Review Article

Current Opinion in Gynecology and Obstetrics Para-Aortic Lymphadenectomy by Minimally Invasive Surgery

Puerta Sanabria JM^{1*}, Rios Lorenzo M² and Gilabert-Estelles J^{3,4}

¹Ruber Hospital and Quironsalud Group, Madrid, Clínica Sanabria SL, Granada, Spain

²Hospital Vithas Nisa Pardo Aravaca, Madrid, Spain

³Department of Obstetrics and Gynecology, University General Hospital of Valencia, Spain

⁴Department of Pediatrics, Obstetrics and Gynecology, University of Valencia, Spain

***Correspondence:** Jose María Puerta Sanabria, Ruber Hospital and Quironsalud Group, Madrid, Clínica Sanabria SL, Granada, Spain, E-mail: puertajosem15r@gmail.com

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Abstract

Laparoscopic para-aortic lymphadenectomy (PAL) was described first in the literature in 1992. The advantages of the minimally invasive approach compared to the laparotomy are well known, with comparable surgery and long term survival results. The aim of this review is to expose the scientific evidence available on this subject, making a comparative study of the different laparoscopic techniques available to carry out the PAL, as well as other minimally invasive approaches, such as single port or robotic surgery.

Introduction

Laparoscopic para-aortic lymphadenectomy (PAL) was described first in the literature in 1992 by Nezhat et al. [1] and in 1993 by the group of Querleu [2], in cases of endometrial, cervical and ovarian cancer. In the year 2001, this onco gynecological practice began to be carried out using the renal vessels as upper margin of the lymphadenectomy, as it is described in the Manual of Surgical Procedures of the Gynecology Oncological Group (GOG). The main advantages of the minimally invasive approach compared to the laparotomy include a shorter hospital stay, lower blood loss, early recovery, less pain, better aesthetic result and lower digestive morbidity, with comparable results in terms of number of nodes obtained and with the disadvantage of a longer operative time [3].

A minimally invasive PAL can be carried out in two ways: Transperitoneal (TP) or Extraperitoneal (EP). The first reports used only the TP approach, but progressively it has begun to introduce the EP one, being currently

the comparison between both techniques the topic of discussion on the table.

That is why the aim of this review is to expose the scientific evidence available on this subject in current events and in continuous scientific discussion. A review and a comparative study of both laparoscopic techniques will be carried out.

Anatomic Review

This section does not try to make an exhaustive anatomical review of the field on which this surgery is performed, but mention certain key points about the PAL through minimally invasive surgery that have to be taken into account in performing both techniques.

Surgical limits

- Side: arteries and ovarian veins, as well as both ureters.
- Lower: ureter crossing on the bifurcation of the common iliac artery.
- Higher: left renal vein. The left upper lateral limit is

the entrance of the left ovarian vein into the renal vein.

Ganglion groups

The relationship between lymphatic tissue and large vessels could be divided into four anatomical compartments proposed by Querleu and Morrow [4].

Level 1 and 2 correspond to the pelvic anatomy. Meanwhile, the level 3 involves the tissue that extends from the aortic bifurcation to the inferior mesenteric artery, while the area between the inferior mesenteric artery and the renal veins is considered level 4.

From left side to the right side we distinguish the following groups to be cleaved during surgery:

Lateroaortic: distinguishing between infra and supra mesenteric nodes.

- Interaortocaval
- Precaval
- Laterocaval (right side)

Important anatomical data

The anatomical territory of the aorta and cava has a number of peculiarities which means that in many cases vascular structures are not symmetrical, and not only that, but up to 30% of cases there are interpersonal variants, which must be known before starting the surgery [5]. This fact makes essential having an imaging technique prior to performing any surgical technique, in order to know all possible vascular variations. One of the most common anatomical abnormalities used to be polar renal arteries arrangement.

The most important data of the normal vascular anatomy of the aortocavian territory are described below

Ovarian vessels

Right ovarian artery crosses above the inferior cava vein.

Right ovarian vein forms an arch at its entrance to the inferior cava vein.

The left ovarian vein, meanwhile, empties into the left renal vein.

Renal veins

Right renal vein empties into the cava just above the

arch of the ovarian vein.

