Pulling the uterus directly instead of relying on the uterine manipulator: a better surgical technique choice for laparoscopic radical resection of cervical cancer

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Abstract: Cervical cancer is one of the most common malignant tumors among women. The appropriate treatment plan is determined based on factors such as the clinical stage, age of the patient, fertility requirements, general condition and medical expertise. Patients are typically treated with surgery or radiotherapy, along with chemotherapy if necessary. Surgical treatment is typically reserved for patients with early-stage cervical cancer (IA–IIA). In recent years, advancements in screening technology and increased individuals’ awareness of physical examinations have led to a higher rate of early diagnosis for cervical cancer. Thus, it is of vital importance for patients with cervical cancer to undergo surgery treatment, as most patients are in the early stage of the disease when they are first diagnosed and have good prognosis. With the advancement of the minimally invasive concept and technology, laparoscopy has emerged as a surgical treatment method for cervical cancer. It offers several advantages such as reducing intraoperative blood loss, decreasing the rate of wound infection, shortening hospital stay, and not increasing postoperative complications. On the other hand, studies have indicated that laparoscopic radical hysterectomy is associated with lower survival rates and higher recurrence rates compared to conventional open surgery. The potential reasons for the unfavorable prognosis of laparoscopic surgery may be attributed to the use of uterine manipulator, CO₂ pneumoperitoneum, and the treatment of the vaginal stump. In light of the limitations of laparoscopic radical hysterectomy, previous studies have utilized various techniques such as the myoma screw, grasping forceps, uterine hitch technique and uterine rein technique instead of a uterine manipulator. However, these techniques still pose risks such as longer operation time and uterine fragmentation. Consequently, we are continuously working to address the shortcomings of laparoscopic radical hysterectomy. The objective of this video is to present a surgical approach that does not involve the use of a uterine manipulator or its alternatives, by pulling the uterus directly, with the aim of achieving a tumor-free outcome during laparoscopic radical hysterectomy. This approach is intended to preserve the advantages of laparoscopic radical hysterectomy surgery while overcoming the disadvantages of reduced long-term survival and increased recurrence rates.

Keywords: Laparoscopic surgery; radical hysterectomy; cervical cancer; uterine manipulator

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Introduction
Cervical cancer is one of the most common malignant tumors among women. It develops from cervical intraepithelial lesions and is closely linked to persistent high-human papillomavirus (HPV) infection. In recent years, advancements in early screening technology and increased individuals’ awareness of physical examinations have led to early detection and treatment of cervical cancer and precancerous lesions. As a result, the incidence and mortality rates of cervical cancer have significantly decreased. Treatment plans are tailored to each individual’s clinical stage, fertility requirements, and overall health. Surgery is the primary treatment for early-stage cervical cancer. Additionally, postoperative pathology results can help determine the need for additional therapies. Surgical procedures may include radical hysterectomy, pelvic lymphadenectomy, and, if necessary, para-aortic lymph node sampling.

With the advancement of the minimally invasive concept and technology, laparoscopy has emerged as a surgical treatment method for cervical cancer. It offers several advantages such as reducing intraoperative blood loss, decreasing the rate of wound infection, shortening hospital stay, and not increasing postoperative complications (1). On the other hand, studies have indicated that laparoscopic radical hysterectomy is associated with lower survival rates and higher recurrence rates compared to conventional open surgery (2). Currently, numerous research centers, both domestically and internationally, are investigating the factors that could potentially contribute to unfavorable results in laparoscopic surgery for cervical cancer and attempting to overcome them. The potential reasons for the unfavorable prognosis of laparoscopic surgery may be attributed to the use of uterine manipulator, CO₂ pneumoperitoneum, and the treatment of the vaginal stump (3-5). In light of the limitations of laparoscopic radical hysterectomy, studies have found that cutting the vagina without CO₂ pneumoperitoneum, thoroughly cleaning the pelvic and vaginal stump before suturing, can effectively reduce tumor spillage during the vaginal cutting process and decrease tumor recurrence after surgery. Additionally, surgeons are continuously exploring and enhancing laparoscopic radical resection of cervical cancer without the use of the uterine manipulator. Previous reports have utilized methods such as myoma screws, grasping forceps, the uterine hitch technique, and the uterine rein technique instead of a uterine manipulator. However, there are still risks involved, including prolonged operation time and uterine fragmentation. By continuously improving laparoscopic radical resection of cervical cancer, we present a surgical approach that does not involve the use of a uterine manipulator or its alternatives, by pulling the uterus directly, which can not only maintain the advantages of laparoscopic surgery but also minimize its disadvantages, thereby reducing operation time and enhancing long-term patient outcomes.

