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SHORT COMMUNICATION

Fertility outcomes of macroscopic tubal reanastomosis through mini-laparotomy: A retrospective case series study

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Abstract

Introduction: Tubal ligation reversal is a surgical option for restoring fertility, with outcomes influenced by technique, surgeon expertise, and patient factors.

Objective: This study evaluates the fertility outcomes of macroscopic tubal reanastomosis through mini-laparotomy.

Methods: This retrospective study analyzed medical records of women who had previously undergone tubal ligation either during cesarean sections or through laparoscopic electrocoagulation at a tertiary hospital in Türkiye between 2019 and 2022. The primary surgical approach involved a mini-laparotomy, and the anastomosis was performed macroscopically—without the use of an operating microscope—relying instead on direct visual inspection to access and reconnect the fallopian tubes. The suitability of the tubes for reanastomosis was assessed based on the length of the tubes, the presence of adhesion, and the condition of the fimbriae. Fertility outcomes, including live birth rates and time to conception, and surgical success rates, were measured.

Results: The data of 23 patients were retrospectively reviewed. The surgical success rate was 78.2% (unilateral or bilateral reanastomosis of the tubas), with a pregnancy rate of 43.5% and a live birth rate of 34.8%. The mean time to conception was 3.73 months.

Conclusion: Despite lower pregnancy rates compared with the broader literature, these outcomes are deemed acceptable, particularly for centers lacking facilities for more advanced surgical options. Therefore, macroscopic tubal reanastomosis through mini-laparotomy emerges as a feasible alternative for surgeons with limited experience in more intricate microsurgical techniques, providing a viable pathway to restoring fertility with reasonable success.

Keywords: Sterilization reversal; Laparotomy; Fallopian tube reanastomoses; Pregnancy rate

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1. Introduction

Female sterilization through bilateral tubal ligation (BTL) is a leading method of contraception worldwide, used by nearly 25% of women aged 15–44 years (approximately 200 million globally), with the prevalence in the United States for the same age group at

22%.[1,2] Despite its widespread use, BTL must be presented to patients as a permanent method during counseling. The potential for reversal is limited, as success is not guaranteed and depends on factors such as the original surgical technique and the patient's fertility status. Moreover, reversal procedures represent a significant financial barrier, as they are rarely covered by health insurance. Emphasizing these points before agreeing to this procedure is essential to ensure informed consent and minimize future regret.

Interestingly, 5–20% of women who underwent sterilization later regret their choice, and only 1–2% seek to have the procedure reversed.[3] Regret over sterilization often stems from changes in marital status, the death of a child, or shifts in personal perspectives. Key predictors of dissatisfaction with the decision to undergo sterilization include being young, having a new partner, experiencing the loss of a child, or the desire to have more children, with some individuals hoping to become pregnant again.[4] For women who have undergone tubal sterilization, there are two main options for achieving pregnancy: laparoscopic microsurgical reversal and *in vitro* fertilization (IVF) therapy. An American Society for Reproductive Medicine (ASRM) report emphasizes the importance of considering factors such as a woman's age, sperm quality, desire for children, the extent of tubal disease, and the surgeon's experience when treating tubal infertility. While there are not enough studies comparing pregnancy rates between laparoscopic microsurgical reversal and IVF therapy, IVF offers higher per-cycle pregnancy rates. On the other hand, tubal anastomosis for reversing tubal sterilization provides higher cumulative pregnancy rates compared to IVF, with microsurgical anastomosis being the recommended technique. Hence, both treatment options should be evaluated based on patient preferences and clinical factors.[5] Moon *et al.*[6] discussed the comparison of microsurgical tubal reanastomosis and IVF for fertility restoration after BTL. They highlighted that while IVF is commonly preferred for its higher per-cycle pregnancy rates, tubal reanastomosis could provide better cumulative outcomes in specific cases, such as younger women or those wanting multiple children. Despite the dominance of IVF, they suggested that tubal reanastomosis remains a cost-effective and viable option, especially if training for microsurgical techniques is enhanced. Their study advocated for recognizing tubal reanastomosis as a feasible alternative to IVF in modern fertility treatments.

Tubal reanastomosis surgery has seen various technological advances over the years. Initially performed through laparotomy by Garcia[7] in 1972, the procedure was later adapted to laparoscopic methods by Sedbon *et al.*[8] in 1989, and subsequently, robotic techniques were introduced by Falcone *et al.*[9] in 1998. The success rates of these surgeries, varying by the specific surgical method employed, have been reported to range between 57% and 84%.[10] This article aims to share our experiences and present the pregnancy rates of our patients who underwent macroscopic tubal reanastomosis with mini-laparotomy.

