Laparoscopic Surgery for Infertility

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Abstract: Tubal abnormalities are one of the most cause of infertility among women. Tubal adhesion can caused by infection or prior surgical procedures, has important roles causity infertility. Development and improvement of surgical equipments and techniques to date makes the management of infertility better. Laparoscopic surgery procedure was introduced in 1980’s, adhesiolysis were developed. Since then laparoscopic tubal surgery has been gaining under acceptance with good result. This review will discuss the role of laparoscopic surgery in management of infertility.

Keywords: infertility, laparoscopy

INTRODUCTION

In the 1970s, infertility surgery adopted microsurgery under the influence of Swolin and Gomel.1,2 The 1980s saw it replaced by laparoscopic surgery. Several elements can explain this development: the results of microsurgery, apart from recanalizations proved disappointing, the appearance of IVF in the practice of infertility and the advent of newer techniques in endoscopic surgery. The biggest change was brought about by the following two which were instrumental in bringing about radical change in surgical approach:

1. The adaptation of video to endoscopy; that is the advent of the concept of videolaparoscopy offering closed environment and magnification.3
2. The use of the CO2 laser in laparoscopy.4

The first operations were performed by Raoul in the form of adhesiolysis and even some trial neosalpingostomy or fimbrioplasties were performed. The treatment of endometriosis by laparoscopy goes back to 1980 by Bruhat,4 Manhes,5 Keye6 and Feste.7 As concerns, laparoscopic neosalpingostomy, it was performed for the first time by Daniell in 1984.8

Since then laparoscopic tubal surgery has been gaining wider acceptance and good results. The evaluation of the tube, its mobility, patency, and its environment remains the main objective, which defines the therapeutic strategy to be applied. The means of exploring the tubal mucosa has progressed in recent years due to the advent of new, very fine fibreoptics which allow tuboscopy9 to be performed by the laparoscopic (salpingoscopy) or transcervical route (falloposcopy).

GENERAL CONSIDERATION

In the tubal infertility following factors play a vital role.

1. The importance of the tubal mucosa.
2. The thickness of the tubal wall.
3. The mobility of the tube.
4. Systematically searching for an infective foci as infections governs the results. In fact, when reparative surgery is performed, then infections may cause the risk of premature recoclusion and the recurrence of adhesions. So one should be very careful in staving off infection.
5. Other factors of infertility (ovulatory dysfunction, sperm anomalies, associated hormonal pathologies).
6. Age of the patient, if the patient is older (around 40 years old) all of these can lead directly to IVF. Laparoscopic surgery is then only used to prepare the ovarian access for the transvaginal ultrasound guided tapping.
PREOPERATIVE WORK-UP

Hysterosalpingography

It permits easy recognition of the hydrosalpinx, and gives an assessment of the mucous folds and tests the patency of the tube. It also provides information on the flexibility of the wall of the tube and the condition of the proximal portion. In fact, in the case of block at two sites, surgery would be of no use and the patient should be referred directly for IVF.

Laparoscopy

The first phase is most important in the evaluation of the tuboperitoneal factors that is adhesions, tubal mobility with respect to the ovary, condition of the pouch of Douglas, condition of the fimbriae, etc. and allows a search to be made for any early stage of endometriosis. Laparoscopic chromopertubation with methylene blue is carried out and then the second phase is surgical. Whether to proceed for surgery is decided upon by tubal scores as adjudged by the initial laparoscopic findings.

Salpingoscopy

This provides a direct view of the tubal mucosa. However, whilst the technical capabilities of fibre optics are impressive, the field of vision remains small, the antegrade progression difficult and the technique still to be evaluated in routine gynecological practice. This technique can only be used routinely if its use significantly improves the results whilst making the selection of the cases operated on more severe adhesion scores.

CLASSIFICATION OF TUBAL AND ADHESION SCORE

They have the merit of quantifying the lesions and defining the therapeutic indications.

