Atlas of
TRANSVAGINAL ENDOSCOPY

Edited by
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Rudi Campo
Hugo Christian Verhoeven
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Preface

Infertility is a complex disorder with significant medical, psychological and economic aspects. Both the prevalence of infertility and the number of patients seeking treatment of this disorder are increasing. With the introduction and the widespread use of assisted reproductive technologies (ART), the role of diagnostic laparoscopy in the evaluation of infertility has become controversial. Laparoscopy is invasive and expensive and is frequently omitted or postponed in the exploration of the infertile couple. The relative invasiveness of the standard endoscopic techniques and the increasing quality of the indirect imaging techniques are favouring this evolution, possibly resulting in a rather liberal referral to ART programs.

Up till now, however, direct visualisation of the different organs has proved to be superior to indirect imaging techniques. The easy vaginal accessibility of the uterus for hysteroscopy and the close contact of the tubo-ovarian organs with the posterior vaginal fornix make a trans-vaginal endoscopic approach tempting. Indeed culdoscopy was the first technique offering the possibility of direct visualisation of the tubo-ovarian structures. The availability of small diameter endoscopes with high quality images offers today a minimally invasive way of access, enabling the accurate examination by direct visualisation of the reproductive pelvic structures, which was previously impossible. Both hysterosalpingography and diagnostic laparoscopy can be replaced by hysteroscopy and trans-vaginal hydrolaroscopy (TVL) as an ambulatory ‘one stop fertility exploration’. In addition, TVL has been developed as a surgical tool in cases of ovarian capsule drilling in polycystic ovary syndrome, ovarian endometriosis and tubo-ovarian adhesions.

This atlas will show the reader the possibilities of the transvaginal approach in the exploration and, where possible and when indicated, surgical treatment of the uterus and tubo-ovarian structures.

Stephan Gordts
Section I

Diagnostic transvaginal endoscopy
Rationale of transvaginal laparoscopy in infertility

Stephan Gordts and Ivo Brosens

Introduction

Transvaginal laparoscopy (TVL) has been introduced as an alternative to standard laparoscopy (SL) for the exploration of patients with infertility. It is primarily a diagnostic procedure to be used in an office setting as a minimally invasive technique for the investigation of infertile patients with no obvious pelvic pathology. While SL is too invasive and probably not cost-effective to be performed in women without obvious pelvic pathology, the endoscopic exploration of the tubo-ovarian structures in infertility is in current practice frequently postponed or even omitted. As a consequence, diseases such as endometriosis, small endometriomas, or tubal disease are not diagnosed. However, even with the advent of in vitro fertilization (IVF) and the liberal referral to IVF we are not at the stage that we can ignore various uterine and pelvic pathologies associated with infertility, which may have an important impact on the reproductive outcome and can be corrected.

History

While attempts to use the transvaginal access for endoscopic exploration of the female pelvis go back to the beginning of the 20th century, the first successful technique of culdoscopy was introduced in the early 1940s by Decker. The endoscopic visualization of the pelvic organs was performed with the patient in the knee-chest or genupectoral position. It was originally conceived as a complex hospital procedure with the patient in an uncomfortable and unstable position requiring elaborate mechanical and manual bracing and with the physician in an unusual physical orientation to the target organs. Small wonder that, when laparoscopy was introduced in the 1960s, transabdominal access was seen as the answer to some of the problems. Laparoscopy soon became the standard method for gynecologic endoscopy, particularly when it was shown that the technique was superior to culdoscopy for surgical procedures such as tubal sterilization.

