Techniques for Single-Port Gynecologic Oncology

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Single-port or laparoendoscopic single-site surgery (LESS) is an advanced minimally invasive procedure that utilizes a single, small incision within the umbilicus. The feasibility and advantages of this type of surgery in benign gynecologic conditions indicate a promising surgical innovation for gynecologic or gynecologic-oncologic patients.

13.1 Introduction

Single-port surgery or laparoendoscopic single-site surgery (LESS) is an advanced minimally invasive procedure in which the surgeon operates exclusively through a single, small skin incision concealed within the umbilicus. Considering the feasibility and advantages related to this type of surgery in benign gynecologic conditions, its application in gynecologic oncology has been a natural evolution. Our research group and others have described techniques, feasibility, safety, and outcomes associated with the performance of various gynecologic-oncologic procedures via the LESS approach (Table 13.1) [1–7]. These experiences indicate that LESS is a promising surgical innovation that demonstrates several practical applications in oncologic surgery and potential clinical benefits for the patients. This chapter describes LESS techniques in the treatment of various gynecologic oncology conditions.

Table 13.1 Gynecologic oncology indications to single port surgery

Adnexa
Retrieval of ovarian tissue for freezing before any type of RT and/or CT in young cancer patients
Ovarian suspension before pelvic radiation for cervical cancer
RRSO
Conservative and not conservative treatment and (re) staging of borderline ovarian tumors
Potential conservative and demolitive treatment and (re)staging of apparently stage 1 ovarian cancer (both epithelial and others)
Uterus
Treatment and staging of early endometrial cancer
Treatment and staging of IB1 small tumor cervical cancer
Staging for conservative treatment in early stage cervical cancer
Retroperitoneal staging in LACC

RT radiotherapy, *CT* chemiotherapy, *RRSO* risk reducing salpingo oophorectomy, *LACC* local advanced cervical cancer

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13.2 Operating Room Organization

A well-organized operating room is a prerequisite not only for the success of the intervention but also to optimize the timing of surgery and to lower related costs. Surgical team position radically changes during LESS surgery compared with standard laparoscopy, because single-site incisions force surgeons to change their position to maximize mobility of the instruments. In this case, the first surgeon, after inserting the port, stands behind the shoulders of the patient, at the level of the head, the place usually occupied by the anesthesia team. The assistant is positioned at the right shoulder of the patient. An appropriate Trendelenburg position is required to decrease the distance between the surgeon and the patient, which is more extreme than in standard laparoscopy. A third surgeon may be placed between the legs of the patient to manipulate the uterus.

13.3 Surgical Technique

Surgical procedures are performed through a single multiport reusable or disposable trocar (LESS) inserted into the umbilicus. We generally use an Olympus multiport trocar (Olympus Winter & IBE GMBH; Hamburg, Germany). This device consists of three components: the introducer, the fixing valve, and the trocar itself. The trocar, made of a doubled-over cylindrical sleeve of pliable film material fixed to the proximal ring, flows down around the distal ring and then back up and out. To introduce the trocar, the distal ring is passed through an open access into the abdominal cavity using the introducer. A 1.5–2-cm longitudinal transumbilical skin incision is made. The subcutaneous fat is opened, with exposure and incision of the abdominal fasciae for approximately 2 cm. The parietal peritoneum is smoothly dissected with blunt scissors, achieving access into the peritoneal cavity. After the skin incision is made, the distal ring is mounted on an introducer, an instrument used to insert and push the distal ring through the abdominal wall. Then the introducer is removed, the retractable sleeve is gripped to the proximal end, and the outer ring is pushed down to create a perfect seal with the abdominal wall. The excess sleeve is finally cut off. Through the adjustable length of the sheath, the outer part of the trocar can be positioned in contact with the skin regardless of the thickness of the abdominal wall or body mass index of the patient, making it comfortable even in obese patients. Triport (Olympus Winter & IBE GMBH; Hamburg, Germany) has two channels for the transit of gas and three ports for surgical instruments: two measuring 5 mm and one measuring 12 mm. Although a model with four ports is available, three ports seem sufficient to perform any gynecologic-oncologic procedure. The cannula positions are adjustable within the flexible port, and a separate channel allows for carbon dioxide insufflation. In order to maintain the pneumoperitoneum, the ports are sealed