The left renal vein usually passes over the aorta, but in a non-negligible percentage of cases it will pass behind it. It empties into the cava 2-3 cm above the mouth of the ovarian arch. The left ovarian vein and the hemiazygos vein flow into it.

Other data

The inferior mesenteric artery arises substantially constantly about 4-5 cm from the aortic bifurcation, in the left anterolateral side.

The lumbar branches of the aorta are located irregularly, but we emphasize the constant detection of a branch almost up to the aortic bifurcation.

Surgical techniques

In short, the main difference between the TP-PAL and EP is the method of approach to the surgical field, since once the limits of lymphadenectomy are identified, the technique is essentially the same. That is why the differences lie in the disposition of the trocars, the route of entry and certain complementary surgical instruments that can be precise in one technique more than in the other. These differences are summarized below [5]:

Trocars

In the TP technique, a minimum of 4 trocars will be used: generally two 10 mm are used, one intraumbilical and the other suprapubic, placing the optic in the suprapubic during a large part of the surgery. Two 5 mm in both iliac fossa through which the surgeon will work, positioning itself between the legs of the patient. There are groups that place a 10 mm trocar in the right iliac fossa, where they place the optics, making it easier for the assistant to manipulate. On the other hand, there is the option of placing a fifth 5 or 10 mm trocar in the left hypochondrium to help separating the peritoneum and expose the surgical field.

In the EP four trocars are usually also used: one 10 mm intraumbilical to review prior to surgery the abdominal cavity and to control the entry and subsequent formation of the extraperitoneal space with CO₂. The other 3 will be used to perform the lymphadenectomy itself, placing one of 10 mm for the optic, in the middle left clavicular line, 2-3 cm above the iliac crest. The other two will be 5 mm for the surgeon, and are placed under direct vision in the mid-axillary line, one behind the eleventh rib and the other between the eleventh rib and the anterior superior

iliac spine. In the case of difficulty to the infrarenal access due to renal ptosis, a fifth 5 mm trocar, 3 cm cranial to the trocar of the chamber can be placed through which a 5 mm abdominal retractor manipulated by the assistant could be inserted.

Position of the patient: In the transperitoneal technique, the patient will remain in Trendelenburg position throughout the surgery.

In the extraperitoneal, the patient will be placed in a slight position of Trendelenburg and slightly in right lateral decubitus position, about 5°. The right arm is extended and fixed to the patient's body, while the left one is abducted 90°.

Material needed: to highlight the special utility of a 30° optic in the extraperitoneal technique, especially when the right region is approached (laterocaval groups). It should also be taken into account that in the TP approach, laparoscopic retractors are needed to separate the peritoneum.

Approach to surgical limits

Transperitoneal: the root of the mesentery is located, which corresponds anatomically to the place under which the right common iliac artery is located. A small opening of the peritoneum is made in this area that will expand towards the Treitz ligament, until exposing great vessels.

Extraperitoneal: through the 10 mm trocar destined for the optics, a digital blunt dissection of the retroperitoneal space is carried out until the iliac vessels are identified by touch. This maneuver is performed under visual control with the optics in the umbilical trocar. Once this is done, CO₂ is insufflated until a maximum pressure of 12 mmHg is reached, after which a careful dissection of the extraperitoneal space will be initiated, first with the laparoscope and later with the help of the two forceps introduced through the 5 mm trocars, when they could have been introduced under direct vision. The dissection will begin by separating the peritoneum from the left psoas. After this, the left ureter is identified on the anterior surface of the psoas and it is separated with the peritoneum, both being the roof of the dissection plane. Once this has been done, the dissection will be continued in the cranial-skull direction, from the bifurcation of the left common iliac artery and until the surgical limits are located.

- Finally, in both cases, the lymphogras tissue

confined between the aforementioned limits is excised, with the difference that in the TP approach it will be made from right to left, while in the EP it will be made in a left-to-right direction, both in caudo-cranial direction.

- EP-PAL has a final step and is the realization of an opening of the peritoneum (marsupialization) to communicate the extraperitoneal space with the abdominal cavity, reducing the risk of lymphocele. In those cases in which there is suspicion of macroscopic disease, it is advisable not to perform this step and place an extraperitoneal drainage in place, avoiding communication with the abdominal cavity. In the TP technique, peritonization is not performed at the end of surgery.

