

Original Article

Robot-assisted tubal reanastomosis: Initial experience in a single institution

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Abstract

Objective: To assess surgical outcomes for robot-assisted tubal reanastomosis in a single institution.

Materials and Methods: Between March 2009 and January 2010, 10 patients underwent robot-assisted tubal ligation reversal (TLR) with a da Vinci S surgical system. Patient demographic data, including operative times, operative and postoperative complications, hospital stay, conversion to laparotomy and pregnancy rates were recorded.

Results: Mean age and body mass index for the patients were 37.7 (35–42) years and 28.9 (23.9–36.3) kg/m², respectively. The mean console time was 102.5 min and the mean total operation time was 130.6 (102–164) min. The mean hospital stay was 1.2 (1–2) days. There were no significant intra-operative or early-postoperative complications. All surgeries were completed robotically with no conversion to laparotomy. There were seven subsequent pregnancies in the study participants, representing a pregnancy rate of 70%, of which five were intrauterine pregnancies, one was an ectopic pregnancy, and one was an abortus.

Conclusion: Robot-assisted TLR is safe and feasible. This procedure may facilitate minimally invasive treatment for patients who want to regain their fertility without the aid of artificial reproductive techniques.

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Keywords: robotic tubal ligation reversal; tubal reanastomosis

Introduction

Worldwide, female sterilization is one of the most common contraceptive methods used by married women. As of June 2010, improved access to a wide range of highly effective reversible contraceptives caused a recent decline in tubal ligation procedures in the USA after two decades of stable rates [1]. Postpartum sterilizations remained stable and followed 8–9% of all live births. Tubal ligation reversal (TLR) involves microsurgery to repair the fallopian tube after a tubal ligation procedure. The procedure requires thin suture materials, the smallest possible incisions, and nontraumatic tissue-handling techniques. The laparoscopic approach has a steep learning

curve and involves limitations such as tremor amplification and two-dimensional vision. Laparoscopy requires advanced laparoscopic skills to maneuver rigid laparoscopic instruments that are fixed at the skin level by trocars, resulting in an overall reduction in the degrees of freedom for dissection and suturing compared with open surgery. Unfortunately, laparoscopic suturing is still a very difficult and time-consuming task. This can be overcome by robot-assisted surgery. Use of a remotely controlled robot can facilitate laparoscopic suturing by allowing the surgeon to be seated comfortably, by scaling the surgeon's movements by varying increments, by providing 3D visualization of the surgical field, and by filtering out unintentional tremors [2].

The first report on reanastomosis using the da Vinci surgical system was published by Deguelde et al [3]. Although the use of robotics seems to be well suited for TLR, there are few reports on tubal reanastomosis using this technique. In this paper, we report our first experience with robot-assisted TLR.

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Materials and methods

Between March 2009 and January 2010, the first 10 consecutive patients who underwent robot-assisted TLR performed by a single surgeon with the da Vinci S surgical system were enrolled in the study. All patients were appropriately counseled and written informed consent was obtained. The study protocol was approved by the Institutional Review Board. Evidence of normal ovulatory status and spermiogram parameters were documented preoperatively. The main outcome measures included first pregnancy success and live birth after surgery. All cases were followed up until the outcome of interest occurred or until the end of the study. Data on subsequent live births, ectopic pregnancies, miscarriages, operative times, and hospital stays were also recorded.

Setup time (ST) was defined as the time required for skin preparation, dressing, trocar incisions, CO₂ insufflation, port placement, exploration and additional procedures if needed (e.g., laparoscopic adhesiolysis), docking time and skin closure. Console time (CT) was defined as the total time on the console. Docking time was the time for fastening the robotic arms to the inserted trocars and introducing the robotic Endowrist instruments. Operation time was calculated as the sum of ST and CT. Operative time data for all patients who had undergone robot-assisted TLR were kept in the operating room and the duration of the operation was confirmed by video records.

All procedures were performed under general anesthesia with the patient placed in a low dorsolithotomy position. A 4-trocar transperitoneal approach was used for robotic surgery.

A Veress needle was used to establish pneumoperitoneum and the abdomen was insufflated with carbon dioxide to a pressure of 14 mm Hg. A 12-mm blunt-tip disposable trocar was introduced into the abdomen for the camera. The left robotic instrument port was inserted 10 cm lateral to the camera port at the midclavicular line and 2–3 cm below the umbilicus. The right robotic instrument port point was symmetrically contralateral to the left robotic port. A 5-mm trocar for assistance was positioned in the area between the camera and the left robotic arm port. The da Vinci S surgical system was docked at the foot of the bed and the entire procedure was performed from this single docking position. A zero-degree camera was used for the entire procedure. A VCare uterine manipulator (Conmed, Utica, NY, USA) was used or a pediatric Foley catheter was placed into the uterus and fixed with a curette to manipulate the uterus in a similar manner.