However, pioneers of pelvic endoscopy like Raoul Palmer in Europe and Edward Diamond in the USA continued to promote culdoscopy as the method of choice in at least one special application – the diagnosis of infertility, because it provides a closer, clearer, and more detailed view of the fallopian tubes, ovaries, and surrounding pelvic structures than laparoscopy. In 1978 Diamond published a personal series of 4000 outpatient procedures of diagnostic culdoscopy in infertility. The results were impressive, the complications mild, and the failure rate was very low. Fimbrial phimosis and perifimbrial adhesions were more readily detected. Endometriosis could be seen on all the surfaces of the ovary, the distal end of the tube, the lateral pelvic wall, the utero-ovarian and uterosacral ligaments, and even in locations revealed with difficulty or not at all by laparoscopy. In particular, culdoscopy revealed the fine, filmy adhesions that are only rarely picked up by laparoscopy but which may be responsible for a significant amount of ovarian and tubal malfunction. Diamond concluded that the use of diagnostic culdoscopy as an outpatient procedure provides a better access for the diagnosis and treatment of infertility, especially when the pathology is not extreme enough to warrant laparoscopy. His advice was that the technique should be returned to gynecologic training programs, and he concluded:

True, culdoscopy requires laboriously won special skills, but its advantage to patient and physician are well worth the trouble. Once mastered, culdoscopy equips the gynaecologic endoscopist with a rapid and minimally traumatic outpatient option that supplies rich information not only in the initial diagnosis of infertility but also in circumstances where laparoscopy might be inappropriate.

While the technology of laparoscopy has continuously improved, the technology of culdoscopy has not advanced since the 1960s. Improvements such as dorsal decubitus, hydroflotation, and miniculdoscopy were suggested to revive culdoscopy, but received no further interest.
In 1998 Gordts et al. described a new culdoscopic technique, called transvaginal hydrolaparoscopy (THL), for the exploration of infertile patients without obvious pelvic pathology. A somewhat similar technique using a disposable cannula was developed by Watrelot and called fertiloscopy. Both techniques combine the use of small-diameter instruments, dorsal decubitus, and hydroflotation.

Safety
SL requires general anesthesia and full operating room facilities. It is not an innocuous procedure, and the majority of laparoscopic complications occur during the transabdominal access. One-third of the major complications are caused by the instillation of pneumoperitoneum and insertion of trocar. Even in experienced hands, the bowel injury occurs as frequently during the access as during the surgical procedure and remains a major cause of morbidity and mortality. In particular, the delayed diagnosis of bowel injury at SL is a major cause of sepsis and mortality.

The use of the small-diameter cannula and the combined needle trocar system in TVL add to the safety of the transvaginal technique. A large survey of transvaginal pelvic endoscopy reported that all bowel injuries were diagnosed during the procedure and supported the view that the small, non-leaking injury in healthy tissue can be managed expectantly without consequences.

Underwater view
SL is not an ideal technique for the exploration of the tubo-ovarian structures in infertility. The panoramic view of the pelvis is obtained by distending the abdomen with CO₂ and by moving the bowels out of the pelvis using the Trendelenburg position and instrumental manipulation. While this panoramic view is essential in patients with major pelvic pathology or in acute conditions of pelvic pain or bleeding, it is very debatable whether the transabdominal approach and panoramic view of the pelvis are altogether needed for the exploration of infertility. The high intra-abdominal pressure during SL causes collapse of structures like the fimbriae and superficial lesions such as polypoidal endometriosis, filmy adhesions, and neoangiogenesis. In addition, the CO₂ pneumoperitoneum provokes pain with postoperative distress and induces acidosis, which is potentially harmful to the patient.

In transvaginal pelvic endoscopy the tubo-ovarian structures are directly accessible and the exploration is performed without additional manipulation. The aqueous distention medium keeps the organs afloat and enables the visualization of subtle tubo-ovarian structures in their natural position. The superiority of TVL over SL for exploring the tubo-ovarian architecture and physiologic processes, such as ovulation and ovum capture, was demonstrated when the first direct observation of the cumulus mass capture by the fimbriae at the time of ovulation was documented in the human (Figure 1.1).