In this scenario, a 45-year-old patient complained of postcoital bleeding for 3 months. She was generally healthy and had no medical or surgical complications. She had previously undergone laparoscopic bilateral salpingectomy due to an ectopic pregnancy. She has three children and does not plan on having any more. During the gynecological examination, a cauliflower-like lesion measuring 1.5 cm was found in the cervix, with no infiltration into the vaginal wall or parametrium. The size and shape of the uterus and the bilateral adnexal region appeared normal. A computed tomography (CT) scan showed thickening of the posterior lip of the cervix and patchy enhancement nodules, but no enlarged pelvic lymph nodes were observed. A cervical biopsy...
confirmed the presence of squamous cell carcinoma. Based on the biopsy and physical examination, the patient was diagnosed with cervical squamous cell carcinoma [stage IB1, International Federation of Gynecology and Obstetrics (FIGO), 2018]. After communicating with the patient and obtaining their signed informed consent, we proceeded to perform the laparoscopic radical resection of cervical cancer. This procedure was carried out without the use of a uterine manipulator or any other special instruments. Additionally, pelvic lymphadenectomy and selective para-aortic lymph node sampling were conducted. The operation lasted for 165 minutes with an estimated blood loss of 100 mL. The surgery was performed in the operating room of a tertiary hospital. We present this article in accordance with the SUPER reporting checklist (available at https://gpm.amegroups.com/article/view/10.21037/gpm-23-3/rc).

**Preoperative preparations and requirements**

**Patient preparation**

Vaginal scrubbing with 1% povidone-iodine solution was conducted three days prior to the surgery. Bowel preparation involved taking oral gentamicin and metronidazole for three days leading up to the surgery, followed by oral laxatives the night before the surgery, and a cleansing enema both the night before and the morning of the surgery. Preparation of the vulvar and umbilical skin was done one day before the surgery.

**Surgical team**

There are two experienced gynecologic oncologists, two gynecologic surgical nurses, and an anesthesiologist proficient in general anesthesia.

**Ethical statement**

All procedures performed in this study were in accordance with the ethical standards of the institutional and/or national research committee(s) and with the Helsinki Declaration (as revised in 2013). Written informed consent was obtained from the patient for the publication of this article and accompanying images and video. A copy of the written consent is available for review by the editorial office of this journal.

**Step-by-step description**

*Video 1* provides a step-by-step guide on how to do the laparoscopic radical resection of cervical cancer.

**Step 1 routine preparation**

Instrumental preparation: a 30° laparoscopy optic (TC 300, Karl STORZ, Germany), conventional laparoscopic surgical instruments and an ultrasonic knife are required (*Figure 1*). Patient position: the patient was placed in the Trendelenburg position (30°) with abduction of the lower limbs; urethral catheterization. Anesthesia preparation: all procedures were performed under general anesthesia.

**Step 2 creating the working area**

A viewing port was established 4 cm above the belly button...
using a 10-mm trocar, and carbon dioxide was delivered through it to create an artificial pneumoperitoneum. Another 10-mm trocar was inserted in the lower right quadrant, while a 5-mm trocar was placed in both the left midquadrant and left lower quadrant. The surgical incision selection is illustrated in Figure 2.

**Step 3 high ligation of infundibulopelvic ligament**

The peritoneum on the lateral wall of the left pelvis was opened to expose the ureter. Afterwards, the left pelvic infundibular ligament was detached from its elevated position and cut using electrocoagulation with an absorbable biological clip (Figure 3). Repeat the identical procedure on the right side.

**Step 4 lymphadenectomy**

The inferior mesenteric artery was identified as a marker, and the para-aortic lymph nodes located below the inferior mesenteric artery were excised. The sheath of the right common iliac artery was incised 3 cm above the bifurcation of the iliac vessel, and the right common iliac lymph nodes, external iliac lymph nodes, and deep inguinal lymph nodes were dissected and removed using an ultrasonic knife. During the removal of the deep inguinal lymph nodes, it is necessary to expose the superficial circumflex iliac vein as a guide. The obturator foramen was opened, and the obturator nerve was exposed. The obturator lymph nodes and internal iliac lymph nodes were then separated and removed using an ultrasonic knife. The same procedure was performed for the left pelvic lymph nodes (see Figures 4, 5).

