



The Application of Extraperitoneal Para-Aortic Lymphadenectomy in Gynecologic Malignant Tumors by Laparoendoscopic Single-Site Surgery

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Abstract

In gynecologic malignant tumors, the metastasis of Para-Aortic Lymph Node (PALN) has important reference value for prognosis and postoperative treatment. Para-Aortic Lymphadenectomy (PAL) provides a reliable basis for assessing the metastasis of para-aortic lymph node. However, the extraperitoneal para-aortic lymphadenectomy can expose the surgical field of vision more clearly and reduce the intestinal stimulation of the operation. With the increasing demand for the quality of life, the concept of “no scar” has been paid more attention by the majority of gynecologists, and the laparoendoscopic single-site surgery was born. In this paper, from the development of laparoendoscopic single-site surgery, combined with the advantages and technical difficulties of laparoendoscopic single-site surgery, discuss the application of extraperitoneal para-aortic lymphadenectomy in gynecologic malignant tumors by laparoendoscopic single-site surgery through a comprehensive analysis of single-site vs. multiple-site laparoscopic use of extraperitoneal para-aortic lymphadenectomy in domestic and overseas.

Keywords: Gynecologic malignant tumors; Extraperitoneal para-aortic lymphadenectomy; Laparoendoscopic single-site surgery

Introduction

In gynecological malignant tumors, lymph node metastasis is an important metastatic pathway, which has an important influence on the tumor stage and prognosis of patients. In 2009, International Federation of Gynecology and Obstetrics (FIGO) has carried on the new revision to gynecological tumor staging [1], which in the new stage of endometrial carcinoma, lymph nodes near the pelvic and Para-Aortic Lymph Node (PALN) metastasis as an important stage of the basis, and put forward in the standard operation for endometrial cancer, it should be the resection of lymph nodes near the pelvic and PALN. In recent years, more and more gynecology and obstetrics experts believe that Para-Aortic Lymphadenectomy (PAL) is of certain significance for clarifying tumor staging, guiding postoperative treatment and improving five-year survival rate of patients with tumors. However, the extraperitoneal approach for PAL is a new idea. The structure of the retroperitoneal space is complex, and there are many important organs and blood vessels, so there are certain requirements for surgical skills of surgeons. JANG Die [2] and others' research shows that the extraperitoneal approach for PAL can acquire more lymph nodes than the peritoneal approach, the difference was statistically significant ($P < 0.05$), and the extraperitoneal approach help to the exposure of the surgical field and benefit to patients with postoperative. The extraperitoneal approach for PAL requires more extensive of patients' Body Mass Index (BMI) and provides better ways of operation to some obese patients with gynecological malignant tumors. With the continuous development of medical apparatus and instruments and continuous improvement of the doctor's medical technology, Laparoendoscopic Single-site Surgery (LESS) more and more widely used in gynecological surgery from the initial tubal ligation to gynecological tumor surgery and brings to the patient's quality of life greatly improved. The application of LESS to the extraperitoneal approach for PAL is another progress in medical development. At present, there have been many reports of extraperitoneal para-aortic lymphadenectomy by laparoendoscopic single-site surgery in foreign countries, but few in China. In this paper, we will analyze the problems and characteristics of LESS in gynecological malignant tumor surgery and preliminarily discuss the application of extraperitoneal para-aortic lymphadenectomy by laparoendoscopic single-site surgery.

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The Significance of the Extraperitoneal Approach for PAL in Gynecological Malignant Tumors

The meaning of the PAL

Lymph node metastasis of endometrial cancer is related to the location of the tumor. Some scholars [3] have shown that lymph node metastasis of endometrial cancer sometimes shows a jump, which directly metastasized to PALN instead of metastasizing to lymph nodes near the pelvic. Therefore, PAL can accurately assess the stage and prognosis of endometrial cancer patients. Todo et al. [4] found that PAL treatment for patients with endometrial cancer was helpful to improve the prognosis of patients with high-level endometrial cancer. Lymph node metastasis of cervical cancer is progressive. Lymph nodes near the pelvic and lymph nodes near the common iliac are the first group of lymph nodes with endometrial cancer metastasis, which metastasized earlier, while PALN is the second group of lymph nodes with metastasis, which metastasized later [5] and hardly metastasized jumpy [6]. PAL and PALN biopsy in patients with cervical cancer can reduce the tumor burden of patients with cervical cancer, which is of certain positive significance for prognosis and subsequent treatment. PALN metastasis occurs in 2% to 14% of patients with early ovarian cancer [7]. Therefore, comprehensive staging surgery which includes systematic lymph nodes near the pelvic and PALN dissection remains the "gold standard" for the treatment of early ovarian cancer. Further treatment of early ovarian cancer is also required according to the presence or absence of lymph node metastasis. For patients with advanced ovarian cancer (III and above), PAL can improve patients' 5 years of progression free survival [8].