Various classifications have been suggested for the staging of adhesion.

1. Hulka was the first to publish a classification of pelvic adhesions, based on the extent of ovarian involvement (percentage of surface area) and the nature of adhesions (filmy or dense).
2. The American Fertility Society (AFS) is the most widely used classification and takes into account the adhesion around tube and ovary, describing the adhesions as filmy, dense. It takes into account the amount of enclosure of tube and ovary by adhesions, <1/3, 1/3-2/3, and >2/3 enclosure and assigning a score of 2, 4, 6, 8 accordingly. It lacks in precision and does not take into account adhesions with other organs. So, to overcome these problems another scoring system was needed.
3. The American Fertility Society (AFS) published another classification, which was more generally accepted. The Adhesion Scoring Group (1994) has published a more comprehensive classification based on evaluation of 23 individual locations in the abdominal cavity, 13 in the pelvis, for severity (0, none; 1, filmy and/or avascular; 2 dense and / or vascular; 3, cohesive and extent of total area or length (0, none; 1.25%; 2; 26-50%; 3 > 50%). This classification has been shown to reduce interobserver variation in reporting.

Tubal Score

Defined by Mage in 1986, it takes three factors into account: tubal mucosa, tubal wall, patency as per the information provided by the hysterosalpingography and the first phase of the laparoscopy. A score of 0, 5, 10 points depending on the extent of the tubal damage allows 4 stages to be defined:
- Stage 1 most often needs fimbrioplasties
- Stage 2 needs a neosalpingostomy
- Stage 3 will always remain an intermediate case left to the discretion of the surgeon, who will evaluate the surgical approach according to other associated factors previously mentioned
- Stage 4 cases are directly referred for IVF

Adhesion Score

Fundamentally, it will evaluate the peritubal "atmosphere". In fact the extent of adhesions dictates the results directly in terms of pregnancy. It is correlated with the tubal score and will also define the therapeutic indications. The adhesion score takes account of:

1. The quality of adhesions, previously described by Raoul Palmer
   - Type A - Velamentous
   - Type B - Vascular or dense
   - Type C - Cohesive
2. The distribution of the adhesions on the tubes, on the surface of the ovary and in the pouch of Douglas. It is essentially defined into three stages mild, moderate, and severe. Mild and moderate cases are managed laparoscopically and stage three severe cases
are directly referred for IVF, after laparoscopic surgical "preparation" for the transvaginal ultrasound guided oocyte retrieval.

**Equipment**

As for principles of microsurgery, there are two ways:
- that based on the conventional techniques, including electrosurgery
- that based on the use of the lasers (essentially the CO$_2$ laser)

**Equipment for Conventional Techniques**

This includes a pair of laparoscopic scissors,atraumatic type grasping forceps, a very fine unipolar electrode, thin jawed bipolar forceps and a suction irrigation system. Overall, this equipment is fairly ordinary but its use for this indication is especially delicate and safe.

**Technique of CO$_2$ Laser**

It consists of introducing the CO$_2$ laser through the laparoscope, on the condition that a generator with a power output of over 50 watts is available with pulse mode, and preferably ultrapulse. This system is particularly effective and very ergonomic.

**The Other Lasers**

The other lasers are less suited to this type of surgery. The Argon laser has the advantage or being more ergonomic, as it is transported via optical fibres. However, it causes more damage to the tissues and is expensive. The KTP laser, has very similar characteristics to the Argon laser but is little less expensive. The ND-Yag laser has the advantage of being transported via optical fibres and of not being too expensive. However, in its usual version, its therapeutic characteristics are incompatible with most infertility surgery. Therefore, it can only be considered if a sapphire is adapted onto the end of the optical fibre, which makes it very efficient and easy to handle, but which also makes it very expensive.

So the problem of the equipment seems important with the choice ranging from simple, inexpensive solutions to very expensive and sophisticated solutions.