2. Materials and methods

This retrospective study reviewed 23 patients admitted to Konya City Hospital, University of Health Sciences between 2019 and 2022 who requested tubal reanastomosis, which was performed macroscopically through mini-laparotomy. This study was conducted in compliance with the Declaration of Helsinki. The data of the patients were obtained from patient files and computer records. Written and verbal consents are routinely obtained from all patients admitted to our hospital for use in scientific publications.

The inclusion criteria were women with prior tubal ligation, either through the Pomeroy technique during cesarean section or through laparoscopic electrocoagulation, who subsequently desired fertility restoration. All participants underwent comprehensive fertility assessments, including day-3 hormone analysis, baseline ultrasonography, and pelvic examination, to exclude other infertility factors. Normal semen analysis of male partners was mandatory to rule out male factor infertility. Surgical candidates were required to have macroscopically suitable fallopian tubes with adequate length (>4 cm), minimal adhesions, and healthy fimbriae, with no contraindications for mini-laparotomy, such as severe pelvic adhesions and significant comorbidities. Patients were excluded from the study for several reasons: male factor infertility (abnormal semen parameters); other infertility causes, including ovarian dysfunction (e.g., diminished reserve or polycystic ovary syndrome); uterine abnormalities (e.g., fibroids or adhesions); endometriosis; or pelvic inflammatory disease affecting tubal function. In addition, women with unfavorable tubal conditions, including hydrosalpinx and extensive adhesions preventing safe anastomosis, as well as those with medical contraindications to surgery (e.g., uncontrolled diabetes and cardiovascular disease), were not considered candidates. This study specifically focused on Pomeroy and laparoscopic electrocoagulation sterilization methods, excluding other techniques such as clips and rings. Live birth outcomes were the primary outcome, while the mean age of the patients, success rates of tubal reversal (patients with at least one open tube on hysterosalpingography [HSG]), and time to pregnancy were secondary outcomes.

In the Pomeroy technique, a segment of the fallopian tube is isolated and looped. A suture is then placed around

the base of the looped segment, and the encircled portion of the tube is excised. The ends of the tube are then left to heal separately, effectively preventing the passage of an oocyte from the ovaries to the uterus, thus inhibiting fertilization and pregnancy. On the other hand, laparoscopic tubal ligation is a minimally invasive procedure that involves accessing the fallopian tubes through small incisions in the abdomen. During the procedure, the fallopian tubes are cauterized to prevent oocytes released from the ovaries from reaching the uterus. This blockage effectively stops sperm from meeting oocytes, thereby preventing fertilization and subsequent pregnancy.

2.1. Surgical method

All patients were positioned in lithotomy, and the bladders were emptied using a urinary catheter. After administering either general or spinal anesthesia, the abdomens were accessed through a mini-laparotomy in accordance with surgical protocol. A surgical exploration of the abdomen was performed. Suitability of the tubes for reanastomosis, the length of the tubes, adhesions with surrounding tissues, the condition of the fimbriae, and the relationship between the tubes and ovaries were assessed.

Initially, the opposing ends of the ligated tubes were identified, and the fibrotic tissues were excised from both ends using scissors. An 18-gauge epidural catheter was advanced from the fimbrial end and inserted into the lumen of the opposite tube, which had been opened with scissors, and then pushed toward the uterus. The tubes were sutured using the single-layer, four-suture technique described by Berge *et al.*,[11] with 5-0 Prolene sutures aligning the serosal and muscular layers in a single layer. Subsequently, methylene blue dye was administered through a vaginal Rubin cannula to check for patency from the tubes into the abdominal cavity, while keeping the epidural catheter stationary. Following hemostasis, the abdomen was gently closed, and the ends of the epidural catheter were secured to the skin surface. The epidural catheter was completely removed after 48 h, and the patients were discharged 48 h later. They were recalled for an HSG test after 2 months. Patients whose at least one tube was found to be patent were considered part of the successful surgical group and were allowed to pursue spontaneous pregnancy processes.

2.2. Statistical analysis

All data analyses in this study were performed using SPSS version 26 (IBM Corp., US). The data were assessed for normal distribution using histograms, Kolmogorov–Smirnov, and Shapiro–Wilk tests. Normally distributed data were presented as mean ± standard deviation. Categorical data were analyzed using the Chi-squared or Fisher's exact test, and results were expressed as *n* (%). $p<0.05$ was considered statistically significant.

