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Total Laparoscopic Hysterectomy: Surgical Technique and Results

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1. Introduction

Hysterectomy is the most commonly performed major gynecologic procedure around the world. Benign diseases are responsible for more than 70% of the indications for hysterectomy and include menstrual disorders, fibroids, pelvic pain and uterine prolapse (Whiteman et al., 2008).

Traditionally, hysterectomy is performed by laparotomy or by vaginal access (Clayton, 2006). In 1989, Reich et al. (1989) described the first totally laparoscopic hysterectomy, which is currently considered an alternative means of access to traditional techniques for hysterectomy.

Despite the advantages of the laparoscopic and vaginal routes compared with laparotomy, this remains the most widely used access route for performing hysterectomy worldwide. In Denmark, 80% of hysterectomies for benign disease between 1988 and 1998 were performed by laparotomy (Gimbel et al., 2001). In the period between 1988 and 1990, approximately 1.7 million hysterectomies were performed in the United States and 75% were by the abdominal route (Wilcox et al., 1994). In 2003, 538,722 hysterectomies were performed for benign disease in the United States and the abdominal route was still the most common (66.1%), followed by vaginal (21.8%) and laparoscopic (11.8%). This study demonstrated that there was a statistically significant difference in the average hospital stay among the three types of surgical access (3 ± 0.03 days, 2 ± 0.03 days and 1.7 ± 0.03 days, respectively, $p < 0.001$), for abdominal, vaginal and laparoscopic approaches (Wu et al., 2007). In a multicenter cross-sectional study including 23 French university hospitals (Chapron et al, 1999), the rates of laparoscopic, vaginal and laparotomic hysterectomy were 9.6%, 47% and 43.4% respectively. In another study conducted between June and December 2004, including 634 women undergoing hysterectomy for benign disease in 12 French university hospitals, total laparoscopic hysterectomy was performed in 19.1%, laparoscopic assisted vaginal hysterectomy in 8.2%, total abdominal hysterectomy in 24.4% and vaginal hysterectomy in 48.3% (David-Montefiore et al., 2007), showing a significant reduction in the rate of laparotomies for performing hysterectomies. This trend indicates an adaptation to the modern concept of minimally invasive surgery. In some referral centers for gynecological

laparoscopy in France, such as Clermont-Ferrand, the rate of total laparoscopic hysterectomy is up to more than 90%.

The advantages of the laparoscopic approach compared to open surgery include less intraoperative bleeding, shorter hospital stay, faster recovery and lower rates of wound and / or abdominal wall infections, at the expense of a longer surgery (Johnson et al., 2006). Although several authors have demonstrated an increased rate of ureteral and bladder injuries with the laparoscopic access (Johnson et al., 2006; Mäkinen et al., 2001), a recently published series including 4505 women undergoing hysterectomy using different routes of access (laparoscopy, laparotomy and vaginal) showed no statistically significant difference in the rate of major complications when the 3 groups were compared (Donnez et al., 2009).

In this chapter we discussed the technical details of laparoscopic hysterectomy and clinical outcomes of this surgical technique.

2. Overview of the previous studies

2.1 Laparoscopic vs. laparotomic vs. vaginal hysterectomy

There are several studies in the literature comparing the different routes of access to perform hysterectomy. A meta-analysis comparing women undergoing total abdominal hysterectomy (n = 103) and total laparoscopic hysterectomy (n = 98) observed a reduction in the rate of intraoperative and postoperative complications (30.1% vs. 9.2%) and in the intraoperative blood loss (Walsh et al., 2009). There was no statistically significant difference in the rate of major complications (2.9% vs. 4.1%), which included bladder injury, ureteral injury, bowel injury, vaginal vault dehiscence and pulmonary thromboembolism. Surgical time was significantly longer in the laparoscopic surgery, exceeding the laparotomy group by 22 minutes. A systematic review by Kluivers et al. (2008) which included seven randomized controlled studies comparing the quality of life for women after laparoscopic (n = 874) and abdominal hysterectomy (n = 576), observed that the laparoscopic procedure had a quality of life equal to or above the laparotomic procedure. In two studies in which statistically significant differences between the two groups were found, they occurred in the short term, ie. the first 6 weeks after surgery. Vaisbuch et al. (2006) compared 167 women who underwent total laparoscopic hysterectomy and 119 women who underwent total abdominal hysterectomy. A longer surgical time was noted in laparoscopic group (156 vs. 91.2 minutes; $p<0.001$), but a shorter hospital stay (3.9. vs. 6.5 days; $p<0.001$). The rate of conversion to laparotomy was 1.8%.

A Cochrane review (Nieboer et al., 2009) which compared the access routes for hysterectomy included 34 studies with a total of 4495 women. The benefits of vaginal hysterectomy compared with abdominal were quicker return to normal activities (mean difference of 9.5 days), fewer episodes of fever or nonspecific infection (OR 0.42) and shorter hospitalization (mean difference of 1.1 days). The benefits of laparoscopic surgery compared with open surgery were early return to usual activities (mean difference of 13.6 days), lower intraoperative blood loss (mean difference of 45ml), smaller drop in hemoglobin (mean difference of 0.55g/dl), shorter hospital stay (mean difference of 2 days) and lower incidence of fever and abdominal wall infections (OR 0.31), at the expense of a higher incidence of lesions of the urinary tract (bladder and ureter) (OR 2.41) and prolonged operative time (mean difference of 20.3 minutes). The benefits of laparoscopically assisted vaginal hysterectomy compared with total laparoscopic hysterectomy were lower rate of episodes of

fever or nonspecific infection (OR 3.77) and shorter operative time (mean difference of 25.3 minutes). There was no evidence of benefit when comparing the laparoscopic and vaginal hysterectomy; the surgical time (mean difference of 39.3 minutes) and substantial bleeding (OR 2.76) were higher in the laparoscopic group.

Schindlbeck et al. (2008) compared the hysterectomy performed by laparoscopy (n = 43), vaginal (n = 87) and abdominal routes (n = 103), noting that the vaginal route had the shortest operative time (130 vs. 90 vs. 115 minutes; respectively; $p<0.01$), but the greater intraoperative blood loss (200 vs. 300 vs. 250ml, respectively; $p=0.07$). The laparoscopic group had less need for analgesics (1.5 vs. 2 vs. 4 days, respectively; $p<0.01$) and shorter hospital stay (7 vs. 8 vs. 9 days, respectively; $p<0.01$). The major complications included three bladder injuries at laparoscopic hysterectomy, 2 lesions of the rectum at vaginal hysterectomy, and 2 cases of postoperative ileus and one case of vesico-vaginal fistula at total abdominal hysterectomy.

Evaluating the clinical and economic outcomes of laparoscopic (n = 3520), vaginal (n = 3130) and open abdominal hysterectomy (n = 8754), Warren et al. (2009) observed that the rate of postoperative infection was higher in the group undergoing abdominal surgery (15% vs. 14% vs. 18%, respectively; $p<0.05$), length of hospital stay was shorter in the laparoscopic group (1.6 vs. 2.2 vs. 3.7 days; $p<0.001$) and the cost of the procedure was higher in the group undergoing surgery by open approach ($10,868.00 vs. $9544.00 vs. $12,086.00, respectively; $p<0.05$).

2.2 Total laparoscopic vs. laparoscopic supracervical hysterectomy

Some authors have preferred to conserve the cervix at the time of hysterectomy. Urinary and sexual function after surgery, were the clinical parameters for comparison between the total and supracervical techniques. Early studies reported better sexual and urinary function after supracervical hysterectomy, however randomized controlled trials have not confirmed these findings. In a Cochrane review in 2006 (Johnson et al., 2006), a group of randomized controlled trials were evaluated with respect to the results of supracervical and total hysterectomy. Three studies which included 733 patients were analyzed and no difference in urinary incontinence, constipation and sexual function was noted. Sexual function was measured by satisfaction with sex life, the prevalence of dyspareunia and rate of general sexual problems. The supracervical group had lower febrile morbidity and higher cyclic bleeding 1 year after surgery (OR 11.31, 95% CI 5.1 to 31.2). The surgery time (mean difference of 11.41 minutes, 95% CI 6.6 to 16.3) and blood loss (mean difference of 85.1 ml, 95% CI 27.4 to 142.9) were lower in the supracervical group, but there was no difference in the need for blood transfusion. These studies included in the Cochrane review compared the supracervical hysterectomy and total hysterectomy performed through laparotomy, but have been extrapolated to the laparoscopy. A randomized study comparing sexual changes and psychological well-being of patients undergoing subtotal hysterectomy (n = 66) and total hysterectomy (n = 66) (Ellström Engh et al., 2010), noted that women in the subtotal hysterectomy group reported positive changes in the frequency of orgasms and greater sexual pleasure than in the total hysterectomy group. Despite the findings of that study, there was no clear difference in terms of sexual or urinary function in the long term when comparing the two surgical techniques (Sokol & Green, 2009). Preoperative sexual activity is predictive factor of postoperative sexual

activity. However, independently, supracervical hysterectomy may lead to an earlier resumption of sexual activity (Helström, 1994).

In a retrospective series of 1000 supracervical laparoscopic hysterectomies (Bojahr et al., 2009), the median duration of surgery was 70.9 minutes (95% CI 69.2 to 72.5 minutes) and mean uterine weight was 212.5g (95% CI 201 - 223.6g). Surgical time decreased from 85.4 minutes in 2002 to 72.4 minutes in 2006, associated with the increasing in the uterine weight from 192.3 g to 228.7g. There was one case of bladder injury (0.1%) and 4 cases of conversion to laparotomy (0.4%). Milad et al. (2001) compared 27 women undergoing laparoscopic supracervical hysterectomy and 105 undergoing laparoscopically assisted vaginal hysterectomy, noting a shorter surgical time (181 vs. 220min; p=0.007), shorter hospital stay (1 vs. 2 days; p<0.001) and less blood loss (125 vs. 400ml; p<0.001) in the supracervical hysterectomy. No complications occurred in group supracervical hysterectomy. In the group of laparoscopically assisted vaginal hysterectomies there was a complication rate of 13% (p = 0.04), which included bladder injury (n = 3), blood loss exceeding 1000ml (n = 7), and vaginal vault hematoma (n = 4). In 2009 (Cipullo et al., 2009), the postoperative results of total laparoscopic hysterectomy (n = 157) were compared with supracervical laparoscopic hysterectomy (n = 157). The women who underwent supracervical hysterectomy had shorter operative time (100 vs. 110 minutes) and lower rate of major complications (1.3% vs. 4.5%) compared with those who underwent total hysterectomy. The reduction in cancer risk has been cited as an indication for removal of the cervix, however, the risk is low, with a 0.1% risk of cancer when the cervix is retained and a risk of 0.17 % of vaginal cancer. The median time to diagnosis was 26 years after surgery, and survival data were similar to those of patients without prior hysterectomy. Although cancer risk is low, the presence of dysplasia would be a contraindication for cervical preservation (Sokol & Green, 2009). Moreover, the risk of cyclical bleeding after surgery should be considered when discussing the removal of the cervix during a hysterectomy. The bleeding rates are between 5% and 20%, based on data obtained in randomized controlled studies of hysterectomies done by laparotomy and 19% in a prospective observational study of cases done by laparoscopy (Ghomi et al., 2005). The rate of reoperation for cyclic bleeding is 1-2% (Falcone & Walters, 2008; Ghomi et al., 2005). The endocervical fulguration has been shown to decrease the rate of future bleeding, although the efficacy of this modality has not been proven (Ghomi et al., 2005). Another option is excision of the endocervical component, but there is a paucity of literature or data on this technique.