The advantages of extraperitoneal approach for PAL

Deep understanding of the anatomy of retroperitoneal space is needed for PAL via extraperitoneal approach. The posterior peritoneal space is the general name of the anatomical space between the parietal peritoneum and the transverse fascia. It is the potential space filled with fat, connective tissue and fascia. The posterior peritoneal space's anterior border is parietal peritoneum and the posterior border is lumbar maximus and quadratus lumbar fascia. The posterior peritoneal space's upper border is diaphragm which reach down to pelvic floor fascia and the sides are lateral conus fascia. Preperitoneal fascia and posterior renal fascia were used as the dividing line that divides the retroperitoneal space into preperitoneal space, perirenal space and posterior renal space. Peritoneal space was the key area of extraperitoneal approach for PAL. Therefore, according to the anatomical characteristics of the retroperitoneal space, extraperitoneal approach for PAL has the following advantages: 1) With less intestinal interference and a clear surgical field, PALN can be reached quickly; 2) It reduces the risk of intra-peritoneal organ injury and pelvic adhesion formation, which is beneficial to the postoperative recovery of patients; 3) It provides a new surgical route for patients with a history of abdominal surgery or severe pelvic adhesion and shortens the operation time; 4) For patients with gynecological tumors with BMI>35 Kg/m², PAL can also be performed via extraperitoneal approach [9]; 5) The extraperitoneal pelvic space was expanded with water sac and CO₂ gas pressure, which saved a lot of operation time without excessive surgical separation.

Development of LESS in Gynecological Surgery

Today, with the rapid development of science and technology, the

improvement of medical devices is also changing with each passing day. The emergence of laparoscopy pushes the surgery to the era of "minimally invasive" and the emergence of LESS makes "scar-free surgery" possible. In 1972, Wheelless [10] reported the transumbilical laparoscopic tubal ligation, which was the initial attempt of LESS in gynecological surgery. Tarasconi et al. [11] completed salpingectomy with LESS in 1981 and LESS began to be used for the removal of organs. In the same year, China started the preliminary exploration of LESS. He Cuihua and others [12] used LESS to complete 74 female sterilization operations with unipolar electrocoagulation. A landmark year in the history of LESS, Pelosi [13] used LESS to complete hysterectomy and double adjunctive resection in 1991, which marked the use of LESS to complete multi-organ combined resection. With the continuous exploration and innovation of gynecologists, it was proposed to combine LESS with gynecological tumor surgery. In 2009, Fader and Escobar [14] first reported the application of LESS in gynecological tumor surgery. In China, Liu Mubiao et al. [15] reported for the first time the use of LESS for staging of endometrial cancer and dissection for lymph nodes near the pelvic in 2011. After a gynecologist decades of continuous innovation, LESS has been widely used in gynecological surgery that include tubal sterilization surgery, surgery of the oviduct reanalyzed and pelvic adhesion release, ectopic pregnancy surgery, endometriosis, uterine fibroids rejecting operation, ovarian cyst removal surgery, total hysterectomy. LESS also used department operation of three gynecological malignant tumors and lymph nodes dissection. LESS is a better interpretation of the concept of "minimally invasive" and satisfies the masses of women demand of the surgical wound beauty. LESS has a seat in the research field of gynecologic surgery.

Urologists were the first to use LESS in peritoneal surgery via extraperitoneal approach while gynecologists. The kidney is located in the retroperitoneal space, so urologists often perform related operations such as kidney and ureter through the extraperitoneal approach. The medial side of the left kidney is adjacent to the abdominal aorta. This anatomical relationship provides a new idea for gynecologists. In 2011, Gouy [16] first reported single-port laparoscopic extraperitoneal PAL and confirmed the effectiveness and safety of this surgical method, which is an innovative application of LESS in the field of gynecological surgery.

