Case Report


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ABSTRACT

The benefits of laparoscopic surgery over open abdominal surgery have been well documented. Efforts continue for development of strategies that further reduce the size of abdominal incisions and the number of trocars used. Laparoendoscopic single-site surgery (LESS) is a promising approach that can further enhance cosmetic satisfaction and reduce the risks of laparoscopic surgery. Loss of triangulation, instrument crowding and clashing, poor visualization, and ergonomic problems are the most challenging issues associated with the use of LESS. The combination of LESS and the robotic system seems to be a promising choice to overcome the technical difficulties of LESS. The da Vinci Single-Site Surgical Platform is a novel semi-rigid robotic operating system. We present our initial clinical experience with robotic-assisted single-incision transumbilical total hysterectomy using the novel da Vinci Single-Site Surgical Platform. Journal of Minimally Invasive Gynecology (2014) 21, 147–151 © 2014 AAGL. All rights reserved.

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Laparoscopic surgery is minimally invasive. Recently, efforts have been under way to develop strategies that will further reduce the size of the abdominal incisions and the number of trocars used [1]. The potential benefits of these efforts include shorter hospital stay, improved cosmetic appearance, and greater patient satisfaction. Laparoendoscopic single-site surgery (LESS) is an emerging technique and an option for achieving these benefits [2,3]. LESS is feasible and safe for many gynecologic procedures [2–5]. Nevertheless, instrument crowding and clashing, loss of depth perception, ergonomic difficulty, loss of instrument triangulation, and the need for advanced laparoscopic skills are hurdles for greater use of this technique.

Recently, the da Vinci robotic system (Intuitive Surgical, Inc., Sunnyvale, CA) has been used to an increasing extent for assisting laparoscopic procedures. The robotic system has greatly improved surgeon dexterity, surgical precision, visualization, and ergonomics [6]. However, it has considerably increased the size and number of ports required compared with conventional laparoscopy. The combination of LESS and the robotic system seems to be a promising choice that can be used to overcome the technical difficulties of conventional LESS [4,6–8]. Robotic-assisted LESS has been successfully performed using various commercial multiple-channel ports [7,9,10]. However, more recently, interest has been focused on applying robotic technology to the LESS technique. A novel set of robotic instruments, the da Vinci Single-Site Platform, has been developed specifically for LESS. Herein we describe the first single-incision transumbilical laparoscopic total hysterectomy and bilateral salpingo-oophorectomy performed using the da Vinci Single-Site Surgical Platform.

Material and Methods

Patients and Materials

Four patients underwent robotic single-incision transumbilical total hysterectomy and bilateral salpingo-oophorectomy...
using the da Vinci Single-Site Surgical Platform. Patient characteristics are given in Table 1.

The da Vinci Single-Site Surgery Platform is a new semi-rigid robotic operative system designed to work with the da Vinci Si Surgical System. The setup of the console and the 2 arms is similar to that in conventional robotic surgery.

This special system incorporates a multiple-channel single port, the da Vinci Single-Site Port, which accommodates 2 curved robotic cannulas (Fig. 1). In addition, this port enables insertion of a standard robotic 3D 8.5-mm high-definition laparoscope and a 5-mm laparoscopic assistant instrument. The trocar is made to be used through a single facial incision. The cannulas transmit interchangeable semi-rigid instruments that cross each other within the trocar so that the instrument that enters on the right becomes the left-sided operative instrument, and vice versa (Fig. 1). When the Single-Site Platform instruments are docked into the da Vinci Si Surgical System, the instruments are automatically reassigned so that the left hand of the surgeon’s console will control the right arm of the robot, and vice versa. The currently available da Vinci Single-Site Platform instruments have some differences from the conventional da Vinci Si endowristed instrument. First, the entire length of the instruments is semi-rigid, enabling them to be inserted through the curved cannulas. In addition, all are 5-mm instruments. Second, these instruments do not have the wrist at the tip. Third, and possibly most important, this new setup has no bipolar grasper.

**Procedure**

After a 25-mm vertical intraumbilical incision was made, the abdominal cavity was entered using the Hasson technique. The single side port was inserted through this incision, and pneumoperitoneum was established. The robot was docked between the patient’s legs.

Instrument orientation was confirmed at the console so that the surgeon’s left hand controlled the left instrument in the operative field despite the curved cannulas making an opposite configuration. Bilateral infundibulopelvic ligaments were sealed and transected using EnSeal Tissue Sealing and the Hemostasis System (SurgRx, Inc., Palo Alto, CA) through the assistant channel found in the single-site multiple-channel port. Bilateral round ligaments were transected, and a bladder flap was developed using a monopolar hook. After bilateral uterine vessels were skeletonized, they were sealed and transected using the EnSeal system. After the bladder was dissected below the colpotomy cup, a circumferential colpotomy was performed using the monopolar hook. The uterus, cervix, and both ovaries and fallopian tubes were removed through the vagina. The vaginal cuff was closed using the da Vinci Single-Site Surgical Platform, with polyglactin 910 (0-Vicryl) sutures intra-corporeally (Fig. 2). In all cases, the uterus was examined intraoperatively by a gynecologic pathologist to exclude malignancy. The facial defect in the umbilical incision was sutured, and the skin incision was sutured in subcutaneously