Lymphadenectomy indications: Gynecologic cancer surgical staging

Theoretically, surgical staging allows

- The identification of hidden lymphatic and peritoneal metastases.
- Determine the field for radiotherapy when necessary and avoid radiation in those cases with negative staging.
- Improve local control of the disease by reducing the metastatic tumor volume, favoring the efficacy of adjuvant therapies.

The involvement of the aortic lymph nodes in *endometrial cancer* allows the differentiation of sub-stages: IIIC1 (metastases in pelvic nodes) and IIIC2 (metastases in para-aortic lymph nodes). Since 2018 FIGO staging of *cervical cancer* takes into account lymph node involvement, and does so similar to endometrial cancer, with sub-stages IIIC1 and IIIC2 to classify pelvic and para-aortic involvement, respectively. Finally, in the staging of *ovarian cancer*, the status of the lymph nodes is taken into account in stage III, but the sub-stages depend on the size of the lesion itself and not on the location of the affected lymph nodes as in endometrium cancer, with sub-stages IIIA1, IIIA2, IIIB and IIIC [6].

The other question is when to perform a laparotomic or a minimally invasive surgery. Factors influencing the choice of surgical approach include patient characteristics, such as medical comorbidities, obesity, and previous surgeries, as well as surgeon preference, availability of resources, and the extent of disease. Walker et al. [7] demonstrated the superiority of laparoscopy compared with laparotomy with respect to peri-operative outcomes among patients undergoing surgical staging

in endometrial cancer. Furthermore, a comparison of oncologic outcomes in this population, demonstrated similar recurrence-free survival and overall survival in both groups [8].

The polemic study performed by Ramirez et al. in 2018 [9] compared the overall survival with open surgery versus laparoscopy or robotic surgery in early stage cervical cancer, in this case talking about the radical hysterectomy, and showed a decreased overall survival (3 of 312 vs 19 of 319, HR 6.00, 95% CI, 1.48–20.3, $P = 0.004$). Disease-free survival events showed a three-fold increase in the minimally invasive surgery group (7 of 312 vs 27 of 319, HR 3.74, 95% CI, 1.63–8.58; $P = 0.002$). Rates of intraoperative complications did not differ by treatment received (11% in both). They concluded that hysterectomy by a minimally invasive route was associated with higher rates of recurrence than the open approach in early-stage cervical cancer patients. Further studies may be required to further confirm these findings, but anyway should be taken into account at the time of choosing the surgical approach.

Robotic-assisted surgery is being increasingly adopted in North America and is becoming progressively more accessible in Europe. Robotic-assisted surgery allows surgically complex cases to be performed in a minimally-invasive fashion. When compared with conventional laparoscopy, robotic-assisted surgery has been associated with a lower rate of conversion to laparotomy, and therefore, could represent an emerging technique that enhances the management of challenging cases while maintaining the improved peri-operative morbidity demonstrated with laparoscopic surgery.

Cervical cancer

In cervical cancers, the incidence of para-aortic lymph node metastases is 6% in stage Ib, 12-19% in stage II, 29-33% in stage III, and 30-40% in the stage IV of the disease [10]. The evaluation of these lymph nodes is included in the FIGO staging since 2018, and it make sense since the status of the para-aortic lymph nodes is the greatest prognostic factor in the management of this cancer [5].

Locally advanced cervical cancer (stage $\geq$ IIa) is generally treated with chemoradiation limited to the pelvis. Extended-field radiation therapy is only carried out if there is radiological evidence of para-aortic involvement, and may be associated with significant involvement of the gastrointestinal tract and other morbidities.

Imaging techniques have a limited sensitivity in the diagnosis of para-aortic metastases, with a detection rate of 33% for computerized tomography (CT), and slightly higher values in the case of magnetic resonance imaging (MRI). These imaging techniques, especially MRI, demonstrate high reliability in predicting tumor volume (70-90%), or parametrial invasion (87-95%) and vaginal involvement (83-93%) in cervical cancers, but lack the necessary sensitivity and specificity in the diagnosis of lymph node invasion, especially for the detection of micrometastasis [11]. Positron Emission Tomography (PET-CT) with F-fluorodeoxyglucose, designed to combine imaging techniques with increased metabolism in neoplastic cells, seems to be better in detecting metastatic involvement. But even so, although it has a very high specificity, the sensitivity only reaches 84% [12], so the false negative rate continues to be a non-negligible risk of under diagnosis and under treatment. The laparoscopic PAL thus provides a reliable tool to detect micrometastases in the para-aortic ganglia, which allows the precise selection of patients for extended-field radiotherapy, avoiding generating a high percentage of undertreated patients based exclusively on the imaging tests.