**ADHESIOLYSIS**

Laparoscopic adhesiolysis has proven its effectiveness. Several reasons explain the advantages of laparoscopy.

- Closed internal environment, which avoids the drying of the peritoneum and therefore the recurrence or de novo adhesion formation.
- The approach of certain pelvic adhesions, which is much easier via laparoscopy than via laparotomy, particularly for adhesions in the inferior and lateral sections of the pelvis, under the ovaries in particular.
- The positive pressure exerted by the pneumoperitoneum, which creates a "barohemostasis" and therefore limits generalized bleeding considerably.
- The reduced occurrence of postoperative infections.
- Furthermore, the length of the operation and the period of convalescence are much shorter.

**Indications**

Laparoscopic adhesiolysis is indicated in all cases of tuboperitoneal infertility:
- If the adhesions are isolated, then the chances of pregnancy are high.
- If the tubes are blocked, to make a precise assessment of the lesions, and if the tubes are very severely damaged, to help in preparing the patient for safe oocyte retrieval during IVF.

For pure adhesiolysis, the indication and the prognosis depend on the spread of the adhesions, best evaluated by the adhesions score.

The laparoscopic adhesiolysis technique is not universal. The choice of the instrumentation and the approach angles can vary significantly from one surgeon to another.

There are three possibilities open to the laparoscopic surgeon:
- The technique with elective use of the CO$_2$ laser.
- The technique with the dissecting forceps scissors and bipolar coagulation.
- The technique with elective use of unipolar coagulation.

The technique with elective use of the laser consists of tensioning the adhesion with a non-reflective instrument and sectioning it with focussed CO$_2$ laser emissions. The advantages are the rapidity, the accuracy, the possibility of reaching areas where access is difficult. The greater ease of performing resections rather than simple sections. And most importantly almost complete absence of bleeding and keeping the
field clear. The disadvantage are the fumes, which must be evacuated progressively, the difficulty in reaching certain areas at the right angle, such as subovarian zone and the risk of misdirected laser emissions.

The technique with dissecting forceps scissors and bipolar coagulation is the closest to the classic microsurgery techniques. The adhesion is tensioned with the dissector or the forceps. If it appears thick and vascularized, bipolar coagulation is applied before cutting with the scissors, otherwise the adhesion is cut from the outset. The advantage lies in its simplicity and the possibility of reaching virtually all areas. The disadvantages are the necessity of an additional approach route, the relative slowness and the presence of oozing which occurs more often than with the laser. Overall this technique is much safer and simpler.

The technique with elective use of unipolar electrosurgery consists of applying tension on the adhesion with forceps or the dissector then, cutting it via pure electrocautery without any prior hemostasis with a very fine electrode. The advantages are that it is very effective and rapid, and there is virtually no bleeding. The main disadvantage of this method is its relative lack of safety, with the risk of electrical arcing and the risk of burning neighboring organs. Access to the pelvis is not always perfect either, especially in the subovarian region, even more so since the risks of burning means that it cannot be used close towards the structures such as ureter or the intestine.

Several precautions must be observed in order to perform these operations under optimal safety conditions:
- Start with the most simple and progress to the most complex adhesion.
- Start from the middle and work towards the outside, i.e. start by the adhesiolysis of the pouch of Douglas before moving onto the adnexa.
- Proceed from the most superficial and move towards the deeper tissue.
- Respect an adhesion temporarily which allows traction to be exerted: for example, avert the subovarian adhesiolysis until the intertubal-ovarian adhesiolysis is complete, as this allows the organs to be held in tension more satisfactorily.
- A preventive hemostasis using bipolar electrocautery should be considered as being less traumatic.

However, none of these rules are universal and are dictated by the surgeons preference and mandate of the particular case.

