

Fertility outcome analysis after modified laparoscopic microsurgical tubal anastomosis

Jihui Ai, Pei Zhang, Lei Jin, Yufeng Li, Jing Yue, Ding Ma (✉)^a, Hanwang Zhang (✉)^b

Department of Gynecology & Obstetrics, Tongji Hospital, Tongji Medical College, Huazhong University of Science and Technology, Wuhan 430030, China

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Abstract Modified laparoscopic microsurgical tubal anastomosis is an alternative for microsurgical anastomosis via laparotomy to reverse sterilization in women with renewed child wish. The current study aims to evaluate the fertility outcome after modified laparoscopic microsurgical tubal anastomosis. A retrospective study was performed. Fifty-eight women who underwent modified laparoscopic microsurgical tubal anastomosis were monitored to investigate the fertility outcome and characteristics of this new technology. Of the 58 patients, the cumulative pregnancy rate (PR) in the 42 patients with follow-up data was 23.8% (10/42), 57.1% (24/42), 66.7% (28/42), and 73.8% (31/42) within 6, 12, 24, and 36 months after surgery, respectively. The intrauterine PR was 69.0% (29/42). Two patients (4.8%) had ectopic pregnancies that occurred within 24 months of surgery; three cases ended in spontaneous abortion. The delivery rate was 83.9% (26/31). The length of operating time was 1.2 ± 0.3 h, with a range of 1.0–2.5 h (60–145 min), and the mean time was approximately 75 min. The blood loss was relatively small, between 10 and 50 ml with an average amount of 22 ml. Thus, the modified laparoscopic tubal anastomosis is a highly successful procedure and a viable alternative to open abdominal microsurgical approaches. Compared with the traditional laparoscopic tubal sterilization reversal, this modified approach has three advantages: (1) less invasive approach via a trocar reduction; (2) remodeling of tube is better performing tied together after 3–4 sutures; and (3) faster operating time.

Keywords modified laparoscopy; tubal anastomosis; microsurgery

Introduction

Tubal sterilization reversals have been receiving increasing demand [1]. This is largely due to the large number of tubal ligations performed on women at a young age; some patients regret their decision because of change of spouse or even a loss of a child. The objective of the modified surgery process is to reduce the difficulty of operation and the duration. A higher pregnancy rate (PR) is a common concern among doctors and patients. The transition of the surgical process from traditional laparotomy under the microscope re-pass to laparoscopic tubal anastomosis that reduces pelvic tissue interference and unnecessary damages, thereby significantly

reducing postoperative adhesion formations, is a great progress in the field of medicine.

The video monitoring system and surgical technique are recent advances in laparoscopic tubal anastomosis development that enable better surgery performance [2]. In recent years, the laparoscopic tubal anastomosis technology has been improved in many places. The modified laparoscopic microsurgical tubal anastomosis in the current study yields several important advantages, such as reduced hemorrhage and decreased difficulty during operation, faster laparoscopic microsurgery, and less postoperative discomfort and complications.

Fifty-eight cases of modified laparoscopic tubal anastomosis were performed between March 2000 and March 2010. The current study aims to analyze the fertility outcomes and characteristics of the modified laparoscopic tubal anastomosis technology.

Materials and methods

Patients

Fifty-eight patients underwent modified laparoscopic microsurgical tubal anastomosis in the Tongji Hospital, Affiliated Hospital of Tongji Medical College, Huazhong University of Science and Technology, during a ten-year period (March 2000–2010). The women were informed about the experimental nature of the modified laparoscopic anastomosis before the operation. The surgery was approved by the Ethical Committee of General Hospital, Hubei, China.

A complete evaluation of the fertility potential of each woman requesting modified tubal anastomosis was performed, including obstetric history, pelvic ultrasound, hysterosalpingogram, sex hormones (follicle stimulating, luteinizing, estradiol, prolactin, and thyroid hormones), and midluteal serum progesterone level in some cases. Normal semen analyses and ovulatory cycles were confirmed in all couples. Other infertility workup procedures were performed as indicated.

The mean (\pm SD) age of the patients was 33.23 ± 4.12 years (range: 27 to 44 years). The average length of time from tubal ligation to anastomosis was 8.15 years (range: 2 to 22 years) (Table 1). Subsequent fertility outcome was studied in 42 patients for a minimum of 6 months to three years' follow-up period. Sixteen patients failed to be followed up. The month of operative procedure was set as the starting point, and the month of pregnancy as the end point to calculate the interval from the operation to pregnancy. The gestational sac seen in the uterine cavity via ultrasonography confirmed the pregnancy.

