Laparoscopic tubal anastomosis and reversal of sterilization

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Introduction

At present, tubal sterilization is the most frequently used method of birth control worldwide. In the USA, for example, about 500,000 surgical procedures are performed annually (Hulka and Halme, 1988). This trend has been greatly assisted by the spread of laparoscopic techniques, since these are simple to use and present no medium-to-long term adverse effects. Despite all the precautions, a few treated women (3–5%) request tubal sterilization reversal (Siegler et al., 1985), especially when other determining factors are involved (Gomel, 1978), such as disintegration of couple relationships, young age at sterilization, or sterilizations conducted during a Caesarean section and immediately after delivery. However, medical care programmes are presently evolving toward minimal financial support or even no reimbursement whatsoever for this type of procedure (e.g. in the USA and Northern European countries); this will eventually make the procedure impossible to carry out widely. The current reference technique for reversal of tubal sterilization is microsurgery with end-to-end anastomosis, yielding 60–90% intrauterine pregnancy rates, depending on the report (Winston, 1977; Gomel, 1980; Owen, 1984; Hulka and Halme, 1988; Dubuisson et al., 1995), thus causing it to be preferred to the in-vitro fertilization–embryo transfer techniques, which are more costly and yield fewer positive outcomes (Istre et al., 1993; Dubuisson et al., 1995; Glock et al., 1996). Nevertheless, this microsurgical procedure is not devoid of morbidity risks. This situation therefore prompted us to look into novel laparoscopic surgical techniques, which might offer solutions both in terms of cost and reliability.

Materials and methods

Patients

Between January 1996 and December 1997, patients who required tubal anastomosis were offered laparoscopic microsurgical tubal anastomosis and all 16 of them accepted. All patients had systematic preoperative work-up, including body basal temperature records, oestradiol, day 3 follicle stimulating hormone (FSH), luteinizing hormone (LH), prolactin and testosterone plasma assays, hysterosalpingography, pelvic ultrasound and semen analysis. Other infertility work-up procedures were performed as indicated. Before the surgical procedure was performed, informed consent was obtained and agreement for Medicare requested.

In every case, tubal anastomosis was performed only if the remaining tubal length would have been a minimum of 4 cm long. In all, 27 tubal anastomoses were performed. The mean age of the patients was 35.5 years (range 25–42) and the average number of previous offspring was 2.75 (range 2–4). Subsequent fertility outcome was studied in 14 patients for a minimum follow-up period of 6 months. Two patients could not be included in determining pregnancy rate because of failed follow-up and were therefore regarded as failures.

Surgical procedure

Set-up

The patient, under general anaesthesia, was placed in Trendelenburg’s position with her left arm along her side, her thighs abducted and slightly flexed. After adequate pneumoperitoneum was achieved with CO2 gas, the abdomino-pelvic cavity was systematically explored and the adnexa was inspected, searching for any contraindication to the procedure (Gomel, 1980; Dubuisson et al., 1995). Three 5.5 mm trocars (Surgiport; USSC, Elancourt, France) were inserted supra-pubically; these were placed high, the two lateral ones being positioned outwardly with respect to the epigastic arteries, so as to allow for an approach to the Fallopian tube at right angles to its axis. During the procedure, fineatraumatic forceps and bipolar cautery were used for observance of microsurgery principles, with minimal trauma and careful haemostasis.

Stump preparation and end marking

This step was important because it is necessary to perform the suture in healthy tissues. When using Hulka clips, Li et al. (1996) showed...
that at a distance of 0.5 cm away from the ligated scar, numerous cilia of the epithelium were twisted and adhered, the shape of the epithelial cells was irregular, and many microvilli and cilia were even lost from the local epithelium (Li et al., 1996). The microvilli and cilia of the epithelium, however, were normal on the mucosa 1.0 cm from the ligated scar. This was therefore the best situation that we could hope to achieve. On the other hand, after electrocoagulation sterilization, Pomeroy technique (Kim et al., 1997) or Yoon rings (Rouzi et al., 1995), the significant tissue destruction caused by diffusion of the electrical energy or by the plastic device can ruin the effect of attempted reversal because of the large amount of excised tubal tissue required, which can be as much as 2 cm on each side.