Hydroflotation and direct access to the fimbriae allows for accurate inspection of the fimbrial mucosal folds and the infundibulum by fimbrioscopy. Full salpingoscopy or ampulloscopy is more difficult, but can be achieved without additional instrumentation in approximately 50% of the patients, being most successful in the periovulatory period. Salpingoscopy is not performed during SL in most centers because it requires training, is not an easy manipulation, and there is a need for an additional optical instrument and surgical assistance.

Finally, the use of an aqueous distention medium instead of CO₂ pneumoperitoneum avoids postoperative irritation and allows the patient to leave the office in comfort after the diagnostic procedure.

Accurate diagnosis
Mild and moderate pelvic lesions affecting fertility include peritoneal endometriosis, ovarian endometrioma, tubo-ovarian adhesions, fimbrial agglutination and phimosis, and tubal mucosal adhesions.

Endometriotic disease is today defined by the presence of any laparoscopically visible endometrial implant >5 mm, any visible ectopic endometrial implant with evidence of inflammation or tissue damage, such as neoangi-
genesis or adhesions without another explanation, or an endometrioma of any size. For the accurate diagnosis we need a close and clear inspection of the lesion. Here, TVL offers major advantages over SL (Figure 1.2). First, endometriosis is frequently located at the caudal pole of the ovary and in the fossa ovarica. These locations are directly accessible at TVL. Without the need of supplementary manipulation, the whole ovarian surface and lateral pelvic wall can be inspected. Secondly, in mild and minimal endometriosis, 50% more ovarian adhesions are detected at TVL than at SL. Small ovarian endometriomas, which are missed at transvaginal ultrasound, are detectable at TVL by the presence of superficial lesions, neoangiogenesis, and free-floating adhesions at the site of invagination of the ovarian cortex or agglutination of the ovarian gyri. Finally, endometriotic adhesions between the ovary and lateral pelvic wall, which may rupture and collapse during the manipulation of the ovary and appear as a diffuse bleeding at SL, remain intact. In conclusion, as women should not be considered to have endometriotic disease unless the ectopic endometrial implants show evidence of activity or tissue damage, we need accurate inspection of the lesion. Unfortunately, no recommendations exist under which conditions and by which criteria the tissue damage, inflammation, or neoangiogenesis should be evaluated and scored.

Fimbrial abnormalities and adhesions are also easily detectable at TVL. Studies of the fallopian tube in pelvic inflammatory disease have shown that the endoscopic inspection of tubal mucosa by salpingoscopy is the most accurate technique in predicting the probability of pregnancy and the risk of ectopic pregnancy. In the presence of Chlamydia antibodies, exclusion of any tubal mucosal pathology is important for further fertility management.

Accurate diagnosis of uterine lesions, tubo-ovarian adhesions, and active peritoneal and ovarian endometriotic lesions at an early stage is important in the management of infertility. These lesions are assumed to affect 20–30% of subfertile patients. Capelo et al found that one-third of the patients failing to conceive after four ovulatory cycles of clomiphene citrate had significant intrapelvic pathology. A multicentric study found that the performance of transvaginal endoscopy can mean avoiding laparoscopy in up to 93% of infertile women without clinical or ultrasound evidence of pelvic disease, as the relevant information can be obtained by this less-invasive procedure.

Effective treatment

Endometriosis has been a major argument to opt for an endoscopy-based rather than ultrasound-based fertility investigation. The main question is whether minimal or mild endometriosis is a potential cause of delay in conception and whether surgical treatment is effective. A recent study of infertile women undergoing laparoscopy found that the time to natural conception differs significantly between women with unexplained infertility and infertile women with minimal or mild endometriosis. In that study, a group of 192 fully investigated infertile couples were followed up for up to 3 years following laparoscopy. No surgical therapy was undertaken to treat the
endometriosis found at that time. The authors found that the likelihood of pregnancy was significantly reduced in infertile women with minimal or mild endometriosis compared with those infertile women with a normal pelvis. Another recent study of 315 infertile patients with early-stage endometriosis and a control group of 152 infertile patients who had no endometriosis found significantly more fimbrial pathology, including agglutination, phimosis, and blunting, in the endometriosis group. Clearly, in addition to the endometriotic lesions the presence of other mild pathology deserves endoscopic investigation.