Table 1 Clinical characteristics of the patients

Study period	March 2000 and March 2010
No. of cases	58
Age (year)	33.23 ± 4.12 (27–44)
Interval from sterilization to operation (year)	8.15 (2–22)

The surgical technique was consistently performed by one surgeon (Hanwang Zhang) over the ten-year period. Tubal anastomosis was performed bilaterally in all cases. The patients undergoing unilateral anastomosis were excluded from the current study. The results were analyzed based on the PRs and characteristics of the operation.

Operative procedure

Before the operative procedure, all patients underwent a systemic work-up, including chest roentgenogram,

electrocardiography, liver function test, and complete blood count. Each patient was placed under general anesthesia in the lithotomy position; an indwelling Foley catheter was placed and a uterine manipulator was inserted for uterine manipulation and chromopertubation. A 10-mm trocar was introduced in the subumbilical area after adequate pneumoperitoneum was achieved using CO₂ gas. A 30° laparoscope was inserted. The aforementioned procedure was similar in the previous and modified surgery.

In the previous surgery, one 5-mm trocar was placed at the left Lee-yellow, and two were positioned at areas of the right McBurney point and 3 cm above the pubic symphysis (Fig. 1A). A puncture point (the left Lee-yellow) was reduced based on the previous. One 5-mm trocar was placed at the fold line of the left abdominis rectus outer edge, and another on the intersection of abdominal wall fold line and the white line (Fig. 1B). This is to make the surgical procedure performed by one person easier.

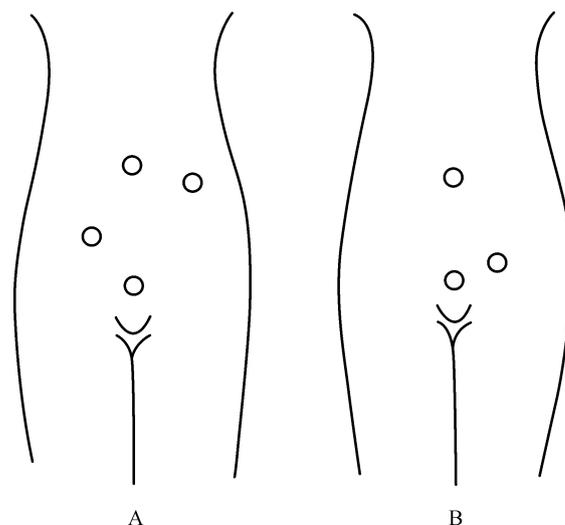


Fig. 1 Trocar site diagram. (A) The previous laparoscopy tubal anastomosis: one 5-mm trocar was placed at the left Lee-yellow, and two were positioned at areas of the right McBurney point and 3 cm above the pubic symphysis. (B) The modified laparoscopy tubal anastomosis: one puncture point was reduced (the left Lee-yellow) based on the previous. One 5-mm trocar was placed at the fold line of the left abdominis rectus outer edge, and another on the intersection of the abdominal wall fold line and white line.

The pelvic cavity was inspected, and then the mesosalpinx was infiltrated with diluted pitressin (1:50) in the previous surgery for hydrodissection and prevention of bleeding. However, the pitressin was diluted to 1:10 in the modified operation for better vascular constrictions, and injected into the tubal serosa to form a water pad using the ninth ordinary long needle or intravenous catheter. Resection of the scar tissue in the mesosalpinx was performed using a low-voltage

microneedle electrode or microscissors. However, the operators separated the serosa using a coarser needle in the previous surgery; it was difficult to puncture, and easy to pierce the mesangium and influence the separation effect.

Subsequently, the tubal serosa was freed. The serosa was cut, but the serous membrane was not removed. This is to preserve enough of the serosa, reduce the tortuosity of the postoperative tubal, and reserve the function of tubal patency and peristalsis better. After the tube was freed, the proximal stump was transected at the point of obstruction, and the tubal opening was identified via injection of indigocarmin dye. The occluded site of the distal tube was raised using forceps and cut perpendicularly, creating an appropriate diameter for the proximal tube. The patency of the distal tube was confirmed using dye passage through the transected end by the epidural catheter that had been placed into the fimbrial end. The verification process was identical to the previous.

