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Gynecological laparoscopy

Methodology guidelines for students

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Introduction

Scientific and technological progress in medicine has stipulated changes in many classical theses and approaches in gynecology. It has also resulted in a significant expansion of indications and contraindications for endoscopic interferences. Gynecologic laparoscopic surgery, previously used for diagnosis, transformed into radical and reconstructive pelvic surgery. Today about 80 % of all gynecological surgical abnormalities may be treated using endoscopic techniques.

Based on the above, integration into global medicine requires from medical students an understanding of opportunities and technologies of new operational methods in gynecology.

The role of diagnostic laparoscopy and transvaginal endoscopy (TVE) in infertility and assisted reproduction technology (ART)

Introduction

Exploring the peritoneal cavity and visualizing its organs is essential in the diagnosis of female pelvic pathology, especially in the case of infertility or pelvic pain of non-specific etiology.

The pelvis can be visualized endoscopically by *diagnostic laparoscopy* or *transvaginal endoscopy*.

Both techniques have benefits and drawbacks so that it is not possible to choose definitively between them. In summary, it can be stated that both are minimally invasive endoscopic techniques that require general anesthesia in the vast majority of cases (even if performed as day surgery) and the use of a fully equipped operating room. Although many authors have suggested the use of local anesthesia for these outpatient procedures applying either technique, general anesthesia is nearly always necessary in our experience.

Diagnostic laparoscopy provides a panoramic view of the pelvis – not feasible by transvaginal endoscopy (TVE) – and facilitates switching to endoscopic surgery in the event of pelvic pathology. From the surgical point of view, transvaginal endoscopy has certain limitations. With the aid of a 30°-hysteroscope and fluid medium for distension of the peritoneal cavity, the transvaginal approach undisputably provides some absolutely unique angles of vision and types of images. Nonetheless, it must be said, that TVE allows salpingoscopy of the distal tubal segment to be performed only in selected cases."

Laparoscopic Diagnosis

Diagnostic laparoscopy is indicated in infertile patients if tuboperitoneal pathology is suspected to be the primary cause of inhibited female reproduction. Among the most common indications are suspected tubal defects or irregularities on the hysterosalpingogram, previous abdominal surgery suggesting the tentative diagnosis of adhesions, and signs of endometriosis or hydrosalpinx on ultrasound. Diagnostic laparoscopy allows conversion to open surgery and immediate surgical treatment of any unexpected pelvic pathology prior to initiating Assisted Reproductive Technology (ART) procedures.

Laparoscopy combined with diagnostic hysteroscopy is therefore considered the gold standard for the assessment of the pelvis and female reproductive tract. Even in the case of Mullerian malformation, the combined use of laparoscopy and hysteroscopy is ideal for a definite diagnosis since it allows assessment of the exterior contour of the uterine corpus. In fact, hysteroscopy on its own does not allow differential diagnosis between a septate uterus and bicornuate uterus so it must always be supplemented by diagnostic laparoscopy or transvaginal ultrasound. Diagnostic laparoscopy is also indicated in infertile patients to exclude the presence of pelvic pathology when 1st level ART procedures for a period of 6–8 months did not yield a positive result. Laparoscopy must be scheduled during ovulation or the second phase of the cycle and must always be combined with diagnostic hysteroscopy to evaluate the condition of the uterine cavity and allow endometrial biopsy sampling, if needed.

The diagnostic measures above must be performed with utmost care and precision to prevent iatrogenic trauma to the tissue being examined. Modern technology allows minimally invasive diagnostic laparoscopy by use of miniaturized telescopes, instruments and trocars.

However, the surgeon must be readily prepared for endoscopic-guided surgical treatment of any pathology encountered during the diagnostic session. Diagnostic laparoscopy is normally performed as day surgery with the patient being discharged on the same day.

Patient Positioning

Positioning on the operating table involves the cooperation of the awake patient. The patient must be placed in gynecological position with her arms close to the body and her legs placed in stirrups, avoiding positions that might cause compression of the plexuses or peripheral nerves. In addition, the legs must be positioned low to prevent interference with the surgeon's maneuvers conducted through the lateral ports. It is preferable to use a uterine manipulator to facilitate viewing the pelvic organs and for injecting methylene blue dye for chromopertubation.

Normally, diagnostic laparoscopy is performed through a double access:

- periumbilical port for the laparoscope and videocamera;
- along the midline of the lower abdomen for the atraumatic forceps needed to manipulate the pelvic organs.

The diameter of the trocars varies according to the diameter of the chosen instruments and laparoscope.

Anesthesia

Diagnostic laparoscopy can be performed under both local and general anesthesia.

Various authors have suggested using local anesthesia with periumbilical skin infiltration and intravenous sedation. In this case it is vitally important to keep abdominal distension very low with insufflation of 1–2 liters of CO_2 at the most to avoid pain caused by abdominal distension and problems related to spontaneous respiration.

In the case of general anesthesia, agents that guarantee rapid recovery can be used so that the patient can be discharged a few hours after the procedure. In this case, too, local infiltration anesthesia applied to the trocar insertion area has proven to be useful to reduce postoperative pain.

Instrumentation

- 5 mm-laparoscope and videocamera
- Insufflation system
- Xenon cold light source
- 6 mm-trocar
- Veress needle
- Atraumatic grasping forceps
- Suction / irrigation system
- Uterus manipulator

Technique

Pelvic endoscopy allows visual inspection of the peritoneal cavity and the female genital tract involved in the reproductive process.

An extensive diagnostic laparoscopy must include full visualization of the entire peritoneal cavity, a panoramic view of the pelvis and pouch of Douglas, the peritoneal liquid, the uterosacral ligaments, thorough inspection of the ovarian and tubal surfaces (including the fimbriae) and chromopertubation.

Various types of instruments can be used for laparoscopy in infertile patients:

• Traditional laparoscopy, performed by using 5 mm- or 10 mm-laparoscopes, provides optimal visibility at relatively low expenditures. The second port is a 5 mm-trocar through which an atraumatic grasping forceps can be used.

Minilaparoscopy is performed with a laparoscope, 3 mm or even 1.2 mm in diameter. The laparoscope may be introduced through the Veress needle; the atraumatic grasping forceps (diameter 3 mm) may be used through a second port. The principal technical problem in this particular case is related to the extremely reduced diameter of the laparoscope which provides only low-level lighting conditions in the operative field, even given the use of a xenon light source. It is therefore necessary to keep the laparoscope close to the area to be inspected to obtain enough light. In addition, this type of laparoscope is particularly fragile and delicate.

Postoperative Care

The patient is discharged 2 to 6 hours after regaining consciousness if no additional surgical procedure has been performed. A mild analgesic is usually given.

Transvaginal Endoscopy (TVE)

A new endoscopic technique known as transvaginal endoscopy (TVE) has been developed recently. It can be performed as a day procedure. With a miniature endoscope introduced through the vaginal wall it is possible to visualize the pelvic organs, evaluate tubal patency and perform salpingoscopy.

TVE is a simple, safe, precise and effective procedure which, in combination with transvaginal ultrasound and hysteroscopy, allows the main

organs involved in reproduction (and infertility) to be assessed with good patient compliance. This technique is a new alternative option in the field of gynecologic endoscopy for diagnosis and surgical treatment in selected cases.

Set for Transvaginal Endoscopy (TVE)

- 30°-hysteroscope, (diameter 2.7 mm) and videocamera
- Microprocessor-controlled suction / irrigation system (HAMOU ENDOMAT®)
- Xenon cold light source
- Specific trocar needle system for use in TVE, (diameter 3.9 mm, length 25 cm)

Patient Selection Criteria

This method is indicated mainly for infertile patients or those with pelvic pain.

Potential indications for diagnostic TVE:

- Diagnostic assessment of infertility
- Visualization of the pelvis after conservative medical therapy or surgical treatment.
- Pain mapping
- Diagnostic assessment of patients with pelvic endometriosis
- Study of tubal and ovarian physiology
- Early diagnosis of extrauterine pregnancy
- Visualization of the appendix

Initially, bimanual vaginal examination and transvaginal ultrasound are performed to assess the position of the uterus and to exclude the presence of pathology in the pouch of Douglas. The purpose of the technique is to visualize and assess the relationships between the tubes and ovaries, the mucosa of the fimbria and ampulla, presence of adhesions or pelvic endometriosis and tubal patency.

The contraindications to this technique are an intact hymen, a particularly narrow vagina, vaginal infection, obliteration of the pouch of Douglas or the presence of prolapsed structures in the pouch of Douglas, retroverted uterus and hemoperitoneum.

Emergency situations, such as acute pelvic inflammation or ectopic pregnancy with hemoperitoneum are not indications for TVE because the presence of adhesions or hemorrhage can severely impede visibility. Undoubtedly, TVE and, in particular, transvaginal salpingoscopy are useful modalities for diagnostic purposes.

Anesthesia

Various authors have reported that this technique can be performed under local anesthesia, suggesting a routine outpatient setting. Unfortunately, this is possible only in selected cases with a particularly high pain threshold since the maneuvers to visualize the pelvic organs are quite painful demanding for general anesthesia in the vast majority of cases.

Technique

Transvaginal endoscopy is usually performed from the seventh day of the cycle onwards. After placing the patient in dorsal lithotomy position and vaginal disinfection with aqueous chlorhexidine solution, the procedure commences with a diagnostic hysteroscopy. A 30°-hysteroscope (diam. 2.7 mm with a 3.5 mm-sheath) is introduced into the vagina. The vaginal walls are gently expanded by continuous inflow of normal saline solution up to a maximum pressure of 120 mmHg. After identification of the cervix, the hysteroscope is introduced into the cervical canal and a traditional diagnostic hysteroscopy is performed.

To carry out TVE, after insertion of a Collin speculum in the vagina, the posterior vaginal fornix and the posterior lip of the cervix are infiltrated with 1.8 ml of local anesthetic(articaine 40 mg with epinephrine 0.006 mg/ml), and the posterior lip is then grasped with a Pozzi forceps and placed under traction. At this point, a trocar needle system designed particularly for this technique is used; the device consists of a type of Veress needle (length 25 cm), a dilator and an external trocar of diameter 3.9 mm, which are put together before starting the procedure. The system is positioned in the midline 10–15 mm below the insertion of the posterior vaginal wall on the cervix. The release button of a trigger mechanism is actuated which causes the Veress needle to penetrate the vaginal wall. This modality reduces pain and allows the vagina to be perforated without traction. Finally, the distal tip of the needle and dilating sheath are located in the pouch of Douglas.