The view that the diagnosis and treatment of minimal endometriosis in an early stage of subfertility is beneficial is supported by the results of the Canadian Collaborative Group on Endometriosis. In a study of 341 infertile patients with minimal and mild endometriosis who were randomized to laparoscopic ablation or expectant management, the authors found that laparoscopic ablation of minimal or mild endometriosis doubled the cumulative fecundity rate after a follow-up period of 36 weeks: 30.7% in the treatment group vs 17.7% in the no treatment group. A second Italian study could neither reject nor confirm this observation. The study included 101 infertile patients, but demonstrated no difference in fecundity rates after a follow-up period of 1 year. A recent review combining the results of these two randomized controlled trials into a meta-analysis showed that surgical treatment is more favorable than expectant management (OR for pregnancy = 1.7; 95% CI 1.1–2.5).26

In a recent meta-analysis of IVF outcome for patients with endometriosis, Barnhart et al recommended that patients with endometriosis of any stage should be referred for early aggressive infertility treatment, including IVF, to increase chances of conception. It remains an unfortunate fact that the diagnosis of endometriosis is still unduly delayed in many patients with infertility and pain.28

Timing the endoscopy-based investigation

The optimal approach in the management of female infertility requires that the timing and the method of the investigation are beneficial for the couple by avoiding both under- and overtreatment. Unfortunately, infertility is a disorder in which the diagnosis and, consequently, reliable treatments are frequently unduly and excessively delayed.

The duration of infertility, or the time to conception, has been used as a major parameter for timing routine exploration and starting treatment. It has been assumed that the longer the interval, the lower is the probability of conception, and therefore investigations should normally not start before 1 year of infertility. On the other hand, a prolonged duration of infertility without preliminary endoscopic pelvic investigation has also been proposed as an indication for the use of assisted reproductive technology (ART). Therefore, in current practice, a delayed diagnosis may paradoxically favor both under- and overconsumption of ART.

Recent prospective studies on fecundity have shown that human beings may be more fertile than has previously been estimated. In a recent debate Brosens et al proposed that in view of the availability of less-invasive and more-accurate diagnostic tools and effective treatments, our current approach in timing the exploration of female infertility needs to be revisited. The issue is no longer when an invasive and expensive procedure like a laparoscopy should be performed, but at which stage a comprehensive minimally invasive fertility investigation is performed to inform the couple who worries about the delay in pregnancy. More than ever, the timing needs to be individualized, depending on factors such as age, medical, menstrual and sexual history, previous experience with contraceptive methods, use of fertility awareness methods for conception, and other individual factors. With the progress in minimally invasive exploration, the decision of timing the fertility investigation depends similarly as for other medical disorders in the first instance not on an abstract duration in time, but on the rational demand of the woman who worries about the cause of the delay in conception.

In older couples, some have argued that laparoscopy can be omitted from the infertility work-up when the hysterosalpingography is normal and there is no abnormal contributing history, and, as a consequence, the cost of fertility treatment is reduced without compromising success rates. However, Balasch argued that in relatively older women an evaluation would find more diseases known to cause infertility, such as pelvic adhesions and endometriosis. Two studies aimed at determining infertility factors in women of advanced reproductive age concluded that there is no unique pattern of infertility diagnosis in such patients. This supports the view that the routine investigation of infertility should not differ based on the age of the patient. Postponing the investigation in these women can be regarded as undertreatment when the couple is affected by a disorder or a combination of disorders for which an effective treatment, such as surgery or ART, may exist.

Conclusion

Today, the exploration of the female reproductive system, which traditionally included as the first step hysterosalpingography and at a later stage transabdominal laparoscopy, can be achieved in one step by minimally invasive transvaginal endoscopy. The procedure includes mini-hys-
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patient acceptability, and cost–benefit analysis. Several of these
issues are discussed in detail in other chapters of this book.