3. Preoperative preparation

3.1 Particulars of laparoscopic hysterectomy

The indications for laparoscopic hysterectomy are similar to those for hysterectomy in general. Specific indications for the laparoscopic approach are the cases where there is contraindication for vaginal hysterectomy (Falcone & Walters, 2008). The Cochrane review of 27 studies with 3643 participants, comparing the results of abdominal, vaginal and laparoscopic hysterectomy concluded that the vaginal route of access should be preferred to abdominal access route, based on the best results. The authors also concluded that when vaginal hysterectomy is not possible, laparoscopic hysterectomy can obviate the need for an abdominal hysterectomy, but require a longer surgical time (mean difference of 25.3

minutes), without imposing any additional benefit to the vaginal route of access (Johnson et al., 2006).

Compared with vaginal surgery, laparoscopy allows the performance of concomitant procedures (appendectomy, adnexal surgery, excision of endometriosis) and inspection of the peritoneal cavity. In 2005, the American College of Obstetricians and Gynecologists Committee Opinion (2005) has listed the following information as appropriate for the use of laparoscopically assisted vaginal hysterectomy: lysis of adhesions, treatment of endometriosis, management of leiomyomas which hinder vaginal hysterectomy, ligation of the infundibulopelvic ligaments to facilitate removal of difficult ovaries, and evaluation of the abdomino-pelvic cavity before hysterectomy. The best diagnostic accuracy of the laparoscopic procedure with a clear view of the entire abdomen and pelvis was confirmed by the eVALuate study (Garry et al., 2004b), which consisted of two randomized controlled trials comparing abdominal (laparoscopy or laparotomy) and vaginal hysterectomy. Laparoscopy was associated with a higher detection rate of unexpected pathologies such as fibroids, endometriosis and adhesions, compared with the vaginal (16.4% vs. 4.8%; $p<0.01$) and the abdominal route of access (22.6% vs. 12.7%; $p<0.01$). However, no data shows that these additional findings influenced the performance of additional procedures by the surgeons or results in the long term.

3.2 Contraindications

The contraindications for laparoscopic hysterectomy are as follows (Sokol & Green, 2009):

- Medical conditions that contraindicate the establishment and maintenance of the pneumoperitoneum.
- Inexperience and / or inadequate training of surgeons.
- Malignancy that may require removal of the intact specimen or special procedures that can not be done due to skill, access or other circumstances.
- Lack of proper equipment.
- Contraindication to a possible laparotomy or non-acceptance of the patient. The consent form must include the potential need for conversion to laparotomy.

3.3 Preoperative details

Randomized studies have shown a decrease in surgical site infection with the use of prophylactic antibiotics in potentially contaminated procedures and it is recommended in cases of laparoscopic hysterectomy (Falcone & Walters, 2008). The prophylactic antibiotics should be administered within one hour of incision in the skin and should not be continued beyond 24 hours.

Several randomized studies have also shown a decreased risk of thromboembolism with enoxaparin prophylaxis.

4. Decision-making, anatomy, and key steps in the operations (Bourdel et al., 2009; Velemir et al., 2009)

4.1 Positioning

The patient is placed in the dorsal decubitus position, under general anesthesia with tracheal intubation. The legs are positioned at 30 degrees flexion, the arms along the body and buttocks slightly exceeding the operating table (Figure 1). The bladder is probed.

Fig. 1. Positioning of the patient for hysterectomy.

The surgeon is positioned to the left of the patient, the first assistant to the right and the second assistant is responsible for the uterine manipulator.

4.2 Uterine cannulation

Uterine cannulation is performed with a specific instrument: the uterine manipulator Karl Storz type Clermont-Ferrand (Figure 2). The cervix is visualized via speculum and dilated to Hegar number 9. The tip of the manipulator is then inserted into the cervix under direct vision. The size of the tip to be used varies with the size of the uterus.

4.3 Positioning of trocars

Four trocars are placed:

- One 10mm umbilical trocar.
- Three 5mm trocars: one 2cm medial to the right anterior superior iliac spine, another 2cm medial to the left anterior superior iliac spine, and a third in the midline, 8 to 10cm below the umbilicus (Figure 3). The latter 5mm trocar can be replaced by a 10 or 12mm trocar during surgery for the introduction of needles to suture the vaginal vault. In cases of bulkier uteri, the trocars can be positioned more cranially.

Fig. 2. Uterine manipulator type Clermont-Ferrand (Karl Storz).

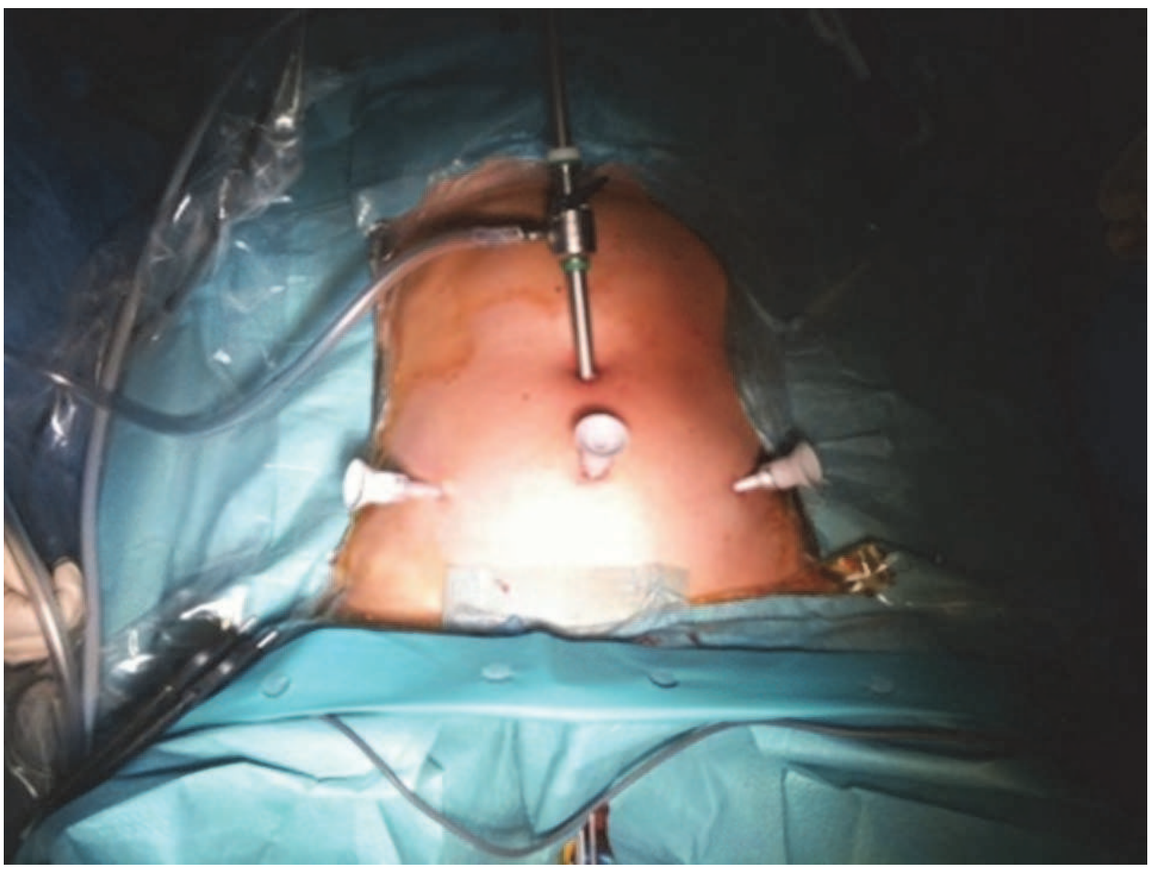

Fig. 3. Positioning of trocars for laparoscopic hysterectomy.

After placing the first trocar, the patient is placed in Trendelenburg position. The small bowel is retracted in cranial direction until the sacral promontory and pouch of Douglas are clearly visible.
The surgeon uses a bipolar cautery in the left hand and scissors in the right hand. The first assistant manipulates the zero degree laparoscope with the left hand and uses an Allis forceps or a grasper in the right hand.

4.4 Presentation of round ligaments

On the left, the release of adhesions between the sigmoid colon and infundibulopelvic ligament allows proper exposure of the round ligament (Figure 4). The uterus is mobilized by the second assistant and maintained in a cranial and anterior position. The round ligament is then grasped and pulled by the first assistant, which facilitates surgical access to the opposite side and thus the beginning of the surgery (Figure 5).

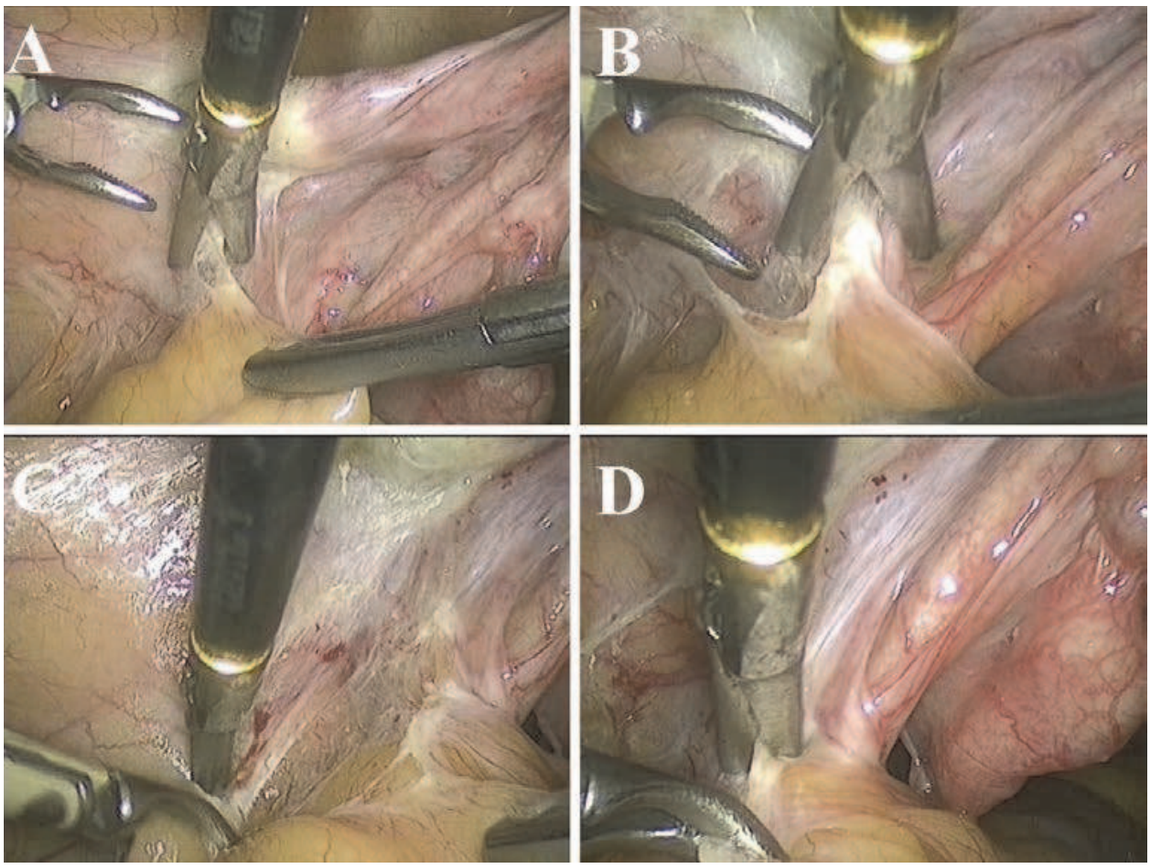

Fig. 4. Releasing the adhesions between the sigmoid colon and the left infundibulopelvic ligament.