The Veress needle and dilating sheath are then removed and the same endoscope used for diagnostic hysteroscopy is introduced through the trocar. Once, the correct intra-abdominal position of the hysteroscope's distal tip has been visually confirmed, continuous flow of pre-warmed saline solution (37 °C) can be started.

Unlike traditional laparoscopy, it is not possible to obtain a panoramic view, so it is appropriate to proceed with imaging in the standard manner. The examination begins with localizing the posterior surface of the uterine corpus. The adnexae are then visualized by on-axis rotation of the hysteroscope and movements to the right and left. Once, the ovary and utero-ovarian ligament have been identified, the tubal isthmus and ampulla are identified and inspected gradually advancing toward the fimbrial tubal portion. The posterior surface of the uterine corpus serves as a guide for moving the endoscope to the contralateral side where the same procedure is repeated. Finally, the pouch of Douglas and uterosacral ligaments are thoroughly inspected.

Tubal patency is assessed similarly to traditional laparoscopy by injection of methylene blue dye via a no. 14 Foley catheter previously placed in the uterine cavity.

Salpingoscopy

With sufficient experience in the technique, it is possible to perform salpingoscopy of a few centimeters of the distal tubal segment. The ampulla

and the proximal tubal ostium are identified and the endoscope is then inserted. The infundibulum is easily identified by its characteristic concentric folds. The endoscope is gradually advanced and, as a result of the reduced inflow of saline, the ampulla is distended until the longitudinal folds come into view. Visualization of the folds and intratubal microanatomy is continued while the endoscope is withdrawn slowly. Canalization of the abdominal tubal ostium is easier in the post-ovulatory phase when the fimbriae are more congested and stiff. Inflow of saline is continued throughout the procedure as this allows the intestine and tubo-ovarian structures to remain floating. The volume of liquid required for distension varies from 200 to 400 ml depending on the duration of the examination (average time 45 min). At the end of the procedure, the liquid is evacuated via the trocar. The point of trocar insertion in the vaginal fornix rarely requires suturing, unless there is bleeding.

Complications

The needle-dilator-trocar system used for TVE has been specially designed to reduce to the minimum accidental injuries which may occur during insertion of the instrument. Moreover, the use of this special TVE instrumentation set is capable to prevent iatrogenically-induced sequelae, such as pelvic infections, rectal or intestinal perforation, bleeding of the vaginal fornix or injury of the posterior surface of the uterine corpus.

To keep to a minimum the potential risk of bleeding in the vagina, it is advisable not to incise the vaginal mucosa but to insert the appropriate-sized needle directly, dilating the vagina a second time and using a vasoconstricting agent in combination with the local anesthetic. In fact, minimal bleeding can give rise to serious problems in terms of unimpeded vision, hence it follows that this complication should be avoided.

Post-operative Follow-up

The patient is informed of the possibility of watery or bloody vaginal discharge and is advised not to use intravaginal tampons and to abstain from sexual intercourse for one day. Prophylactic antibiotic medication is administered (azithromycin 500 mg/day for 3 days). The patient can be discharged at the end of the procedure or when she has adequately recovered from general anesthesia.

Techniques of laparoscopic tubal sterilization

Introduction

Female surgical sterilization is the most widely employed method of family planning in the world and the laparoscopic technique is currently used the most. The historical development of this technique dates from the 1970s with *Rioux* and *Corson.* After that came Kleppinger (bipolar), *Lay* and *Yoon* (silastic rubber ring), *Hulka* and *Clemens* (plastic clip), *Semm* (endocoagulator), up to *Filshie* who in 1996 suggested the use of a titanium clip with a silicone rubber lining and a kind of "memory function". Basically, all the laparoscopic techniques are simple, they do not leave an external scar, the costs are lower compared to

other methods, all of the abdominal cavity can be visualized panoramically and the procedure is usually performed as day surgery. In most cases, the period of convalescence is short, which explains the widespread patient acceptance of laparoscopic techniques. Anesthesia is normally general, especially in industrialized countries. In a few cases, patients receive spinal and/or epidural anesthesia. The best form of anesthesia is certainly local anesthesia since it is safer, more economical and without late effects, and can be combined with a sedative and antiemetic.

Patient Selection

Potential candidates for tubal sterilization are women who want an irreversible method of contraception or those for whom pregnancy itself constitutes a risk factor of potential clinical significance. The sterilization procedure can be performed during or outside the postnatal period. Today, clinicians have the choice among a wide range of endoscopic techniques and it is possible to choose the most suitable time for sterilization. There are a few contraindications, obviously apart from the presence of a gynecologic malignancy or any other major gynecologic disease. According to the literature, the main contraindications relating to the technique are adhesions following multiple laparotomies, severe obesity, previous history of peritonitis or salpingitis and any other pelvic disease. Ileus and large abdominal tumors are reported in association with a high rate of complications and failures. Severe cardiopulmonary disease or dysfunction can be generic contraindications to tubal sterilization and to the creation of a pneumoperitoneum.

Patient Positioning

The patient should be placed in gynecologic position with the legs positioned so as not to interfere with maneuvers performed through the lateral trocar ports. An uterine manipulator should be used to facilitate vision and exposure of the fallopian tubes. The Trendelenburg position makes the procedure easier.

Laparoscopic tubal sterilization is normally performed via the following three ports:

- periumbilical primary port, for laparoscope and video camera
- two other lateral ports in the lower quadrant of the abdomen, used for grasping forceps holding the tube and the instrument required for tubal sterilization. The trocar size varies according to the instruments required.

Instrumentation

- 5 mm laparoscope and videocamera
- Insufflator
- Electrosurgical unit
- Xenon light source
- 6 mm trocar
- Veress needle
- 5 mm atraumatic grasping forceps
- 5 mm scissors

- Suction/irrigation system for irrigation and hydrodissection
- Uterine manipulator

Technique

There are various techniques of tubal sterilization, which employ electricity, heat or mechanical devices. Surgical interruption of the tubes by transection via a laparotomy or laparoscopy approach has been found to account for recanalization in up to 4 % of cases. For this reason, mere transection with scissors is not recommended.

Unipolar Electrocoagulation

This is probably the most widely employed method and has a very low failure rate. A panoramic view of the operating field is imperative before proceeding to sterilization. A distorted video image and the loss of overall vision that can occur if the distal lens of the laparoscope is too close to the operating field can confuse even the most experienced laparoscopist. After removing the intestine from the operating field, the junction zone between the proximal and mid-tubal Segments is grasped to dislodge it from the pelvic cavity toward the anterior abdominal wall. Once, the fimbriae have been visualized and the forceps is in correct position, the electrosurgical unit can be connected to the grasping forceps, a precaution that prevents inadvertent pedal activation, which might cause electrical injury to a vital intra-abdominal organ. In general, a power of 50 W is sufficient to induce complete tubal occlusion by unipolar electrocoagulation of the tubal tissue between the jaws of the forceps. The tissue damage extends 0.5–1 cm laterally. The tube becomes whitish and the passage of electrons through the tissue leads to cellular vaporization and creates a clean cutting effect.

It is appropriate to coagulate about 3 cm of tube. Further applications are frequently required to achieve this effect; they should be toward the medial part of the tube, that is, in the direction of the uterine body to avoid electrical injury to the bowel close to the distal segment or tubal fimbriae.

The tube must be viewed from all sides to confirm that coagulation is appropriate. "Missed spots" in the coagulated target area can be coagulated again. At least 0.5 cm of the adjacent mesosalpinx should also be coagulated, thus cutting off the vascular supply.

Bipolar Electrocoagulation

The principles of the bipolar mode represent an extremely important element in techniques of female sterilization. Even if the macroscopic appearance of a tube coagulated by bipolar energy can appear the same as that coagulated by means of unipolar energy, it must be considered that the depth of destruction and lateral extension of the thermal trauma is certainly reduced, so the maneuver has to be performed for a longer time to achieve the same effect. In reality, the outcome of any method of electrocoagulation, unipolar or bipolar, depends more on the length of the tubal segment destroyed than on the number of applications. Most authors consider that coagulation of a tubal segment of at least 3 cm is necessary.

The isthmic tubal portion must be grasped with the bipolar forceps approximately 2 cm from the uterine cornu so as not to cause injury to the uterine corpus. The HF electrosurgical unit should be set to a power no greater than 25 W using direct current. 2 or 3 applications are often required to achieve coagulation of a 3 cm tubal segment. In the literature there is still controversy whether or not to transect the tube following coagulation.

Thermal Sterilization

The Waters instrument is used for thermal sterilization or real cauterization. This is a thermal hook, which resembles the resistance of a toaster, sheathed in a heat-resistant plastic protector. The hook is used to grasp the tube and pull it inside the plastic protector where the energy can be activated to induce thermal damage to the tissue. However, the extent of tissue destruction is less than 1 cm.

Another instrument, suggested by *Kurt Semm*, is called the Semm Endotherm. This consists of a type of forceps coated with Teflon, which produces a temperature of 120 °C to 160 °C and performs cauterization of the tubal segment during an exposure time of 60–90 seconds. The area of thermal injury is limited to the width of the forceps so repeated applications are required to achieve coagulation of 2 to 3 cm of tube.

Mechanical Devices

Tubal sterilization with Yoon rings

Inbae Yoon first published successful occlusion of the fallopian tubes using a silastic ring in 1974. This technique was then adapted to operative laparoscopy with an applicator 8 mm in diameter, which allows a tubal segment to be lifted up with a pronged forceps inside the applicator sheath and the silastic ring to be put on.

Various complications have been reported with this technique, the majority associated with possible injury to the posterior mesosalpinx and with hemorrhage. Rigid or large tubes can be divided by the applicator and bleed. The bleeding can be controlled with bipolar coagulation.

Sterilization with Clips

This method offers the greatest reversibility since only a few millimeters of the tube are damaged, if properly applied in the isthmic portion. Therefore, the technique can be recommended in women under 30 years who request sterilization. The clips that have proven effective are Filshie and Hulka-Clemens clips. The Filshie clips are made of titanium coated on the inside with silicone, while the Hulka-Clemens clips are made of 3 mm Lexan plastic with jaws articulated by a small metal spring.