**Step 5 radical hysterectomy**

Laparoscopic vascular forceps were used to gently clamp the right corner of the uterus, and an upward pull in the left oblique direction was used to expose and free the right uterine artery. An absorbable biological clamp was then used to clamp the uterine artery near the origin of the internal iliac artery. The forceps were used to clamp the uterine body and pull it towards the abdominal cavity, exposing and opening the vesicoperitoneal reflexes, this helped to separate the vesico-cervical space and push the bladder down to approximately 4 cm below the vaginal fornix. The ureteral tunnel was then opened, and the ureter was released to the bladder neck ligament. The uterine body was held by forceps and pulled towards the anterior abdominal wall.
The Douglas pouch was exposed and incised, the rectum and lateral fossa were pushed down and the uterosacral and principal ligaments were incised at a distance of 4 cm from the cervix. To separate the paravaginal tissue, if the left paravaginal tissue needs to be separated, clamp the lower portion of the uterus and pull it towards the right side. Then, completely separate the vaginal area to be removed by approximately 3 to 4 cm (Figure 6).

Step 6 remove the uterus through the vagina and suture the vaginal incision

Please close the CO\textsubscript{2} pneumoperitoneum. Remove the uterus and the excised lymph nodes through the vagina after disinfection. Disinfect again, replace any instruments that have not come into contact with the tumor, and suture the severed vaginal end vaginally (Figure 7).

Step 7 clearing the surgical area

A thorough examination of the surgical wound showed no signs of bleeding. The pelvic and abdominal cavity were washed multiple times using diluted iodophor to minimize the presence of cancer cells. Moreover, anti-adhesion membranes were applied to cover the exposed areas of blood vessels and ureter. Additionally, an abdominal drainage tube was inserted.

Postoperative considerations and tasks

Prophylactic antibiotics and intravenous analgesics were administered for 24 hours after the surgery. Patients were encouraged to begin moving as soon as possible and utilize air pressure assisted therapy on both legs to prevent blood clots. The drainage from the abdomen was closely monitored, and the tube was removed 7 days after the surgery. The patient was successfully discharged without any complications 7 days after the surgery. The patient was removed 21 days post-surgery, and the patient was able to urinate without any issues. The post-surgery examination revealed that the tumor remained confined to the cervix and measured approximately 2 cm. There was no evidence of spread to the lymph nodes or any other areas. Based on these findings, the patient did not require any additional treatment as there were no high-risk factors. However, it was emphasized that the patient should undergo regular and thorough follow-up care following the surgery.

Tips and pearls

(I) Before undergoing surgery, it is crucial to effectively communicate with the patient and provide them with comprehensive information regarding the benefits and drawbacks of laparoscopic radical resection for cervical cancer. The patient should be afforded the opportunity to select their preferred surgical approach.

(II) Surgeons should possess a thorough comprehension of the strategy and collaborate efficiently in order to expose the surgical field by gently pulling the uterus.

(III) Before removing the uterus through the vagina, the CO\textsubscript{2} pneumoperitoneum should be closed. While removing the uterus through the vagina, it is essential to exercise caution to preserve the integrity of the uterus and prevent any cutting or damage. Subsequently, the lymph nodes should be taken out from the vagina.

(IV) It is important to pay attention to protecting the ureter that is exposed.

Discussion

Laparoscopic surgery offers several advantages, such as a
clear visual field, clear anatomy, reduced bleeding, quick recovery, and shorter hospital stays. As patients increasingly prioritize their quality of life, minimally invasive surgery for cervical cancer has gained recognition and is widely performed by doctors and patients alike. However, studies have revealed that patients who undergo minimally invasive surgery face a significantly higher risk of recurrence and death compared to those who opt for open surgery. This finding has sparked widespread attention and intense debate on the global stage regarding minimally invasive surgery for cervical cancer. As gynecological oncologists, it is our responsibility to fully inform patients about the pros and cons of both surgical approaches in terms of survival rates and potential complications. This way, patients can make informed decisions and choose minimally invasive surgery voluntarily. On the other hand, we need to treat patients in a more comprehensive and extensive manner. This involves continuously exploring and enhancing the limitations of current laparoscopic surgery, so that patients can derive benefits from it.

