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Robotic-Assisted Laparoscopy in Gynecological Surgery

Camran Nezhat, MD, Naghmeh S. Saberi, MD, Babac Shahmohamady, MD, Farr Nezhat, MD

ABSTRACT

Background: Laparoscopic surgery has revolutionized the concept of minimally invasive surgery for the last 3 decades. Robotic-assisted surgery is one of the latest innovations in the field of minimally invasive surgery. Already, many procedures have been performed in urology, cardiac surgery, and general surgery. In this article, we attempt to report our preliminary experience with robotic-assisted laparoscopy in a variety of gynecological surgeries. We sought to evaluate the role of robotic-assisted laparoscopy in gynecological surgeries.

Methods: The study was a case series of 15 patients who underwent various gynecologic surgeries for combined laparoscopic and robotic-assisted laparoscopic surgery. The da Vinci robot was used in each case at a tertiary referral center for laparoscopic gynecologic surgery. An umbilicus, suprapubic, and 2 lateral ports were inserted. These surgeries were performed both using laparoscopic and robotic-assisted laparoscopic techniques. The assembly and disassembly time to switch from laparoscopy to robotic-assisted surgery was measured. Subjective advantages and disadvantages of using robotic-assisted laparoscopy in gynecological surgeries were evaluated.

Results: Fifteen patients underwent a variety of gynecologic surgeries, such as myomectomies, treatment of endometriosis, total and supracervical hysterectomy, ovarian cystectomy, sacral colpopexy, and Moskowitz procedure. The assembly time to switch from laparoscopy to robotic-assisted surgery was 18.9 minutes (range, 14 to 27), and the disassembly time was 2.1 minutes (range, 1 to 3). Robotic-assisted laparoscopy acts as a bridge between laparoscopy and laparotomy but has the disadvantage of being costly and bulky.

Conclusion: Robotic-assisted laparoscopic surgeries have advantages in providing a 3-dimensional visualization of the operative field, decreasing fatigue and tension tremor of the surgeon, and added wrist motion for improved dexterity and greater surgical precision. The disadvantages include enormous cost and added operating time for assembly and disassembly and the bulkiness of the equipment.

Key Words: da Vinci robot, Robotic-assisted laparoscopy.

INTRODUCTION

Laparoscopic surgery has revolutionized the concept of minimally invasive surgery for the last 3 decades.[1] Since then, we have experienced development of new equipment, cameras, and energy sources that have enabled surgeons to perform more complex surgeries that were once only performed by laparotomies.[1] In the field of gynecology, almost all types of cases now can be performed through a laparoscope, depending on the skills and experience of the surgeon and the availability of proper instrumentation.[1]

Robotic-assisted surgery is one of the latest of the innovations in the field of minimally invasive surgery. Already, many procedures have been performed in urology, cardiac surgery, and general surgery. In 2004 in the United States, 10% of all radical prostatectomies were performed using robotic surgery.[2]

Robotic-assisted surgery has also been applied in gynecology. Falcone et al[3] described robotic-assisted laparoscopic tubal reanastomosis in 1999. Diaz-Arrastia[4] reported 11 patients undergoing laparoscopic hysterectomy using a computer-enhanced surgical robot. Advincula et al[5] reported on 31 patients who underwent robotic-assisted laparoscopic myomectomy. Robotic-assisted laparoscopic sacral colpopexy[6] and tubal ligation[7] have also been reported in the gynecology literature.

In this article, we attempt to report our preliminary expe-

Department of OB/GYN and Surgery, Stanford University Medical Center, Palo Alto, California, USA (Dr C. Nezhat).

Center for Special Minimally Invasive Surgery, Stanford University Medical Center, Palo Alto, California, USA (Drs Saberi, Shahmohamady).

Department of Gynecologic Oncology and Reproductive Medicine. Mount Sinai Medical Center. New York, New York, USA (Dr F. Nezhat).

Address reprint requests to: Camran Nezhat, MD, Clinical Professor of OB/GYN and Surgery, Stanford University Medical Center. 900 Welch Road, Suite 403. Palo Alto, California. 94304. Telephone: 650 327 8778. E-mail: nssaberi@ quimbus.com.

rience with robotic-assisted laparoscopy in a variety of gynecological surgeries.

METHODS

Fifteen patients undergoing different gynecologic laparoscopic surgeries consented to having both laparoscopic and robotic-assisted laparoscopic procedures. The investigation met internal review board approval at Stanford University. The da Vinci robotic surgical system (Intuitive Surgical, Sunnyvale, CA) was used in all the cases. Different gynecological surgical procedures were evaluated to provide us with a better understanding of the role of the robot in gynecological surgeries. **Table 1** summarizes the type and the number of procedures performed.

All patients were positioned in the dorsal lithotomy position in direct OR stirrups. A HUMI uterine manipulator and a Foley catheter were placed. Four trocar sites were inserted: a 12-mm intraumbilical, 2 lower lateral 5-mm, and a 12-mm suprapubic trocar. Each case was started by performing the surgery laparoscopically and then switching to robotic-assisted surgery. The 2 lateral trocars were subsequently exchanged for an 8-mm trocar when we were ready to use the robot. The suprapubic trocar was used by the assistant to provide ancillary laparoscopic instruments as needed by the surgeon. The two 8-mm trocars were mounted on the 2 operating arms of the robot. The patient-side surgical cart was placed in the middle, next to the patient's legs.