An operative laparoscope designed for clip application is available although the clip can be applied through a second port using an applicator. Application through a second port also facilitates exposure, rotating from one side to the other. The clip must be applied at an angle of 90° in the isthmic

tubal segment 2 or 3 cm from the uterine cornu. Application of the clip to a different part of the tube can be ineffective due to the diameter of the tubal lumen which may not be occluded completely while pinched between the jaws of the clip. Following application, the clip remains closed owing to a spring mechanism. It is always necessary to reconfirm proper placement of the clip. If residual tubal patency is suspected, a second clip should be applied.

Postoperative Cere

The patients are usually discharged 2 to 6 hours after the surgical procedure. It is advisable to give postoperative analgesia to prevent pain due to acute necrosis of the tissue following ring / clip application.

Laparoscopic tubal surgery

Introduction

The most recent technical developments provide surgeons working in the field of infertility with ever more sophisticated and effective methods of surgical reconstruction including endoscopic procedures. On the other hand, it should be borne in mind that the outcomes of assisted reproduction technology **(ART)** procedures are improving constantly, raising the question of whether surgical repair of a tubal defect may be useful. In practice, if tubal damage is suspected or confirmed, it is necessary to decide whether to directly proceed to ART procedures or to diagnostic laparoscopy and endoscopic surgical treatment of confirmed tubal infertility. This decision is influenced by a range of secondary factors, such as the patient's age, presence of other pathology or changes in semen quality. Younger patients with distal tubal occlusion should consider surgery first and then ART, whereas ART procedures should start directly in women between 37 and 43 years. Moreover, the indication for laparoscopic tubal reconstructive surgery is inversely proportional to the extent and severity of the tubal damage. In other words, the "typical" patient for surgical laparoscopy will be young, with tubal damage of modest degree and preferably located distally. However, it should be noted that adequate decision-making often calls for diagnostic laparoscopy in view of the inherent limitations of other diagnostic techniques such as hysterosalpingography or transvaginal ultrasound, which do not allow definitive assessment in the majority of cases. Another crucial factor influencing the choice between reconstructive tubal surgery and ART procedures is the logistical and economic factor, since the latter requires the patient to be close to specialized and highly reliable centers, where the costs are usually high.

Preoperative Assessment

The diagnostic follow-up in couples with infertility problems must be performed within a short time and should be as non-invasive as possible for emotional reasons. They should include a complete clinical history, transvaginal ultrasound with sonohysterosalpingography and diagnostic hysteroscopy with the goal of assessing the uterine cavity accurately.

The possible presence of pelvic inflammatory disease (PID) should be considered; this can lead to tubal infertility in more than 20 % of cases. In all infertile women, cervical and vaginal swabs are advisable to detect the presence of micro-organisms commonly responsible for pelvic inflammatory disease such as *Chlamydia trachomatis, Neisseria gonorrheae and Mycoplasma hominis.*

Diagnostic laparoscopy should be performed in all patients with a high probability of pelvic or tubal pathology.

Patient Positioning

The classical position for gynecologic laparoscopy is lithotomy with uterine manipulator, including the option to change to the Trendelenburg position if required by the surgeon. Two accessory 6-mm trocar ports are usually required, one in each lower abdominal quadrant.

Instrumentation

- 5-mm or 10-mm laparoscope and video camera
- Laparoinsufflator
- Electrosurgical unit
- Xenon light source
- 6-mm or 11 -mm trocars
- Veress needle
- 5-mm atraumatic grasping forceps
- 5-mm scissors
- Suction/irrigation system for irrigation and hydrodissection
- Bipolar forceps
- Laparoscopic suturing instruments
- Uterine manipulator

Diagnostic Laparoscopy

Laparoscopy allows direct inspection of the pelvis and abdominal organs and assessment of tubal function by means of chromopertubation. When the umbilical primary trocar and the accessory ports are in place, the pelvis is inspected systematically. If the patient is in Trendelenburg position, the intestine can be pushed in cephalic direction, distant from the pelvis. The pelvic organs are assessed first: the uterus, tubes and ovaries on both sides. If necessary, a fluid sample is taken from the pouch of Douglas for micro-biological culture. Particular attention must be paid to looking for typical and atypical endometriotic implants, inspecting the peritoneal surface quadrant by quadrant and also using the laparoscopic contact view. In the case of pelvic and adnexal adhesions, these must be determined accurately and graded according to their extent. In the presence of periadnexal adhesions only, these should be treated by salpingoovariolysis during diagnostic laparoscopy *(tab. 1.)*. This simple treatment results in an intrauterine pregnancy rate between 51 % and 62 % and an extrauterine rate between 5 % and 8 %.

Table 1

Laparoscopic classification system of adnexal adhesions according to the American Society for Reproductive Medicine (ASRM)

	Adhesion	< 1/3 occlusion	1/3–2/3 occlusion	> 2/3 occlusion
Ovary	R Filmy	1	2	4
	Dense	4	8	16
	L Filmy	1	2	4
	Dense	4	8	16
Tube	R Filmy	1	2	4
	Dense	4*	8*	16
	L Filmy	1	2	4
	Dense	4*	8*	16

(*) If the fimbrial end of the fallopian tube is completely occluded, the score is set to 16.
Prognostic classification of adnexal adhesions:
Minimal 0–5
Mid 6–10
Moderate 11–20
Severe 21–32

The outer surface of the ovaries must first be assessed; they are then elevated and the ovarian fossa and the rest of the pelvic wall must be assessed, paying special attention to the uterosacral ligaments. The proximal part of the tubes is then examined, looking initially for the presence of adhesions, endometriosis or specific tubal pathology such as nodular isthmic salpingitis. The distal end of the tube must be assessed for tubal function and then phimosis or obstruction is looked for. The fimbriae in particular must be assessed carefully.

Salpingoscopy can be performed at the same time as laparoscopy and provides a direct endoscopic view of the ampullar/part of the tube using a specific rigid optic. This allows the endotubal epithelium to be assessed according to the following classification (*tab. 2*).

After the internal genitalia have been examined, chromo-pertubation is performed. The instillation of the methylene blue used for the test allows assessment of tubal patency and to check for the presence of tubal phimosis or fimbrial adhesions.

Laparoscopic Surgery for PID and Tubo-ovarian Abscess

One of the main causes of tubal damage is pelvic inflammatory disease **(PID).** The main objective in the management of PID is eradication of etiologic organisms, which in the majority of cases are Chlamydia trachomatis or Neisseria gonorrheae. It is necessary to make a correct diagnosis with culture of the peritoneal fluid and an antibiogram. Treatment frequently requires a combination of several antibiotics. The technique that allows definitive diagnosis is laparoscopy**.**

Table 2

Salpingoscopic classification of tubal lesions

Score	Mucosal folds	Adhesions	Nuclear staining	Vascular alterations
1	Floating, flexible, trophic	Absent	Absent	Absent
2	Slight flattening	Mild, without intra-luminal occlusion	A few isolated nuclei, 25 % of the mucosa stained	Morphology altered in 25%
3	Marked flattening, dense, focally absent	Moderate intraluminal occlusion > consistency and extent	> concentration of stained nuclei, occupying between absent 25–50 % of the mucosa	Vessels altered in 50 % or more. Areas of neovascularization
4	Absent	Severe intraluminal occlusion	High concentration of stained nuclei, > 50 % of he mucosa affected	Reduced vascularization of tubal wall, neo-vascularization in all of the tube
Tubal epithelium type A: score ranging from 8 to 10 points. The tubes are normal or show a minor pathologic abnormality. **Tubal epithelium type B:** score ranging from 11 to 17 points. The tubes are considered abnormal, usually with combined pathology.			**Tubal epithelium type C:** score ranging from 18 to 32. The endosalpinx is severely damaged or completely destroyed	

The laparoscopic criteria for the diagnosis of PID are listed in the following table *(tab. 3).*

Table 3

Laparoscopic classification of PID

Mild	Erythema, edema, the tubes are mobile. Absence of purulent discharge
Moderate	Erythema, edema more marked; mucopurulent discharge; tubes are fixed; fimbriae may not be visible
Severe	Presence of pyosalpinx and/or abscess

In cases of tubo-ovarian abscess, some authors prefer the open laparoscopic technique regardless of the size of the abscess. In a first step, blunt removal of all adhesions by traction and stretching must be performed. Lysis with scissors or electrosurgery should be conducted with great care to avoid possible intestinal perforation taking into account that the intestinal mucosa is particularly edematous and fragile in these cases. Perihepatic adhesions (Fitz-Hugh Curtis syndrome) are correlated with pelvic infection wit! *Chlamydia trachomatis* and do not need to be removed surgically if they are asymptomatic**.**

Following complete lysis of adhesions, the tubo-ovarian abscess must be aspirated and drained**.** Aspiration is performed with a laparoscopic suction tube or by introducing a 5–10 mm trocar through the abdominal wall, perforating the wall of the abscess and aspirating it through the trocar. Once the purulent liquid has been completely evacuated, copious lavage is performed with Ringer lactate through the trocar cannula which is left in place until the aspirated liquid is completely clear. Assessment of the tube will permit a decision on whether or not removal is indicated. At the end of the procedure, it is important to

introduce a drain (e.g., Jackson-Pratt) into the pelvis. The drain should be removed 24 to 48 h after operation.

Reconstructive Laparoscopic Tubal Surgery

The fallopian tubes can be occluded proximally or distally, i.e., at the fimbrial ends. The condition can coexist with peri-adnexal adhesions. Tubal blockage can also be correlated with an inflammatory process or a medical history of surgical interruption. Reconstructive surgery is feasible only in cases of a minor, circumscribed damage, and if possible, not bilateral. Some pathological findings, such as salpingitis isthmica nodosa and/or genital tuberculosis, which by definition is associated with severe tubal damage, rule out the option of reconstructive laparoscopic surgery, mainly because they are considered to have a poor prognosis regarding the predictable degree of functional recovery.