3. Results

The analysis of data from 23 patients revealed that the mean age was 33.8 ± 6.3 years. Of these patients, 18 patients (78.3%) underwent tubal ligation through the Pomeroy technique during cesarean section, while 5 patients (21.7%) had laparoscopic tubal ligation with electrocoagulation. The mean duration between sterilization and tubal reanastomosis was 70.43 ± 40.01 months. These patient characteristics are summarized in Table 1. Regarding surgical outcomes, tubal reversal was successful in 18 patients (78.3%), with 11 (47.8%) achieving bilateral reversal and 7 (30.4%) unilateral reversal. The overall pregnancy rate post-reversal was 43.5% (10 patients), with a live birth rate of 34.8% (8 patients). The average time to conception after the reversal procedure was 3.73 ± 5.29 months.

4. Discussion

In this study, where reanastomosis of the fallopian tubes was performed macroscopically through mini-laparotomy, 78.3% of patients had their bilateral or unilateral tubal patency, which were detectable on HSG, successfully opened (47.8% bilateral, 30.4% unilateral). Of the 23 patients, 10 (43.5%) achieved pregnancy, and 8 (34.8%) had live births.

Tubal reanastomosis can be performed using three different techniques: (i) microsurgical method, (ii) laparoscopic method, or (iii) robotic method. The laparoscopic method offers several benefits, including reduced post-operative pain and the need for pain relief, decreased hospitalization duration, faster recovery, and improved cosmetic outcomes.[6] Nevertheless, laparoscopic microsurgery requires a significant amount of time and faces certain technical challenges.[12] Similarly, robotic surgery, while highly costly, also extends the duration of the operation and elevates the risk of complications during the procedure.[13]

The 2021 ASRM Committee Opinion recommended microsurgical anastomosis as the preferred method for reversing tubal ligation.[5] Mini-laparotomy appears to have similar pregnancy rates to laparoscopy, ranging from 54% to 88% versus 31% to 85%, respectively.[4] A previous study compared pregnancy outcomes after tubal reanastomosis using laparotomic, laparoscopic, or robotic methods among women desiring pregnancy after tubal sterilization.[10] Although the percentage of pregnancy was lowest in the laparotomy group with 52.6%, there were no significant differences in pregnancy rates among the three surgical

Table 1. Patient characteristics

Parameters	Number (n=23)	
Age (years)	33.8±6.3	
Tubal ligation method (%)		
C/S (Pomeroy)	18 (78.3)	
L/S BTL	5 (21.7)	
Interval between sterilization and reversal (months)	70.43±40.01	
Successful reversal of tubes by HSG (%)		
Bilateral	11 (47.8)	
Unilateral	7 (30.4)	
No passing	5 (21.7)	
Overall pregnancy	10 (43.5)	
Tubal ligation method (%)		
C/S (Pomeroy)	7 (70)	p=0.401
L/S BTL	3 (30)	
Abortion (%)	2 (8.7)	
Live birth (%)	8 (34.8)	

Notes: Data of age and interval between sterilization and reversal are represented as mean±standard deviation; data of other parameters are expressed as *n* (%).
Abbreviations: C/S: Cesarean section; HSG: Hysterosalpingography; L/S BTL: Laparoscopic bilateral tubal ligation.

methods. The overall pregnancy rate in the current study was 43.5%, which was lower than the pregnancy rate in the laparotomy tubal reanastomosis group in the previous study. In addition, laparoscopic surgery may be preferred due to a shorter hospitalization duration. Nonetheless, a surgeon's preference and experience, as well as hospital conditions, are the prominent factors in choosing tubal reanastomosis methods.

Every surgical method for tubal reanastomosis has a generally acceptable success rate range. A 2017 systematic review of pooled data reported consistent pregnancy rates ranging from 42%, 68% to 65% for laparotomic macrosurgical, laparotomic microsurgical, laparoscopic microsurgical, and robotic technique, respectively.[14] Pregnancy outcomes after tubal reanastomosis, however, are influenced by more than just surgical technique. The mother's age is the primary determinant.[15] Data from over 14,000 individuals suggest that pregnancy rates are higher among younger women.[16] Specifically, the pregnancy rate for women under 30 was 76.3% (confidence interval: 53.0–99.5%), and it declined with age: 60.6% for women aged 30–35, 59.4% for women aged 36–39, and 52.4% for women aged 40 years and older. In the present study, the mean patient age was 33.8 ± 6.3 years, and the pregnancy rate was 43.5%, slightly lower than previously reported.