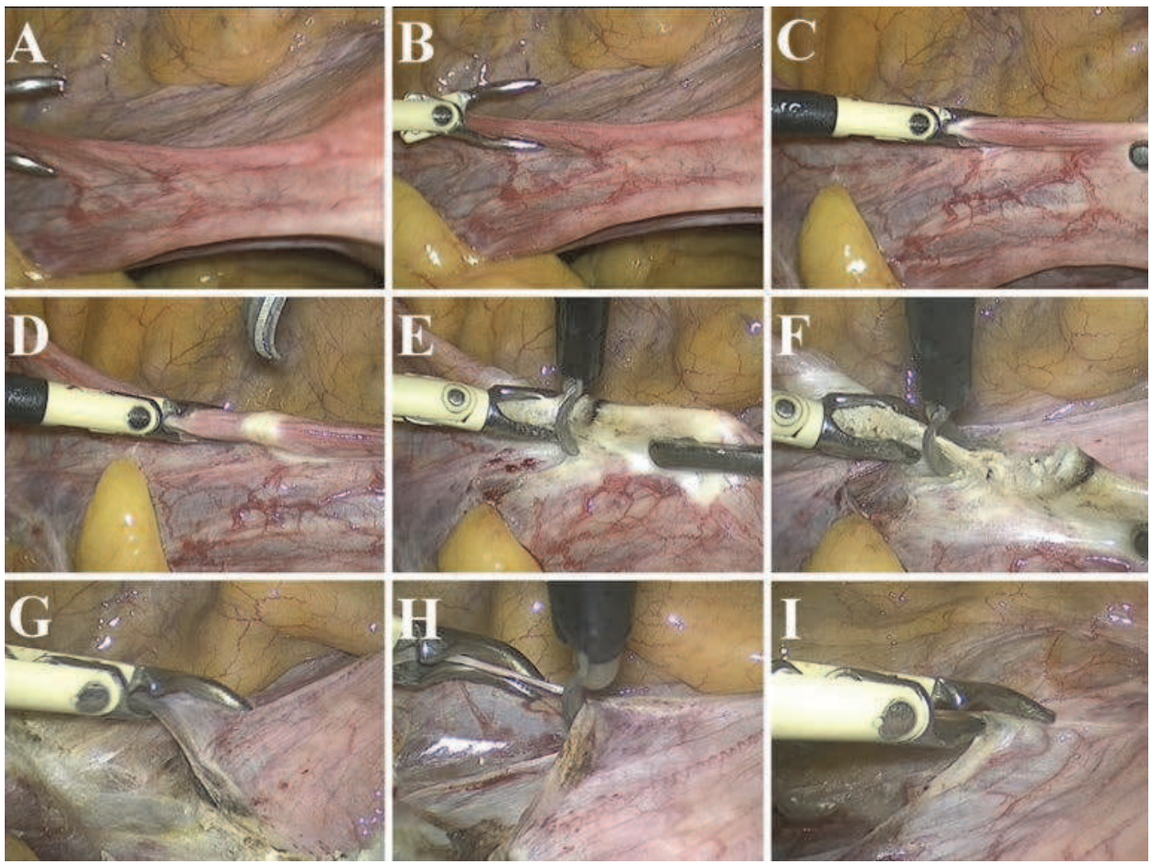

Fig. 5. (A and B) Uterine manipulation using the uterine manipulator of Clermont-Ferrand, exposing the left round ligament. (C) The first assistant pulls the left round ligament and the surgeon starts the coagulation with bipolar cautery. (D to F) Coagulation and section of the round ligament with laparoscopic scissors. (G to I) Opening the anterior leaf of the broad ligament from the round ligament up to the anterior peritoneal reflection.

4.5 Coagulation and division of the round ligaments

The round ligament is held about 2 to 3cm medial to lateral pelvic sidewall. It is then coagulated using bipolar cautery and the transection is performed with laparoscopic scissors (Figure 5).

4.6 Opening the anterior fold of the broad ligament up to the peritoneal vesicouterine fold

The uterus is maintained in a horizontal orientation by the second assistant. The anterior leaf of the broad ligament is coagulated with bipolar forceps and sectioned, from the round ligament up to the vesicouterine peritoneal reflection (Figure 5).

4.7 Fenestration of the broad ligament

The capillaries of the posterior leaf of the broad ligament are coagulated. The blue-gray appearance of the peritoneal leaf indicates that there are no underlying structures which can be inadvertently damaged. The posterior leaf of the broad ligament is cut and the opening is

enlarged using divergent traction between the bipolar forceps and scissors (Figure 6). The ureter is then displaced laterally and inferiorly along with the peritoneum where it is less susceptible to injury.

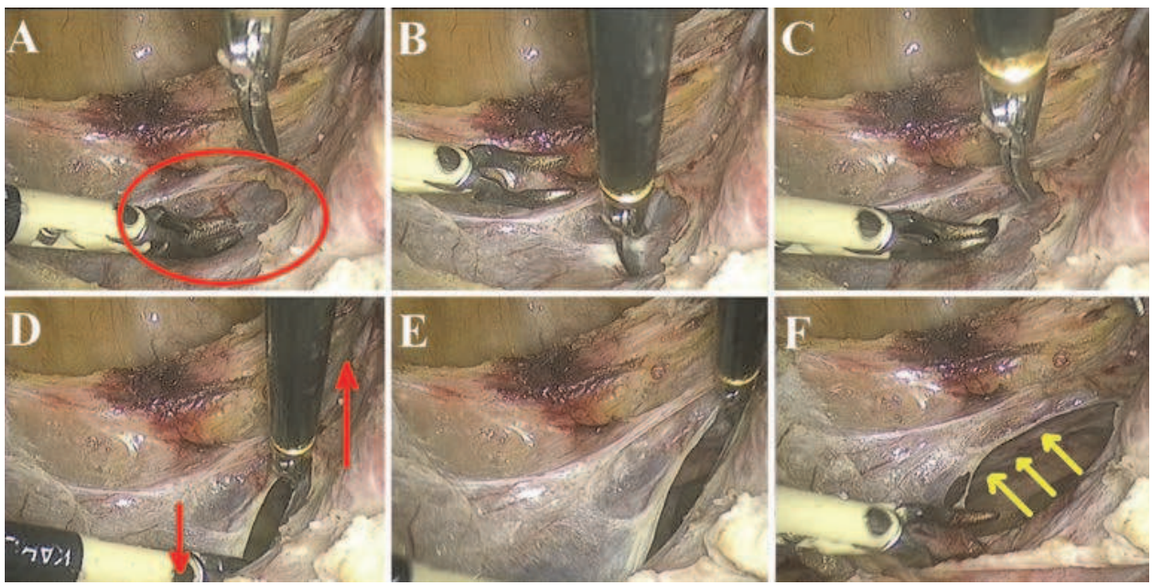

Fig. 6. (A) Coagulation of the capillaries of the posterior leaf of the broad ligament (red circle). (B and C) Opening of the blue region of the posterior leaf of the left broad ligament. (D and E) Fenestration of the broad ligament and the anteroposterior divergent pull of two instruments (scissors and bipolar forceps). (F) The ureter stays laterally along the left pelvic sidewall (yeloow arrows).

4.8 Coagulation and section of the infundibulopelvic ligament (total hysterectomy with bilateral adnexectomy) or the utero-ovarian ligament and the tube (interadnexal hysterectomy)

The first assistant should grasp the round ligament pedicle and apply traction towards the contralateral side of the infundibulopelvic ligament. The coagulation-section of the ligament should be progressive, plane by plane (peritoneum, followed by the vessels and the connective tissue) (Figure 7). When ovarian conservation is desired, the coagulation-section is performed on the tube and the utero-ovarian ligament (Figure 8).

4.9 Opening the posterior leaf of the broad ligament up to the uterosacral ligament

The dissection continues on the posterior peritoneum of the broad ligament, avoiding inadvertent injury of the uterine vessels (Figure 9). The peritoneum is stretched and dissected, coagulated and cut toward the uterosacral ligaments. Thus the uterine pedicle is isolated. All steps, from the coagulation-section of the round ligaments to the opening of the posterior leaf of the broad ligament, are performed in the same way on both sides.

4.10 Opening of the vesicovaginal space

The uterus should be mobilized cranially and slightly posterior, to expose the base of the vesicouterine space. The assistant uses an atraumatic forceps to grasp the peritoneum and

bladder in the midline, applying cranial and superior traction. The peritoneum and the adjacent connective tissue are coagulated and sectioned, thus accessing the vesicovaginal plane. The dissection continues in the caudal direction, initially in the midline and then laterally. Coagulation-section of the vesico-uterine ligaments is performed (Figure 10). The second assistant advances the uterine manipulator valve into the vaginal fornix to reveal the plane and facilitate dissection.

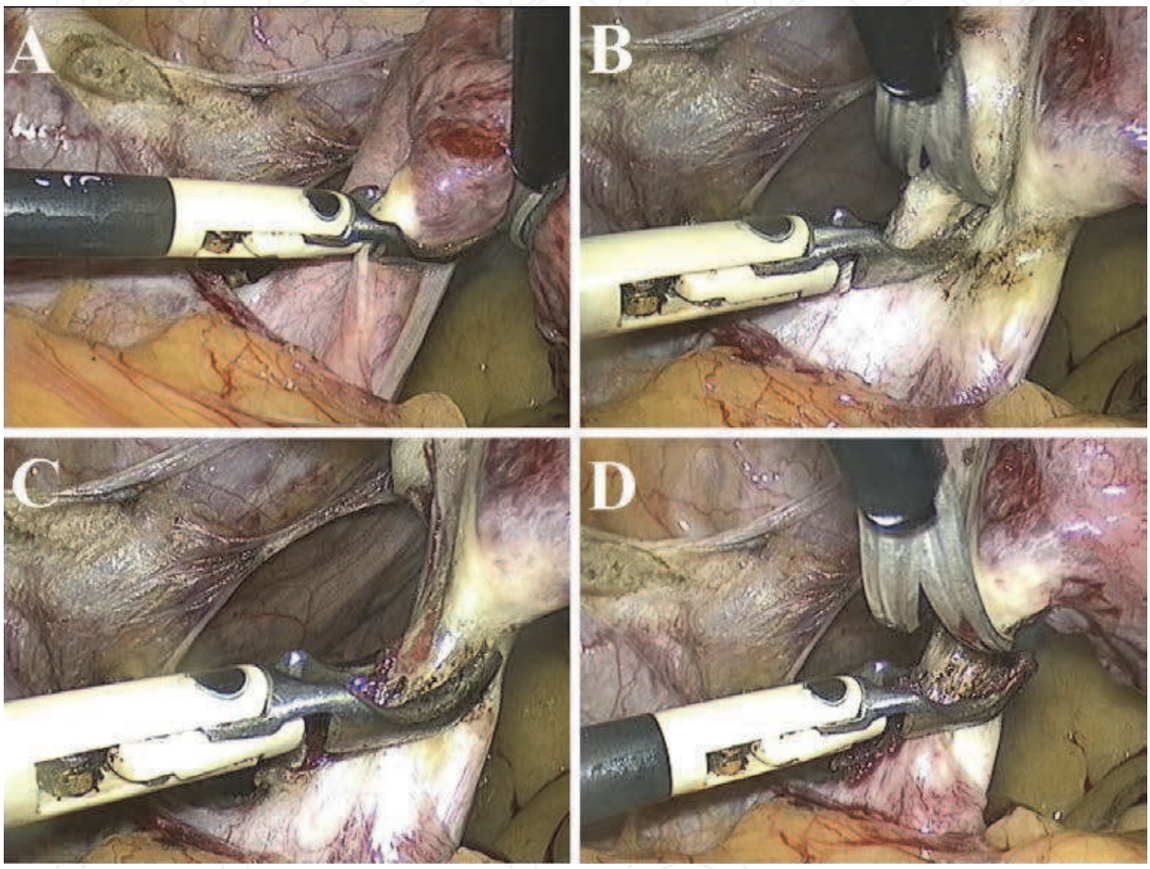

Fig. 7. Traction of the left adnexa by the assistant, followed by progressive bipolar coagulation of the infundibulopelvic ligament.