Special Cases

Few special cases have to be dealt specifically.
- Adhesiolysis between the intestines and another organ must be performed with special care. These are the adhesiolysis which cause the worse accidents in laparoscopy, which is to say unrecognized intestinal wounds. No risk should be taken with thick adhesions which do not interfere with the infertility.
- Sub-ovarian adhesions are particularly difficult to reach at a correct angle. If there is a space between the infundibulopelvic pedicle and the posterior surface of the broad ligament, the cleavage should be started at this level, possibly by fitting a trocar very high in the corresponding iliac fossa. Otherwise, the cleavage plane must be looked for at the posterior surface of the ovary, which is generally in contact with the side of the uterus. Lastly, the dissection can be started at the posterior surface of the ovary along the uterosacral ligament, but it often turns into a subperitoneal cleavage which causes bleeding and deperitonization. The proximity of the ureter in any case must not be forgotten and limits the use of electrocoagulation to perform the hemostasis. This dissection is often performed in anterograde fashion progressively, the ovary rotated upwards and forwards, and the scissors remaining in contact with its inferior surface. The laparoscope magnifies the view, which makes laparoscopy "microsurgical". It is also possible to use aquadissection with warm saline, which permits concomitant hemostasis-lavage to be performed, however the drawback is to make the mesosalpinx edematous rapidly in the case of peritoneal openings.

Salpingo-ovariolysis

Tubo-ovarian adhesions are common. They are to be looked for by lifting the tube upwards. Most often, they are fine in isthmic portion and dense in the ampullary region and most often cause stenosis in the fimbrial region. Adhesiolysis must be started as close as possible to the uterus by inserting forceps or a suction irrigation cannula into the tubo-ovarian fossa. The instrument allows the adhesions to be
tensioned, which are then sectioned either with the laser or by electrosurgery or by scissors. The adhesiolysis between fimbria and ovary is the most delicate part. Ideally, it should be performed in continuation of the tubo-ovarian adhesiolysis in the ascending direction. Otherwise, the adhesiolysis should be performed directly. The cleavage plane is generally easier to find posteriorly. The difficulty consists in not damaging the fimbria by either grasping or by cutting. Furthermore, it is not always easy to differentiate between the adhesion and the end of mesosalpinx, with the risk of damaging the external tubal artery causing bleeding. All actions require a great deal of expertise in handling either the laser or the electrosurgical equipment. Salpingo-ovariolysis often precedes neosalpingostomy.

The results of the pure adhesiolysis depend on the adhesion stage. In the case of slight or moderate adhesions, the pregnancy rate is around 60 percent as opposed to just 20 percent in severe cases. These figures are very similar to those obtained after microsurgery.

Neosalpingostomy

Neosalpingostomy is the operation, which attempts to recreate a new ostia when the tube has a hildrosalpinx. So as to say that when there is complete obstruction and original fimbria have completely disappeared or buried beneath adhesions then, neosalpingostomy is carried out. First of all adhesiolysis is carried out and when the end of the tube is free, then methylene blue is injected under high pressure to distend the hydrosalpinx. The most important point is to determine the opening point on the former ostium. It is sometimes easy to find, and is situated at the tubal puncture point of the methylene blue or at the convergence of several fibrous folds separating the underlying mucosa. Otherwise, the point of the first incision will be chosen at the center of the hydrosalpinx. Atraumatic forceps are used to hold the chosen at the center of the hydrosalpinx. The scissors must then be removed and 2 pairs of atraumatic forceps with long jaws are used to widen the opening by pulling the peritoneum gently in opposite directions. The avascular zones must be left intact. In the case of microbleeding, bipolar coagulation is performed with continuous irrigation. It is useful to make one of the incisions at the 12 'Oclock position down to the mesosalpinx in order to recreate a "Richard neofimbria".

The condition of the terminal portion of the intra-ampillary tubal mucosa is then assessed directly or by means of the salpingoscope. The latter is inserted under continuous irrigation with warm saline to improve the view and try to collapse the intratubal intermucosal adhesions. Finally, this evaluation can lead to the decision of a salpingectomy in the case of advanced grade four adhesions.

