Original Article

Robotic-assisted laparoscopic complex myomectomy: A single medical center's experience

Hsin-Yi Cheng a, b, Yi-Jen Chen a, b, *, Peng-Hui Wang a, b, Hsiao-Wen Tsai a, b, Yen-Hou Chang a, b, Nae-Fang Twua, b, Chi-Mou Juanga, b, Huahsi Wua, b, Ming-Shyen Yena, b, Kuan-Chong Chaoa, b

a Department of Obstetrics and Gynecology, Taipei Veterans General Hospital, Taipei, Taiwan
b School of Medicine, National Yang-Ming University, Taipei, Taiwan

ARTICLE INFO

Article history:
Accepted 14 September 2012

Keywords:
complex myomectomy
laparoscopic myomectomy
robotic myomectomy

ABSTRACT

Objective: Conventional laparoscopic myomectomy (LM) has inherent limitations due to its rigid structure. The robotic system is a newly developed technology equipped with a flexible EndoWrist that offers good performance in delicate motions. Our objective was to share our clinical experience in the management of complex myomectomy using this robotic system.

Materials and methods: From October 2010 to March 2012, 21 patients with symptomatic complex uterine myomas were evaluated. Complex myomectomy was defined as surgery involving more than two fibroids, large fibroids, or preexisting pelvic adhesions. We recorded and analyzed the preoperative characteristics of the patients and the fibroids, the detailed surgical time, and several postoperative outcomes to evaluate the feasibility and efficacy of robotic-assisted LM (RALM) for complex fibroids.

Results: A total of 21 patients were enrolled in this study. The mean age of the patients was 40.1 ± 4.5 years and the mean size of the largest fibroid was 7.3 ± 3.5 cm. RALM achieved satisfactory results, including a short postoperative hospital stay (3.1 ± 0.9 days), a low conversion rate (none of our patients required conversion to either a minilaparotomy or conventional open surgery), and a low complication rate (1 case in 21 patients, 4.8%). The average estimated blood loss was 235.7 ± 283.3 mL.

Conclusion: Our study results demonstrated that RALM is a safe and effective method for handling complex fibroids.

Introduction

Laparoscopic surgery has been embraced by gynecologic surgeons for decades. Compared with laparotomy, laparoscopic surgery usually has the advantages of shorter hospitalization, faster recovery, less morbidity, and better cosmetic outcome [1,2]. In recent years, the increasing demand for myomectomy has reflected the desire for expanded fertility associated with the prevalence of delayed marriage and childbearing [3]. As a consequence, the use of laparoscopic myomectomy (LM) has been expanding because it provides a good alternative therapy to laparotomy [4]. However, LM is technically more difficult than abdominal myomectomy, especially in surgeries involving more than two fibroids, large fibroids, and pelvic adhesions. This is attributed to some technical limitations associated with using such a rigid instrument, including difficulties in identifying an appropriate pseudocapsule plane and performing a strong and layered closure for the uterine incisions [5].

Robotic surgical systems are expected to provide a solution to overcome these shortcomings [6,7]. The da Vinci robotic surgical system was developed for laparoscopic surgery in 2000 and approved by the U.S. Food and Drug Administration in 2005 for use in gynecologic surgery. With advanced EndoWrist technology, robotic systems offer surgeons natural dexterity and the wide-angled motion of joints, such as those in the human hand and wrist [8]. Using a three-dimensional, high-definition visual system offers a
better operative field of view. Based on the aforementioned advantages, robotic technology appears to overcome the limitations inherent in traditional laparoscopy and promote the endoscopic surgical performance of myomectomy [9], especially in cases with complicated conditions such as large myomas, multiple myomas, or pelvic adhesions formed between the uterus and adjacent tissues and organs.

In October 2010, we began assessing robotic-assisted LM (RALM) in a prospective setup. This study describes our clinical experience in managing complex myomectomies in 21 consecutive patients, focusing on the feasibility and potential advantages as well as the pitfalls and challenges of using RALM.