The clip or the sterilized zone was caught in the jaw of the forceps, lifted up, and the section was performed with scissors perpendicular to the Fallopian tube, in such a way as to preserve the infratubal vascularization. Hysteroscopically guided backward catheterization of the proximal tubal stump and intubation of the prepared distal tubal stump were then carried out with a Teflon catheter (Cook, Charenton, France) of 1 mm in diameter.

**Suture**

The anastomosis consisted firstly of a single-stitch suture placed in the mesosalpinx, using Polysorb metric 1.5 (USSC, Elancourt, France) with intra-abdominal knot formation. This initial suture approximated both stumps and permitted the execution of tension-free anastomosis. Through the serosa three extramucosal stitches were performed in a triangular fashion with Polysorb metric 0.7 at the anterior and posterior sides and at the antemesial edge of the Fallopian tube. Those were left in situ and tied intracorporeally after the last stitch had been made. In this way, each stitch related adequately to the tubal lumen and provided for a perfect alignment of the tubal stumps. The catheter was then removed under visual control once the sutures had been tied up.

At the beginning of the study, the operation time for two tubes was as long as 3.5 h, but more recently the mean operation time has been shortened to ≈2 h.

The patient was discharged 48 h after the procedure. Hospitalization and surgery were billed through the hospital at a cost of US$1200–1800. Hysterographic follow-up checks were requested within 2 months after the operation.

Results

Our intention was to use our first cases to develop a surgical technique which would be further evaluated in a large series. With this technique, the overall pregnancy success rate was 31.2% (5/16). Within 6 months of surgery there were five pregnancies, including one ectopic and four ongoing pregnancies. Three have already delivered healthy offspring. The mean age when conception occurred was 33.4 years (range 27–37).

For five patients, there were associated infertility factors (Table I): sperm abnormalities (n = 3), tubal endometriosis (n = 1) and salpingitis (n = 1).

Out of 11 hysterographic checks carried out, patency was demonstrated in only four patients. On six occasions when one or both tubes were not patent, we performed a tubal cannulation with a coaxial catheter using a hysteroscope, and succeeded three times; however, the only pregnancy subsequently obtained was ectopic. The other attempts were made only a few months ago and results are not yet available. Table I summarizes the main data concerning these patients.

Discussion

Evolution of techniques and constant material improvements have allowed this type of surgical procedure to be performed by laparoscopy. The first intrauterine pregnancy to have been achieved was obtained after using biological glue and a catheter guide (Sedbon et al., 1989). Tulandi (1996) emphasized that in future, most procedures would be done by endoscopy, and laparotomy would be reserved only for selected cases. After tubal distal surgery, proximal tubal pathology can now be successfully investigated, following refinement of the microsurgical laparoscopic instruments and lens systems and cameras. In 1995, Koh published the first true microsurgical laparoscopic technique for tubal anastomosis and developed new microinstrumentation, which consisted of 2 mm graspers, needle holders and scissors (Koh, 1995). The pregnancy rate

<table>
<thead>
<tr>
<th>Patient no.</th>
<th>Age (years)</th>
<th>Sterilization technique</th>
<th>Associated infertility factors</th>
<th>Anastomosis</th>
<th>Control salpingogram</th>
<th>Secondary recanalization</th>
<th>Pregnancy</th>
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<tr>
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<td>Unilateral</td>
<td>Failed follow-up</td>
<td>Failed follow-up</td>
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<td>–</td>
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<td>–</td>
<td>–</td>
</tr>
<tr>
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<td>Unilateral</td>
<td>Unilateral patency</td>
<td>–</td>
<td>–</td>
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<tr>
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</tr>
<tr>
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<td>–</td>
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was 71% (22 out of 31 patients) and the ectopic pregnancy rate was 3.2% with a 12 month follow-up.