4.11 Coagulation and section of the uterine pedicles

The uterus is again directed cranially and laterally by the second assistant. The first assistant pulls the adnexa or the round ligament cranially and laterally. The pedicles must be very well isolated to allow an effective bipolar coagulation. The coagulation-section of the uterine pedicles, performed at the ascending uterine artery, should be carried in a progressive manner. The bipolar forceps is introduced by the lateral trocar, on the same side of the pedicle to be coagulated (Figure 11).

After coagulation of the uterine vessels, the pericervical fascia is incised at the same level of the coagulated uterine pedicles in order to enter the intra-fascial plane. The cervicovaginal vessels and the insertion of the uterosacral ligament are coagulated and sectioned (Figure 11).

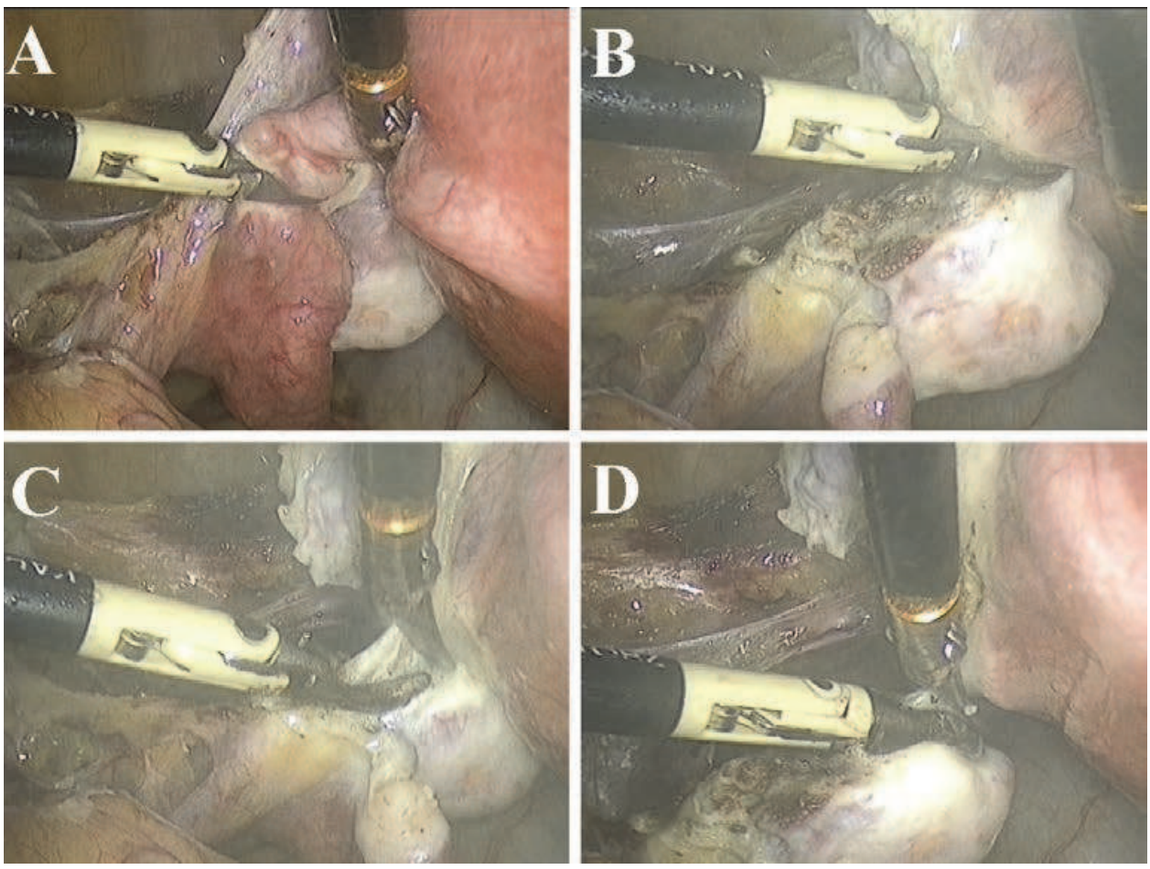

Fig. 8. Coagulation and section of the left fallopian tube and utero-ovarian ligament in case of left adnexal preservation.

4.12 Vaginal opening

The silicone ring system for prevention of loss of pneumoperitoneum is inserted into the vagina and the valve handle is pushed towards head. The monopolar section is performed on the valve starting at the anterior vaginal wall in the midline. It is continued laterally to the left, then posterior. The second assistant systematically exposes each part of the vaginal fornix rotating the valve. The opening of the vaginal vault continues towards the right side and ends posterior. The first assistant aspirates cautery smoke from the operative field. Sometimes additional hemostasis of the vaginal vault with a bipolar forceps is needed (Figure 12).

4.13 Surgical extraction of the uterine specimen

The extraction is performed vaginally in most cases (Figure 12). On some occasions it may be necessary to morcellate the uterus which can be performed laparoscopically, by cold knife or electric morcellator (Figure 13) or vaginally using the classic technique with a cold knife.

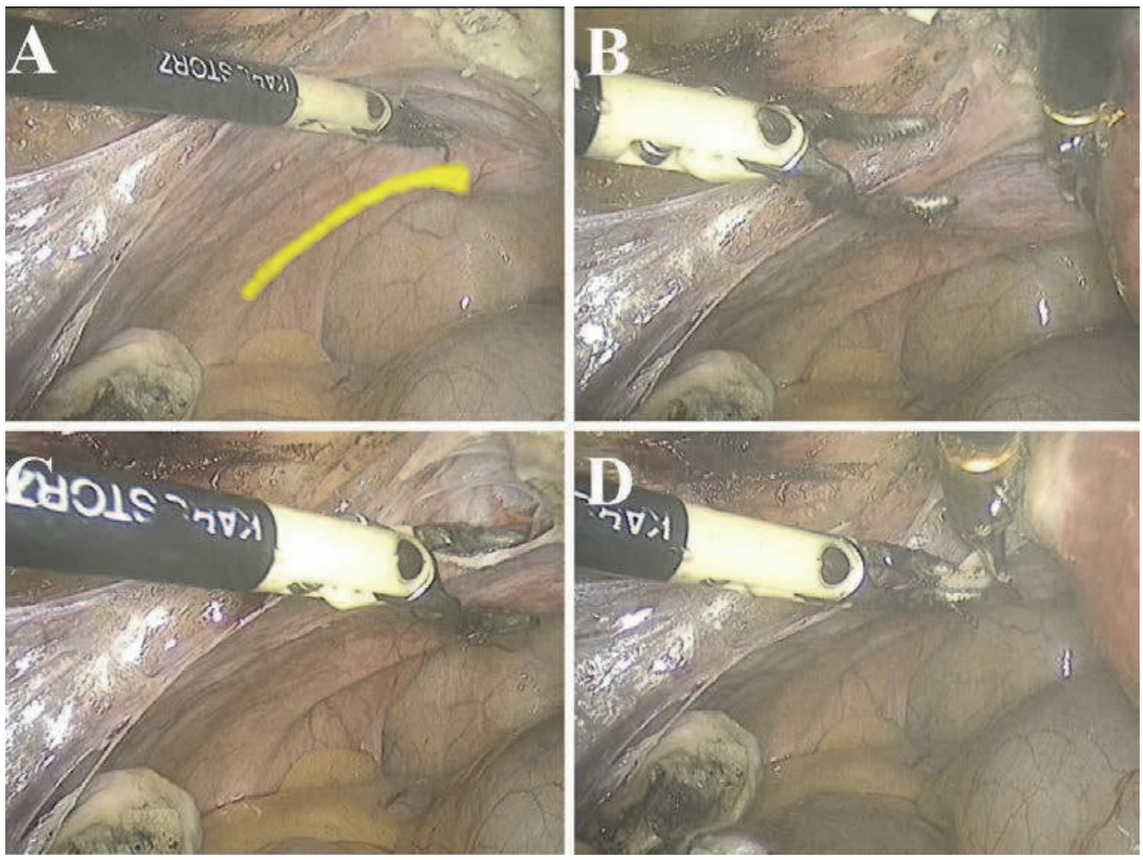

Fig. 9. Opening of the posterior leaf of the broad ligament up to the uterosacral ligament (in yellow).

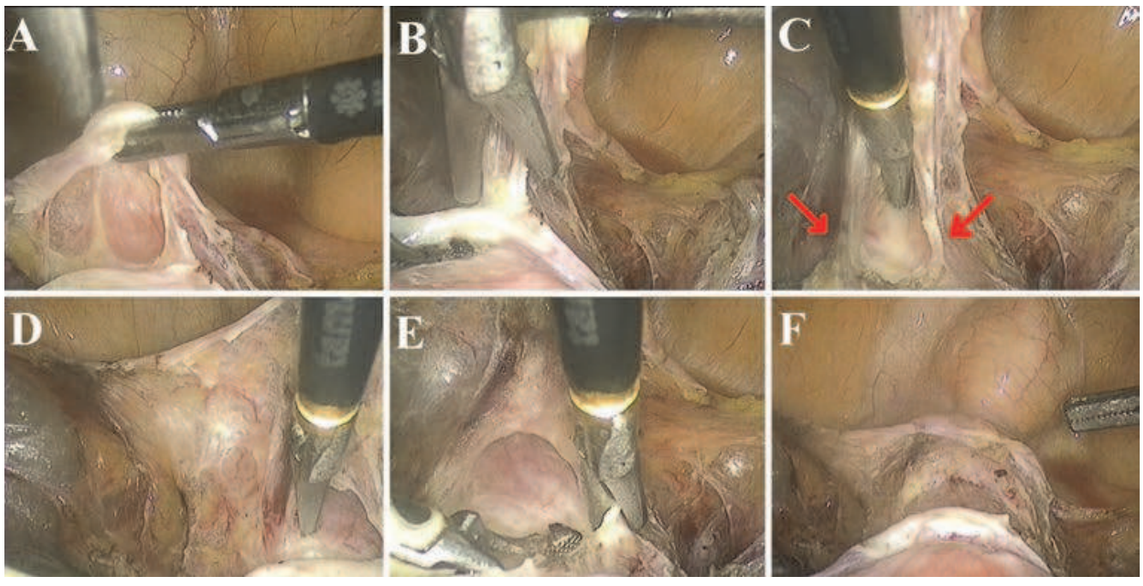

Fig. 10. Dissection of the vesicovaginal space. The green arrows indicate the area to be coagulated (vesico-uterine ligaments).