Fimbriopiasty

Fimbrial phimosis (agglutination of the fimbriae) often coexists with peri-adnexal adhesions and is repaired by laparoscopy. The intrauterine pregnancy rate after laparoscopic fimbriopiasty varies between 40 % and 48 % depending on its severity and extent, with an extrauterine pregnancy rate ranging between 5 % and 6 %. In cases where the mucosal folds are densely adherent or in the presence of ampullary mucosal adhesions, the prognosis is very poor.

The principle of fimbriopiasty is anatomical and functional repair of the infundibulum. To visualize the phimotic region, it is often necessary to perform perioperative chromo-pertubation to distend the tube. Surgical repair can be achieved with a fine atraumatic grasping forceps, introducing the closed tip into the area of phimosis extremely careful and gradually opening the jaws. The maneuver must be repeated several times, changing the direction in which the forceps is opened. Manipulation of the tissues must be very gentle to avoid bleeding**.**

Rarely, even though the fimbrial ends appear normal, proximal stenosis can be found at the abdominal opening of the tube (prefimbrial phimosis). This stenosis can be diagnosed by chromopertubation only. The surgical management involves dissecting along the antimesenteric border of the tube from the fimbriae as far as the distal ampulla, traversing the area of stenosis. Dissection is performed by use of electrosurgery. As a final step, the site of repair is sutured with a very fine suture (6/0).

Salpingostomy (Salpingoneostomy)

Hydrosalpinx can be treated by laparoscopic salpingostomy. The main factors contributing to the outcome of salpingostomy are the diameter of the distal tubal portion, the thickness of the wall, the condition of the tubal epithelium and the type and extent of adhesions. In cases with a favorable prognosis, pregnancy rates vary between 40 % and 60% and fall to 20 % in less favorable cases. The decision-making regarding the appropriate surgical approach must be based on laparoscopic examination of the tubes and pelvis, preferably including salpingoscopy *(tab. 4, 5).*

Table 4

Classification according to *Mage* modified by the intraoperative assessment of tubal occlusion

Parameter	Extent of tubal damage	Score
Patency	Normal Phimosis Hydrosalpinx	0 5 10
Wall	Normal Thin Fibrous	0 5 10
Mucosa	Normal Reduced folds Absence of folds	0 5 10

Classification of tubal occlusion by intraoperative assessment

Grade	Tubal occlusion	Score
1	Mild	0a5
2	Moderate	10a15
3	Severe	20 a 30

Table 5

Classification of distal tubal occlusion (American Fertility Society)

Distal ampullary diameter	< 3cm 1 1	3–5 cm 4 4	> 5cm 6 6
Thickness of tubal wall	Normal thickness 1 1	Moderate or edematous 4 4	Increased and rigid 6 6
Mucosal folds	Normal / > 75 % preserved 1 1	35–75 % preserved 4 4	< 35% preserved (adhesions in the mucosal folds) 6 6
Adhesions	None/minimal/mild 1 1	Moderate 3 3	Extensive 6 6
Type of adhesions	None/filmy 1 1	Moderately dense (or vascular) 2 2	Dense 4 4

The management of hydrosalpinx is based essentially on the quality of the tubal mucosa:

• For thin-walled hydrosalpinx with normal mucosa and without mucosal adhesions, salpingostomy via the laparoscopic approach is indicated. The majority of pregnancies occur within the first year post-operatively.

• For thin-walled hydrosalpinx with focal adhesions, either reconstructive surgery or ART procedures are indicated. Reconstructive surgery in these cases is associated with an increase in the risk of extrauterine pregnancy.

• For thin-walled hydrosalpinx with extensive mucosal adhesions (> 50 % of the mucosal folds), ART procedures only are indicated, more specifically in vitro fertilization. Many authors, including ourselves, regard it as

appropriate in these cases to perform laparoscopic salpingectomy because this has been found to considerably improve the outcomes of ART.

In the presence of adnexal adhesions, diagnostic laparoscopy is followed by adhesiolysis with gentle maneuvers using closed atraumatic forceps in the case of filmy and avascular adhesions; if they are dense and vascular, it is advisable to use bipolar coagulation and scissors. The tubo-ovarian ligaments must be exposed to confirm patency of the fimbriated tubal portion. If the tube is fixed to the ovary, the two structures must be separated.

Once adnexal adhesiolysis has been completed, the tube should be distended by transcervical instillation of methylene blue dye using the uterine manipulator. In the area of occlusion, scar tissue can frequently be found. The target site of the cross- or star-shaped neo-ostium should be located at the thinnest and most avascular area possible, which usually corresponds to the original site of the ostium. The cruciate incision at this level is made using scissors, electro-surgery or by laser application with the aim of creating eversion of the mucosa of the distal tubal portion. Closed atraumatic grasping forceps can be introduced in the opening to gently incise the margins of the neo-ostium. To make the margins evert properly, fine bipolar forceps may be used at low current setting; this is performed by touching the serosa at the base of the margins previously created to induce shrinking and simultaneous eversion. If the tubal wall is thick, sero-serous sutures can be placed alternatively with atraumatic sutures (Vicryl 5–7/0).

In conclusion, the surgical procedure to create a neo-ostium involves two steps, incision and eversion:

- To create the neo-ostium, two to four 1–2 cm incisions are made parallel to the longitudinal mucosal folds, in an avascular area.
- Eversion is obtained with various techniques, such as bipolar coagulation of the serosa or placement of a few sutures.

Tubo-tubal Anastomosis

True pathological occlusion of the proximal tube necessitates a microsurgical procedure with tubo-cornual re-anastomosis, which can be performed laparoscopically. Laparoscopic techniques of tubal anastomosis have recently been described in patients who had a previous history of tubal sterilization. The image magnification properties of videoendoscopy and the unique angles of vision offered by modern laparoscopes, together with the option of bringing the video image close to the operating field, provides advantages superior to traditional microsurgery.

The major application of laparoscopic microsurgery is tubo-tubal anastomosis regardless of its site and regardless of whether it is done because of the presence of occlusion or to reverse previous tubal sterilization. The surgical technique of tubo-tubal anastomosis does not vary from the laparotomy approach with a traditional microscope. In the case of adhesions, salpingo-ovariolysis is first performed. This is followed by infiltration of the mesosalpinx in the area

chosen for the anastomosis with 1 or 2 ml of a solution of vasopressin to reduce bleeding and facilitate accurate hemostasis. The proximal end of the tube is distended by means of transcervical injection of methylene blue, which facilitates localization of the occluded segment of the proximal tube. At this point, a cut is made at the level of the occlusion using laparoscopic scissors. It is very important to avoid damage to meso-salingeal vessels. The tubal segment is separated from the mesosalpinx by electrosurgery. Hemostasis of the tubal segment of tube is accomplished by electrocoagulation (microelectrode) of the most important bleeding points. Continuous irrigation allows even small bleeding points to be visualized rapidly. The distal tubal segment is prepared in a similar way so that there is no difference or asymmetry between the two stumps to be anastomosed. In this case, too, transcervical instillation of methylene blue can be used to facilitate delineating the margins. The two stumps are then approximated and sutured in two layers. The first layer joins the endotubal epithelium and muscle and the second joins the serosa. The distal suture must be placed at the antimesenteric border, and can be placed perfectly on the other stump also.

Laparoscopic management of ectopic pregnancy

Introduction

Implantation of the zygote outside the uterus occurs in approximately 1 in 200 pregnancies and the incidence appears to be increasing. This increase in ectopic pregnancy correlates with the high incidence of sexually transmitted disease, delayed median age of first pregnancy and improved accuracy of diagnosis.

The most common site of ectopic pregnancy is at the ampullary tubal portion where fertilization normally occurs and then, less frequently, other parts of the tube, the cervix, the ovary and the abdominal cavity.

All variants of extrauterine pregnancy can be treated by a minimally invasive approach in the majority of cases. In the last decade, laparoscopic surgery has become very widespread in both gynecology and general surgery. The main advantages of the minimally invasive approach are reduced postoperative morbidity, less postoperative pain, and accordingly, less analgesic medication, early resumption of intestinal activity, reduced length of hospital stay and a rapid return to normal activity.

Preoperative Assessment

The clinical picture includes nausea, amenorrhea, lower abdominal pain, cramps and abnormal uterine bleeding. Pain in the shoulder raises the suspicion of tubal rupture with hemoperitoneum. Diagnostic preoperative assessment must include the history and bimanual gynecologic examination (which is able to diagnose an adnexal mass in 50 % of cases). However, early diagnosis of ectopic pregnancy can be made with the combination of transvaginal ultrasound and measurement of the serum beta-HCG. The sensitivity of beta-HCG allows the diagnosis to be made only 10–15 days after ovulation. The growth curve of this hormone is abnormal in 46 % of patients. A delayed increase in beta-HCG

should raise the suspicion of extrauterine pregnancy. The most recent generation of ultrasound allows visualization and localization of the gestational sac before the sixth week in 98 % of cases. The presence or absence of a gestational sac on transvaginal ultrasound should be correlated with the pregnancy week and the serum levels of beta-HCG.

Other useful tests in diagnosing ectopic pregnancy are: endometrial thickness (cut off < 8 mm), sonohysterography, color Doppler and blood progesterone level (cut off 17.5 ng/ml). Unfortunately, progesterone is not of use in patients who have undergone induction of ovulation.

Positioning of the Patient

The patient is positioned on the table in the classic gynecologic position. An intrauterine manipulator and Foley bladder catheter can be used.

5 mm-or 10 mm-laparoscope with the primary trocar introduced at the umbilicus. Two accessory 6 mm-ports in the right and left iliac fossa and a 6 mm suprapubic port for the grasping forceps, bipolar forceps and suction cannula.

Instrumentation

- Laparoscope, diameter 5 mm or 10 mm
- Videocamera
- Microprocessor-controlled insufflation system
- Electrosurgical unit
- Xenon cold light source
- Trocars, diameter 6 mm or 11 mm
- Veress needle
- Atraumatic grasping forceps
- Scissors
- Suction and irrigation system
- Monopolar hook electrode
- Bipolar forceps
- Disposable extraction bag
- Uterine manipulator

Surgical Technique

Evacuation of the Hemoperitoneum

A 5 mm suction cannula is usually sufficient for evacuating the hemoperitoneum. If the tube has ruptured and/or the patient is in shock with a large hemoperitoneum, an 11 mm-trocar may be used to introduce the suction tube. The surgical management essentially involves partial or total salpingectomy, however, depending on each individual case, preservation of the organ may well be the approach of choice.