with a gelatinous plastic material, which prevents the escape of gas during surgical maneuvers; this does make it necessary to lubricate the instruments to avoid excessive friction. Once pneumoperitoneum (12 mmHg) is achieved, intra-abdominal visualization is obtained with a 5-mm 30° telescope or, alternatively, a 5-mm 0° laparoscope with a flexible tip (EndoEYE; Olympus Winter & IBE GMBH; Hamburg, Germany) (Fig. 13.1). Straight conventional 5-mm instruments are inserted into the remaining two ports, namely, the surgeon's choice of graspers, scissors, suction/irrigation, bipolar coagulator, and a multifunctional versatile laparoscopic device that grasps, coagulates, and transects simultaneously. The combination of one standard 33-cm long instrument with a 43-cm long instrument is preferred to prevent excessive contact between the surgeon's instruments outside the abdominal cavity and to facilitate stripping and traction maneuvers (Fig. 13.2). Changes in the positions of the instruments and camera are performed according to the needs of the surgeon. A steep Trendelenburg position is usually needed to complete the surgery (about 30°). At the end of the procedure, each layer of the access port is separately sutured to prevent subsequent umbilical hernia occurrence. In particular, the abdominal fascia is closed by separate delayed reabsorbable sutures, and the skin is repaired with rapid absorbable suture.

The following table describes some of the most common surgical procedures performed in gynecologic oncology (Table 13.2).

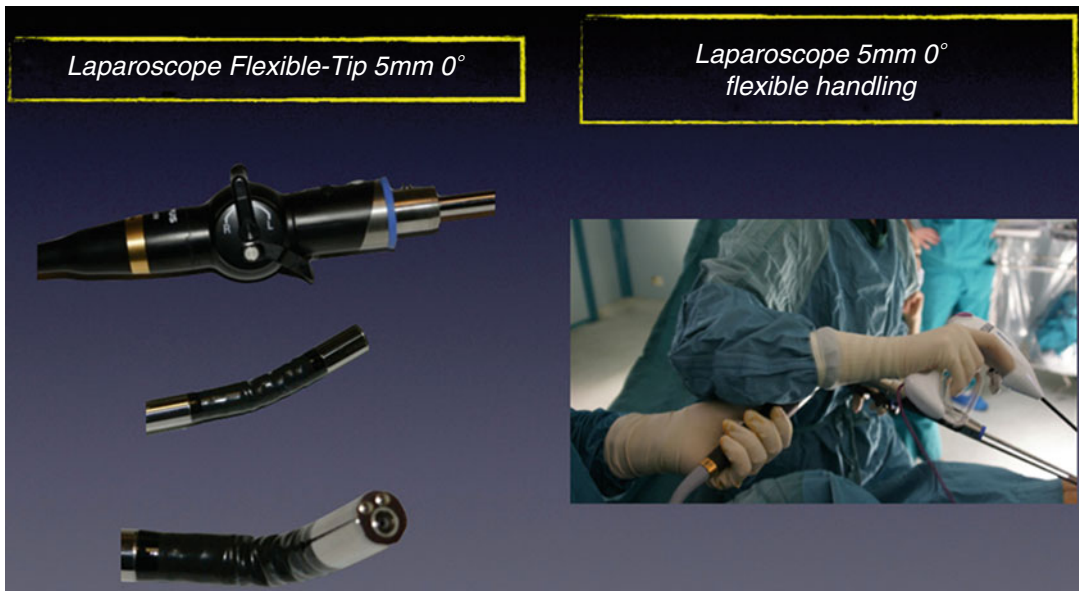

Fig. 13.1 Laparoendoscopic single-site surgery (LESS) for conservative treatment of borderline ovarian tumors: external view (**a**); internal view (**b**)

