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Review

Laparoscopic and robotic techniques for radical hysterectomy in patients with early-stage cervical cancer

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Contents

Introduction

Laparoscopic surgery is associated with less morbidity than laparotomy. Numerous studies have shown that laparoscopic surgery is associated with decreased blood loss, lower transfusion rates, decreased analgesic requirements, shorter length of hospital stay, improved cosmesis, and faster return to normal daily activities. In the 1990s, gynecologic oncologists began using laparoscopic surgery to perform hysterectomy and lymph node dissection for the treatment of patients with endometrial cancer.

Patients with early-stage cervical cancer (stage IA2 and IB1) have traditionally been treated with abdominal radical hysterectomy and pelvic lymphadenectomy. Over the past 10 years, however, there has been increasing evidence in the literature that total laparoscopic radical hysterectomy is safe and feasible for patients with early-stage cervical cancer and does not compromise oncologic outcomes [1–9]. More recently, there is growing evidence highlighting the benefits of robotic surgery in management of gynecologic malignancies.

Total laparoscopic radical hysterectomy

Laparoscopic radical hysterectomy for cervical cancer was initially described by Canis et al. [1] and Nezhat et al. [2]. Since those initial reports, a number of other groups have published their experiences showing the feasibility and safety of this

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procedure for cervical cancer. In addition, these studies have shown that recurrence and overall survival rates in patients with early-stage cervical cancer are equivalent in patients who undergo laparoscopic radical hysterectomy and those who undergo surgery performed by laparotomy [1–9].

The use of laparoscopic hysterectomy is expanding owing to a variety of factors. Surgeons continue to expand their training in minimally invasive surgery, and as a result, their proficiency in performing advanced laparoscopic surgery continues to grow. Not only is there greater emphasis in training programs on assuring that graduates are adequately trained to perform advanced laparoscopic surgery, but also there are plentiful opportunities for surgeons to attend training sessions through gynecologic oncology societies and industry-sponsored programs. In addition, the availability of much better equipment has improved the safety of the laparoscopic approach. Finally, patients are increasingly aware of the option of minimally invasive surgery to treat early-stage cervical cancer and often request this approach.

Surgical technique

The surgical technique for total laparoscopic radical hysterectomy is as follows. The patient is placed in the low lithotomy position with her arms tucked at her sides. The uterine manipulator is placed. Traditionally we have used a modified vaginal ring and uterine manipulator [10]. The patient is then placed in the steep Trendelenburg position. A 5-mm or 12-mm trocar is placed at the level of the umbilicus. The choice of trocar size is based on surgeon preference and availability of endoscope. In patients with a prior midline incision, the initial entry into the abdominal cavity is made in the left upper quadrant approximately 2 cm below the left costal margin at the level of the midclavicular line. The abdominal cavity is insufflated. Two additional trocars (5-mm or 12-mm) are then placed in the right and left lower quadrants, and an additional trocar (5-mm or 12-mm) is inserted in the midline above the pubic symphysis.

The pelvis and abdomen are explored to rule out intraperitoneal disease. The round ligaments are transected bilaterally. An incision is made in the peritoneum over the psoas muscle immediately lateral to the infundibulopelvic ligament. The ureter is identified. The lymph-bearing tissue along the pelvis is then evaluated for obvious metastatic disease. Any suspicious pelvic lymph nodes are removed and sent for frozen-section examination. If these are positive for metastatic disease, the procedure is aborted. The paravesical and pararectal spaces are opened and exposed. The uterine artery and vein are identified and transected at the point of origin from the internal iliac vessels. The bladder is mobilized inferiorly. The ureters are separated from their medial attachments to the peritoneum. The parametrial tissue is then brought over the ureters, and the ureters are dissected to the point of their insertion into the bladder bilaterally. The lateral aspect of the vesicouterine ligament is then divided, and the bladder is mobilized further inferiorly to ensure adequate vaginal margins.

The infundibulopelvic ligaments are transected bilaterally when a bilateral salpingo-oophorectomy is performed. If the ovaries are maintained then the utero-ovarian ligaments are transected. The uterus is anteflexed, and the peritoneum overlying the interface between the rectum and posterior vagina is then incised, exposing the recto-vaginal space. The attachments between the rectum and the vagina are cut in the midline, exposing the uterosacral ligaments, which are then transected. The specimen, including the upper vaginal margin, cervix, and uterus, is completely separated from the upper vagina and removed while attached to the uterine manipulator. The vaginal cuff is sutured laparoscopically.