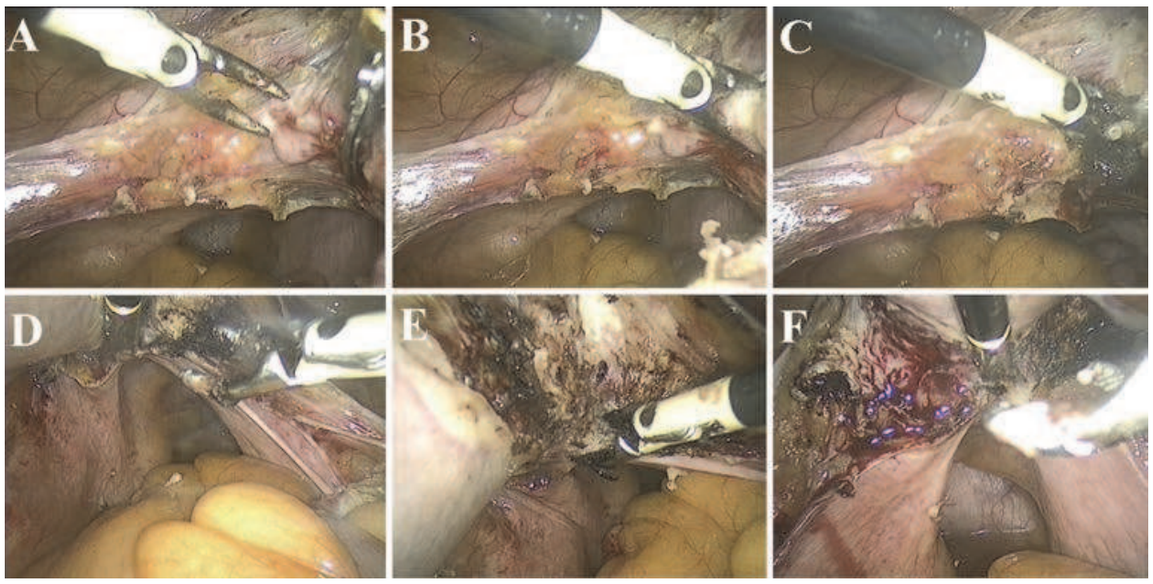

Fig. 11. (A to C) Progressive coagulation of the left uterine vessels using bipolar forceps. (D to F) Intra-fascial plane on right side.

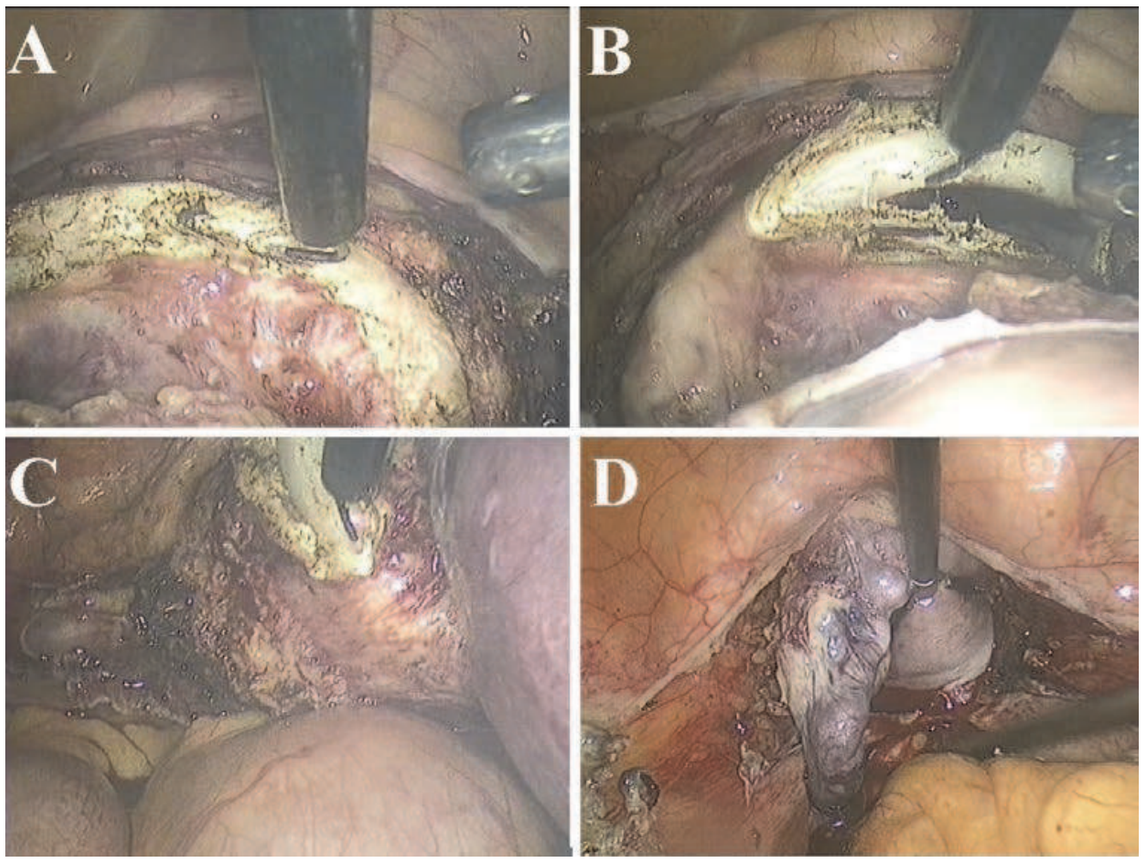

Fig. 12. (A to C) Opening of the vaginal vault with monopolar cautery. (D) Extraction of the uterine specimen without morcellation.

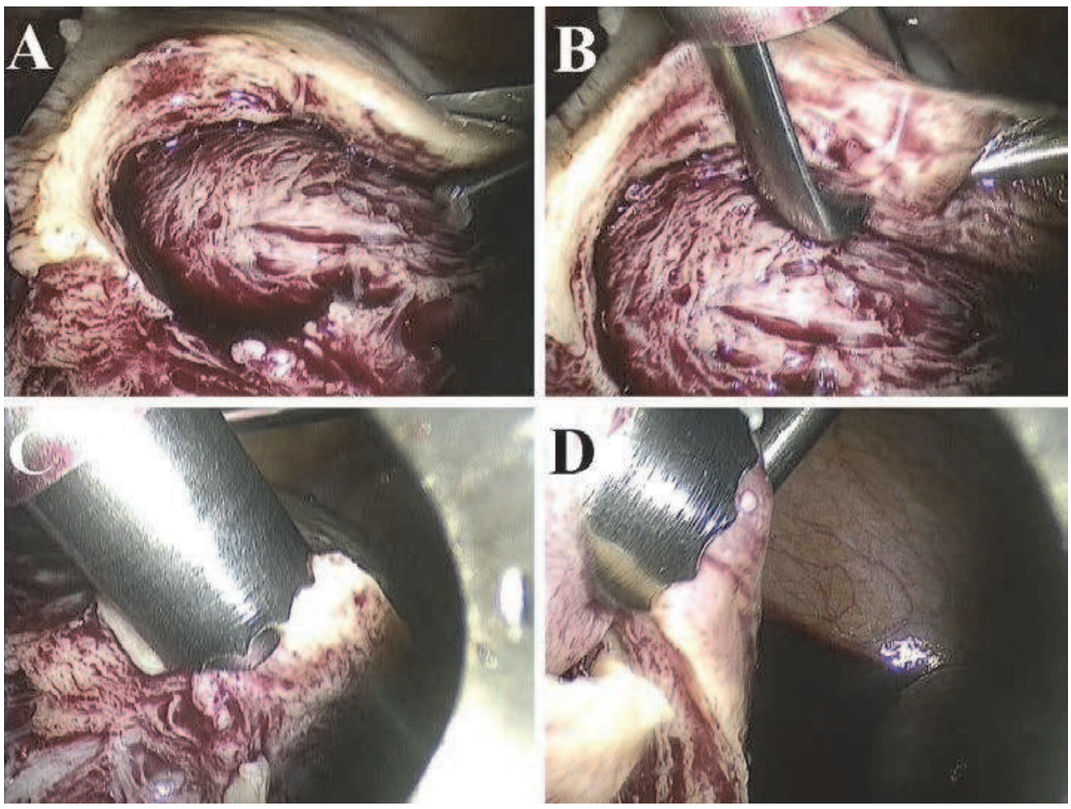

Fig. 13. Extraction of the uterine specimen using an electric morcellator.

4.14 Closure of the vaginal vault

The vaginal vault is sutured at three points using zero monofilament absorbable sutures (Poliglecaprone, Caprofyl ®, Ethicon Inc) (Figure 14).

4.15 Adnexal pexy

In cases of laparoscopic interadnexal hysterectomy we perform the adnexal pexy (fixation of the ovary and tube to the ipsilateral round ligament) using 2-0 polyester (Ethibond®, Ethicon Inc), to avoid adnexal torsion in the postoperative course (Figure 15).
Hemostasis is checked (Figure 15). The fascial defect of the 10mm trocar in the midline is sutured. The pneumoperitoneum is deflated and the skin is sutured with 3-0 monofilament absorbable suture (Poliglecaprone 25, Monocryl ®, Ethicon Inc).

4.16 Alternative techniques to the use of bipolar energy

There are some technical alternatives to the use of bipolar energy for total laparoscopic hysterectomy. Bipolar energy seems to be a safe cost-effective method with good control and accuracy during dissection and sectioning of the uterine vessels and other structures. However, the use of disposable laparoscopic instruments can afford the surgeon a slightly shorter surgical time. Options include endoscopic linear cutting staplers (Figure 16), the LigaSure® Vessel Sealing system (Valleylab) (Figure 17), the EnSeal® tissue sealing system (Advanced Tissue Sealing Technology) (Figure 18), and the Ultracision® harmonic scalpel (Figure 19).