An initial survey of the abdominopelvic anatomy was performed and if necessary, laparoscopic adhesiolysis was performed before the docking procedure. After port placement, the patient was placed in a steep Trendelenburg position to aid visualization and bowel mobilization away from the surgical field. The da Vinci surgical system was then docked. The operative technique for robot-assisted TLR is shown in Fig. 1. The patency of the proximal tubal segment was checked via chromopertubation. The ligated segment of the tube was resected proximally and distally using scissors. After checking the proximal passage of methylene blue from the incised part of the tube, the distal patency was checked by irrigation from the fimbrial end of the tube. The mesosalpinx was reapproximated with one interrupted 7/0 polyglactin

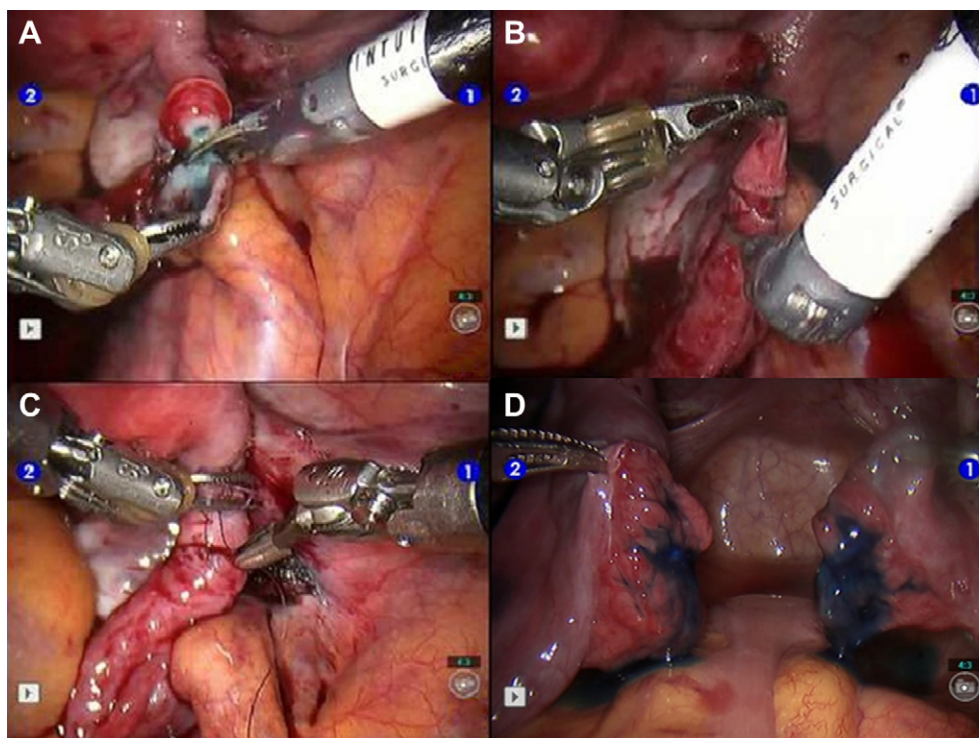


Fig. 1. The operative technique for robot-assisted tubal ligation reversal. Resection of the ligated segment of the tube (A) proximally and (B) distally. (C) Saturation of the submucosal and muscular layers of the tube for anastomosis. (D) Checking of tubal patency via chromopertubation.

suture. The submucosal and muscular layers of the tube were sutured with four or five interrupted 7/0 sutures. After checking the tubal patency via chromopertubation, the serosal part of the tube was also sutured. The same procedure was performed on the other fallopian tube.

Results

The mean age and body mass index for our patients were 37.7 (range 35–42) years and 28.9 (23.9–36.3) kg/m², respectively. Patient characteristics and outcomes for robot-assisted TLR are listed in Table 1. All of the patients had undergone postpartum tubal ligation during a cesarean section. During the procedure, the ST was 28.1 (20–35) min and the docking time was 2.6 (2–5) min. The time required for reanastomosis was similar for the right (46.1 min) and left tubes (40.8 min). The CT was 102.5 min and the total operation time was 130.6 (102–164) min. The mean hospital stay was 1.2 (1–2) days. There were no significant intraoperative or early-postoperative complications. All surgeries were completed robotically with no conversion to laparotomy.

All of the patients were followed for 18 months and all pregnancies occurred within the first year. There were seven pregnancies in the study, representing a pregnancy rate of 70% (defined as a qualitatively positive level of beta-human chorionic gonadotropin). Among the patients who underwent robotic TLR, five patients had confirmed intrauterine pregnancies (50%), one patient had ectopic pregnancy (10%) and one patient had an abortus (10%). Four patients delivered babies by cesarean section at a gestational age of 37 weeks without any complications.