Salpingectomy

Extensive tubal dilatation is not necessarily an absolute contraindication to laparoscopic treatment. Unilateral or bilateral adhesiolysis is often performed in the same setting. Salpingectomy is the method of choice in women who

abandoned the desire for future pregnancies or in the case of tubal rupture. Other indications for salpingectomy are extrauterine pregnancy following failed sterilization, in a blocked tube, in a previously reconstructed tube, in a woman requesting sterilization, in the case of persistent bleeding after salpingotomy, when the beta HCG > 100,000 mil/ml, in the case of recurrent tubal pregnancy and in the case of tubal pregnancy > 5 cm. Following evacuation of the hemoperitoneum, the bipolar forceps and scissors are introduced into the abdominal cavity to coagulate and dissect the tube and mesosalpinx

The tube containing the gestational sac is then removed from the peritoneal cavity through the 11 mm-umbilical port with the aid of forceps located in the suprapubic port. However, it is preferable to use an endobag for removing the tube and product of conception. After reinsertion of the laparoscope, final inspection of the abdominal cavity is recommended because in some cases, while grasping the tube for removal, the product of conception may slip out unnoticed which requires either aspiration with a suction tube or extraction by use of forceps.

Salpingotomy

Preservation of the tube should be attempted in all patients who wish to maintain fertility if they have a stable hemodynamic status and there is no evidence of tubal rupture.

After draining the hemoperitoneum, the adnexa is mobilized with the suction/irrigation tube or by dissection in the presence of adhesions.

*Indications for linear salpingotomy***:**

- desire to preserve fertility
- hemodynamical stablility
- size of ectopic pregnancy less than 5 cm
- gestational sac located in the ampulla, infundibulum or isthmic portion
- absence of pathology of the contralateral tube

Vasopressin: the mesosalpinx can be infiltrated with vasopressin 20 IU diluted in 50 ml of normal saline. A syringe with 22 gauge needle can be used for injection through one of the accessory ports. Alternatively, the outer sheath of a Veress needle can be used directly through the abdominal wall at pubic level, lateral to the deep inferior epigastric vessels, introducing a spinal needle (22 gauge) inside it. Great attention is required when starting infiltration of the mesosalpinx because of the risk of iatrogenic laceration of blood vessels. The serosa should be grasped gently prior to injecting 10–20 ml of solution, which will cause visible swelling of the mesosalpinx. The effect can last for about 2 hours, permitting physiological hemostasis.

Because of its high metabolic rate, the trophoblast requires oxygen and the cells cannot withstand anoxia. It is most probable that vasopressin, by reducing the oxygen supply for about an hour, has fatal consequences for the trophoblast that has inadvertently left behind, reducing by a factor of five the 15 % risk of persistence of ectopic pregnancy in the case of conservative salpingotomy. Use of vasopressin is contraindicated in patients with ischemic heart disease.

Incision and evacuation: with an unipolar knife electrode introduced through the 6 mm port, a 1–2 cm incision is made in the antimesenteric tubal wall at the site of maximum distension, using a cutting or blended current (20 or 70 W). In general, it is possible to identify the different layers of the tubal wall: serosa, muscularis externa and mucosa.

If the product of conception cannot be localized when the serosa is incised at the point of maximum dilation, it will be necessary to incise the still intact muscularis externa and mucosa to advance to the lumen of the tube. Once the ectopic pregnancy, which is usually of very friable consistency, has been identified, it can be evacuated by aspiration. If a mass surrounded by clot is encountered, the product of conception must be delivered through the tubal incision with the aid of pressurized irrigation or with grasping or biopsy forceps**.**

The site of implantation and the tubal incision are then irrigated, making sure that the liquid introduced through the salpingotomy incision drains from the fimbrial end and vice versa.

Transcervical instillation of methylene blue will allow demonstration of tubal patency.

It should be borne in mind that when the ectopic pregnancy is located in the extraluminal space, it is possible that the tubal surface exhibits dilation without intraluminal involvement. It is often easier to make a small incision for evacuation of a distinct, large-sized intraluminal ectopic pregnancy of friable consistency, compared to one of small size and poorly visible in the thickness of the tubal wall. The preferred route for removing the product of conception with or without the tube is through the 11-mm umbilical port. Alternatively, it can be reduced piecemeal by use of a biopsy forceps or suction cannula. In a few cases, it is advisable to use an extraction bag for removing the product of conception.

The salpingotomy incision usually does not require suturing. Seromuscular suturing will be necessary only if the incision is very large or in the case of mucosal eversion.

Hemostasis: if there is bleeding from the incision margins or site of implantation, hemostatic tamponade can be applied with grasping forceps prior to electrocoagulation, laser application or placing a suture. Often, 5 minutes of compression are sufficient for hemostasis. Even elevating the adnexa out of the pelvis can produce the same result as by compressing the vessels of the mesosalpinx.

Arterial bleeding can be present after removal of blood clot. In this case, the best hemostatic effect can be achieved by selective and targeted use of bipolar coagulation forceps, particularly if combined with continuous irrigation. Diffuse venous bleeding, especially from the site of implantation in the muscle layer in the case of extraluminal location, can be controlled readily with electrocoagulation. The superficial eschar in the extraluminal space does not interfere with normal healing of the tubal epithelium.

Following removal of an ampullary pregnancy, uncontrollable bleeding can occur. In such cases, an endoloop may be used, which is removed after

5–10 minutes; this makes it possible to localize and coagulate the source of bleeding. In severe cases, the mesosalpingeal vessels can be ligated selectively.

Partial Salpingectomy

Partial laparoscopic salpingectomy can be attempted to preserve the tube in the case of failed salpingotomy, tubal rupture, isthmic pregnancy, distal interstitial pregnancy or recurrent tubal pregnancy.

The procedure involves coagulation with bipolar forceps followed by division of both ends of the distended part of the tube and corresponding mesosalpinx with subsequent removal of the tubal segment through the umbilical port. Alternatively, to avoid thermal (but not ischemic) injury, two endoloops, and if required, bipolar coagulation can be applied to complete hemostasis.

Extirpation of Tubal Pregnancy through the Fimbrlal End

Extirpation of the tubal pregnancy through the fimbrial end, tubal aspiration or tubal abortion without salpingotomy are procedures that involve removal of the product of conception located at the fimbrial end or distal tubal segment. This is accomplished by aspiration or use of grasping forceps operating from inside or outside, gently pushing the product of conception until it is extruded. In certain cases tubal abortion has already occurred.

Since many ectopic pregnancies have actually not implanted in the intraluminal tubal portion, this type of procedure is often associated with incomplete removal of the trophoblast and damage to the tubal wall. For this reason, even though some authors have reported excellent results when the pregnancy is located in the fimbrial portion, these techniques are not commonly recommended, neither by way of laparoscopy nor by laparotomy.

The technique may be applied in selected cases of intraluminal ectopic pregnancy not yet visible (invasion of the muscularis and serosa has not yet occurred) by introducing the suction tip into the tube from the distal ostium and instillation of liquid, that acts mechanically to dislodge and expel the product of conception into the peritoneal cavity eliminating the need for making an incision in the tubal wall.

Extraluminal Ectopic Pregnancy

This occurs when the ectopic gestation while growing rapidly infiltrates the tubal wall until occupying the space between the muscularis externa and serosa. In the majority of cases, as soon as the serosa is incised at the point of maximum distension, the gestational sac slips out without the need to enlarge the opening. Irrigation in this case will not produce a flow of liquid from the distal part of the tube. Rarely, the surgeon will be faced with the dilemma of having to enter the tubal lumen which should be avoided as much as possible.

Occasionally, it is possible to infiltrate 360° of the space between serosa and muscularis. In this case, after removing the trophoblast and achieving hemostasis with the aid of compression or electrocoagulation, the surgeon can conclude the operation and follow the patient carefully with serial beta HCG measurements. Methotrexate can be considered as possible adjuvant treatment.

Interstitial or Cornual Ectopic Pregnancy

Interstitial ectopic pregnancy can be treated laparoscopically by electrosurgical resection of the uterine cornu. This procedure will allow the greater part of the tube to be preserved on the one hand, but on the other hand, the complete destruction of the interstitial part will make it highly probable that any anastomosis will fail. Coagulation of the ascending branch of the uterine artery and utero-ovarian arteries can be necessary to achieve good hemostasis. Use of vasopressin is not considered in this case.

In both laparotomy and laparoscopy, the approach is piecemeal resection of the uterine cornu using cutting or blend current**.** The technique is very similar to myoma removal. Hemostasis must be obtained with bipolar coagulation and hydrodissection of the tissue planes using pressurized normal saline.

Rupture of a tubal pregnancy has always been considered a contraindication to the laparoscopic approach even though removal of a ruptured tube can be accomplished easily with bipolar coagulation. There is controversy about the management of patients with hemodynamic instability. In this case, hemorrhage must be arrested at once and the tube removed as quickly as possible. The majority of surgeons prefer to manage the situation by emergency laparotomy. The laparoscopic bipolar forceps is capable o' coagulating even large uterine or ovarian vessels. Alternatively, ligature with an endoloop may be employed. After achieving hemostasis, the tube or part of it is removed Rupture of an interstitial pregnancy may also be treated with simple coagulation of the uterine and ovarian vessels but this approach is associated with a higher risk of persistent and recurrent ectopic pregnancy.

Ectopic Ovarian Pregnancy

Ectopic ovarian pregnancy, when diagnosed, must be treated like any ovarian cyst of unknown origin and must therefore be enucleated intact through a small incision in the ovarian cortex. Ovarian function usually remains unchanged. An ovarian pregnancy should be suspected when the serum levels of beta HCG exceed 6 000 mil/ml, ultrasound shows an empty endometrial cavity and tubal pregnancy is not found on laparoscopy. With monopolar forceps, the ovarian surface is incised along its major axis at the point where the neoformation appears most superficial. The trophoblastic material can then be dissected and removed, using a suction/irrigation system. The gestational sac is usually removed as a whole and suturing of the ovarian parenchyma is not necessary.