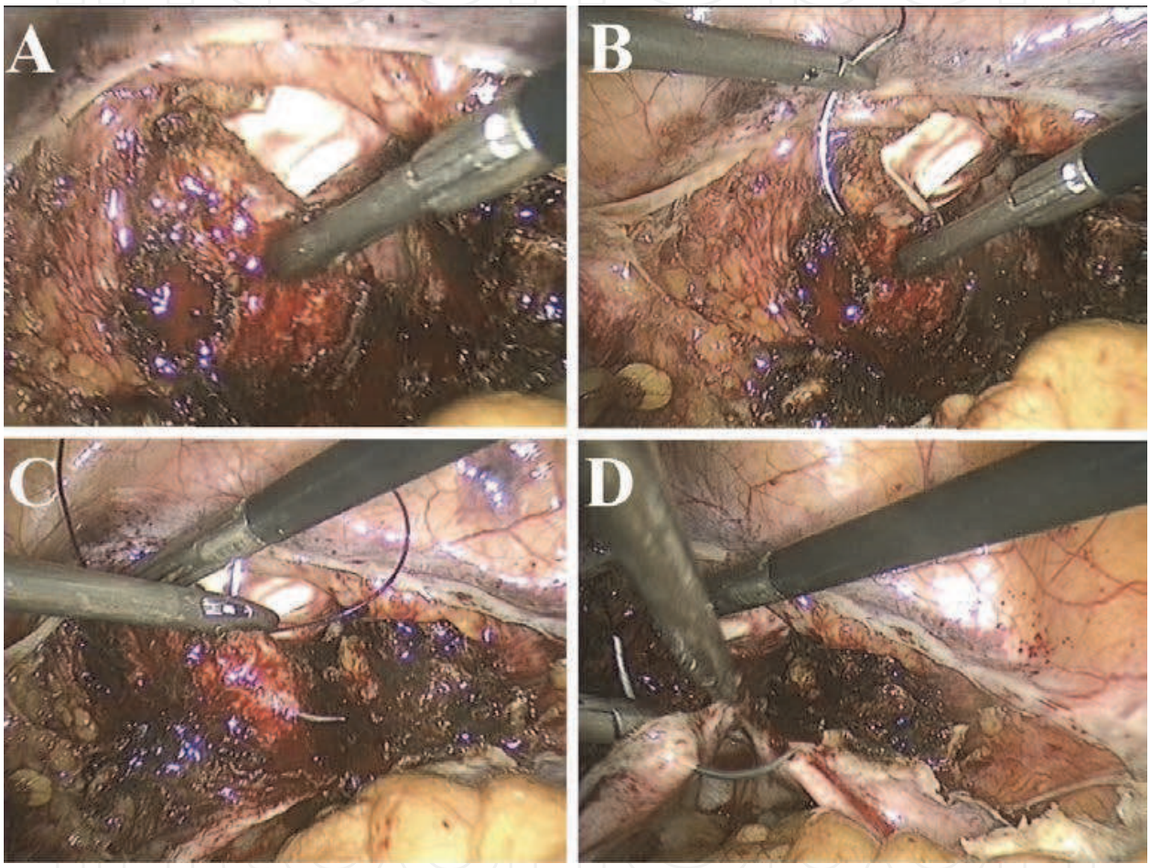

Fig. 14. Suturing the vaginal vault. The first assistant pulls the vagina and three interrupted X-shaped sutures are placed using zero Caprofyl®. The picture illustrates the suture at the left corner of the vagina, which must include the left uterosacral ligament (D).

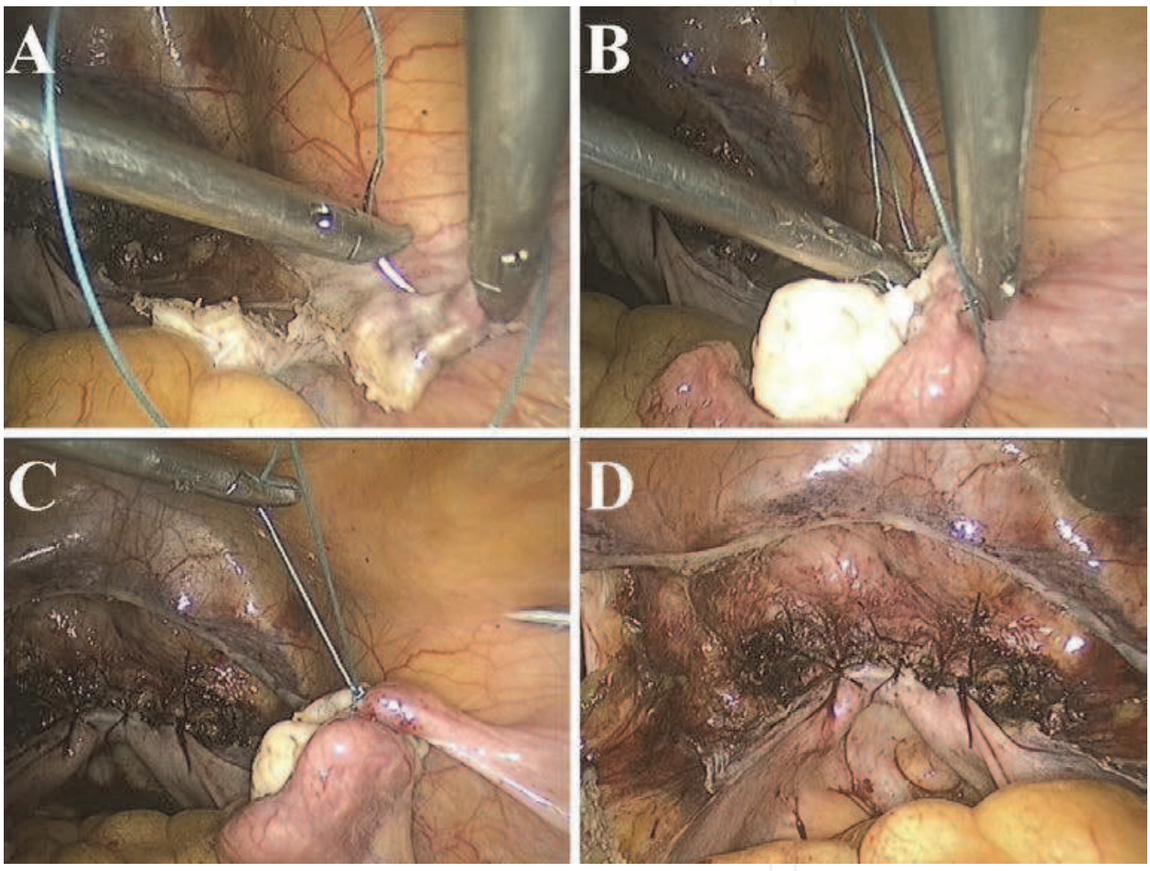

Fig. 15. (A to C) Fixation of the ovary to the round ligament on the right side using 2-0 Ethibond®. (D) Final appearance of the vaginal vault after homeostasis.

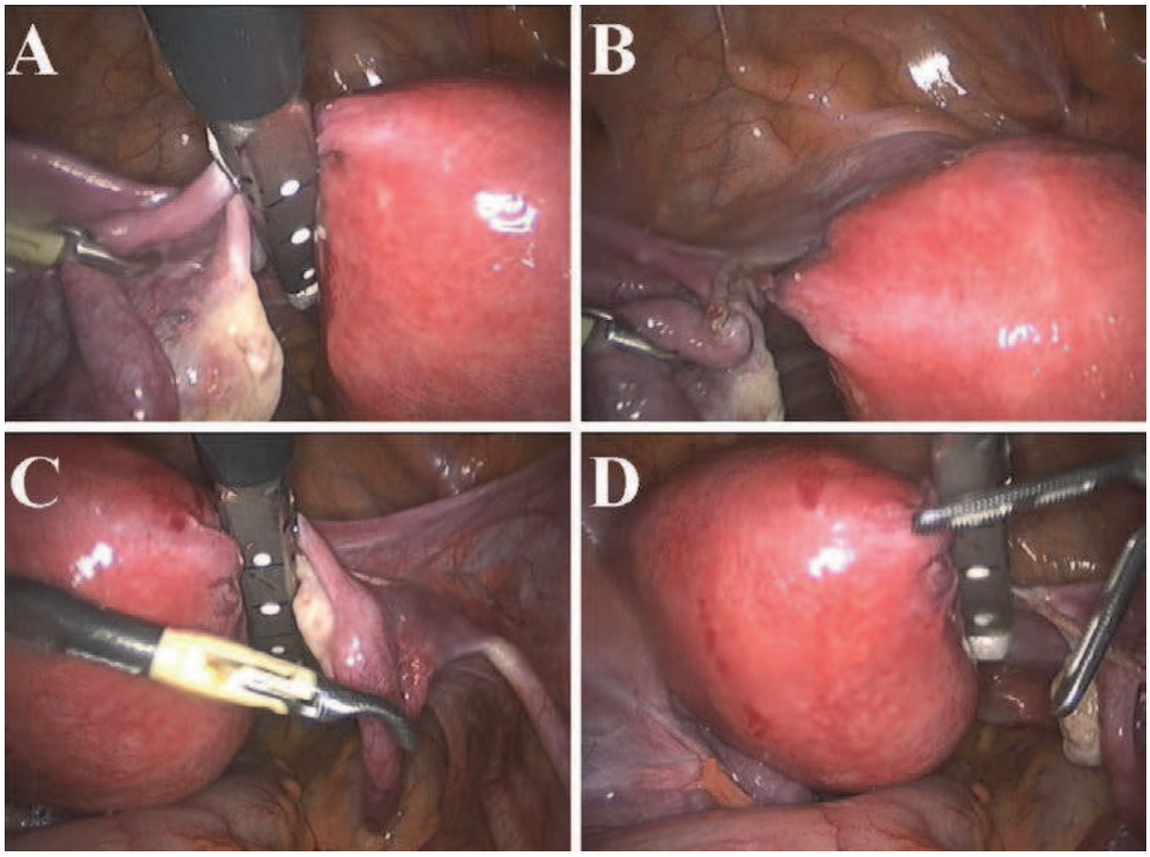

Fig. 16. Use of endoscopic linear cutting staplers for total laparoscopic hysterectomy.

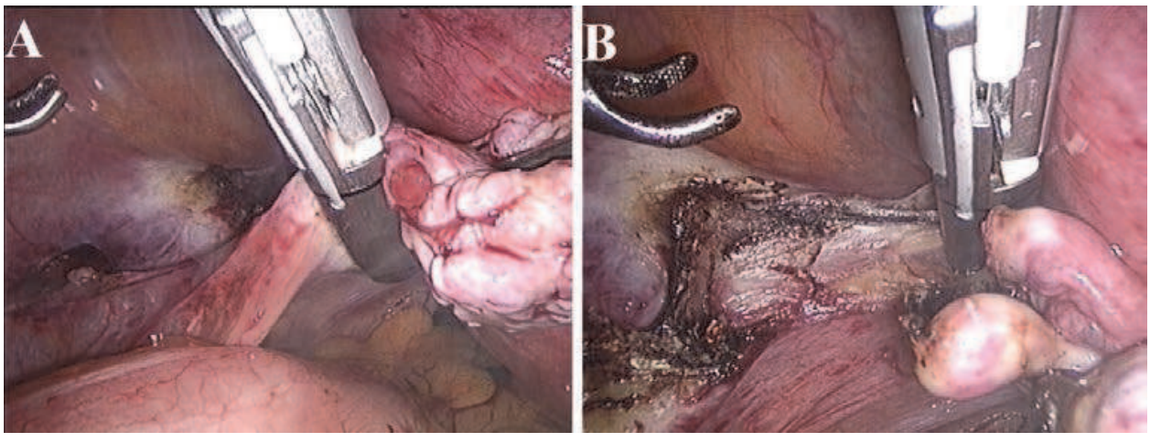

Fig. 17. Use of the LigaSure® Vessel Sealing for control of the infundibulopelvic ligament in total laparoscopic hysterectomy