The muscle layer of the tube in the current process was sutured with 5-0 Polydioxanone, whereas the previous with 7-0 Polydioxanone. It was introduced to the 5-mm tractor through the reducer using 3-mm forceps, and then placed into peritoneal cavity. First, the 6 o'clock site of the proximal segment was sutured deeply from the outer to inner direction including the mucosa, and then from the inner to outer direction, to ensure that the line ends out of the lumen. As the line has some hardness, after playing a slipknot, the suture line was not tightened, but formed a loop, the sutures tightened together after all slipknots done (Fig. 2B). This is to ensure that the two ends of the fallopian tube are still separated, making the other sites of the suture easier to operate. The previous surgery did not form a loop, but performed a surgical suture knot directly, making the present technique more efficient and convenient (Fig. 2A), and the tube two segments anastomosis better. The 2 and 10 o'clock sites in the tubal stump were sutured using the second followed by the third pin. The second pin performed a slipknot, and the third pin employed a surgical suture knot

directly. Knots 1, 2 were then tightened directly and cut off the excess line, making the muscular layer match each other. The muscle layer at the contralateral was sutured in the same manner. After suturing the muscle layer, the diluted indigocarmin was infused, and the dye spillage through the fimbriae was identified.

Therefore, the modified laparoscopic tubal anastomosis is convenient and efficient. The reduction of one puncture point makes the whole surgery doable by one person. In addition, a loop was formed first, in which the suture to slipknot is Lord and tighten last, making the process easier.

Results

Fifty-eight patients underwent modified laparoscopic sterilization reversal. All the patients had two operable tubes. The tubal sterilization was performed using two methods. Out of the 58 patients, 47 underwent the wrapping method and 11 used the twofold tubal ligation method. Sixteen patients were lost to follow-up. The cumulative PR in the 42 patients was 23.8% (10/42), 57.1% (24/42), 66.7% (28/42), and 73.8% (31/42), within 6, 12, 24, and 36 months after operation, respectively. Two patients (4.8%) had ectopic pregnancies that occurred within 12 and 24 months after operation; three cases ended in spontaneous abortion (7.14%, 3/42) (Table 2). The intrauterine PR, including births and miscarriages, was 69.0% (29/42). The delivery rate was 83.9% (26/31). The time of operation was 60–145 min, and the average time was approximately 75 min. The main time of pregnancy was within 24 months, especially concentrated in 12 months after the operation. No immediate or long-term postoperative complications were identified. The volume of bleeding was relatively small (10–50 ml), and the average amount was 22 ml.

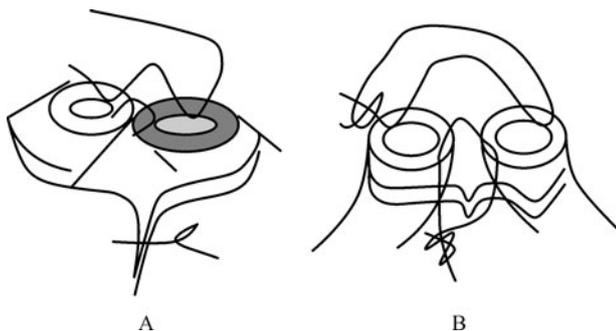


Fig. 2 Schematic diagram of the wall and serosa suture. (A) The previous laparoscopy tubal anastomosis: the suture line was tightened after the slipknot is done. (B) The modified laparoscopy tubal anastomosis: the suture line was tightened one after another after all the knots had been completed.

Table 2 Pregnancy outcome of the modified laparoscopic microsurgical tubal anastomosis

No. of operations	58
No. of follow-up patients ^a	42 ^b
Overall pregnancy rate (%)	73.8% (31/42)
Intrauterine pregnancy (%) ^c	69.0% (29/42)
Spontaneous abortion (%)	7.14% (3/42)
Ectopic pregnancy (%)	4.8% (2/42)
Delivery (%)	83.9% (26/31)
The pregnancy rate related to the time after operation	
6 months	23.8% (10/42)
12 months	57.1% (24/42)
24 months	66.7% (28/42)
36 months	73.8% (31/42)

a. The minimal follow-up period was 6 months.
b. Sixteen patients were unable to follow up.
c. Including births and miscarriages.

Discussion

Laparoscopy was initially introduced as a diagnostic tool and thereafter became a surgical tool for sterilization. The stimulus for changing the access route from laparotomy to laparoscopy results in reduced morbidity, costs, outpatient hospital stay, and early return to work [3]. The laparoscopic approach has several advantages over laparotomy, but it requires specific skills, such as hand-eye coordination while viewing the procedure on the video monitor and handling of delicate instruments in a restricted area [4]. Thus, the surgeon should have extensive experience with both classic microsurgery and laparoscopic techniques. In addition, the location of the surgeon, assistant, scrub nurse, and video monitor is important to facilitate the procedure. Not all surgeons have the required perceptual and fine motor skills to perform this procedure. Thus, these cases should be concentrated into the fewest hands possible because of the considerable practice required [4].