There are many studies that have demonstrated the presence of para-aortic lymphatic metastases in patients with advanced cervical cancer and negative imaging tests, with percentages ranging between 15 and 30% of detection of metastases according to the different series [13-14].

The influence of adjuvant treatment modifications on patient survival based on a previous PAL remains a controversial issue. Leblanc et al. in 2007 [15] published a series of cases with a sample of 184 patients, and reported similar survival rates after comparing patients with microscopic para-aortic disease treated with extended radiation fields and patients with negative para-aortic lymph nodes. On the other hand, Holcomb et al. [16] founded that the survival time of 89 patients with lymph node pre-treatment staging was 29 months, while this survival time on 179 patients without staging prior to treatment was 19 months ($p = 0.01$). Marnitz et al. [17] founded those patients with positive results of para-aortic lymph node staging, whose radiochemotherapy had been adapted according to the extent of their disease, had survival rates equivalent to those of patients with negative results. Lastly, the Gynecologic Oncology Group (GOG) conducted a retrospective analysis of three phase III clinical trials in 2008, which included

585 women with stage IIB-IVA of cervical cancer. Those patients who underwent PAL prior to radiation had a better progression-free survival at 4 years (48.9% vs. 36.3%) and overall survival (54.3% vs. 40%) compared to patients who only underwent evaluation of aortic nodule by imaging procedures prior to the adjuvant technique, to the point that the management of these patients by imaging techniques was an independent predictor of recurrence and worse overall survival compared to the surgical staging [18]. Unfortunately, despite being encouraging, studies published to date are retrospective and the answer to this question still requires randomized trials.

Ovarian cancer

Ovarian cancer apparently limited to the ovaries is associated with an excellent prognosis even in the absence of adjuvant chemotherapy. In such cases, it is essential to perform complete staging by pelvic and para-aortic lymphadenectomy, as well as omentectomy, cytology and peritoneal biopsies, before making decisions regarding the use of adjuvant chemotherapy [19]. Since metastases can spread directly along the gonadal vessels to the para-aortic area, again the laparoscopic approach to lymphadenectomy can be a very useful tool for the accurate staging of an apparently early disease. The involvement of the para-aortic lymph nodes would modify the staging of the disease to a FIGO III stage, instead of a stage Ia or Ib, with the consequent prognostic and therapeutic implications of the disease.

Similarly, in advanced ovarian carcinoma, complete surgical debulking, including pelvic and aortic lymphadenectomy, has been associated with better survival, so it must always be practiced.

Endometrial cancer

In patients with endometrial cancer, the advantages of lymphadenectomy include accurate staging and prognostic determination. In practice, the performance of lymphadenectomy in stages I and II varies considerably among the different groups and centers, being from the practice of complete pelvic and para-aortic lymphadenectomy, to selective emptying of the pelvic lymph nodes or even non-performance of lymph node excision.

Although the role of lymphadenectomy remains controversial, it is likely to reduce the need for radiotherapy and have a possible benefit in the debulking or progressive reduction of lymph nodes [19]. The cases

in which the practice of PAL is clearly recommended are those tumors of high histological grade (poorly differentiated), regardless of stage, and in stages ≥ IIA.

Histologic evaluation of para-aortic lymph nodes, especially in high-grade cancers or those with radiological evidence of para-aortic lymph node disease, helps to accurately select candidates for extended-field radiotherapy. (Table 1)

Table 1: PAL indications for the different gynecologic cancers.

Pal Indications	
Cervix Cancer	Initial stages (IA2-IIA) with positive pelvic nodes
	Advanced stages: staging and/or debulking
Ovarian Cancer	Initial stages
	Advanced stages: Optimal surgery
Endometrium Cancer	Initial stages: controversial perform if intermediate/high risks
	Advanced stages: II-III

Comparative analysis TP-EP

Transperitoneal PAL

TP-PAL is a surgical technique that requires a certain degree of surgical skill on the part of the surgeon. A minimum of 20 interventions are considered necessary to master the technique, after specific training in oncological surgery and advanced laparoscopy [20]. The safety of the technique measured by the performance in number of resected lymph nodes is equal to open surgery after a learning phase. The group of Vergote et al. [21] also proved that the number of lymph nodes obtained between the fifth and the tenth surgery performed increases significantly. In some cases, the number of lymph nodes obtained remains stable throughout the learning phase, but with a decreasing duration of surgery [22].