The clinical implementation of a new diagnostic tool,
however, requires assessment of various aspects of the
technique, including feasibility, safety, diagnostic accuracy,
patient acceptability, and cost–benefit analysis. Several of these
issues are discussed in detail in other chapters of this book.
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1 Chapter 1. Rationale of transvaginal laparoscopy in infertility


12. Oshinsky GS, Smith AD. Laparoscopic needles and


Table 4.1 Successful evaluation of the pelvis

<table>
<thead>
<tr>
<th>Structure</th>
<th>Standard Transvaginal laparoscopy</th>
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<tr>
<td>Pouch of Douglas (%)</td>
<td>100</td>
</tr>
<tr>
<td>Posterior wall of the uterus</td>
<td>100</td>
</tr>
<tr>
<td>+ sacrouterine ligament (%)</td>
<td></td>
</tr>
<tr>
<td>Tubes (%)</td>
<td>100</td>
</tr>
<tr>
<td>Ovaries (%)</td>
<td>100</td>
</tr>
<tr>
<td>Ovarian fossa (%)</td>
<td>100</td>
</tr>
</tbody>
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5 Chapter 5. Risks and complications of transvaginal access to the peritoneal cavity


6 Chapter 6. Fertility-enhancing hysteroscopic surgery


Chapter 7. Bipolar resectoscope: the future perspective of hysteroscopic surgery


When a rectovaginal nodule is felt at clinical examination, this constitutes a major contraindication to perform a transvaginal endoscopy. Since one can never predict if and how the anterior wall of the rectum is involved in this process, the risk of bowel perforation at the insertion of the TVL needle is too high. Thus, deep rectovaginal endometriosis is one chapter of the disease where a TVL cannot be used.
Chapter 9. Role of transvaginal salpingoscopy


Chapter 10. Operative transvaginal laparoscopy

Table 10.1 Advantages and disadvantages of the vaginal approach in operative procedures

Advantages

• Direct access to Fallopian tubes, ovaries, fossa ovarica and posterior leaf of the broad ligament not requiring extra manipulation

• Watery distention medium keeps organs afloat and intestines at a distance

• Accurate identification of small superficial lesions

• Low morbidity

Disadvantages

• No panoramic view

• Limited to minor procedures

• Uncontrolled bleeding will blur the vision

• Contraindicated in acute situations (e.g. bleeding or infection)

• Still time consuming

• Training is mandatory


Chapter 11. Cost-effectiveness of office transvaginal laparoscopy


14. Mastrominas M, Pistofidis GA,


Table 11.6 Comparison of manpower and equipment for TVL, laparoscopy, and HSG TVL Laparoscopy HSG

<table>
<thead>
<tr>
<th></th>
<th>TVL</th>
<th>Laparoscopy</th>
<th>HSG</th>
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<tbody>
<tr>
<td>Nurse day care unit</td>
<td>No</td>
<td>Yes</td>
<td>No</td>
</tr>
<tr>
<td>Transport to and from theater</td>
<td>No</td>
<td>Yes</td>
<td>No</td>
</tr>
<tr>
<td>Anesthesiologist</td>
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<td>1</td>
<td>0</td>
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Assistant 0 1 0
Theater nurse (2) 0 2 0
Nurse recovery unit No Yes No
Assistant OPD 1 0 0
Gynecologist 1 1 1
Radiologist 0 0 1
Assistant radiologist 0 0 1
Procedure time 20 30 20 minutes minutes minutes
Duration stay in 30 >6 45 hospital minutes hours minutes
Hospital bed No Yes No
Equipment
Sterile covers Yes Yes No
Speculum, tenaculum Yes Yes Yes
Intrauterine balloon/ Yes Yes Yes catheter
Camera–light– Yes Yes No monitor unit
Radiology unit No No Yes
TVL, transvaginal laparoscopy; HSG, hysterosalpingography;
OPD, outpatient department.