Outcomes

Spirtos et al. [5] described 78 patients with early-stage cervical cancer undergoing laparoscopic radical hysterectomy. In that series, 94% of the procedures were completed laparoscopically. The mean follow-up time was 67 months. The mean operative time was 205 min, and the mean blood loss was 225 mL. One patient required a blood transfusion, three patients had unintended cystotomies, two patients required laparotomy to control bleeding, and one patient suffered an ureterovaginal fistula. Three patients had microscopically positive or close margins. The authors reported a cervical cancer recurrence rate of 5%.

Abu-Rustum et al. [6] reported 19 patients with stage IA1 or IB1 cervical cancer who underwent total laparoscopic radical hysterectomy with pelvic lymphadenectomy. The mean estimated blood loss (301 mL) and mean hospital stay (4.5 days) were significantly less than in historical controls. Mean operating time was longer with the laparoscopic approach than with laparotomy (371 min vs. 295 min). Two patients required conversion to laparotomy. Five patients had unintended cystotomies, five patients had iliac vein injury, and one patient had a ureteral transection.

Pomel et al. [11] reported 50 patients with stage IA1–IB1 cervical cancer who underwent total laparoscopic radical hysterectomy. The median operating time was 258 min, and the mean number of lymph nodes harvested was 13. No conversions to laparotomy were reported. The median length of hospital stay was 7.5 days. The authors reported that 10 patients had early complications (within 2 months of surgery) and that three of those patients required reoperation. They also reported that three patients had late complications (more than 2 months after surgery) and that two of those patients required reoperation. Three patients experienced recurrence with a median follow-up time of 44 months.

Gil-Moreno et al. [8] reported a series of 12 patients with cervical cancer who underwent total laparoscopic radical hysterectomy with sentinel lymph node identification. The mean operating time was 271 min, and the mean blood loss was 445 mL. The mean length of hospital stay was 5.25 days. No intraoperative complications were reported, and there were no conversions to laparotomy. No recurrences were detected with a median follow-up of 20 months.

Ramirez et al. [7] evaluated 20 patients with stage IA2 or IB1 cervical cancer. The median blood loss was 200 mL (range, 25–700). The median operative time was 332.5 min (range, 275–442). The surgical margins were free of disease in all cases, and no patients required conversion to laparotomy. This was the first study to report a median length of hospital stay of 1 day after surgery.

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A retrospective study by Li et al. [12] compared the morbidity, recurrence rates, and mortality of patients undergoing laparoscopic radical hysterectomy versus abdominal radical hysterectomy. The authors found that the recurrence rates (14% and 12%, respectively; $p \geq 0.05$) and mortality rates (10% and 8%, respectively; $p \geq 0.05$) were similar for the two groups.

Frumovitz et al. [9] compared patients undergoing total laparoscopic radical hysterectomy with those undergoing total abdominal radical hysterectomy. The mean estimated blood loss was significantly lower in the laparoscopic-surgery group than in the open-surgery group (319 vs. 548 mL; $p=0.009$). The mean operative time was significantly longer with laparoscopic surgery (344 vs. 307 min; $p=0.03$), but the median hospital stay was significantly shorter (2.0 vs. 5.0 days, $p<0.001$). Postoperative infections were much less common after laparoscopic surgery (18% vs. 53%; $p=0.001$).

Robotic radical hysterectomy

Although laparoscopic surgery has many advantages, it is also associated with a number of potential drawbacks, including limited range of motion intra-abdominally (only 4° of freedom), counterintuitive movements, amplification of tremors in prolonged cases because of the length and rigidity of the instrumentation, and reduced depth perception secondary to a two-dimensional view.

The advantages of the robotic system include three-dimensional vision, tremor reduction, 7° of intra-abdominal articulation, and motion scaling. Among the disadvantages of robotic surgery are loss of tactile feedback, large bulky robotic arms, limited variety of instrumentation, and cost. The da Vinci robotic system (Sunnyvale, CA) costs approximately $1.5 million, and each instrument costs approximately $2000 for every 10 uses.