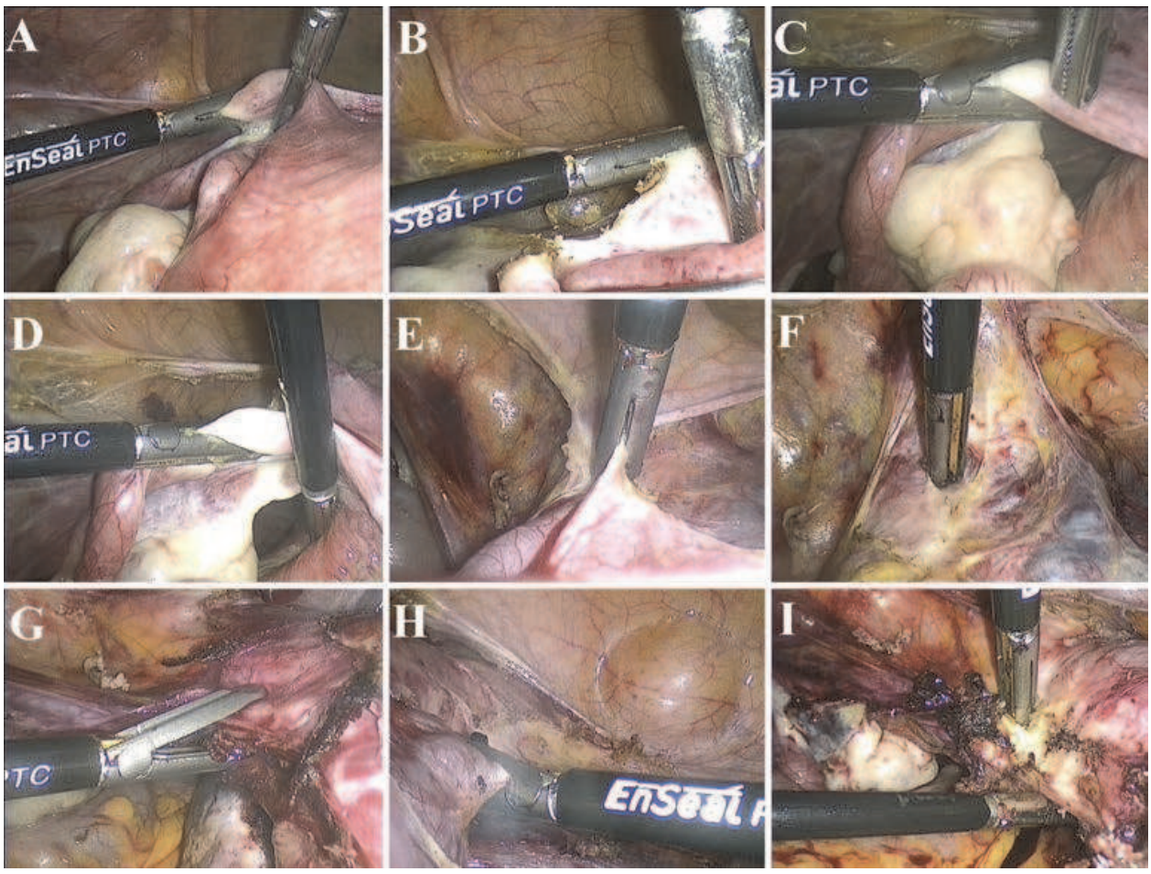

Fig. 18. Use of EnSeal® during total laparoscopic hysterectomy.

5. Surgical tricks

Some situations require further consideration: total laparoscopic hysterectomy in obese women and those with large uteri. The indications for removal of the ovaries and fallopian tubes are the same as in open surgery.

5.1 Bulky uterus

The access route to the achievement of hysterectomy in women with enlarged uteri is still controversial (Claerhout et al., 2005). A uterus is usually considered large when its size exceeds 12 weeks of gestation (average 280g) (Daraï et al., 2001). Despite the fact that a large uterus can be removed vaginally or laparoscopically, most gynecologists prefer to perform surgery by laparotomy. Randomized studies comparing open and laparoscopic hysterectomy for large uteri have shown the benefits of minimally invasive surgery with respect to blood loss, length of hospital stay and postoperative pain (Ferrari et al., 2000; Marana et al., 1999; Schütz et al., 2002; Sesti et al., 2008). However, disadvantages include longer surgical time (Ferrari et al., 2000; Johnson et al., 2006) and the significant learning curve, which has direct bearing on the frequency of major complications (Mäkinen et al., 2001).

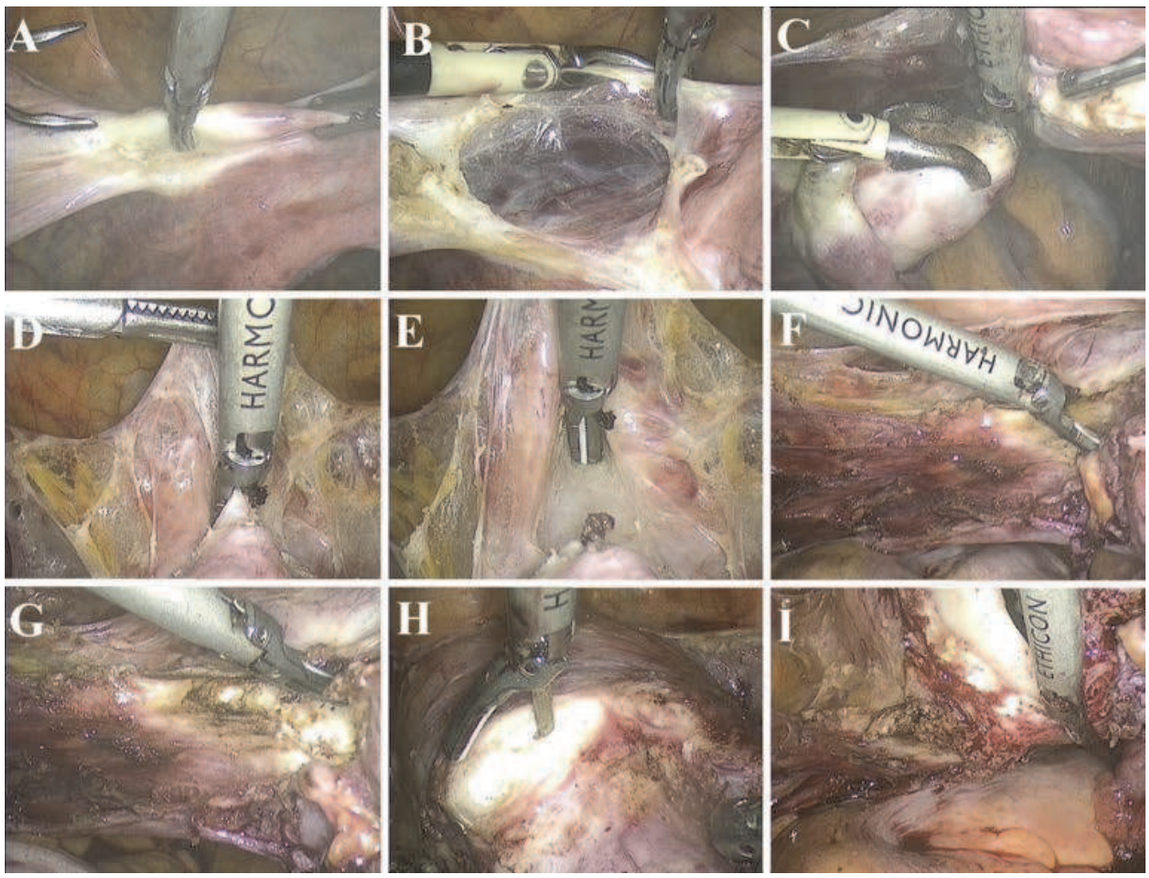

Fig. 19. Use of Ultracision® harmonic scalpel in total laparoscopic hysterectomy.

The size of the uterus seems to be an important factor for the occurrence of intraoperative bleeding and postoperative complications during laparoscopic hysterectomy, especially when performed for uteri larger than 500g (Bonilla et al., 2007). Some authors suggest the use of selective uterine artery coagulation at its origin during the laparoscopic procedure in large uteri to avoid or reduce intraoperative bleeding (Roman et al., 2008).

Laparoscopic hysterectomy for enlarged uteri has been studied by several authors. Wattiez et al (2002a) compared women undergoing total laparoscopic hysterectomy for uteri > 300g and ≤ 300g, and only the operative time was higher in the first group (156 vs. 108 minutes; p<0.001). There was no difference in the drop of hemoglobin levels, the need for analgesia and the time hospital stay between groups. In 2007, Bonilla et al. (2007) evaluated the impact of uterine weight in total abdominal and laparoscopic hysterectomy for benign diseases. The patients were divided into three groups according to the uterine weight (< 200g, 201-500g and > 500g) and it was observed that the average length of hospital stay and the risk of bleeding, the transfusion requirements and the postoperative complications increased with increasing uterine volume. Laparoscopic surgery was strongly associated with decreased morbidity, reduced hospitalization time and less blood loss compared to open surgery. Using a cut off of 500g to define a bulky uterus, Wang et al. (2004) demonstrated a prolonged operative time (91.1 vs. 77.4 minutes; p<0.01) and a increased intraoperative blood loss (570 vs. 262ml; p< 0001) during laparoscopic assisted vaginal hysterectomy for uteri of increased size. A recent study by Fanning et al. (2008) confirmed the feasibility of

performing laparoscopically assisted vaginal hysterectomy for uteri above 1000g. They were able to successfully carry out 14 of 15 procedures (93%), with an average uterine weight of 1090g, a surgical time of 210 minutes and a blood loss of 400ml.

To perform laparoscopic hysterectomy in patients with bulky uterus is necessary to use a uterine manipulator with a long tip to reach the uterine fundus, allowing the manipulation of the entire uterus. The placement of trocars more cranial allows a greater surgical field and greater mobility of the laparoscopic instruments. The use of 30 degrees laparoscope allows a greater range of visual fields, and facilitates some surgical steps during the procedure for enlarged uteri.

5.2 Obese women

The impact of obesity on the outcomes of laparoscopic hysterectomy is still controversial. Although some authors suggest that laparoscopic hysterectomy can be safely performed in women with overweight and obesity, others report an increased risk of longer surgeries, intraoperative bleeding (Heinberg et al., 2004) and conversion to laparotomy (Leonard et al., 2005; Sokol et al., 2003). Comparing obese and nonobese females who underwent total abdominal hysterectomy, Pitkin (1976) observed a high incidence of wound complications (risk of 7x compared with the nonobese control group), which was directly responsible for the increased febrile morbidity and need for prolonged hospitalization. Similarly, Obermair et al. (2005) reported a 48% incidence of wound infections after surgery in obese women operated by laparotomy for endometrial cancer. In 2006, O'Hanlan et al. (2006) compared patients with uterine cancer undergoing total laparoscopic hysterectomy according to body mass index. The patients were stratified into five groups (underweight, ideal weight, overweight, obese and morbidly obese) and no statistically significant difference in mean duration of surgery, blood loss and hospital stay as observed between groups. Pellegrino et al. (2009) did not identify any difference between obese and nonobese women undergoing laparoscopic radical hysterectomy for stage I endometrial cancer in terms of surgical time, and intraoperative and long-term complications. Only blood loss was significantly higher in obese patients.

5.3 Salpingectomy / bilateral oophorectomy

The bilateral oophorectomy at the time of hysterectomy for benign disease is commonly performed in order to prevent the subsequent development of ovarian cancer or ovarian pathology that may require additional surgery. Currently, bilateral oophorectomy is performed in 78% of women aged between 45 and 64 years who undergo hysterectomy, and a total of 300,000 prophylactic oophorectomies are performed in the United States each year (Parker etl a., 2009b). Estrogen deficiency resulting from oophorectomy in pre- and post-menopause has been associated with increased risk of coronary heart disease, stroke, hip fracture, parkinsonism, dementia, cognitive impairment, depression and anxiety. In general, removal of the ovaries at the time of hysterectomy should be carefully evaluated in women who are not in the high risk group for developing breast cancer or ovarian cancer (Hickey et al., 2010; Parker etl a., 2009b; Parker, 2010). The Nurses' Health Study evaluated 16,345 women who underwent hysterectomy with bilateral oophorectomy and 13,035 undergoing hysterectomy with ovarian conservation (Parker et al., 2009a). They observed a reduced risk of ovarian cancer and breast cancer in the group undergoing concomitant oophorectomy, but an increased risk of mortality, fatal and nonfatal coronary heart disease, and lung cancer. In no analysis was oophorectomy associated with increased survival.