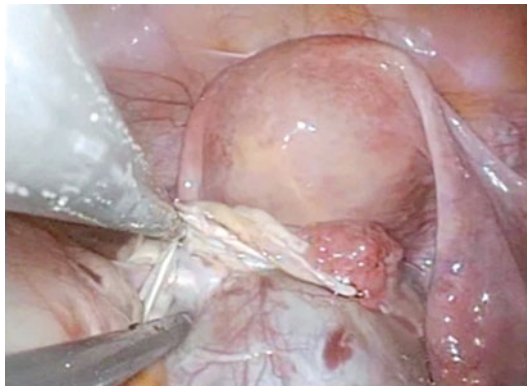

Fig. 13.2 The position of instruments during stripping of an ovarian cyst

Table 13.2 Single port surgical procedures in gynecologic oncology

Intraperitoneal
Abdominal inspection and washing
Peritoneal biopsies
Infra-colic omentectomy
Appendectomy
Extrafascial and radical hysterectomy
Adnexectomy, cystectomy, salpingectomy
Retroperitoneal
Pelvic and para-aortic lymphadenectomy

13.3.1 Risk-Reducing Salpingo-Oophorectomy, Bilateral Salpingo-Oophorectomy for Adnexal Masses, and Ovarian Cancer Staging

An intrauterine device (intrauterine manipulator-Olympus Winter & IBE; Hamburg, Germany) may be used to make surgery easier (i.e., pelvic endometriosis or large adnexal masses). Once pneumoperitoneum is achieved (12 mmHg), intra-abdominal visualization is obtained, and one grasper and one multifunctional versatile laparoscopic device that grasps, coagulates, and transects simultaneously are inserted to perform surgery. However, the use of different surgical instruments does not change the surgical technique. Pelvic washing is performed in all cases. The broad ligament is transected between the ovarian pedicle and the iliac vessels, and the retroperitoneal structures and the ureter are identified. The infundibulopelvic ligament is skeletonized and transected using the 5-mm multifunctional device. The fallopian tube and mesosalpinx are dissected, and the utero-ovarian ligament is transected. The same procedure is repeated on the opposite side. The adnexa are inserted into a 10-mm Endocatch bag (Covidien; Mansfield, MA) and removed through the umbilicus after taking out the single-port device. In the case of large adnexal cysts, they may be emptied within an endobag to avoid spillage.

13.3.2 Simple Extrafascial Hysterectomy and Bilateral Salpingo-Oophorectomy

The patient is placed in the dorsal lithotomy position, and both arms are gently tucked and padded at the patient's sides. A high-quality uterine manipulator with a colpotomy valve is utilized in order to achieve the necessary counter-traction for LESS hysterectomy cases. It is positioned only after bilateral coagulation of the tubes in order to prevent tumor from spreading into the peritoneal cavity. In our experience, the use of a manipulator is not detrimental to any procedures in terms of increased bleeding or difficulty with pathologic evaluation. This was corroborated by Rakowski and colleagues and Fanfani and colleagues, who demonstrated that minimally invasive radical hysterectomy cases performed with a uterine manipulator did not show any clinical-pathologic differences in depth of invasion, lymphovascular space invasion, or parametrial involvement compared to open cases [8, 9].

A combination of one straight 33-cm long, 5-mm instrument with one 43-cm long, 5-mm instrument (such as graspers, cold scissors, suction/irrigator) and a 5-mm multifunctional device (that grasps, coagulates, and transects simultaneously) plus a 5-mm flexible-tipped laparoscope are used. After coagulation and section of the round ligament, entry into the retroperitoneal space is performed, and the ureter is visualized. Hemostatic clips or direct coagulation is performed at the origin of the uterine artery

(Fig. 13.3a, b) [10]. The infundibulopelvic ligaments are skeletonized and transected. A bladder flap is developed using the multifunctional instrument. An adequate margin of the vagina is ensured before colpotomy, which is performed using a monopolar hook. The uterus, cervix, and bilateral fallopian tubes and ovaries are removed through the vagina, and the vaginal vault may be closed either via the vagina with single stich technique or by a laparoscopic extracorporeal knotting technique. Vascular or visceral injuries, loss of pneumoperitoneum, or intraoperative port-site bleeding are in line with literature data such as wound hematoma, wound infection, or delayed bleeding postoperatively [1–6]. Median operative time reported in the literature is about 100 min (range, 45–155 min) with a median estimated blood loss of 30 mL (range, 10–500 mL) [10]. Most patients report complete satisfaction with cosmetic appearance and postoperative pain control. They are discharged home one day postoperatively with only optional analgesic therapy.