Robotic surgery is an ideal tool for teaching since it allows expert surgeons to instruct novice surgeons from distant sites, a practice known as *telementoring*. In addition, robotic surgery allows for *telepresence*, whereby a surgeon may operate on a patient from a distant site. The first such case was reported in 2001 by Marescaux et al., who performed a cholecystectomy on a patient in France while seated at a console in New York. [13]

Surgical technique

The surgical technique for robotic radical hysterectomy is as follows. A Foley catheter is inserted in the bladder and a V-care (ConMed, Utica, NY) uterine manipulator is placed. A 12-mm bladeless trocar is placed in the midline approximately 3 cm above the umbilicus under direct visualization. The abdomen must be fully insufflated before placement of additional trocars. The patient is then placed in steep Trendelenburg position. A second trocar of the same type is placed above and 8 cm to the left of the previously placed trocar. This second trocar is used by the assistant. The robotic system trocars are then placed as follows: the first robotic trocar 8 cm to the left and slightly below (15°) the assistant trocar, the second robotic trocar 8 cm to the right of the midline trocar, and the third robotic trocar 8 cm to the right and below the second robotic trocar. The third robotic trocar is used to insert the fourth arm of the da Vinci system.

Once all trocars are placed, the surgical cart is positioned between the patient's legs. The camera and the robotic arms are docked. We use an EndoWrist Maryland bipolar grasper on the left hand and an EndoWrist monopolar curved scissors on the right hand. We typically place an EndoWrist Cadiere forceps in the fourth arm. The steps of robotic radical hysterectomy are the same as those described above for the laparoscopic approach.

Outcomes

In 2006, Sert and Aveler [14] were the first to publish on robotic radical hysterectomy in cervical cancer. The same authors went on to publish a subsequent small series [15] comparing 7 patients who underwent robotic radical hysterectomies with 8 patients who underwent radical hysterectomy by laparoscopy. The BMI in the robotic group was 24.6 kg/m^2 vs. 22 .5 kg/m^2. A cystotomy occurred in each group. Postoperative complications included a lymphocyst in two patients in the robotic group and three in the laparoscopic group; one patient in the laparoscopic group developed a compartment syndrome which required bilateral fasciotomies. Mean operative (console) time for the robotic group was 241 min (range, 160–445), and for the laparoscopy group was 300 min (range 225–375). The docking time was 25 min. The estimated blood loss in the robotic group was 71 mL vs. 160 mL in the laparoscopic group (p 0.038). The length of hospitalization was 4 days in the robotic group and 8 days in the laparoscopy group (p 0.004).

A third series was published by Kim et al. [16], the authors reported on 10 patients with early-stage cervical cancer. All operations were completed robotically; there were no conversions to laparotomy. The mean operative time was 207 min (range, 120-240); the mean docking time was 26 min (range, 10–45); the mean estimated blood loss was 355 mL, and the mean number of pelvic lymph nodes removed was 27.6 (range, 12–52). The authors reported no ureteral injuries or fistulae. Most recently, Magrina et al. [17] published a comparative series of patients undergoing robotic radical hysterectomy with a group of patients who underwent laparoscopic radical hysterectomy or open abdominal radical hysterectomy. This study evaluated patients during a 41 month period. To date, this is the only study that compares these three different surgical approaches. The mean operating times for patients in the robotic, laparoscopy, and laparotomy radical hysterectomy were 190, 220, and 167 min, respectively; the mean blood loss was 133.1, 208.4, and 443.6 mL, respectively; and the mean length of stay was 1.7, 2.4, and 3.6 days, respectively. There were no significant differences in intra- or postoperative complications among the three groups and no conversion in the robotic or laparoscopic groups.

Conclusion

Total laparoscopic radical hysterectomy is a feasible and safe procedure that is associated with fewer intraoperative and post-operative complications than abdominal radical hysterectomy.

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Long-term outcomes after total laparoscopic radical hysterectomy are most likely equivalent to those after abdominal radical hysterectomy. We await results from additional series of radical hysterectomy performed by robotic surgery. Our institution has recently opened to accrual an international prospective randomized trial evaluating outcomes in patients randomly assigned to either open or laparoscopic/robotic radical hysterectomy.

Conflict of interest statement

The authors declare that they have no conflicts of interest to disclose.

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