Advantages

- Possibility of performing other abdominal and pelvic surgical techniques without the need to change ports of entry.
- Lower incidence of symptomatic lymphoceles.
- Greater ease to completely check the abdominal cavity.
- It offers a dissection of the right laterocavo territory

more efficiently, with an average of obtaining 7 lymph nodes compared to 2.4 on average per extraperitoneal route, according to the study carried out by the group of Dargent et al. [23].

Disadvantages

- Greater technical difficulty in patients with a history of previous abdominal surgery.
- Greater difficulty in women with obesity with a BMI above 35. In those patients, a lower number of lymph nodes is obtained, and the complication rate is higher than general population, and it is possible to complete the procedure successfully in just 44% of them, requiring conversion to the laparotomy in 36.4% of cases [24,25]. O'Hanlan et al. [26] did a comparative study in 2015 on 115 patients who underwent aPAL by EP (79) or TP (31) approach. Among the 14 patients in the cohort whose BMI was greater than 35, two of whom had a BMI greater than 40, the mean nodal performance was 31 per EP approach, compared with an average of 6 lymph nodes per TP approach.
- Slightly higher rate of postoperative adherencial processes.
- Poorer and more difficult exposure of the surgical field, with frequent difficulty in the mobilization of the small intestine and the sigmoid colon, especially in patients with a short mesentery, distended bowel, intestinal adhesions or in those who do not tolerate the Trendelenburg position [27].
- Due to the circumstances previously described, the rate of intraoperative complications and conversion to laparotomy is higher in this surgical approach compared to the EP [24].

Regarding the lymph node count obtained, the literature figures between 3.7 and 22 lymph nodes per surgical act [28]. There is no clearly established a lower limit, however a lymph node count below 10 is questioned. The so-called "lymph node sampling" has demonstrated its limitations, because it predisposes to a risk of under staging with a morbidity similar to the wide excision, so it is imperative trying to stick to the surgical limits of lymphadenectomy when carrying out the technique. Köhler et al. [20] also found significant differences in the para-aortic ganglia obtained between the first 5 years of experience in TP-PAL, compared to the last 4-year period of their study. The authors concluded that the surgical experience contributes significantly to the growing number of para-aortic lymph nodes obtained

during surgery, as previously explained.

Extraperitoneal PAL

The EP-PAL may have its maximum exponent in the pre-therapeutic evaluation of locally advanced cervical cancer to limit the field of irradiation, since other abdominopelvic surgical procedures are usually associated with both ovarian cancer staging and endometrial cancer surgery, so it can condition the approach.

Advantages

- It is not necessary to place the patient in an important Trendelenburg position, which facilitates the intervention from the anesthetic point of view, reducing hemodynamic and respiratory complications [29].
- In general, previous surgeries represent a minor problem.
- By not associating an intra abdominal intervention, the risk of intra and postoperative digestive complications, including direct intestinal lesions, ileus or intestinal obstruction, is significantly reduced [30]. For this same reason, the formation of intestinal adhesions is lower in the EP technique, which means that the digestive toxicity derived from the application of postoperative radiotherapy (moderate-severe enteritis) decreases a 25-30% with respect to the TP pathway [5].
- The access to the lymphatic area is faster than in the TP technique, obtaining in addition an adequate exposure of the surgical field [30]. That is why the surgical time is usually relatively short, with an average between 65 and 80 minutes depending on the series [19,21]. Compared with the surgical time of the TP-PAL, it represents a significant difference, since the different published series report surgical times for the TP approach ranging from 64 to 157 minutes, associating the shorter processes with a lower lymph node count in the obtained sample [20,21,31].
- The rate of intraoperative complications is low, approximately between 3 and 4%, with vascular injury being the most frequent, followed by ureteral injury [15]. In comparison, the average of major intraoperative complications in the TP approach is between 8 and 9% according to the series [20].