Discussion

Female sterilization is a widely used contraceptive method, but post-sterilization regret occurs in a small group of women in some circumstances. A dilemma for these women is the choice between surgical reanastomosis and *in vitro* fertilization (IVF). IVF is expensive and time-consuming, and carries the risk of multiple gestation and drug side effects [4]. Considering the cost of IVF, a better choice may be reanastomosis. Traditionally, tubal reanastomosis has been performed microscopically via laparotomy. The laparoscopic approach yields high pregnancy rates comparable to those obtained after microsurgery by laparotomy and yields important advantages

such as less postoperative discomfort, fewer complications, no incisional scar, a shorter recovery time, and earlier resumption of normal activities [5]. Robotic surgery for TLR has been advocated to bridge the learning gap between an open approach and laparoscopy.

There are a few published data on robot-assisted surgery for TLR. The first complete robot-assisted TLR was performed in 1997 by Falcone et al [6]. Ten successful reanastomoses were performed with no complications. The mean operative time was 159 ± 33.8 min. Postoperative hysterosalpingography at 6 weeks after surgery demonstrated patency in 17 of the 19 (89%) tubes anastomosed. The same authors compared surgical results for robotic (*n* = 10) and laparoscopic (*n* = 15) approaches [2]. The mean operative time was 2 h longer with robotic assistance (*p* < 0.001). The increase in estimated blood loss for the robotic approach (70 ± 68 ml vs 20 ± 16 ml) was statistically but not clinically significant. Tubal patency and clinical pregnancy rates were not significantly different. They concluded that robotic assistance increases operative times for laparoscopic tubal anastomosis without an appreciable improvement in patient recovery or clinical outcomes. However, the system used in the study was a Zeus robotic system.

The first report of TLR using the da Vinci robotic system was published by Deguelde et al [3]. Eight patients underwent robotic TLR and tubal patency was confirmed. The mean operative time was 140 min and mean surgical time was 52 min per tube. After their feasibility study, the same group carried out a study of 28 patients who underwent robotic TLR with a mean operative time of 122 min [7]. Our mean times are comparable to the first study: the mean operative time was 130.6 (102–164) min and the CT for each tube was 46.1 and 40.8 min.

Rodgers et al compared tubal anastomosis using a robotic system (*n* = 26) with outpatient minilaparotomy (*n* = 41) [8]. Surgical times were 229 (205–252) min for the robotic technique and 181 (154–202) min for minilaparotomy (*p* = 0.001). Hospitalization times, pregnancy, and ectopic pregnancy rates were not significantly different. The robotic technique was more costly. The median difference in procedure costs was \$1446 (*p* < 0.001). Patel et al compared tubal reanastomosis using a robotic approach (*n* = 18) and laparotomy (*n* = 10) [9]. The mean operative time for the robotic technique was 201 min, which was statistically greater than for laparotomy. The hospital stay for the robotic and laparotomy techniques was 4 h and 34.7 h, respectively. During the 8.9-month follow-up period, the pregnancy rates were comparable between the groups (62.5% for robotic, 50% for laparotomy) and the cost per delivery was similar. The authors concluded that the robotic approach is feasible and cost effective.

A recent study by Caillet et al included 97 patients with available follow-up who underwent TLR [10]. The overall pregnancy and birth rates were 71%, and 62%, respectively. Some 91% of patients <35 years old became pregnant and 88% delivered at least once. This represents a satisfactory birth rate after tubal reanastomosis by robot-assisted laparoscopy in patients aged ≤ 40 years. The overall pregnancy rate in our study seems to be similar to that in the literature. However, our follow-up period after surgical intervention was

Table 1
Patient characteristics and outcomes for robot-assisted tubal reversal.

Parameter	Result (<i>n</i> = 10)
Age (y)	37.7 (35–42)
BMI (kg/m ²)	28.9 (23.9–36.3)
Set-up time (min)	28.1 (20–35)
Docking time (min)	2.6 (2–5)
Console time (min)	102.5 (67–139)
Operation time (min)	130.6 (102–164)
Anesthesia time (min)	145.3 (120–175)
Hospital stay (d)	1.2 (1–2)
Complications	—

short. We hope to achieve higher pregnancy rates during longer-term follow up.

Our study has a few limitations. First, it was carried out in a single center with a short follow-up period for patients undergoing robot-assisted TLR to determine the long-term outcomes of robotic technique. Most of the patients were from other cities and there were problems with follow-up. Information on patients living in other cities was collected only by telephone interview. Despite these limitations, this study represents the first robotic data on robotic TLR in Turkey.

Robotic surgical systems offer the surgeon the advantages of a minimally invasive option using a modality the traditional open surgeon can adopt with a demonstrated steep but short learning curve. Further randomized controlled trials are warranted to determine if robotic surgery truly offers a benefit over laparoscopy in terms of surgical and pregnancy outcomes after TLR.

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