Advantages and Limitations of LESS in Gynecological Malignant Tumor Surgery

Advantages of LESS in gynecological malignant tumor

Studies have shown that LESS has no statistical significance in acquiring number of lymph nodes, operation time and intra operative blood loss compared with traditional laparoscopic surgery [17], which indicated that LESS is also suitable for gynecological malignant tumor surgery. Other researchers pointed out that LESS is a safe and effective method in gynecological tumor surgery and LESS can reduce the incidence of recent surgical complications [18]. Compared with traditional laparoscopic surgery, LESS has the following advantages: 1) Like the traditional laparoscope, the single-site laparoscope also has a magnifying lens which can magnify the anatomical structure. It is helpful for gynecologists to clearly identify the anatomical relationship between tissues, easily find the lesion site and facilitate the operation; 2) LESS conventional transumbilical incision was used as a single incision that surgical instruments entered directly from the top, which made it easier to reach the uterine and obturator regions; 3) The risk of postoperative incision infection is reduced because

of LESS' single incision, especially for gynecological tumor patients with obesity and diabetes; 4) For women of special professions, such as dancers, models, actors etc., the incision scar of LESS is perfectly integrated with the skin fold of the umbilical cord, which can basically achieve "traceless" and greatly improve the quality of life of patients; 5) Because there is no incision in the lower abdomen the follow-up treatment after surgery can be carried out in time without delaying the treatment opportunity for patients with gynecological malignant tumor; 6) The incision size of LESS is generally 2.5 cm that is larger than the traditional laparoscopic incision, which is convenient for gynecologists to obtain surgical specimens.

Limitations of LESS in gynecological malignant tumor surgery

The operation of gynecological malignant tumor is difficult, the operation range is wide and the operation process is complicated, which limits the operation of single-hole laparoscopic surgery for gynecological malignant tumor. The application of LESS in gynecological malignant tumor has the following limitations: 1) LESS is a single incision that can realize multiple pathways for the access of surgical instruments by conversion set. Therefore, compared with traditional laparoscopy, Trocars is in the same plane of multiple channels and loses the surgical triangle region, which increases the difficulty of surgery for surgeons; 2) The incision of LESS is only 2.5 cm which allows surgical instruments passing to operation. It is difficult to avoid the interference between surgical instruments. The traditional laparoscopic basic suture and knot is also difficult in LESS; 3) Because most of the endoscopic surgical instruments are long and straight and have a narrow gap with Trocar, gynecologists will cover part of the lens during operation that affect the surgical field of vision and make the operating space relatively narrow; 4) For patients with advanced gynecological malignant tumor, it is extremely difficult to use LESS because that some tissues have lost their normal anatomical structure due to tumor invasion in many parts. Therefore, cell reduction for advanced gynecological malignant tumor is tentatively set as contraindication to LESS [19]; 5) In most cases, LESS incision through umbilicus increases the risk of umbilical hernia formation in patients, which puts forward higher requirements for umbilical suture technology of gynecological surgeons.

Advantages of Extraperitoneal Approach for PAL by LESS in Gynecological Malignant Tumor Surgery

Extraperitoneal approach by LESS vs. Extraperitoneal approach by multihole laparoscopy

Rossittoc et al. [20] found that the indications of extraperitoneal approach for PAL by LESS and multihole laparoscopy were basically the same. In terms of age, BMI and surgical history of patients, extraperitoneal approach for PAL by LESS did not put forward more stringent requirements for patients. These basically indicate that extraperitoneal approach for PAL by LESS is feasible but it does not indicate that this surgical method is superior to the extraperitoneal approach for PAL by multihole laparoscopy. Hudry D et al. [21] will divide 69 patients with extraperitoneal approach for PAL into two groups. One group uses LESS while another group uses multihole laparoscopy. Respectively on two groups of patients with operation time, blood loss, patients with lymph node number, length of hospital stay were compared, which found no difference between the two groups on the bleeding. But the uses of LESS have shorter operation time and patients in hospital time and get the more number of

lymph nodes. This study further demonstrated that extraperitoneal approach for PAL by LESS still has certain advantages over multihole laparoscopy in some aspects. At present, the use of LESS in gynecological malignant tumor surgery is still in the preliminary exploration stage in China, so there are few comparative studies on extraperitoneal approach for PAL by LESS and multihole laparoscopy. It should be fully demonstrated that LESS is more advantageous than multihole laparoscopy in extraperitoneal approach for PAL, which need more samples to comparative study.

