical cancer at a younger age. Many of these women are of childbearing age and wish to preserve their fertility. Radical trachelectomy (RT) is a surgical procedure that was developed by Daniel Dargent45 in the 1990s. This is the best fertility-sparing procedure for patients with early-stage cervical carcinoma. It can be performed via laparotomy, but most teams use a laparoscopic–vaginal approach—lymphadenectomy is performed laparoscopically and RT via a vaginal approach.42,43 Pregnancy after RT is feasible and the majority (50–70%) of patients who attempt to conceive succeed at least once.46–48

Criteria for consideration for laparoscopic-assisted radical vaginal trachelectomy42,43 include: (1) childbearing age with the desire to preserve fertility; (2) reasonable ability to conceive; (3) FIGO stages IA2 to IB, with lesions less than 2 cm in greatest dimension; (4) limited endocervical involvement on colposcopy; (5) no positive lymph nodes; (6) no lymphovascular space invasion; and (7) adequate understanding and comprehension of the procedure.49 It has been confirmed that pregnancy is possible after RT but the premature delivery rate is high.50 Prematurity is initiated by premature rupture of the membranes because of the absence of a cervical plug, which leads to ascending chorioamnionitis.50 Antibiotics should be considered. The isthmic cerclage seems to be efficient, but delivery by classical cesarean section

<table>
<thead>
<tr>
<th>Table 3. Recurrences after laparoscopic or laparotomic conservative surgery for borderline ovarian tumors in the literatures</th>
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<tr>
<td>Maneo et al [56]</td>
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<tr>
<td>Number of cases</td>
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<td>Rupture of the cyst (%)</td>
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<td>Cystectomy (%)</td>
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<tr>
<td>F/U (mon)</td>
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<tr>
<td>Recurrence (%)</td>
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<td>Survival (%)</td>
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Figure 2. Operative procedures for laparoscopic pelvic lymphadenectomy. (A) Open the retroperitoneal space. Incision of the lateral peritoneum is performed from the paracolic fossa to the round ligament of the uterus. The peritoneal incision is extended a few centimeters caudad towards the umbilical ligament (arrowhead). (B) Open the paravesical space. The umbilical ligament is dissected, and then retracted medially with an atraumatic grasper. The paravesical space is opened using simple diverging traction with the graspers. (C) Dissect the external iliac artery (EIA). The round ligament is retracted laterally with a grasper to expose the EIA, which must be dissected along the adventitia of the vessel. The external nodal chain above the EIA is dissected using simple traction. This dissection is continued to the iliac junction. (D) Dissect the external iliac vein (EIV). The surgeon then dissects the internal surface, followed by the superior surface of the EIV. This makes it possible to obtain the nodes situated between the EIA and EIV. (E) Dissect the obturator nerve (ON). The internal and inferior surfaces of the EIV are dissected. By dissecting free the lymph nodes, the surgeon can identify the ON, which represents the deep limit of lymphadenectomy. Once identified, the nerve is dissected along the portion that corresponds to lymphadenectomy. (F) The anatomical landmarks at the end of the procedure are: umbilical ligament (arrowhead), EIA, EIV, ON, and ureter. EIA = external iliac artery; EIV = external iliac vein; ON = obturator nerve.
is necessary at the onset of labor or at 35–38 weeks' gestation.51

**Borderline Ovarian Tumors**

Borderline ovarian tumors, also referred to as low-malignant-potential tumors, represent 15% of epithelial ovarian tumors, and are characterized by histological features of malignant tumors without identifiable destructive stromal invasion.52 They occur predominantly among women of reproductive age, with a recurrence rate of 10–20% and have excellent prognosis. Therefore, fertility-sparing is important and LS in borderline ovarian tumors has become increasingly common.53,54 Fertility-sparing options can range from cystectomy to adnexectomy, but patients who undergo conservative ovarian cystectomy carry a substantial risk of relapse, which can even develop after many years.54–58 Therefore, when borderline ovarian tumors are identified at surgery by intraoperative histology, the recommended conservative treatment is laparoscopic salpingo-oophorectomy.54 Table 3 shows the recurrence after LS or laparotomy conservative surgery for borderline ovarian tumors. Although the rate of intraoperative rupture is higher for LS than laparotomy, it does not affect the recurrence risk.56,58,59 Moreover, ovarian cyst rupture is not related to the surgical route but to the frequency of cystectomy.58 The rate of recurrence after cystectomy is high, therefore, it is suggested that laparoscopic cystectomy should be considered only for women with one ovary or with bilateral tumors who wish to preserve their childbearing potential.54,57,58

**Ovarian Cancer**

Accurate surgical staging is pivotal for correct management of all ovarian malignancies. According to the FIGO guidelines, complete surgical staging should include total abdominal hysterectomy, bilateral salpingo-oophorectomy, omentectomy, pelvic lymph node dissection, and peritoneal washings. Since the first report on the feasibility of laparoscopic surgical staging for early-stage ovarian cancer in 1994,60 gynecological oncologists have been using laparoscopic staging more frequently in the management of ovarian cancer.1,61–65 Nezhat et al63 reported the longest mean follow-up in a case series of 36 patients with invasive ovarian carcinoma managed with LS, and have concluded that LS is safe and efficacious in staging early ovarian cancer. The mean duration of follow-up was 55.9 months, and there was a demonstrated 100% overall survival rate.63

Park1 compared the feasibility, accuracy, and safety between LS and laparotomy staging of early-stage ovarian cancer and found that they show similar surgical staging adequacy and accuracy. Moreover, LS shows more favorable operative outcomes, such as shorter operating time, lower transfusion requirement, faster return of bowel movement, and shorter postoperative hospital stay. In addition, LS has a shorter time interval than laparotomy to adjuvant chemotherapy. LS for staging early-stage ovarian cancer is also thought to carry the risk of surgical tumor rupture. However, it has been found that the incidence of iatrogenic rupture of ovarian cancer was similar in the LS and laparotomy groups (10.5% vs. 12.1%).1 After a median follow-up time of 17 months, there was no recurrence or death from disease in either group.1 Therefore, LS can be an alternative to LT for the treatment of early ovarian cancer.

With regard to the possibility of fertility-sparing surgery, some studies have demonstrated that well-selected ovarian cancer patients, such as grade 1, FIGO stage Ia, can safely benefit from conservative treatment as well.52,66,67 Moreover, if fertility-sparing surgery is performed in clear-cell histotype, grade 2–3, stage >Ia, platinum-based adjuvant chemotherapy is indicated.62,66,67 However, longer follow-up is needed to draw definitive conclusions concerning survival data.

In conclusion, laparoscopy is selectively adopted for the management of apparently early-stage disease, defined as organ-confined cancer with no evidence of gross metastatic disease, and
References


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