The principle of laparoscopy without a tumor should be followed throughout the entire operation. Among all the procedures used in laparoscopic surgery for cervical cancer, the use of a uterine manipulator has the greatest potential to affect the prognosis. Literature reports indicate that uterine manipulation can increase the likelihood of tumor surface destruction and artificial paracentral migration. It has also been suggested that the uterine manipulator can increase the spread of tumors through the lymphatic capillary channel and direct transmission. Other studies suggest that the mechanical pressure exerted by the uterine manipulator promotes the tumor's entry into the lymphatic vessel. In the past, surgeons have used alternative methods to replace the uterine manipulator. These methods include suturing the uterus through the external abdominal pull and the lower uterine ligature pull. However, these additional surgical procedures can lengthen the operation time. Some surgeons may choose to use a Sharp grip forceps, like a myoma screw, to pull the uterus. However, this approach can potentially cause the uterus to break and increase the risk of the tumor entering the abdominal cavity. Our surgical method involves a laparoscopic radical surgery without the uterine manipulator. We only use ordinary laparoscopic vascular forceps to directly pull the uterus. This technique not only shortens the operation time but also provides complete exposure of the surgical field, making the procedure easier. Additionally, CO₂ pneumoperitoneum is also considered a potential factor contributing to a negative prognosis in laparoscopic radical resection of cervical cancer cases. Lin et al. (9) demonstrated that following CO₂ pneumoperitoneum, the growth of cervical cancer cells was temporarily suppressed, but subsequently, their proliferation ability was significantly increased. Moving forward, we aim to explore the possibility of conducting laparoscopic radical resection of cervical cancer without the use of pneumoperitoneum or a uterine manipulator, by directly manipulating the uterus. The principle of being tumor-free has always been our pursuit. Throughout the entire operation, we made every effort to operate with utmost care in order to avoid direct contamination resulting from the opening of the vagina during the laparoscopic procedure. Therefore, we opted for transvaginal hysterectomy, although there were still some drawbacks. Currently, we have improved the surgical method: after performing laparoscopic radical hysterectomy, we use laparoscopy to cerclage the middle and upper vagina in order to isolate the cervical cancer, and then proceed to cut and suture the vagina. In the future, we plan to attempt cutting the vagina at a distance of 2 to 3 cm from the lower edge of the cervical cancer prior to commencing the surgery, and then seal the vaginal stump to create a vaginal cuff for isolating the cervical cancer, followed by the subsequent surgical procedures.

While this method is simple and effective, it does have some drawbacks. Direct uterine traction exposed the surgical field, without the assistance of the uterine manipulator, the patient's uterus was not fully supported, and the surgeon may have difficulty obtaining a wide surgical field of view and dealing with blood vessels. This requires sufficient technical skill and clinical experience to achieve satisfactory surgical results. Additionally, using only gentle instruments for uterine traction may result in insufficient traction or slipping during the operation. This may require repeated traction and increase the duration of the operation. To overcome these challenges, it is important to have a thorough understanding of the anatomy of the uterus, experience in finding the most suitable traction position and strength, and good cooperation with the surgeons. These factors are crucial for a successful operation.

Surgeons have always strived to minimize and avoid damage to surrounding tissues as much as possible during surgery. This requires accurate identification of anatomical structures. The exposure of blood vessels should be tailored to each operation in order to reduce bleeding and ensure a clear visual field. There are many spaces that can make
it easier to dissect the tissue, including para-vesical space, para-rectal space, uterosacral space, vesicovaginal space, rectovaginal space, vesicovaginal cervical space. Carefully exposing the location of the ureter and nerve along its shape, and accurately and gently dissecting it, is crucial for the operation. Simultaneously, it is important to pay attention to minimizing thermal injury.

Conclusions

In recent years, studies and reports have emphasized the importance of focusing on the concept of tumor-free during laparoscopic radical resection of cervical cancer. Gynecological oncologists have consistently sought to explore and enhance surgical methods to ensure efficacy and safety while minimizing complications. Our method partially mitigates the drawbacks of laparoscopic radical hysterectomy by directly pulling the uterus, without relying on the uterine manipulator or other alternatives. This surgical approach aims to achieve favorable treatment outcomes for patients. However, there are still some shortcomings in our operation, we will continue to explore improved approaches to enhance patient benefits.

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Ethical Statement: The authors are accountable for all aspects of the work in ensuring that questions related to the accuracy or integrity of any part of the work are appropriately investigated and resolved. All procedures performed in this study were in accordance with the ethical standards of the institutional and/or national research committee(s) and with the Helsinki Declaration (as revised in 2013). Written informed consent was obtained from the patient for the publication of this article and accompanying images and video. A copy of the written consent is available for review by the editorial office of this journal.

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