Since then, the feasibility of reversal of proximal tubal sterilization by the laparoscopic route has been demonstrated, and the literature records, to the best of our knowledge, ~100 successful pregnancies worldwide (Gauwerky, 1991; Istre et al., 1993; Reich et al., 1993; Katz and Donesky, 1994; Chyi-long et al., 1995; Frishman and Seifer, 1995; Koh, 1995; Yoon et al., 1997; Dubuisson and Chapron, 1998). The largest published series (Yoon et al., 1997) shows a pregnancy rate of 77% (38 pregnancies out of 49 patients) which compares favourably with the oldest series of microsurgery (Dubuisson et al., 1995). The anastomosis procedure was identical to the microsurgical tubal anastomosis technique by laparotomy, with suture of the muscle layer of the tube with four stitches including the mucosa followed by intermittent suture of the serosal layer. Since then, the second largest series (32 patients and 48 attempted tubal sterilization reversals) described by Dubuisson and Chapron (1998), used a single stitch suture at the antimesial edge after one approximating mid-Fallopian stitch. To date, the patency rate has been 87.5%, the overall intrauterine pregnancy rate has been 53.1% with an overall delivery rate of 40.6% and two ectopic pregnancies have been noted (6.25%). Apart from these series, results obtained have been poor.

For example, Reich et al. (1993) reported a series of 22 patients in whom anastomosis was achieved by means of two stitches placed at 6 and 12 o’clock respectively, with and without a catheter. They obtained a low score compared to microsurgery, with a 36% intrauterine pregnancy rate. Gauwerky and Klose (1991), working on a 12-case series achieved three intrauterine pregnancies (25%) with two ectopic pregnancies (16.7%) by combining biological glue with suture. With 16 cases and five pregnancies, our results are similar to the other studies, giving a crude pregnancy rate of 31%.

The problem set by laparoscopic proximal surgery is still the absolute necessity to obtain complete congruence of the two tubal stumps. It is therefore mandatory to have both lumina perfectly aligned and to have them fixed thus.

The use of a tubal guide, irrespective of the type, seems to us unavoidable. In fact, it enables confirmation of the permeability of the two stumps, improved visualization of the tubal mucosa and maintenance of the lumina in perfect alignment. Naturally, there is a risk of induced intraluminal trauma, but the benefit offered by this procedure seems to us to outweigh this potential disadvantage.

Fixing the position of the tubes can be achieved by different techniques. Stapling systems could simplify the operation and appear to be an easier way to reapproximate the tubal segment (Stadtmauer and Sauer, 1997). These workers reported six pregnancies in 6/14 (43%) patients within 6 months, and in the non-pregnant patient group, 11/16 tubes studied demonstrated salpingogram patency at 6 months. If these rates of success are confirmed by others, this technique, which avoids intraperitoneal stitches, could be handled by most endoscopic surgeons on an outpatient basis, thereby boosting laparoscopic techniques for proximal tubal surgery.

We excluded any use of biological glue due to the risk of obstructing the tubal lumen via intraluminal deposit formation, and we therefore prefer to perform intraperitoneal sutures.

Triangulation with ideally equidistant suture techniques provides good mount stability, as well as promoting effective healing. There has been indirect experimental evidence of the value of the suturing technique provided by Belker et al. (1991), who achieved reversal of epididymal closure; they showed that the number of successful results yielded by the three-stitch suturing technique is greater when compared to the single stitch method (Belker et al., 1991).

The first difficulty with laparoscopic proximal surgery is to handle the needle holder after introduction of the trocar into the abdominal wall; only this angle is available for suturing the tissues, and the position of the access determines the suture outcome. Many authors have listed numerous other difficulties of the technique, such as, for example, manipulation of the tubes with long laparoscopic instruments, visualization of the tubal lumens and tying intracorporeal knots. These difficulties undoubtedly have been the reason for the delay in conducting proximal tubal surgery trials, while surgery of the distal portion of the Fallopian tube has long been proven reliable. It is true that laparoscopic distal surgery is much easier to perform, probably because sutures are rarely needed and outcomes are better than after conventional microsurgery (Pouly et al., 1989; Tulandi and Guralnick, 1991).

However, it is well known that success increases as the learning curve is followed, and is also more likely if there is at least 4 cm of healthy tubal tissue remaining at the end of the procedure in women <40 years old, when the tubal sterilization was done with clips (Dubuisson et al., 1995; Glock et al., 1996; Kim et al., 1997; Yoon et al., 1997).

Under such conditions, which were not exactly the same as ours, it is likely that the success rates will equal those recorded after microsurgery and allow this new technique to be validated, with all its advantages (Gomel, 1995), including minimal access, short recovery time, dramatically reduced cost and finally improved quality of life.

We confirm here the feasibility of laparoscopic tubal sterilization reversal. It is now a matter of improving the outcome, not only through better laparoscopic techniques but also through careful screening for surgical indications.

References