Ectopic Abdominal Pregnancy

Ectopic abdominal pregnancy is a rare event and accounts for 1.1 % of all ectopic pregnancies. Since it is a condition with high maternal and fetal morbidity and mortality, early diagnosis using transvaginal ultrasound, magnetic resonance imaging and laparoscopy is essential. It is a condition that can be treated readily by laparoscopy if this is done early and if the pregnancy does not involve vascular structures that can cause uncontrollable bleeding. In the case of abdominal pregnancy with a live fetus, the approach must be by laparotomy.

Methotrexate

In selected cases, medical treatment with methotrexate can be as effective as laparoscopic surgery. However, the possible side effects associated with methotrexate therapy can adversely affect patient compliance to a higher degree than the surgical treatment option. As regards infertility, the prognosis after ectopic pregnancy does not appear to correlate with the characteristics of the extrauterine pregnancy but rather with the patient's age and medical history. Medical treatment is to be preferred in patients with previous surgery, diffuse adhesions, contraindications to anesthesia, cornual pregnancy or failure of surgical treatment. Medical treatment is indicated if the levels of beta HCG are between 5 000 and 10 000 mU/ml and the diameter of the adnexal swelling is less than 4 cm. Methotrexate should be administered locally or systemically by intramuscular injection of 1 mg/kg or 50 mg/m^2. Patients with a hematocrit < 35 % should take ferrous sulfate 325 mg twice daily.

Postoperative Follow-up Care

Patients may be discharged a few hours after the surgery. The bladder catheter is removed at the end of the operation. Antibiotic medication should be administered postoperatively. The first serum beta-HCG test is performed on the second day and the reduction compared to the preoperative value should be at least 70 %. The test is repeated after seven days to exclude the persistence of trophoblastic tissue. If the level is not below 20 mU/ml, the test is repeated two weeks later and if it is still positive, the patient should undergo further medical or surgical treatment. Persistent trophoblastic tissue can be treated successfully with methotrexate, ensuring that any anemia present is treated preventively.

Laparoscopic Surgery for Symptomatic Endometriosis

Introduction

Endometriosis is the presence of endometrial glands and stroma in an heterotopic location. Endometriosis is a progressive, debilitating disease that affects 10–15 % of women during their reproductive years. Among gynecological disorders, endometriosis is second only after uterine myomas in frequency, and accounts for 25 % of all laparotomies performed by gynecologists. In the planning of treatment, many variables must be considered, such as age of the patients, extent of disease, degree of symptoms, and desire for immediate or deferred fertility. In most instances the indications for therapy include pain or infertility or both, and the treatment may be surgical or medical, or a combination of both.

Preoperatiwe Assessment

The diagnosis of endometrioma is revealed by the presence of ovarian cyst fluid that can be suspected by transvaginal and transabdominal ultrasound (TU) and physical examination. The most common symptoms are infertility and/or pelvic pain which should facilitate establishing the final diagnosis. However, the diagnosis of peritoneal endometriosis is confirmed only by direct visualization with the aid of laparoscopy and histological examination of biopsy specimens. Unfortunately, blood serum levels of anti-endometrial

antibodies, placental proteins PP 14 and CA 125 marker do not have sufficient sensibility or specificity to be routinely used for diagnostic evaluation. Diagnostic preoperative examination must include in all patients a thorough history-taking, physical examination and TU.

Patient Positioning

Classical gynecological laparoscopic position, with intrauterine manipulator. Two accessory 6 mm trocars should be used, one in either quadrant, medial to the umbilical artery ligament. If a third accessory trocar is needed, this is placed in the midline, suprapubically.

Instrumentation

- Laparoscope and video camera
- 5 mm grasping forceps
- Scissors
- Bipolar or unipolar HF electrosurgery unit or laser system
- 6 mm trocars
- Suction-irrigation system for hydrodissection

Technique

The surgical treatment options for endometriosis are radical or conservative surgery. The aims of conservative surgery are:

- removal of both typical and atypical endometriotic implants;
- complete removal of endometriotic cysts (endometrioma)
- complete adhesiolysis, with restoration of normal tubo-ovarian relationship to enhance fertility potential;
- relief of pain;
- minimize the risk of disease recurrence.

Laparoscopy

Diagnostic Laparoscopy

The first stage of the procedure involves exploring the pelvic anatomy and mapping out the extent of disease and the location and boundaries of the bladder, ureter, colon, rectum, utero sacral ligaments and major blood vessels.

Operative Laparoscopy

Peritoneal implants may be coagulated using unipolar or bipolar electrosurgery, vaporized by laser application or may be excised.

The hydrodissection technique permits treatment of endometriotic implants on the ureter or major vessels without causing any damage to these structures.

Initially, a small port is made into the retroperitoneum using either the laser or scissors. Ringer's lactate or saline solution is injected next to the lesion to create a protective cushion of fluid between the lesion to be excised and the underlying ureter, bladder or blood vessels. Excision of large endometriotic implants is superior to coagulation or vaporization because the technique is not associated with problems related to contamination by smoke and combustion residues. An additional advantage is, that it allows for the collection of specimen for histological diagnosis.

Ovarian Endometriosis

Ovarian implants of endometriosis or small endometrioma of less than 2 cm in diameter may be cauterized, resected by laser application or excised using scissors, biopsy forceps or electrodes.

For endometrioma larger than 2 cm in diameter, the first step of the procedure involves adhesiolysis of the ovary on the posterior leaf of the broad ligament. In most cases, the cyst is ruptured during this step, which requires that the liquid be aspirated immediately to prevent pelvic contamination.

The cystic cavity is repeatedly irrigated with a suction-irrigation tube.

Examine the cystic wall for malignant lesions. Drainage of the cyst must be followed by removal of the capsule to prevent recurrences. The capsule of the cyst must be separated from the surrounding ovarian stroma and removed by grasping its base with forceps and pulling it away from and out of the ovarian capsule**.**

Exposure of the right plane will permit blunt dissection by applying contralateral traction with two 5 mm-forceps. If stripping of the capsule is incomplete or difficult to accomplish, the residual part must be eradicated by laser application or electrocoagulation.

Presurgical treatment with GnRH analogues is useless in ovarian endometriomas, because it is not effective in reducing the size and volume of cysts and not even in facilitating the surgery.

Adnexectomy

Adnexectomy could be necessary even in fertile patients when endometriosis has infiltrated most of the parenchyma. After coagulation with a bipolar forceps, the proximal portion of the tube and of the uteroovarian ligament must be dissected with scissors. In addition, the infundibulo-pelvic ligament is coagulated and dissected applying traction to the ovary with grasping forceps. Therefore, the mesosalpinx should be completely dissected, after coagulation, to liberate the adnexa and to extract it by use of a disposable bag.

Adhesiolysis

Adhesiolysis may be performed using hydrodissection, scissors, CO_2 laser or atraumatic forceps. Before cutting the tissue it is important to mobilize and identify the relevant anatomical structures. Mechanical dissection with forceps or hydrodissection is not associated with any thermal effect, therefore this technique should be preferred.

Cul-de-sac obliteration is an important problem. It suggests rectovaginal involvement, with deep endometriosis and dense adhesions, and significant distortion of the regional anatomy involving bowel, vaginal apex, posterior cervix, ureter, and major blood vessels.

To facilitate localization of anatomic landmarks and identification of tissue planes, we usually place a loaded sponge forceps in the posterior fornix, and, if necessary, insert a rectal probe. In difficult cases, ureteral probes can be placed preoperatively.

Postoperative Care

According to the difficulties encountered during surgery, patients should be discharged 24 to 48 hours after surgery. Mild narcotic analgetics are usually sufficient to control postoperative pain. Postoperative therapy may include administration of GnRH analogues, Danazol or Gestrinone to prevent recurrences, to reduce pelvic pain and to facilitate subsequent induction of ovulation in infertile patients.

Laparoscopic management of deep endometpiosis

Introduction

Endometriosis is a highly debilitating disease that affects mainly women of childbearing age, characterized by symptoms such as pelvic pain, dysmenorrhea, painful defecation, dysuria and infertility. To date, all medical treatment options directed toward suppression of the disease and the pain associated with endometriosis have had similar effects in terms of symptom alleviation. None of them have proven long-term efficacy. Interruption of medical treatment is associated with a high risk of recurrence. However, evidence-based data suggest that complete laparoscopic excision of the endometriosis offers good long-term results with regard to the degree of regression, especially in those patients with severe and debilitating symptoms. *"The surgical treatment of endometriosis should aim at removing all visible areas of endometriosis .... with margins free from disease as is the case in oncologic surgery ... better with excision en bloc" (Redwine)* and restoration of the anatomy, removal of adhesions.

Although it is difficult to know the real incidence of deeply infiltrating endometriosis, in a study on 132 patients, covering the predefined depth of endometriotic infiltration, we found deeply infiltrating lesions in 33 %. Involvement of the gastrointestinal tract is present in about 3–36 % of women affected by endometriosis and 50% of these are affected by severe disease. The gastrointestinal predilection sites are the rectum and sigmoid, accounting for 72–85 % of cases. This means that to ensure complete removal of the disease and thus improve the outcome in terms of quality of life, surgery on the bowel with or without bowel resection can be necessary.

Instrumentation

- 10-mm laparoscope with 3 CCD videocamera
- One 11-mm trocar
- Two 6-mm trocars
- One 11/6 mm reducer
- Bipolar forceps
- Bipolar scissors with electrosurgical unit
- Suction and irrigation system
- Dissecting forceps (Schnaider)
- Grasping forceps (Dorsey)
- Maxon sutures with straight needle

Preoperative Assessment

Pre-operative assessment of endometrial implants plays a key role in the decision-making on the most effective strategy planning, possibly with the assistance of a general surgeon or urologist. Our pre-operative assessment comprises a questionnaire, physical work-up, instrument-aided investigations and serum markers. Particular attention is paid to the patient's history and symptoms, such as dysmenorrhea, pelvic pain, dyspareunia, painful defecation, covered by a specific questionnaire and assessed on a 10-point analog scale: 0 = absent 10 = unbearable. In addition, rectal and vaginal examinations are performed. Rectal examination allows the physician to reach 2.5 cm into the pelvis and assess a good portion of the rectal mucosa (about 7–8 cm of the rectum's length of 11 cm), palpate any masses and assess the thickness of the rectovaginal septum and the nodular structure of the uterosacral ligaments. Rectal examination has a failure rate of 17–64 % and is not sufficient on its own to diagnose deep endometriosis. Factors that can influence the diagnosis are the type of lesion, the depth of infiltration, the dimensions and the site of the lesion. Even if the examination is performed under general anesthesia, the sensitivity remains very low; its function as a screening test is limited and always requires another test for confirmation. Accurate data regarding co-involvement of the bladder and bowel cannot be obtained with a simple rectal and vaginal examination and a negative examination does not rule out involvement of these organs. The validity of the examination may be improved if performed during menstruation.