<table>
<thead>
<tr>
<th>Patient</th>
<th>Age, yr</th>
<th>BMI</th>
<th>Parity</th>
<th>Previous surgery</th>
<th>Diagnosis</th>
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</thead>
<tbody>
<tr>
<td>1</td>
<td>46</td>
<td>25.5</td>
<td>2</td>
<td>Cesarean section</td>
<td>Endometrial hyperplasia with atypia</td>
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<tr>
<td>2</td>
<td>49</td>
<td>33.2</td>
<td>2</td>
<td>Cesarean section</td>
<td>Menorrhagia</td>
</tr>
<tr>
<td>3</td>
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<td>26.2</td>
<td>3</td>
<td>Laparoscopic sterilization</td>
<td>Menorrhagia</td>
</tr>
<tr>
<td>4</td>
<td>48</td>
<td>28.5</td>
<td>3</td>
<td>None</td>
<td>Endometrial hyperplasia with atypia</td>
</tr>
</tbody>
</table>

BMI = body mass index.
Mean docking time was 6 minutes (range, 5–8 minutes), and console time was 116 minutes (range, 90–160 minutes). Estimated blood loss was 66 mL (range, 30–120 mL), and uterine weight was 150 g (range, 110–190 g). The postoperative course was uneventful. There were no complications such as infection or port-side hernia at postoperative week 4. All patients were pleased with the cosmetic appearance of the umbilicus.

Discussion

Surgeons everywhere would like to perform major abdominal procedures using a minimally invasive approach, in particular one that leaves no visible incision scar. Laparoscopic surgery has been one of the milestones in making this a reality. Furthermore, LESS has recently become popular as a result of advances in laparoscopic instruments and techniques. LESS was first used for tubal sterilization, and
Quinones et al [11] and Pelosi and Pelosi [12] in 1991 have performed total hysterectomies using this technique. In recent years, multiple-channel single-access ports, articulating or flexible laparoscopic instruments, and flexible laparoscopes have been developed that improve the success and reproducibility of LESS. Despite these previous efforts and technologic improvements, however, LESS has not become a standard surgical technique for several reasons. In addition, the technique is not ergonomic for the surgeon and is associated with a longer learning curve. At this point, the da Vinci robotic system has already been introduced in LESS by some avant-garde surgeons [8,9]. More recently, Nam et al [7] performed one of the largest studies of single-incision transumbilical total hysterectomy using the robot and concluded that the approach was technically feasible in selected patients. Although the robotic arms are placed in parallel with conventional single incisions, the endowristed instruments of robot can help to triangulate the instruments at the surgical site [9]. In addition, use of the robotic surgical system can reduce instrument collisions, and it is ergonomically superior to conventional LESS because of the console system [7]. However, gas leakage and structural integrity in response to movement of the robotic arms are major problems in single-incision transumbilical hysterectomy using a robotic system with conventional multiple-channel access ports [7,9]. In addition, because the robotic surgical system has generally been used with 12-mm optics and 8-mm endowristed instruments, the umbilical incision in this approach is larger than that in a conventional single-incision approach [7,9,10]. Furthermore, setup of this technique has some limitations including reduced range of motion of the robotic intracorporeal and extracorporeal instruments, arm clashing, and poor access for bedside use [13,14].

Lately, interest has been focused on the application of robotic technology for single-incision hysterectomy to overcome these challenges. The novel da Vinci Single-Site Surgical Platform was specifically designed to overcome some of the drawbacks associated with standard single-incision laparoscopy. Similar to Kroh et al [14], we thought the major advantage of this novel development in total hysterectomy was restoration of triangulation using semi-rigid instruments through rigid canulas. This enables an appropriate distance between the instruments at the working end while keeping the shafts of all instruments within close proximity. In addition, the da Vinci Si Surgical System can automatically reassign the da Vinci single-site instruments so that the surgeon’s right hand can control the movements of the right instrument (left arm of the robot) without a change in the surgeon’s view of his/her hands. This situation can easily be managed by changing the controls of the robotic instruments at the console. This technical feature is not possible in conventional single-incision laparoscopic procedures. In addition, using a 30-degree robotic camera down or up, depending on the case and surgeon desire, can facilitate the surgical procedure [9]. However, inasmuch as the bipolar instrument for vessel sealing does not exist for the da Vinci Single-Site Surgical Platform, we preferred to use a 5-mm external bipolar instrument through the assistant channel found in the single-site port. In our opinion, this technique requires advanced surgical assistance. Vaginal cuff suturing was performed intracorporeally and, on the basis of our experience, was more feasible and easier than suturing using a conventional single-incision laparoscopic approach. Although working without endowristed instruments and bipolar instrument was associated with few operative challenges, these can be overcome with patience by the surgeon. Another challenging factor related to performing LESS with a single-site platform is patient selection. Similar to our experience, it has been hypothesized that large body mass index, short stature, short distance between the umbilicus and the pubic symphysis, and large uterine size would have a negative effect on surgical performance of the hysterectomy and cuff closure because of the long length of the curved canulas [15].

In conclusion, robotic-assisted single-incision transumbilical total hysterectomy and bilateral salpingo-oophorectomy using the da Vinci Single-Site Surgical Platform is feasible, in particular in selected patients. We believe that further experience and technical refinements will continue to improve operative results. Further work is needed to develop and advance the single-site robotic platform, articulation of the instruments, and instrumentation using bipolar energy. Furthermore, additional studies should be performed to identify the possible benefits of robotic single-incision transumbilical hysterectomy.

References