Disadvantages

- The most frequent complication is lymphocyst formation, although its prevalence is low (around

5%) and most of them can be treated conservatively by ultrasound-guided percutaneous drainage or guided by CT. This complication can be reduced, as previously mentioned, if at the end of surgery a small window is opened in the peritoneum of the left paracolic gutter, allowing intraperitoneal drainage of the extraperitoneal dissection area (marsupialization), or placing a drainage in those cases of macroscopic lymphatic involvement. Leblanc showed that postoperative lymphocele was present in 40 of the first 104 patients (rate of 13.4%). However, after carrying out a preventive marsupialization, only three of 77 patients (3.8%) developed the complication [15].

- The maintenance of the integrity of the peritoneum is a key factor during the EP-PAL. However, in some cases, the peritoneum may be damaged and open, losing the advantage of exposure to the surgical field provided by the pneumoperitoneum. Possible solutions to this drawback include occluding the foramen with a Foley catheter balloon or performing a closure with a current suture using a transperitoneal approach. In some circumstances, however, it is impossible to close the hole and the procedure must be converted to a TP approach or directly to a laparotomy in the worst case [32].

Evidence in other types of minimally invasive surgery

Robotic surgery

Robotic assisted laparoscopy offers us a three dimensions image, articulated instruments that allow 7 degrees of movement, and an increase in precision and ergonomics. However, the advantages of robotic surgery in PAL have not been demonstrated, since, as we have seen, the conventional laparoscopic technique, and especially the EP one, is extremely ergonomic with minimal complications [33]. Despite this, the rapid learning curve of robotic surgery compared to laparoscopy means that in countries with high economic resources such as the USA, robotic surgery is being implemented with relative speed over laparoscopy, especially for complex surgeries such as the PAL.

The first article describing the technique was published by the team of Fastrez, Vergote et al. [34], and subsequently many other teams have shared their experience. The position of the trocars is crucial, due to the small surgical field, and although there is still no standardized placement due to the relative novelty of the technique, this disposition does not vary much between

authors, most of them describing the EP technique through the use of only three robotic arms and an additional laparoscopic port, while for the TP, 4 arms and two additional laparoscopic ports are usually used [5].

As in conventional laparoscopy, the use of a 30° optic in the EP technique is crucial to obtain a good view of the right paracaval area. In this sense, the Da Vinci robotic system allows to change the camera from 0° to 30° comfortably from the console if necessary.

In general, PAL-EP assisted with a robot is a procedure that can be done with a margin of safety but without better results in terms of the number of lymph nodes and intra-surgical complications compared to conventional laparoscopy. However, thanks to its vision in 3 dimensions, the abolition of the tremor and the articulated instruments, a precise and careful dissection is possible in a surgical field as small and delicate as that of the PAL.

The group of Wisner et al. [35] has made in 2015 a review of the case series existing in the literature on PAL carried out by laparoscopy or robotic surgery, reaching the following conclusions:

Most of the laparoscopic cases were performed by EP approach, while the robotic approach was performed primarily through the TP approach. The most common complication in both groups was the formation of lymphoceles, observed in 3-12% of patients with laparoscopic surgery versus 3-16.7% with robotic surgery. Lymphedema was observed in 5.2-7.8% of patients who underwent robotic surgery. Few cases of both groups required conversion to laparotomy. Finally, the robotic surgical approach was similar to traditional laparoscopy in most of the standard measures of perioperative outcomes related to PAL.

Hudry et al. [36] also in 2015, compared the EP approach with the TP in robotic surgery, with 58 and 487 patients respectively in each group. The only significant difference founded was a shorter hospital stay in the EP group. There were no differences in blood loss, operative time, intra and postoperative complications or in the number of resected nodes.