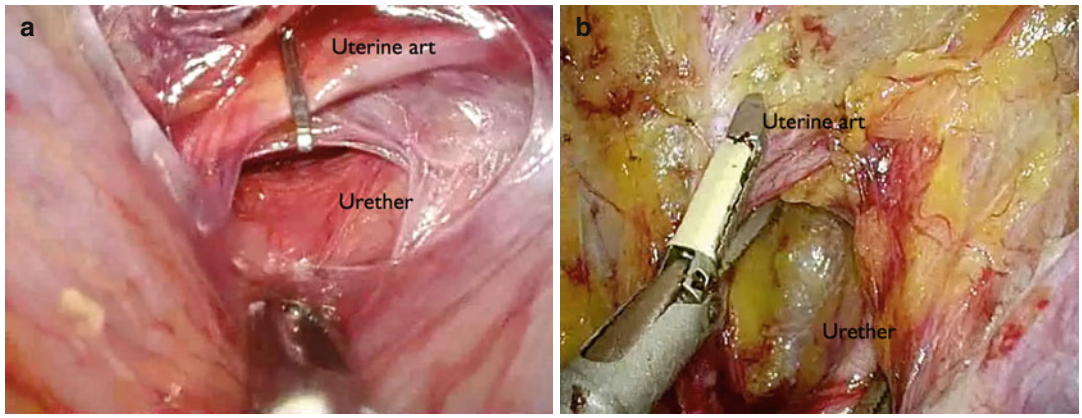

Fig. 13.3 (**a**, **b**) Hemostatic clip (**a**) or coagulation (**b**) at the origin of the uterine artery (*UA*) crossing over the ureter (*U*)

13.3.3 Radical Hysterectomy

Few cases of LESS radical hysterectomy have been reported in the literature [7, 11]. This may be considered one of the most advanced procedures performed by LESS currently. The first steps of preparation for radical hysterectomy are the same as those for simple extrafascial hysterectomy. After placing the patient in a steep Trendelenburg position (Fig. 13.4) and folding the small bowel out of the pelvis, a methodical survey of the abdomen, pelvis, and peritoneum as well as identification of bilateral ureters is performed.

It is our preference to perform bilateral pelvic lymphadenectomy prior to radical hysterectomy (see below for a technical description) to allow for frozen section assessment of pelvic nodes to tailor the extent of radical hysterectomy.

We usually work in an opposite way, which means having the active multifunctional instrument at the opposite side of the operating field (i.e., working on the right side of the pelvis and using the multifunctional device with the left hand). The laparoscopic grasper is usually positioned to obtain the right traction, but only the working device moves inside the surgical field. In fact, with LESS, instrument exchanges should be limited, and only one hand should be positioned at a time to limit intracorporeal instrument "sword fighting." It is important to utilize a multifunctional instrument that ligates, cauterizes, divides, and dissects the tissue. We will describe consecutive steps to perform LESS radical hysterectomy. Median operative time is about 260 min (including bilateral pelvic lymphadenectomy) comparable to those of published [6, 7] early experiences with multiport laparoscopic radical hysterectomy. A 10 % conversion rate from LESS to an alternate surgical approach has been reported for this type of surgery [6, 7]