Based on the deficiency of previous surgery, the modified surgery demonstrates several improvements and advantages. The modified surgery reduces areas of air-exposed internal organs during the one puncture point reduction to decrease moisture loss, eliminate cell damage caused by tissue edema, and prevent postoperative adhesions. One person can complete the operation because of the reduced puncture, avoiding inconsistencies, and thereby making the surgery more convenient and smooth. The pitressin was injected into the tubal serosa to form water pad with the ninth ordinary long needle or intravenous catheter. The materials used can be obtained easily, and the procedure is fast. The tubal serosa was not excised during the process to maintain the maximal extension of the fallopian tube. The suture process was changed. The suture line was not tightened after performing the slipknot to make the subsequent sutures as easy as the first pin. The suture lines were tightened one after another after all the knots had been completed to ensure that the tubal serosa is in good cooperation and to avoid distortion of the tube. This step also shortens the operation time. Reducing the suture site decreases foreign bodies, but it does not affect the healing process of the fallopian tubes. Thus, the surgery relies on the self-healing and regeneration capacity of the tissue, which is more conducive to tubal function recovery.

The technology is modified; at the same time, we want to see the results. An increasing amount of studies on the fertility outcome of previous laparoscopic tubal anastomosis has been reported. The laparotomy microsurgical tubal reanastomosis following tubal sterilization has been performed for more than 30 years [5], with recently reported PRs 60%–91% [1]. Koh and Janik [6] reported a 71% PR during a follow-up of 12 months after the laparoscopic microsurgical tubal anastomosis. Dubuisson and Chapron [7] also reported a 53.1% PR after laparoscopic tubal reanastomosis using a single-suture technique. Yoon *et al.* [2, 4] reported two studies in 1997 and

1999 in which the overall PRs were 77.6% (38/49) and 84.9% (158/186). Schepens *et al.* [8] revealed in a retrospective cohort study on laparoscopic tubal anastomosis that the cumulative clinical PR in a 40-month follow-up period was 74%. Tan and Loh [9] also reported that the PRs with same surgery were 47.4% (< 6 months), 57.9% (6–12 months), 68.4% (12–48 months), and 73.7% (> 48 months). The findings in the current study (23.8%, 57.1%, 66.7%, and 73.8% at 6, 12, 24, and 36 months after operation, respectively) are consistent with studies published in other places. The current study has a relatively small population size, but has a satisfactory PR of 73.8%.

The mean operating time in a study conducted by Kaloo and Coopere [10] was 115 min (SD 28.3, range: 90–200 min) and it yielded a PR of 78.9% (15/19). Ribeiro *et al.* [11] reported operation time ranged from 95 to 155 min, and a PR of 56.5% (13/23). Both mentioned studies were performed using the previous laparoscopic tubal anastomosis procedure. No further results on the amount of blood loss were reported in these documents. With similar fertility outcome, a greater difference occurs in the operative time. In the present study, the average time required to complete the anastomosis of both tubes was 75 min (range: 60–145 min). The volume of blood loss was relatively small, and the average amount was 22 ml (between 10 and 50 ml).

In recent years, robotic tubal anastomosis has obtained encouraging progress, but its popularity is very difficult in some countries because of the costs and technology. Dharia Patel *et al.* [12] reported that the mean operative time for robotic anastomoses was 201 min (range: 140–263 min), which is significantly greater than the modified laparoscopic anastomosis. The mean time in the same study on robotic operation performed by Falcone *et al.* [13] was 159 ± 33.8 min, and the mean blood loss was 70 ml.

In summary, innovative equipment, multipurpose instruments, and improved surgical skills in the future would enhance the ability of the surgeon to perform laparoscopic microsurgical tubal anastomosis [2]. Tubal anastomosis via the modified laparoscopic approach has several advantages, including shorter operation time, less amount of blood loss, and a smaller incisional scar. The modified approach is especially beneficial for a patient who previously has undergone a laparotomy or cesarean section because it avoids a second laparotomy and reduces one puncture point. Meanwhile, the operation will be more convenient and fast for the surgeon. This technique could be an alternative procedure to patients requesting reversal of sterilization.

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