In recent years, significant work has been done to study the role of robotic surgery in the cytoreductive surgical treatment of advanced ovarian cancer. The group of Magrina et al. [37] carried out a pioneering

work in 2011 in which they compared 25 debulking procedures for ovarian cancer by robotic surgery, 27 by laparoscopic surgery and 119 by abdominal laparotomy. Surgical procedures were classified as type I debulking (hysterectomy with double adnexectomy, omentectomy, pelvic and PAL, appendectomy and removal of metastatic peritoneal disease), type II (type I debulking plus additional major procedure) and type III (cytoreduction type I and two or more additional major procedures). Both in the robotic and laparoscopic approaches for type I and II surgery, favorable blood loss results were obtained, as well as length of hospital stay, intraoperative and postoperative complications, presenting as a single drawback longer operative times in the robotic group compared to laparoscopy and laparotomy. It is noteworthy that there were no differences in the number of lymph nodes resected or survival rates with the minimally invasive approach. There was no general improvement in morbidity or hospitalization in type III surgeries by robot, and due to excessive surgical time requirements, the author's recommended the practice of laparotomy in these cases. These data are corroborated with more recent studies that advocate an improvement in surgical performance and in the survival of ovarian cancer patients treated with robotic surgery when compared with cases of laparotomy [38].

The most recent robotic platforms (*Da Vinci X and Xi, Intuitive Surgical, Inc., Sunnyvale, CA®*) can overcome some of the limitations of previous systems with smaller operating arms that require less space in the abdomen and have more range in the top and bottom of the abdominal-pelvic spaces.

Single-port surgery

Single-port surgery has also been described in the treatment of oncological processes. The first publication in this regard was in 2009 by Fader et al. [39] with a series of 13 patients, and was defined as a safe, feasible technique that requires less postoperative analgesia.

In 2010, Escobar et al. [40] were the first to publish a PAL procedure through a single port for gynecological cancer through a TP approach. The advantages offered by this technique compared to conventional laparoscopy include better aesthetic results and better management of postoperative pain.

This same group published in 2012 a comparative study between the conventional laparoscopic approach of endometrial cancer versus single-port surgery and

robotic surgery [41]. Each group was formed by 30 patients and found no significant differences in terms of surgical time, complications, hospital stay and number of para-aortic lymph nodes removed, with an average of 6 nodes obtained by single port compared to 3.5 with robotic surgery and 6 with conventional laparoscopy, all of them considered low numbers of lymph node count.

Fagotti et al. [42] published the same year a retrospective multicenter study with the longest series of single-port surgery and endometrial cancer, with 100 cases in which they describe how access by single port is technically possible, safe, and offers both aesthetic and morbidity advantages, presenting less pain and rapid recovery, with an average of para-aortic nodes obtained of 7 (2-28).

Lambaudie et al. [43] also described in 2012, for the first time, an EP-PAL using the single port technique on 14 patients, with an average para-aortic lymph node count of 16 (7-40). Iacoponi et al. [44], meanwhile, published in 2013 another series of cases of EP-PAL with a single port with an average lymph node count of 17 (10-25); both cases comparable with the lymph node count reported by Querleu et al. in the conventional laparoscopic EP approach.

In the literature published when this article was written, there were 6 studies, counting on the two previously cited [43-48], about EP-PAL by single port, being 4 of them series of cases, and only one comparative with PAL-EP by conventional laparoscopy [47]. In all of them they obtained as results that the single port approach does not increase the surgical times (120 minutes on average for the PAL), it does not suppose a greater number of surgical complications, the number of removed nodes is equivalent and even superior in some cases, and presents a shorter hospital stay. Regarding aesthetic satisfaction and postoperative pain, more prospective studies are required to be correctly evaluated, although the available evidence advocates an improvement in these variables.

Finally, it is important to note that the main disadvantage of single port surgery is the collision between the instruments; this, however, is not a significant problem during EP-PAL, since by the EP approach on the left side, it is already close to and in front of the para-aortic territory, so that conventional instruments can be used without the need to cross them.

That is why, in view of the results founded in the

literature, the single-port approach for PAL can be a valid alternative in selected cases and in the hands of an expert surgeon.

Conclusions

In addition to the possible healing effect of PAL in gynecological cancers with poor prognosis, the surgical approach is the only reliable method for the staging of the para-aortic lymph nodes, which allows a correct therapeutic decision.

With the development of endoscopic techniques and the simplification of the surgical approach, the indications and the realization of an PAL should no longer be restricted for technical or anatomical reasons, being the endoscopic approach the route of choice with respect to laparotomy due to its low morbidity, with comparable oncological results, and the added value of not delaying the start of the eventual adjuvant treatment.

The question of the approach remains secondary and will be decided according to the "schools", the indication of the surgery and the characteristics of the patient. This reflection will depend in turn on the results of lymphadenectomy, which must be permanently submitted to the quality criteria of the self-assessment.

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