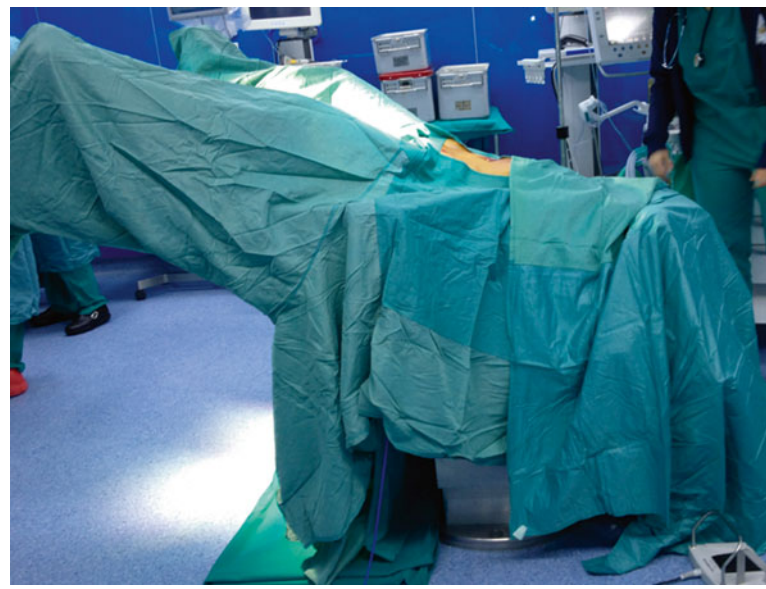

Fig. 13.4 Patient position for LESS surgery

13.3.3.1 Approach to the Retroperitoneum and Exposure of Pararectal and Paravesical Spaces

While moving the uterus to the opposite side with the uterine manipulator, a multifunctional instrument is used to coagulate and cut the round ligament at the lateral pelvic side wall. The broad ligament is opened, and the dissection is carried above the level of the pelvic brim in order to identify and expose the ureter. The ureter is mobilized medially and can be seen crossing the common iliac artery at the pelvic brim. Next, the pararectal and paravesical spaces are developed. Keeping the umbilical artery medially and the external iliac vessels laterally, the paravesical space is developed. Then, the surgeon can easily enter the pararectal fossa by displacing the ureter medially and dissecting bluntly toward the pelvic floor between the ureter and the internal iliac artery with either a suction irrigator instrument or a Maryland grasper (Medline Industries, Mundelein, IL). Development of these avascular spaces allows the surgeon to define the paracervix, which lies between the pararectal and paravesical spaces. The uterine artery and vein will easily come into view at the most caudal aspect of the spaces. Next, we move back to the left side of the uterine Dissection.

13.3.3.2 Isolation and Ligation of the Paracervix

The anterior division of the umbilical artery is identified, and the uterine artery and vein are isolated. One of the defining features of a class III radical hysterectomy is that the uterine vessels are ligated laterally to the ureters, near their origin. It is critical to isolate the artery from the vein and ligate them separately to ensure blood flow is halted and to optimize the radicality of the parametrial Dissection. A Maryland dissector and suction irrigator are used to perform the ureterolysis and dissect the ureter medially and away from the uterine vessels. Then the suction-irrigator, together with the bipolar grasper of monopolar scissors, are used to atraumatically continue taking down the bladder off the proximal vagina. If the ovaries are being removed, you can keep the infundibulopelvic ligament intact until the uterine vessels are ligated in order to maximize the degree of counter-traction applied to the medial leaf of the broad ligament. The same multifunctional instrument is used to ligate the infundibulopelvic ligament. Once one side is complete, the uterus is deviated to the opposite side, and the other uterine dissection is begun.

13.3.3.3 Anterior Paracervix

The ureter is further dissected from the medial peritoneum at the level of the uterosacral ligament. The ureter is dissected laterally with either a Maryland dissector or a suction-irrigator. The parametrial vasculature, once isolated and ligated with a multifunctional instrument, is flipped on the ureter that is rolled laterally out of the tunnel. The vesicouterine peritoneum is reflected caudally below the manipulator valve, exposing the proximal vagina. The ureter is dissected free from the surrounding tissue up to the level of the bladder. The procedure on the ureter is repeated on the opposite side until its insertion into the trigonal region of the bladder. Finally, the remaining attachments of the bladder and ureter to the anterior vagina are sharply dissected at the level of the inferior colpotomy valve.

13.3.3.4 Posterior Paracervix

The uterus is positioned upward and caudad using the uterine manipulator. The incision made in the posterior leaf of the broad ligament is extended across the cul-de-sac peritoneum between the cervicovaginal junction and rectum to develop the rectovaginal space. At this point, the ureters are mobilized laterally away from the point of dissection. The uterosacral ligaments are developed during this portion of the procedure. The multifunctional instrument, the suction irrigator, and the Maryland dissector serve as excellent dissecting tools to safely isolate the rectum from the cervix and the vagina. The posterior wall of the vagina is gently dissected off the anterior wall of the rectum. The uterosacral ligaments are coagulated and cut at this point, halfway down to the insertion point at the sacrum. The upper half of the uterosacral ligament is incised, and the lower half, containing the sympathetic nerves to the bladder, is spared. The surgeon can tailor the radicality of the procedure, and more of the uterosacral ligament may be ligated if necessary.