Materials and methods

From October 2010 to March 2012, 37 patients underwent robotic-assisted surgery at a tertiary medical center in northern Taiwan. Of these, 22 patients were diagnosed with symptomatic complex uterine myomas and underwent RALM surgery. Complex myomectomy was defined as surgery involving more than two fibroids, large fibroids (diameter >8 cm), or preexisting pelvic adhesions. All patients were operated on consecutively using the da Vinci Si robotic surgical system (Intuitive Surgical Inc., Sunnyvale, CA, USA) at our institution. Preoperative characteristics and post-operative data of the 22 patients were screened. One patient received not only a myomectomy but also a bilateral salpingectomy and adhesiolysis for severe pelvic adhesion and was therefore excluded from the study. All surgical procedures were performed by a single surgeon, according to the procedure described in the following section.

Under general anesthesia, the patients were placed in the Trendelenburg position, with a urinary catheter and uterine manipulator (Kronner Medical Mfg., Roseburg, Oregon, United States) placed before the surgery. After pneumoperitoneum was created by CO2 insufflation pressure using a transumbilical Veress needle, five bladeless trocars were placed in the patient’s abdomen as follows: one 12-mm central port, three 8-mm ports for the robotic arms, and with one additional 12-mm port for the assistant (Fig. 1). Following the docking of the robotic arms, the three-dimensional zero-degree stereoscopic endoscope and EndoWrist instruments were then inserted into the robotic ports, including monopolar scissors, PK forceps, and a large/mega needle driver (Intuitive Surgical Inc.). Then, the surgeon moved to the console to control the robot remotely. Vasoressin (30 μL/mL diluted in 90 mL saline solution) was injected at various points on the dome of the uterus and at the region of attachment of the uterus to the myoma.

After enucleation of the myomas, the myometrial edges were sutured with interrupted intracorporeal knots (Polysorb 0). The left lower quadrant port was then converted into the insertion site of the morcellator (Karl Storz, Tuttinglen, Baden-Württemberg, Germany). The morcellation and extraction of the excised myomas were executed using the traditional laparoscopic method after disassembling the robotic system. Finally, a closed wound vacuum reservoir was inserted and placed in the cul-de-sac. All trocars were removed under direct visualization. Adequate suturing was performed to approximate the fascia and subcutaneous tissues.

The preoperative characteristics that may have an influence on surgical outcomes were age, body mass index history of abdominal surgery, and identities of the myomas (Table 1). The important time intervals were the following: (1) docking time, defined as the time spent attaching the robotic camera and arms to the previously placed trocar sites; (2) console time, defined as the time spent operating at the robotic console, including enucleation time and suture time; 3) morcellation time, defined as the time spent retrieving the specimen by morcellation and the laparoscopic grasper; (4) total operative time, defined as the time from skin incision to skin closure; and (5) total anesthesia time, defined as the time from intubation to awakening (Table 2). The outcome measures were estimated blood loss, transfusion rates, conversion rate, complications rate, and the duration of the postoperative hospital stay (Table 3).

Statistical analysis

In our study, mean and standard deviation were used to describe normal distribution, and the median and interquartile range were used for nonnormal distribution. The mean docking time in different time frames was compared using independent sample t tests. All statistical analyses were performed using SPSS statistical software version 19.0 for Windows (SPSS, Inc., Chicago, IL, USA). A p value <0.05 was considered statistically significant.

Table 1

<table>
<thead>
<tr>
<th>Patient and fibroid characteristics.</th>
<th>Value (minimum–maximum)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Age (y)</td>
<td>40.1 ± 4.5</td>
</tr>
<tr>
<td>Body mass index (kg/m²)</td>
<td>24.1 ± 4.4</td>
</tr>
<tr>
<td>History of abdominal surgery</td>
<td>4 (19.0%)</td>
</tr>
<tr>
<td>Adhesion lysis</td>
<td>3 (14.3%)</td>
</tr>
<tr>
<td>Fibroids</td>
<td></td>
</tr>
<tr>
<td>Numbera</td>
<td>3.1 (1.0–17.0)</td>
</tr>
<tr>
<td>Size of largest (cmb)</td>
<td>7.3 ± 3.5 (2.0–17.9)</td>
</tr>
<tr>
<td>Weight (g)</td>
<td>367.4 ± 317.7 (10–1070)</td>
</tr>
<tr>
<td>Location within uterus, n (%)</td>
<td></td>
</tr>
<tr>
<td>Anterior</td>
<td>17 (81.0%)</td>
</tr>
<tr>
<td>Posterior</td>
<td>9 (42.9%)</td>
</tr>
<tr>
<td>Fundal</td>
<td>10 (47.6%)</td>
</tr>
<tr>
<td>Broad ligament</td>
<td>0</td>
</tr>
</tbody>
</table>

a Value is expressed as the mean (minimum–maximum).
b Data are shown as the mean ± standard deviation (minimum–maximum).
All data are shown as the mean ± standard deviation (minimum—maximum).