EVERSION OF FIMBRIA

In the past performed by microsurgery using prolene 5/0 serous micropoints, it is now performed via laparoscopy by heating. The magnificent "tissue effect" discovered by Bruhatl7 is obtained by the heat retraction of the ampullary serosa. This is undoubtedly where the CO2 laser triumphs with its unfocused emissions (increase of spot size, power dropped to 10 watts) starting at the most distal edge of the serosa and descending towards the ampulla. When a laser is not available, successively touching with the bipolar forceps obtains the same anatomical results. In this case, the coagulation current should be reduced to avoid whitening of the serosa. Laparoscopic suturing with 5-0 vicryl remains controversial in this indication. The operation is completed at the time by abundant washing with saline and simple hydrofloatation of 1,000 ml is systematically left in peritoneal cavity at end of surgery.

Fimbrioplasty is done when these fimbriae are partially or completely present, but are agglutinated whether there is complete distal occlusion or partial, the technique used is a fimbrioplasty, for which the prognosis is generally better. Fimbrioplasty refers to the reconstruction of existent fimbriae in a partially or totally occluded oviduct. In the majority of such cases periadnexal adhesions are also present in which case salpingo-ovariolysis is carried out first. Stenosis or obstruction of the distal tube may be the result of agglutination of the fimbriae. As a result the terminal end of the tube may have a phimotic appearance with a lesser degree of patency. Transcervical chromo-perturbation will distend the ampulla prior to the dye solution. In other instances, the agglutinated fimbrial end is also covered by a fibrous layer that may cause complete occlusion at the site. When the fimbrial end is covered by a fibrous
layer, it will be necessary to incise or excise this layer in order to expose the agglutinated fimbriae. This can be accomplished using laparoscopic scissors or laser energy. To deagglutinate the fimbriae a closed 5 mm curved atraumatic grasper is introduced into the fallopian tube through the phimotic opening. The jaws of the grasper are opened within the tube and the forceps withdrawn with the jaws in the open position. This procedure is repeated several times, varying the direction of the jaws, until satisfactory fimbrial deagglutination is obtained. With gentle manipulation bleeding is seldom encountered. Copious irrigation and lavage is done.

COMPLICATIONS
Some bleeding of the hilum of the ovary or tube has been observed, and treated by bipolar coagulation, otherwise no significant peroperative problems have been seen. On the other hand, during difficult adhesiolysis, serious accidents have been reported. Such cases are due to the inexperience of the surgeon and failure to respect the surgical contraindications. Above all the surgeon must know when to stop when the difficulties are too obvious do no harm must remain a dogma in this surgery in particular.

DISCUSSION
In the light of these results, there is absolutely no doubt that the stages I and II with slight or moderate adhesion scores are the domain of laparoscopic surgery. The stage IV and severe adhesion cases must be put onto the IVF program. As regards the stage III cases, they are in between. Most of them can be treated by laparoscopy but the surgeon must take into account the parity of the patient, her age, any associated male factor and possible endometriosis. The evaluation of these factors can lead one to switch the patient to the IVF-ET. Finally, there remain two special situations, lesions at two sites in the tube secondly recur blocks or infections. These should indicate IV these cases, it can be useful to elect for a laparoscopic bilateral salpingectomy or ligating them, but proper counseling and consent of the couple.

CONCLUSION
Technical progress has allowed laparoscopic surgery to be standardized. Adhesiolysis and neosalpingostomy techniques allow satisfactory anatomical results to be obtained in favorable cases and results in terms of conception which are fairly comparable to those previously obtained via microsurgery. The patients must always be rigorously selected, taking into account not just the tubal lesions and associated adhesions but also other parameters influencing fertility of the couple. The surgical indications, including all of these elements, are better defined with regard to IVF, the only therapeutic alternative at present.

REFERENCES