13.3.3.5 Colpotomy

The monopolar hook is used to perform a colpotomy. This results in the removal of the proximal 2–3 cm of vagina en bloc with the parametria, uterus, and cervix. It is our preference to perform cuff closure vaginally to decrease the risk of dehiscence compared with the laparoscopic approach.

13.3.3.6 Closure

Once hemostasis is obtained and no bladder injury has been identified, complete insufflation of carbon dioxide should be obtained to avoid significant postoperative pain. A well-positioned umbilical incision should be relatively concealed at the base of the navel once healing is complete, resulting in a scarless appearance. In order to minimize the risk of umbilical hernia at the incision site, we recommend a tight running closure of the umbilicus fasciae with a zero, delayed absorbable suture. Optimal cosmesis is achieved when the skin incision is closed with 3–4 single stitch using 2-0 absorbable suture, preferably Monocryl. The first stitch should bisect the incision and anchor the skin to the underlying umbilical tissue. This maneuver essentially results in reinverting the navel and restoring the native umbilical anatomy. The patient can be potentially discharged home on postoperative day 1 with a urinary catheter, which is removed 2 days later.

13.3.4 Pelvic and Low Para-Aortic Lymphadenectomy

With the patient in a steep Trendelenburg position, folding the small bowel and rectosigmoid colon gently out of the pelvis with atraumatic graspers optimizes pelvic exposure. It is our preference to perform bilateral pelvic lymphadenectomy prior to radical hysterectomy. While displacing the uterus to the opposite side with the uterine manipulator, the broad ligament is opened and the dissection is carried above the level of the pelvic brim in order to identify and expose the ureter and all the retroperitoneal lymph and vascular spaces. The pararectal and paravesical spaces are created by gentle blunt dissection using the Maryland grasper.

Some surgeons prefer to position the laparoscope so that the external iliac vessels are viewed horizontally, similar to the view seen during open pelvic lymphadenectomy by the contralateral surgeon. The bifurcation of the common iliac, the right external iliac arteries and the hypogastric arteries, veins, and the right ureter are identified. Using a soft-tissue grasper and a multifunctional 5-mm laparoscopic instrument (which allows tissue fusion and/or vessel sealing, spot coagulation, and in some cases, endoscissor functions in one instrument), the dissection is initiated lateral to the external iliac artery. The peritoneum between the external iliac artery and the psoas muscle is elevated and incised parallel to the artery (Fig. 13.5).

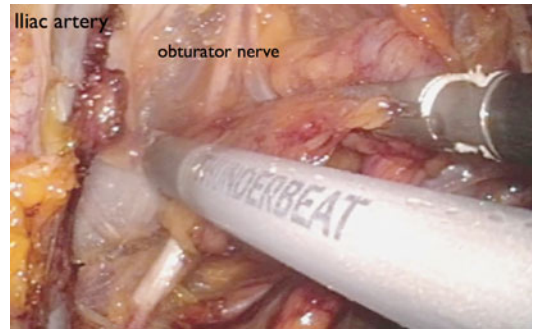

Fig. 13.5 Left pelvic lymphadenectomy

The external iliac vessels are then skeletonized anteromedially and laterally, away from the psoas muscle, taking care to avoid injury to the genitofemoral nerve, which runs anteriorly along the muscle. All nodal tissue is then removed from the midportion of the common iliac artery superiorly to the circumflex iliac vein inferiorly and from the midportion of the psoas muscles laterally to the ureters and the hypogastric artery and vein medially. Furthermore, the nodal tissue within the obturator fossa is also carefully dissected and excised, anterior to the obturator nerve and vessels. The dissection is performed with a combination of gentle blunt dissection with either the reticulating Maryland soft-tissue grasper or the tip of a suction aspirator. The excised nodal tissue is placed in a sterile endoscopic bag, which is extracted through the umbilicus after removal of the single-port device and sent for frozen section analysis. The same procedure is performed on the opposite side in a similar fashion and within the same anatomic boundaries as the right pelvic lymph nodes. Notably, on the left side, it is often

necessary to first divide physiologic adhesions from the sigmoid colon to the left pelvic side wall (with endoscissors or the tip of the multifunctional instrument) to optimize exposure of the left pelvic vasculature and node-bearing tissues.