The laparoscopic equipment used for the laparoscopic portion of the procedure included a Harmonic scalpel, Ligasure, CO_2 laser, and Kleppinger bipolar system. The instruments used for the robotic portion of the procedure included a needle holder, PreCise bipolar, and scissors.

The time taken between switching from laparoscopy to robot was measured as assembly time. This included moving the already draped robot, switching the 5-mm to 8-mm trocar, changing the camera and attaching the chosen surgical instrument where the surgeon was ready to operate at the console. The disassembly time was defined as the time it took to switch from the robot back to laparoscopy to close the trocar sites. This included removing the robotic surgical instruments, moving the robot away from the patient, changing the camera and interchanging equipment to laparoscopy equipment so that the surgeon was ready to perform laparoscopy, finish the case, and close the trocar sites.

RESULTS

The average assembly time was 18.9 minutes **(Table 2)**, and the average disassembly time was 2.1 minutes **(Table 3)**. In our facility, the robot is draped before start time, which takes an average of 10 minutes.

As can be seen in **Table 4**, fifteen patients underwent various gynecological procedures. In each case, more than 1 procedure was performed. Robotic-assisted laparoscopy was used for resection of endometriotic lesion, lysis of adhesions, enterocele repair, ovarian cystectomy, and suturing for a variety of procedures like myomectomy, attaching mesh for sacral colpopexy, and repairing the ovary after cystectomy.

We noticed that having the 7-degrees of freedom enabled the operator to handle tissue and perform the procedure more easily. This definitely proved to be an added benefit during the suturing aspects of surgery. It was easier to manipulate the needle holder, as well as drive the needle through the tissue. Also, we noted the learning curve for suturing was less steep than that for laparoscopy, which could allow a less-skilled laparoscopist to perform suturing. The 3D visual image provided by the robot also provided a better view of the operative field and thus

Table 1.
Main surgical procedure

N	Main procedure
5	Myomectomy
1	Sacral colpopexy
6	Treatment of endometriosis
1	Total laparoscopic hysterectomy
2	Supracervical hysterectomy

Table 2.
Assembly time

N	Assembly time (Minutes)
3	20
3	15
3	18
1	19
1	17
1	14
1	27
1	22
1	25
N = 15	Average = 18.9

Table 3.
Disassembly time

N	Disassembly time (Minutes)
12	2
1	1
2	3
Total 15	Average = 2.1

Table 4.
Robot use in procedure

Procedure	N	Main procedure
Sacral Colpopexy (suturing mesh)	1	1 in sacral colpopexy patient
Myomectomy (suturing)	6	5 in myomectomy patient
		1 in endometriosis patient
Treatment of endometriosis	2	2 in endometriosis patient
Lysis of Adhesion	2	2 in endometriosis
Cervical stump (suturing)	2	2 in supracervical hysterectomy patient
Ovarian cystectomy and suturing	1	1 in endometriosis patient
Vaginal cuff suturing and uterosacral placation	1	1 in Total Laparoscopic Hysterectomy patient
Moskowitz	2	1 in Total laparoscopic hysterectomy patient
		1 in Supracervical hysterectomy patient

allowed the surgeon to perform surgery with better clarity and accuracy.

No conversion to laparotomy was necessary in any of these cases. No postoperative complications occurred, including blood transfusion, infection, ileus, or readmission to the hospital. During the laparoscopic portion of the procedure, we noted a much easier exchange of instruments through the trocar compared with the robotic portion of the procedure. There was less of a need for a surgical assistant during surgery. On the other hand, because of the bulkiness of the robot, it was hard to move the equipment to manipulate the uterus or even to provide ancillary laparoscopic instruments through the suprapubic trocar such as irrigation and sutures.

DICUSSION

In this study, we had the opportunity to evaluate various gynecological procedures and the role of robotic-assisted laparoscopy. We noticed improved dexterity, coordination, and visualization with robotic-assisted laparoscopy. However, the disadvantages included, the cost, bulkiness, and availability of the robot in different hospitals. With the cost of the equipment being as high as 1.4 million dollars, the annual maintenance fees, and the cost of semi-disposal instruments (limited use instruments) the return on investment is challenging to achieve. Additional costs include the extra OR time needed to assemble, disassemble, and prepare for the robotic portion of the surgery. As with any new device, it also requires additional training of the OR personnel. Also, these instruments have no haptics. The bulkiness of the robot during use and the space requirement in the operating room may require using a larger OR room. Finally, it was awkward for the assistant to work around the robot to interchange equipment, manipulate the uterus, and exchange instruments in the accessory ports. In a standard laparoscopy, it is much easier and faster to exchange instruments.

On the other hand, the disassembly of the robotic arm and pushing the robot out of the way required much shorter time. This is especially important in an emergency situation that needs to immediately be converted to a laparotomy.

Methodologic weaknesses include a small sample size and the diversity of cases performed.

CONCLUSION

Robotic-assisted laparoscopy is new to the field of surgery. Since its introduction, surgeons have been intrigued by it, and each discipline is trying to find its appropriate role. It appears to assist the less-skilled laparoscopist in performing surgery that one might have not attempted. It might be the answer to the shortcomings of laparoscopy being adopted by more surgeons. Robotic-assisted laparoscopy simply acts as a bridge between laparotomy and advanced operative laparoscopy. It provides 3D vision and easier suture capability without tremor. Its disadvantages are the enormous cost, bulkiness, added time to assemble, and a new learning curve.

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