### Table 2
Robotic surgical details.

<table>
<thead>
<tr>
<th>Outcome</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Docking time (min)</td>
<td>20.8 ± 9.9 (7–40)</td>
</tr>
<tr>
<td>Enucleation time (min)</td>
<td>72.8 ± 53.8 (5–233)</td>
</tr>
<tr>
<td>Suture time (min)</td>
<td>69.6 ± 23.8 (20–110)</td>
</tr>
<tr>
<td>Console time (min)</td>
<td>142.4 ± 63.8 (42–283)</td>
</tr>
<tr>
<td>Morcellation time (min)</td>
<td>71.8 ± 28.0 (20–137)</td>
</tr>
<tr>
<td>Total operative time (skin to skin) (min)</td>
<td>278.6 ± 67.0 (110–415)</td>
</tr>
<tr>
<td>Total anesthesia time (min)</td>
<td>323.8 ± 64.9 (180–460)</td>
</tr>
</tbody>
</table>

### Table 3
Surgical outcomes.

<table>
<thead>
<tr>
<th>Outcome</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Estimated blood loss (mL)</td>
<td>235.7 ± 283.3</td>
</tr>
<tr>
<td>Transfusion rates, n (%)</td>
<td>5 (23.8%)</td>
</tr>
<tr>
<td>Postoperative hospital stay (d)</td>
<td>3.1 ± 0.9</td>
</tr>
<tr>
<td>Conversion rate, n (%)</td>
<td>0</td>
</tr>
<tr>
<td>Complications rate (%)</td>
<td>1 (4.8%)</td>
</tr>
</tbody>
</table>

Results

Between October 2010 and March 2012, 21 consecutive RALMs were performed at our institution. The average age of the 21 women in this study was 40.1 years (range, 32–48 years), and their mean body mass index was 24.1 kg/m² (range, 18.4–35.16 kg/m²).

The maximum fibroid size was 17.9 cm and the maximum fibroid number in a single patient was 17. The mean total operative time was 278.57 minutes (range, 110–415 minutes). The mean intraoperative blood loss was 235.7 ± 283.3 mL. Five patients (23.8%) received a blood transfusion after surgery. The mean postoperative hospitalization time was 3.1 ± 0.9 days. No patient required conversion to either a minilaparotomy or conventional open surgery. The postoperative course was unremarkable in all patients, and the passage of flatus was on schedule. There was no morbidity directly related to the robotic system. Only one patient presented with a wound complication of focal erythema and slight tenderness during outpatient clinical follow-up. She received oral antibiotic treatment for mild wound cellulitis.

Discussion

Our study offers evidence that robotic-assisted laparoscopy provides surgeons with the capability to handle complex myomectomies and extends the capabilities of minimally invasive surgery to include larger fibroid size, greater fibroid numbers, and more complicated intra-abdominal conditions. In fact, the robotic-assisted surgical system is an emerging technology with a wide application in various surgical fields. Its superiority in intuitive manipulation and its real stereopicture have allowed it to become quickly adopted worldwide [10]. The robotic surgery system has the same advantages as laparoscopic surgery, including less morbidity, less pain, and reduced postoperative adhesion formation [11]. It has significantly improved the operative performance of myomectomy in providing delicate dissection and a stronger suture [12]. It is not difficult for skilled endoscopic surgeons to cross the threshold as long as they are familiar with the robotic operating arms. Other minor constituents of the learning curve may be related to accommodating the three-dimensional vision and interaction between the console surgeon and team members at the operating table. However, the lack of tactile sensation and force feedback is the Achilles heel of the robotic surgical system and may lead to invisible tissue damage during the surgery [13]. This drawback can be compensated for by the visual information and accumulated experience of the surgeons and can ultimately facilitate the surgery.