Previous studies have shown that tubal reanastomosis outcomes largely depend on several key factors. For example, younger women tend to have higher pregnancy rates.[17] Other favorable factors include shorter intervals since sterilization, longer post-operative oviduct lengths (>7 cm), and the site of anastomosis, with isthmus–isthmus connections proving most effective. In addition, another study suggests that the type of original sterilization method also plays a critical role—less invasive methods, such as clips or rings, are associated with higher reversal success rates than electrocautery.[13] A remaining tubal length of at least 4 cm after reversal is also associated with better pregnancy outcomes. Collectively, these factors are key determinants of fertility restoration success after tubal reversal.

At present, IVF is frequently selected as the initial treatment after tubal ligation. The primary factor in deciding between tubal reanastomosis and IVF is the likelihood of achieving pregnancy, as the ultimate aim is to conceive. Direct comparison of pregnancy outcomes is challenging because IVF pregnancy reports are either mandatory or standardized, unlike those for tubal reanastomosis. Thus, outcomes should be evaluated on an individual basis, considering additional factors, such as cost-effectiveness, ease of the procedure, potential complications, side effects, personal preference, coexisting infertility factors, and the availability of skilled surgeons. Only two studies have compared the pregnancy outcomes of tubal reanastomosis and IVF for women seeking conception after tubal ligation. Boeckxstaens *et al.*[18] reported live birth rates per patient of 59.5% for tubal reanastomosis and 52.0% for IVF, with no significant difference. A meta-analysis by van Seeters *et al.*[14] found that both pregnancy and live birth rates were generally higher in the tubal reanastomosis group than in the IVF group. In women over 40, one study found that although tubal reanastomosis historically showed higher pregnancy rates, IVF now achieves competitive success rates, is often more cost-effective, and carries lower procedural risks.[19] IVF also offers the advantage of embryo cryopreservation for future use, despite potential increases in obstetric complications and the risks associated with multiple pregnancies. The choice between IVF and tubal reanastomosis should consider the individual's fertility circumstances and preferences, with IVF generally recommended for its efficiency and safety in older women. On the other hand, the benefits of tubal reanastomosis include being a one-time, typically minimally invasive outpatient procedure, where patients can try to conceive monthly without additional interventions and potentially achieve multiple pregnancies.

While tubal reanastomosis offers a viable path to restoring natural fertility, the inherent risk of ectopic

pregnancy is a significant consideration that must not be overlooked during counseling. The literature reported varying rates for this complication, ranging from 2% to 7%. For example, Karayalcin *et al.*[20] observed an ectopic pregnancy rate of 3.7%, whereas Barac *et al.*[21] reported a higher incidence of 8.53%. This risk may also be influenced by surgical factors, with Barac *et al.*[21] noting a significantly higher incidence when anastomosis was performed closer to the fimbrial end of the tube. A notable limitation of the present study is the inability to track ectopic pregnancy rates. Due to the retrospective design, comprehensive follow-up on pregnancies that did not result in live births at our institution, including potential ectopic pregnancies, was unavailable. Therefore, although acknowledging this well-documented risk from the literature, the present study cannot contribute data on this complication, which should be considered a limitation.

This study has other limitations. First, the conclusion is based on a relatively small sample size of 23 patients, limiting the generalizability of the findings to a broader population. Second, being a retrospective study, the findings are subject to potential biases related to data collection and selection. Prospective studies are needed to confirm these results and allow for more controlled assessments of outcome variables. Third, without a comparison group, such as patients undergoing alternative surgical techniques or IVF, it is challenging to directly attribute observed outcomes solely to macroscopic tubal reanastomosis through mini-laparotomy. Finally, although the study focuses on mini-laparotomy, variations in surgical technique and surgeon experience were not controlled, which may have influenced the results.

5. Conclusion

Macroscopic tubal reanastomosis through mini-laparotomy was successful in 78.2% patients, with an overall post-reversal pregnancy rate of 43.5% and a mean time to achieve pregnancy of 3.73 ± 5.29 months. Although the pregnancy rate achieved in this study is lower than that reported in the literature, it is still considered acceptable. Therefore, this approach can be recommended as an alternative method for surgeons lacking extensive experience in laparoscopic microsurgery for tubal reanastomosis.

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Conflict of interest

The authors declare that there are no conflicts of interest.

Author contributions

Conceptualization: Dilay Gök Korucu, Şükran Doğru
Data curation: Dilay Gök Korucu
Methodology: Dilay Gök Korucu, Şükran Doğru
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Ethics approval and consent to participate

This study was conducted with the approval of the Konya City Hospital Local Committee (Date: 06.03.2025; number: 09-58). Patients provided verbal and written consent to participate in this study.

Consent for publication

Patients provided verbal and written consent for publication on registration into our hospital.

Availability of data

Data are available from the corresponding author on request.

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