Instrument-aided investigations are essential: transvaginal ultrasound, ultrasound of the bladder and ureters, double-contrast enema, CA 125 and CA 199. As an alternative to the contrast enema, transrectal ultrasound can be performed but this requires specific instruments.

All patients should have stopped treatment with progestogens, GnRH agonists or the contraceptive pill 3–4 months before surgery. If intestinal involvement is suspected, specific preoperative preparation is necessary.

Preparation begins 24 hours beforehand. When intestinal surgery is highly likely, the patient must take 40 ml of Phosfo-Lax orally, diluted in a glass of water, followed by 1 liter of water at 2 p.m. and then at 4 p.m., or else 2 liters of Selg-Esse 1000 in the morning and 2 liters in the afternoon and 40 Mylicon tablets at once. Antibiotic prophylaxis consists of 2g of cefazoline at induction of anesthesia followed by 1g 3 times a day and metronidazole 500 mg 3 times a day for 3 days. If intestinal involvement and thus intestinal surgery are ruled out, an enema is administered on the day prior to surgery and 2 g of cefazoline are given with induction of anesthesia as antibiotic prophylaxis. A Foley catheter is left in the bladder throughout surgery and until the patient is able to reach the toilet independently (usually on day 1 after surgery). After spontaneous urination, the post-voiding residual urine is measured until it is less than 100 cc in two successive measurements. If the post-voiding residual urine

remains significant for more than 3–4 days after surgery, the patient is discharged after being instructed in self-catheterization. Before starting the operation, the patient usually has a second vaginal and rectal examination under anesthetia.

Laparoscopy begins with the creation of a pneumoperitoneum using a Veress needle through the umbilicus, insertion of the 11-mm umbilical trocar for the laparoscope and placement of two accessory 6-mm ports lateral to the inferior epigastric vessels bilaterally and a third 6-mm suprapubic port. Complete resection of endometriotic lesions is achieved by use of bipolar scissors. In general, if bowel surgery is required, this is performed by a general surgeon specialist assisted bygone of the two gynecological surgeons. At the end of the operation, copious lavage of the peritoneal cavity is performed with 500–1000 ml of Ringer's lactate solution and 4 % icodextrin solution is left in the abdomen for adhesion prevention. In these cases, a drain is left in place close to the anastomosis for 8–12 hours. The drain is usally removed after the first bowel movement. In general, a nasogastric tube is not required. During postoperative day 1, the patient is given continuous epidural analgesia through an elastomeric pump, after which analgesia is replaced by 100 mg of ketoprofen and 100 mg of tramadol i.m. or 0.3 mg of buprenorphine s.c, as required. Intravenous fluids are administered on the day of the operation and the next day patients can start to take food orally with a gradual increase in diet. The patients are discharged without a special diet. Prior to surgery, the patients are informed of the potential risks and benefits of the procedure by a written informed consent form.

The Surgical Technique

The type of surgery depends on the depth of invasion and the topographic distribution of endometriosis. The "classical" steps of the technique are as follows:

The laparoscopic procedure begins with laparoscopic inspection of the pelvic anatomy and systematic mapping of the endometriotic lesions. The caecum must always be inspected for the presence of endometriotic implants which could not be confirmed by preoperative double-contrast enema.

The operation proceeds with adhesiolysis, drainage and stripping of endometriomas, excision of endometriotic implants and other parietal implants, making sure that adequate healthy margins of retroperitoneal tissue are included. Our standard method is to remove endometriomas completely without coagulating or vaporizing superficial peritoneal implants to be sure that there is no deep endometriosis.

Adhesions can be removed with various techniques but we prefer to use mechanical dissection with cold or bipolar scissors.

Traction and blunt dissection can assist greatly in mobilizing and localizing structures that must be separated. We recommend avoiding hydrodissection and use of liquids because lavage of the peritoneum is much

more difficult when distended with CO_2. In case of hermorrhage, application of a suction tube or a dry gauze pledget is recommended.

Very small endometriomas can be coagulated but in general, the "stripping" technique is preferred to avoid recurrence.

The first step is to mobilize the ovary from the posterior leaf of the broad ligament to which it frequently forms dense adhesions. In the majority of cases, the cyst ruptures during this maneuver, which requires, that the chocolate-colored fluid be aspirated promptly. Ensuingly, the cavity of the cyst is irrigated several times. The cyst capsule is removed by grasping the margin of the fenestration and stripped off from the ovarian stroma to which counter-traction is applied with a 5-mm forceps. The correct plane of dissection is chosen when the capsule appears white or slightly yellow without red streaks; this allows bloodless dissection without any hemorrhage.

Following stripping, meticulous and highly selective coagulation is required, holding the ovary with a forceps and visualizing each bleeding site by dripping saline on the base of the cyst. The capsule is extracted by use of a disposable bag. Very often, the ovary adheres to the pelvic wall and the peritoneum underneath can obscure additional endometriotic implants. These lesions must also be excised. It must be taken into account that the retroperitoneal fibrosis caused by the overlying adhesions frequently involves the ureter which often necessitates careful ureterolysis. Many endometriotic cysts are fixed to the ipsi-lateral uterosacral ligament by dense adhesions so the entire adhesion area between the cyst wall and the uterosacral ligament is removed en bloc.

In rare cases, adnexectomy is required. It is usually possible to maintain to some extent the ovarian follicular reserve and function. When surgery is performed on the ovaries, they are suspended temporarily at the end of the operation using non-absorbable 2/0 polypropylene sutures that are removed on the third postoperative day, as described by *Abuzeid.* This procedure allows better access to the pouch of Douglas and prevents formation of adnexal adhesions to sites of the pelvic cavity that were denuded of peritoneum.

Starting from the pelvic area, the ureters and large vessels are localized and the ureter is then exposed down to the muscle wall following its course in the pelvis until healthy tissue is reached. If endometriosis extends deeply and laterally in the uterosacral cardinal ligament, it is sometimes necessary to sacrifice branches of the internal iliac artery, usually the uterine artery, or expose it as far as the intersection with the ureter. In extreme cases, the ureteric muscularis can be invaded by endometriosis, leading to partial constriction. In these cases, resection of the involved segment of the ureter may become necessary, followed by reanastomosis.

The basic principle is to liberate the obliterated cul-de-sac by en-bloc excision of the deep pelvic endometriosis.

The line of resection in healthy non-fibrosed peritoneum starts laterally and runs parallel to the base of the uterosacral ligament. The area is then exposed

by blunt dissection. A transverse incision is made at the uterine isthmus superior to the point of adherence to the bowel, and is carried downwards along the posterior cervical wall with intrafascial dissection. The plane of dissection is continued caudally as far as the rectovaginal septum so that the healthy rectal wall can be liberated from the endometriotic nodule. The uterosacral ligaments are resected at the site of insertion in the cervix. As it is often difficult to find the correct planes of dissection, it is necessary to operate behind the nodule. Every adhesion of fibrous or fat tissue between the rectum and the lateral pelvic wall is gradually divided until the bowel has been sufficiently mobilized.

In this way, the entire endometriotic nodule remains adherent to the anterior wall of the bowel forming a single mass with the uterosacral ligaments and obliterated cul-de-sac. Where the disease invades the posterior vaginal fornix, the vagina is opened. In the case of endometriotic infiltration of the vaginal mucosa itself, a vaginal approach can be useful to delineate and mobilize the nodule by digital dissection prior to initiating laparoscopic dissection; this follows the posterior lip of the cervix first and then the vaginal incision, making sure that all of the vaginal lesion is included in the mass adherent to the bowel.

Bowel surgery is performed at this point and can involve superficial, partial thickness, full thickness or segmental resection. Given the frequent involvement of the submucosal layer, to ensure complete excision of the endometriosis we recommend full thickness or segmental intestinal resection. We consider superficial "peeling" or peeling of the mucosa only in selected cases.

Even if full thickness bowel resection can be performed stepwise while the nodule is excised from the bowel and sutured in double layers, we consider the use of a linear stapler positioned perpendicular to the bowel axis is extremely safe and, beyond that, not expensive .The bowel segment invaded by the endometriotic nodule is grasped with a forceps while positioning a linear stapler and firing precisely below the nodule. The technique is limited in that it can be used only for small-sized lesions (< 3 cm) and if the reduction in bowel lumen is less than 50 %. To completely remove an anterior rectal lesion smaller than 3 cm, which would require an ultralow resection (up to 6 cm from the anal sphincter), we suggest the use of a circular stapler (CEEA) as described by *H. Reich.* The nodule is transfixed perpendicular to the bowel axis in such a way that it can be pushed between the anvil and the body of the circular stapler which has been inserted through the anal canal.

When transanal resection is planned, after placing a fourth trocar in the right upper outer quadrant, the bowel is mobilized laparoscopically using an ultrasonic scalpel (Ultra-cision).

The involved bowel segment is exposed, safeguarding the mesentery and the vessels close to the intestinal wall. The fat is stripped away from the healthy distal bowel segment, exposing the intact muscularis propria through 360 degrees so that the sutures for colorectal anastomosis can be placed very safely with the circular stapler using the Knight-Griffen technique. A linear

endoscopic stapler is then applied with a safety margin of 1 cm away from the nodule in the healthy distal bowel. Then, the proximal segment of rectosigmoid colon with the endometriotic nodule at its stapled end is extracted through the suprapubic port, which is prophylactically extended. The bowel segment involved is transected at about 1 cm proximal to the endometriotic mass. The anvil of the circular stapler is secured with a purse string suture to the distal bowel opening and reintroduced into the abdominal cavity. Next, a28 or 32 mm circular end-to-end anastomosis (CEEA) stapling device is introduced transanally to complete the procedure. Occasionally, for rectosigmoid lesions, a segmental bowel resection through a Pfannenstiel minilaparotomy with end-to-end hand-sewn anastomosis is performed under direct visual control.