In this study, we have presented our surgical experience from preoperative information to intraoperative data and postoperative outcomes. In accordance with recent studies [14,15], we have shown that robotic-assisted surgery can provide an efficacious outcome for patients undergoing myomectomy, especially with regard to the low morbidity rate and short hospital stay (3.1 ± 0.9 days). The robotic technique has been demonstrated to promote surgical performance, particularly for quick and precise suturing of uterine incisions. This meticulous and strong closure improves hemostasis and reduces blood loss, successfully overcoming the adversity formerly encountered in LM [16,17]. There is indeed some evidence supporting the claim that robotic-assisted surgery is associated with a low incidence of blood transfusion [18]. The results of our series seemed to show less operative blood loss than that of other LM experiences in previous studies [19]. Five patients in our study received a blood transfusion postoperatively. Three of these patients had an imperative indication for transfusion due to greater blood loss during surgery (>500 mL). The maximal size of the fibroids in these patients was 14.0 cm, 13.7 cm, and 6.5 cm, respectively, and the total number of fibroids was one, three, and three, respectively. The other two patients received a blood transfusion mainly due to menorrhagia-induced chronic anemia that existed before the surgery. Nevertheless, the lack of a comparison group of LM patients limited our ability to definitely state the potential advantages of RALM in hemostasis and reducing intraoperative blood loss in comparison with laparoscopic surgery.

With the exception of one case that presented with postoperative infection, there was no obvious morbidity or complication specifically related to the robotic access. Moreover, none of the patients in our study required conversion to either a minilaparotomy or conventional open surgery, and this emphasizes the safety and effectiveness of the robotic surgical system in dealing with complex uterine fibroids. Overall, postoperative hospitalization was relatively short and there were no extreme cases. Rapid recovery after robotic surgery was the main reason for the short hospital stay, and no conversion to laparotomy was also an indirect cause. As we have clearly observed, a dedicated operating room equipped with a robotic surgery system and a proficient team can speed up each step of the surgery. Our mean docking time was 27.1 minutes in the first 6 months, and with growing experience, the setup time was reduced to 15 minutes in the following 12 months (p < 0.05).

However, some reported evidence has shown that RALM is not more beneficial than LM with respect to short-term outcomes [19,20]. In addition, robotic-assisted laparoscopic surgery is far more costly than laparoscopy or laparotomy; therefore, its cost effectiveness is not well established [21]. However, there may still be some long-term potential advantages of RALM, which should be investigated with more clinical cases and long-term follow up. The unique level of precision in RALM could help to achieve complete tissue excision and decrease the chances of a possible uterine rupture or tearing during future pregnancies. Furthermore, RALM enables the surgeon to address complex conditions such as large adenomyomas, severe pelvic adhesion, bleeding, or urinary tract injury [22,23]. Therefore, conversion to an open abdominal excision is less likely, even in difficult situations. Women of reproductive age are usually concerned about the cosmetic effect, reproductive outcome, and future recurrence after myomectomy surgery. RALM appears to meet these requirements better than LM. However, more prospective trials are needed in these areas of interest.

An additional value of robotic assistance is that it may be used for complex diseases that require more delicate maneuvering (e.g., tubal anastomosis, surgery, severe adhesion, and oncologic surgery) [24]. The robotic surgical technique offers gynecologic surgeons a platform for executing complex procedures with less morbidity, and perhaps, with improved surgical outcomes.
In conclusion, our data clearly support the safety and feasibility of the robotic technique in complex myomectomy surgery. The analysis showed satisfactory surgical outcomes in terms of a low morbidity rate, low conversion rate, and short hospitalization time. However, the published data are preliminary results, and a long-term follow-up study is required to completely appreciate the contribution and impact of RALM.

Conflicts of interest

The authors declare no conflicts of interest.

Acknowledgments

This work was supported in part by the National Science Council (NSC 101–2314-B-075-MY3 and NSC-102–2314-B-010-032), Taipei Veterans General Hospital (VGH-102-EA-009, V103C-040, V103E4-003, and VGH-103EA-20).

References