Repasy et al. (2009) evaluated the impact of removal of the tubes at the time of hysterectomy on ovarian survival, noting that 35.5% of patients in whom the fallopian tubes were intact developed hydrosalpinx. However, there was cystic degeneration of orphan ovaries (absence of the Fallopian tube) earlier than in the group with preservation of the tube (50 vs. 84.2 months; p=0.031). The authors' conclusion was that the removal of the tube during hysterectomy decreases the incidence of development of pelvic masses in the future, but it causes earlier cystic degeneration in remaining ovaries.

6. Postoperative care

The patient is given a regular diet 6 hours after the procedure. If the postoperative course is uneventful, patients can be discharged on the first postoperative day. They must be advised to avoid vaginal intercourse for 40 days.
Postoperative consultations are performed within 7 days to remove the dressings and 40 days to evaluate the healing of the vaginal vault.

7. Impact of the technique on modern practice

7.1 Complications

A hysterectomy is a safe procedure with a low mortality rate, estimated at 0.12 to 0.34 per 1000 surgeries (Falcone & Walters, 2008). Complications directly related to the laparoscopic approach include those related to the positioning of the Verees needle and trocars (bleeding, bowel injury), those related to pneumoperitoneum insufflation, hernia at the fascial defect created by the trocar and need to convert to open surgery. Other complications are related to the surgical procedure itself and are basically the same, regardless of the approach used for the hysterectomy, such as bleeding, urinary and bowel injuries, anesthetic problems, pulmonary thromboembolism, postoperative infection (urinary, pulmonary, surgical), problems in the vagina (hematoma, abscess and dehiscence), etc.
The VALUE study (Vaginal Abdominal Laparoscopic Uterine Excision) was a prospective nonrandomized study that evaluated the severe complications in 37,295 women undergoing abdominal (67%), vaginal (30%) and laparoscopically assisted vaginal hysterectomy (3%) (McPherson et al., 2004). The overall rate of severe complications was 3.5%, including visceral injury, bleeding, death, myocardial infarction, thromboembolic disease, stroke and organ failure. The risk was higher in patients undergoing surgery for fibroids (OR 1.34), in those with comorbidities (OR 1.47) and those subjected to laparoscopic surgery (OR 1.92). The laparoscopic procedures doubled the risk of complications compared to abdominal hysterectomy (6.1% vs. 3.6%).
The eVALuate study (Garry et al., 2004a) comprised two parallel randomized controlled trials: one comparing laparoscopic hysterectomy with abdominal hysterectomy and another comparing laparoscopic to vaginal. Laparoscopy was associated with a higher rate of major complications than laparotomy (11.1% vs. 6.2%; p=0.02). The conversion to laparotomy was included as a major complication, and when this was excluded, there was no statistically significant difference between the two types of access. When comparing the laparoscopic and vaginal access, no difference in complications was observed (however, this study arm did not reach the minimum required number of patients for treatment). The study confirmed some advantages of laparoscopy as less pain, shorter hospital stay, faster postoperative recovery, and better quality of life in the short term when compared with laparotomy. The disadvantages included the increased operative time and the highest rate of injuries to the urinary tract.

In a meta-analysis, laparoscopy was associated with increased risk of urinary tract lesions compared with abdominal hysterectomy (OR 2.61) (Johnson et al., 2005). When lesions of the ureters and bladder were considered separately, there was no increased risk of ureteral injury with laparoscopy. Laparoscopy was associated with fewer infections (OR 0.32), fewer episodes of fever (OR 0.65), less blood loss (mean difference 45.3ml) and smaller drop in hemoglobin (0.55g/l) compared with abdominal hysterectomy. Similar findings were noted comparing vaginal and abdominal hysterectomy. There was no difference in the fistula formation, urinary dysfunction, sexual dysfunction or patient satisfaction comparing all the access routes for hysterectomy. No difference was observed in the need for blood transfusion, occurrence of pelvic hematoma, infection of the vagina, urinary tract infection and thromboembolic events.

A total of 10,110 hysterectomies were analyzed in Finland during 1996 (Mäkinen et al., 2001), including 5,875 abdominal, 1,801 vaginal and 2,434 laparoscopic, noting an overall rate of complications (including major and minor) of 17.2%, 23.3% and 19%, respectively. Lesions of the ureter occurred predominantly in the laparoscopic group (0.2%, 0% and 1.1% respectively), whereas the intestinal lesions were more frequent in the vaginal group (0.2%, 0.5% 0.4%, respectively). The intra-operative bleeding requiring surgical intervention or blood transfusion during surgery was more common with vaginal hysterectomy (3.1% compared with 2.1% in abdominal hysterectomy). Infections (wound, intra-abdominal, vaginal, urinary tract, fever of unknown origin, etc.) were the most frequent complications, with an incidence of 10.5%, 13% and 9% in the abdominal, vaginal and laparoscopic hysterectomy groups, respectively.

The recent series of Donnez et al. (2009) which included 3,190 laparoscopic hysterectomies showed no increased rates of major complications when laparoscopic hysterectomy is performed by experienced surgeons. There was no difference in the rate of ureteral injury after vaginal (0.33%) and laparoscopic hysterectomy (0.25%). Bladder injuries occurred in 0.44% of women undergoing vaginal hysterectomy and 0.31% in those undergoing laparoscopic hysterectomy.

Some studies have observed that the incidence of vaginal vault dehiscence after laparoscopic hysterectomy is higher than after hysterectomy abdominal (Rivlin et al., 2010). In the case of total laparoscopic hysterectomy, the vagina is sutured using absorbable sutures. A study that reviewed 7,286 hysterectomies found an incidence of dehiscence of the vaginal vault of 4.93% after laparoscopic hysterectomy, 0.29% after vaginal hysterectomy and 0.12% after abdominal hysterectomy. The relative risk compared with vaginal and abdominal was 21 and 53.2, respectively, which was statistically significant (Hur et al., 2007). There are no prospective studies comparing methods of vaginal vault closure and the subsequent risk of dehiscence, partly due to the infrequent occurrence of this complication. In the absence of data that can clarify these findings, recommendations for colpotomy and the vaginal vault closure include: minimizing energy use in the vaginal dome, ensuring adequate depth at the time of vaginal suture, and paying attention to meticulous surgical technique, including hemostasis.

Another reported complication after laparoscopic hysterectomy is adnexal torsion. The prevalence of this complication was 7.91 per 1,000 cases and occurred approximately 2.64 years after laparoscopic hysterectomy in Mashiach et al. (2004)' study. To avoid this complication, we perform adnexal fixation (ovary and fallopian tube to the round ligament) at the time of laparoscopic hysterectomy as a routine measure.

7.2 Conversion

Risk factors for conversion in laparoscopic surgery include body mass index, history of previous laparotomy, suspected malignancy, presence of adhesions, technical difficulties, complex cases, surgeon experience and uterine weight (Sokol et al., 2003). Risk factors for conversion during laparoscopic hysterectomy in the first 5 years of experience included (Leonard et al., 2005): increased body mass index (adjusted OR 1.09, 95% CI 1.01 to 1.18), length of the uterus on transvaginal ultrasound of 8 to 10cm (adjusted OR 4.01, 95% CI 1.54 to 10.45), uteri greater than 10 cm in length on transvaginal sonography (adjusted OR 9.17, 95% CI 2.74 to 30.63), lateral myoma measuring more than 5cm on transvaginal sonography (adjusted OR 3.57, 95% CI 0.97 to 13.17) and history of previous surgery or pelvis infection as a basis for adhesions or scarring (adjusted OR 2.92, 95% CI 1.23 to 6.94).

7.3 Learning curve

Observational and retrospective studies have shown a lower rate of complications and conversion to laparotomy with increasing surgeon experience, thus demonstrating a learning curve for the procedure.

In the study by Mäkinen et al. (2001), surgeons who performed more than 30 laparoscopic hysterectomies had lower rates of complications of the ureter, bladder and bowel compared with less experienced colleagues. Ghomi et al. (2007) showed that after the initial experience of 30 cases the surgical time of laparoscopic supracervical hysterectomy decreased significantly. Ascher-Walsh & Capes (2007) observed a significant reduction in surgical time (from 201.4 minutes to 137.2 minutes, $p<0.001$) comparing the first 2 cases and the last two cases of laparoscopic supracervical hysterectomy performed by senior residents.

In 2002, Wattiez et al. (2002b) compared the frequency of complications of total laparoscopic hysterectomy during 1989-1995 (n = 695) and 1996-1999 (n = 952). The rate of major complications decreased from 5.6% to 1.3%. There was also significant reduction of excessive bleeding (1.9% vs. 0.1%) and the need for blood transfusion (2.2% vs. 0.1%) in the second period. The rate of urinary complications was 2.2% in the first period (10 lacerations of the bladder, 4 ureteric injuries and 1 vesico-vaginal fistula) and 0.9% in the second period (6 lesions of the bladder, 2 ureteral lacerations and 1 vesico-vaginal fistula), which was statistically significant ($p<0.005$). A single case of intestinal injury and intestinal obstruction occurred in the first period. The rate of conversion to laparotomy was 4.7% in the first period and 1.4% in the second period. The surgical time was reduced from 115 minutes in the first period to 90 minutes in the second period ($p<0.005$). Likewise, Brummer et al. (2008) observed that the overall incidence of major complications in laparoscopic hysterectomy in the period 1992-1999 (n = 13,885) was 1.8% and in 2000-2005 (n = 13,942) decreased to 1 %. During the same period, the urinary tract injuries decreased from 1.4% to 0.7% and specifically, lesions of ureter decreased from 0.9% to 0.3%.

8. Recommendations and conclusions

The benefits of minimally invasive hysterectomy (laparoscopic or vaginal) are undeniable when compared with open surgery. The exploration of the abdomino-pelvic cavity and the ability to perform a safe oophorectomy represent some advantages of laparoscopy over the vaginal route. Specific indications for each surgical technique remain uncertain. However, the proposal is not that laparoscopic hysterectomy replace vaginal hysterectomy but serve to

increase the therapeutic armamentarium of the gynecologist surgeon to perform minimally invasive surgery for a wide range of indications, obviating the need for an abdominal hysterectomy in the presence of adnexal tumors, pelvic adhesions, endometriosis, previous pelvic surgeries, bulky uteri and obese patients.

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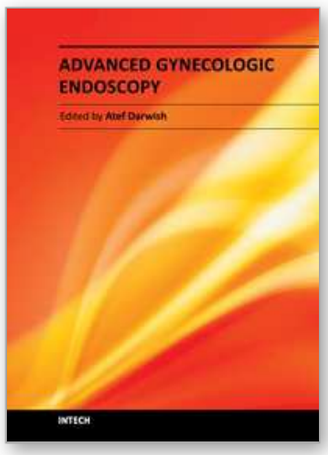

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The main purpose of this book is to address some important issues related to gynecologic laparoscopy. Since the early breakthroughs by its pioneers, laparoscopic gynecologic surgery has gained popularity due to developments in illumination and instrumentation that led to the emergence of laparoscopy in the late 1980's as a credible diagnostic as well as therapeutic intervention. This book is unique in that it will review common, useful information about certain laparoscopic procedures, including technique and instruments, and then discuss common difficulties faced during each operation. We also discuss the uncommon and occasionally even anecdotal cases and the safest ways to deal with them. We are honored to have had a group of world experts in laparoscopic gynecologic surgery valuably contribute to our book.

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