The device is then reinserted into the umbilical incision, the abdomen is reinsufflated with carbon dioxide gas, and the pelvis is irrigated and inspected to ensure hemostasis. Endoclips are used generously to prevent blood loss and to close the lymphatic vessels [12].

Low para-aortic dissection is carried out to the level of the inferior mesenteric artery in a similar fashion. The peritoneum on top of the lower aorta is elevated and incised parallel to the artery starting cephalad to the bifurcation of the common iliac arteries. The ureter is dissected laterally using the graspers and the nodal tissue is then gently removed. The dissection is then carried out distally, exposing the bifurcation of the common iliacs and left common iliac vein. Of note, on the left side, the sigmoid colon has to be mobilized, depending on the approach to the dissection of lymph nodes around the left common iliac artery.

13.3.5 High Para-Aortic Lymphadenectomy

Single-port laparoscopic aortic lymphadenectomy to the level of the renal veins is a very complex procedure, which may be performed transperitoneally and extraperitoneally.

13.3.5.1 Transperitoneal

A 5-mm rotatable deflecting-tip laparoscope is inserted through the most inferior port on the single-port device (EndoEYE; Olympus Winter & IBE GMBH, Hamburg, Germany), and the first surgeon takes a place at the level of the right leg of the patient. The patient is then placed in the steep Trendelenburg and semiflank position (tilt to patient's right); folding the small bowel to the patient's right flank optimizes exposure of the aorta. The descending colon is either dissected and mobilized medially through the white line of Toldt or left in situ for a transmesenteric approach to the aorta, depending on patient characteristics (e.g., obesity, short intestinal mesentery, intestinal adhesions, and/or distended bowel). The peritoneum and nodal tissue are grasped and dissected away from the aorta and vena cava from the aortic bifurcation to the left renal vein in caudal to cranial direction. The inferior mesenteric artery is preserved in all cases [13].

13.3.5.2 Extraperitoneal

A single 2–3-cm left iliac incision is made perpendicular to a point situated two thirds of the way along a line drawn from the umbilicus to the anterosuperior iliac spine or a point situated one third of the way along the line from the anterosuperior iliac spine toward the umbilicus. First, the fascia in front of the left rectus abdominis muscle is incised, and the muscles are divided in the direction of their fibers, plane by plane, up to the peritoneum, which is opened to introduce the single device used to perform a transperitoneal inspection. In the absence of peritoneal or ovarian spread, after peritoneal cytologic examination, the single-port device is removed, and a para-aortic lymphadenectomy is performed through the same incision via a left-sided extraperitoneal approach.

For this second step, through the same incision, the fascia in front of the anterolateral abdominal muscles is incised, and a large finger dissection of muscle fibers is performed to introduce the single port into the extraperitoneal space. Although the transperitoneal incision of the peritoneum is performed very close to the extraperitoneal approach, there is no gas transfer from the extraperitoneal to the intraperitoneal cavity.

The surgeon is positioned to the left of the patient during the procedure. The assistant stands on the left of the patient and to the left of the surgeon. For ergonomic reasons, the assistant can be placed between the legs of the patient during the dissection of the left renal vein.

The nodal tissues are grasped and dissected away from the aortic bifurcation to the left renal vein. The inferior mesenteric artery is preserved in all cases. Lymph nodes are extracted through the single-port device.

Conclusion

Laparoendoscopic single-site surgery oncologic surgery is feasible and safe in select patients. Future innovations that may allow

greater diffusion of this surgical approach include refinement of single-port tools and techniques to merge robotics and single-site technology [14]. Further investigation is needed to determine the long-term outcomes of the LESS approach with oncologic patients.

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