Alternatively, the proximal bowel segment can be exteriorized transvaginally, resected and placed in the anvil of the circular stapler. After completing the end-to-end anastomosis the vagina is closed laparoscopically and an omental flap is created and interposed between vagina and colon to prevent the two sutures from getting into contact. The integrity of the anastomosis is tested by filling the pelvic cavity with saline and insufflating air into the rectum while the more proximal part of the sigmoid is occluded mechanically with forceps.

In our experience of 600 cases of complete excision of advanced endometriosis, we have found negative effects on the bladder, rectum and sexual activity. In this respect, the results of studies recently published by *Thomassin* and *Darai,* do not correspond with our own. There may be various rationales for this inconsistency. However, all authors agree on the significance of sparing the pelvic nerve plexuses.

The autonomic pelvic nerves in fact provide neurogenic control of the rectum, bladder and sexual area (vaginal lubrication and sweating). Among position-related iatrogenic nerve injuries, the inferior hypogastric plexus is most often affected during excision of endometriotic nodules from the uterosacral ligaments and the lateral adjacent area. To reduce to a minimum the risk of inadvertent nerve injury at this level the best safeguard is to observe certain rules that will be described below.

Protection of the Sympathetic Mesorectum Nerve Fibers; Superior Hypogastric Plexus, Hypogastric Nerves and Lumbosacral Sympathetic Trunk

The superior hypogastric plexus is formed by sympathetic nerve fibers lying in the presacral space at the level of the promontory, covered by peritoneum and by the anterior layer of the visceral pelvic fascia. The right and left hypogastric nerves originate from this plexus and descend 8–10 cm lateral to the mesorectum in the visceral pelvic fascia following the cranio-caudal course of the ureter. These nerves can be localized by opening the peritoneum at the level of the sacral promontory to gain access to the presacral space. Blunt dissection of the loose adipose tissue in the rectosacral space as far as the rectosacral fascia allows identification of the superior hypogastric plexus and

the hypogastric nerves close to the sacrum and distant from the mesorectum, which is drawn ventrally and caudally with the rectum. If this is done, innervation is preserved completely during dissection of the upper part of the mesorectum. To mobilize the rectosigmoid fully and reach the inferior part of the mesorectum as far as the rectal wings, the pararectal fossae must be unified in the retrorectal space by blunt dissection as far as the space known as *"The Holy Plane of Heald"* located in the midline; when this has been identified, the posterior and lateral mesorectal fascia is preserved by dissecting the loose and relatively avascular connective tissue between the visceral mesorectal fascia and the parietal endopelvic fascia. The medial and distal segments of the hypogastric nerves adhere to the mesorectum fascia at this level and can be injured if they are not exposed. Dissection is continued as far as the floor of the pararectal spaces, always staying close to the rectum to preserve the superior hypogastric plexus and the hypogastric nerves medially and cranially, and the ganglia and lumbosacral sympathetic trunks laterally and dorsally, close to the sacrum.

Protection of the Sympathetic Fibers of the Inferior Mesorectum: the Inferior-most Aspect of the Hypogastric Nerves and the Proximal Aspect of the Inferior Hypogastric Plexus

It is extremely important to localize and lateralize the hypogastric nerves and their connections to the proximal part of the inferior hypogastric plexus. After opening the retroperitoneum of the presacral space and prior to initiating dissection of the uterosacral ligaments and rectal pillars, the thin and delicate lateral part of the visceral presacral pelvic fascia between the prerectal space and the pararectal space is mobilized and lateralized carefully. This lateral part is crossed by the hypogastric nerves, the anterior branches of the Sacral sympathetic trunks, the parasympathetic pelvic splanchnic nerves and more ventrally and caudally by the proximal aspect of the inferior hypogastric plexus. It is not always easy to identify the hypogastric nerves in the presacral space because their thickness varies greatly (4–7 mm), they are completely surrounded by fatty tissue and they sometimes give off multiple nerve fibers. However, clear identification, exposure and preservation of these nerves are feasible through laparoscopy and should always be attempted. At this level, they run from lateral to medial in a cranio-caudal direction approximately 20 mm to 5 mm inferior to the ureter.

Protection of the Splanchnic Nerves and of the Medial and inferior Aspects of the Hypogastric Plexus in the Inferior Mesorectal Spaces

The parasympathetic innervation of the pelvic organs, rectosigmoid and anal canal is provided by the splanchnic nerves which originate from the S2-S4 sacral roots. 3–5 branches originate from the pelvic splanchnic nerves 3–4 and 1–2 cm laterally and inferior to the pouch of Douglas; they perforate the endopelvic fascia, cross the ventral aspect of the piriformis muscle and then converge with the terminal branches of the ipsilateral hypogastric nerve about 1

cm ventral to the inferior hypogastric plexus. The plexus is located bilaterally in the presacral aspect of the endopelvic fascia between the posterior vaginal fornix and the rectum in the ventral part of the lateral rectal ligaments. When the inferior-most aspect of the posterolateral parametrium is involved by endometriosis, it is resected sparing the dense connective tissue and the fatty tissue surrounding the nerve fibers of the cranial and medial aspect of the inferior hypogastric plexus. Ideally, the plane of dissection should not enter the space, similar to the keel of a boat, which is located between the anterolateral planes of the mesorectum and the rectal wings. A surgical anatomical reference point that we use to separate the lateral parametrium and the vascular part (ventral and cranial) of the nerve (dorsal and caudal) is the deep uterine vein.

The lateral ligaments of the rectum run close to the splanchnic nerves in 30% of cases, cross the pelvic plexus and then continue with the medial efferent bundle of the pelvic plexus up to the lateral or anterolateral surface of the rectum. In a recent study, *Ercoli* showed, that the pelvic splanchnic nerves are at high position-related risk of iatrogenic injury because they are in close proximity to these ligaments in 70 % of cases. Proper identification of the splanchnic nerves at their origin from the sacral roots allows safe dissection of the rectal wings and the inferior mesorectal planes.

Always keeping the parasympathetic nerves under vision allows the nerve fibers to be kept distant from the debulking planes.

Moreover, by following their course until they converge with the hypogastric nerves it is possible to localize the origin of the pelvic plexus, caudal to the course of the deep uterine vein, particularly the efferent branches and the visceral afferent branches of the uterus, vagina and bladder. During bowel resection, after excision of the mesosigmoid with sparing of the innervation described above, only selective neuroablation of a small quantity of nerve fibers of the medial efferent bundle of the pelvic plexus is performed, directed medially towards the rectum and traversing the mesorectum. In fact, only the rectal fibers of the resected segment of bowel are transected, minimizing rectal denervation.

Protection of the Caudal Aspect of the Inferior Hypogastric Plexus

The distal aspect of the inferior hypogastric plexus is located in the posterior part of the vesico-uterine ligament, lateral and caudal to the distal ureter. To preserve it, after preparing the ureteric tunnel and the so-called space of Morrow medial and central to the ureter, the lateral aspect of the nerves and the medial vascular part of the vesico- uterine ligament are dissected. It is necessary to divide the pubocervical fascia consisting of the cranial and caudal part of the vesico-uterine and vesico-vaginal ligaments at the point where its reflection will form the ureteric tunnel. In this way, the surgeon gains safe access to the paravaginal space.

Literature

1. Адамян А. В., Яроцкая Е. Л. Генитальный эндометриоз: дискуссионные вопросы и альтернативные подходы к диагностике и лечению / А. В. Адамян, Е. Л. Яроцкая // Журнал акушерства и женских болезней. – 2002. – Вып. 3, т. LI. – С. 103–113.
2. Гладышев В. Ю. Оперативная лапароскопия в гинекологии : учебное пособие для врачей-курсантов / В. Ю. Гладышев, Н. В. Гаранин. – Воронеж : Издательство….., 2006. – 86 с.
3. Запорожан В. М. Оперативна гінекологія : практ. порадник / В. М. Запорожан. – Одеса : Одес. держ. мед. ун-т, 2006. – 448 с.
4. Хирургическое лечение распространенных форм генитального эндометриоза с поражением соседних органов / А. И. Ищенко, Е. А. Кудрина, Д. Озген, А. А. Бахвалова // Журнал акушерства и женских болезней. – 2002. Вып. 3, том LI. – С. 46–51.
5. Савельева Г. М. Лапароскопия в гинекологии / Г.М. Савельева, И. В. Федоров. – Москва : Гэотар Медицина, 2000. – 325 с.
6. Федоров И. В. Оперативная лапароскопия в хирургии, гинекологии и урологи / И. В. Федоров. – Москва : Профиль, 2007. – 288 с.
7. Штыров С. В. Лапароскопическая хирургия при «остром животе» в гинекологии / С. В. Штыров // Вопросы акушерства, гинекологии и перинатологии. – 2002. – Т. 1, № 2. – С. 86–90.
8. Diagnostic Accuracy of Sonosalpingography for Assessing Tubal Pathology in Women with Secondary Infertility Taking Laparoscopy as Gold Standard Surgical Science / Amit Nandan Dhar Dwivedi, Madhu Jain, SuchiTripathi, Sunny Garg, Shivi Jain. – 2012. – 3. – P. 414–417.
9. Atlas of transvaginal endoscopy / Edited by Stephan Gordts and Rudi Campo. – 2007. – Informa UK Ltd.
10. Catenacci M. Transvaginal hydrolaparoscopy / M. Catenacci, J. M. Goldberg // Semin Reprod Med. – 2011. – 29. – P. 95–100.
11. Cohen S.M. Operative laparoscopy and hysteroscopy / S. M. Cohen (ed.). – New York : Churchill Livingstone. – 1996. – 320 p.
12. Adamson G. D. Endoscopic management of gynecologic disease / [edited by] G. David Adamson, Daniel C. Martin. – 1996. – 440 p.
13. Mencaglia L. Manual Gynecological Laparoscopic Surgery / Luca Mencaglia, Luca Minelli, Arnaud Wattiez – 11nd Edition. – 2010. – Tuttingen, Germany : Endo: Press tm. – 258 p.
14. Operative gynecologic laparoscopy. Principles and techniques / Nezhat C.R. et al. (eds.). – McGraw-Hill, Inc., 1995. – 337 p.

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