Extraperitoneal approach vs. peritoneal approach for PAL by LESS

Surgical incision of extraperitoneal approach for PAL by LESS is generally selected at 1cm above the left McCullough point [22]. With the left and right lumbar maximus as the indicator points, push away the posterior peritoneum and expose space to obtain lymph nodes from bottom to top to expose the vessels of left and right ovaries, inferior mesenteric artery and abdominal aorta [23]. The incision of extraperitoneal approach for PAL by LESS is usually made in the umbilical cord. Studies have shown that the higher the position of laparoscopic incision and the larger the wound would cause the more obvious the postoperative pain of patients [24]. The incision level of extraperitoneal approach for PAL by LESS is lower than peritoneal approach for PAL by LESS. Therefore, extraperitoneal approach for PAL by LESS for patients will result in lower postoperative wound pain. The umbilical cord is prone to hiding bacteria. Extraperitoneal approach for PAL by LESS avoids the umbilical cord and further reduces the risk of postoperative incision infection. Prodromidou [25] conducted a Meta analysis on 7 subjects of 608 female patients with three major gynecological malignancies, which indicated that extraperitoneal approach for PAL by LESS takes less time and postoperative complications than peritoneal approach for PAL by LESS. Passh et al. [26] reported that more number of nodes were obtained via extraperitoneal approach for PAL than via peritoneal approach for PAL by LESS. Further study by Morales et al. [27] suggested that the positive rate of PAL nodes obtained via extraperitoneal approach for PAL than via peritoneal approach for PAL by LESS. No matter extraperitoneal approach for PAL or peritoneal approach, the surgery is performed by LESS. Therefore, the above results show that extraperitoneal approach for PAL by LESS have less surgical complications, more lymph nodes and higher positive rate of lymph nodes compared with peritoneal approach. However, at present, some scholars still question the extraperitoneal approach for PAL, such as the formation of lymphocyst, hypercapnia, incisional hernia, etc., while no literatures have reported that extraperitoneal approach for PAL can reduce the risk of lymphocyst and hypercapnia. The application of extraperitoneal approach for PAL by LESS has some advantages in some aspects.

Brief Summary

PAL is a positive surgical method for patients with gynecological malignant tumors, which can help patients with accurate tumor staging and guide the follow-up treatment after surgery and improve the five-year survival rate of patients. The extraperitoneal approach for PAL can reduce the stimulation to the intestinal tract and the incidence of pelvic adhesion, which is more suitable for obese patients with gynecological tumors. It is an innovative attempt to PAL. LESS is more and more favored by gynecological tumor patients due to its advantages such as small surgical trauma, low postoperative pain, small incision infection rate and timely follow-up treatment.

Although multiple research institutions have published that LESS is safe and reliable in gynecological malignant tumor surgery [28-30], some scholars still question it. Some research organizations collect 899 cases with LESS and 1186 cases of multi hole laparoscopy surgery to be analyzed and think the two operation means without statistical significance in surgical complications, the operation time and intra operative bleeding [31]. There is no literature reported that survival outcome of LESS in patients with gynecological tumors have what kind of influence and evidence of LESS of evidence-based medicine applies to all of the patients with gynecology tumor. Although the gynecological tumor surgery using LESS is still in the preliminary trial stage, which restricted by various conditions. It is undeniable that the learning curve of LESS is long and tortuous, which requires gynecologists to have solid endoscopic surgery skills and indomitable spirit. However, no matter the application of LESS or extraperitoneal approach for PAL, extraperitoneal para-aortic lymphadenectomy in gynecologic malignant tumors by LESS is a reform and innovation of surgical methods based on traditional surgery, which promotes the development of gynecological surgery technology. Therefore, medical institutions at all levels can consider using extraperitoneal approach for PAL by LESS among patients with gynecological malignant tumors under the conditions that the patient's condition, the medical equipment and the surgical skills of doctors are allowed.

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