Instruments and Techniques

Robotic-Assisted Laparoendoscopic Single-Site Surgery in Gynecology: Initial Report and Technique

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ABSTRACT

Robotic surgery has greatly improved surgeon dexterity and ergonomics but has substantially increased the number and size of ports required. The typical robotic surgical procedure will use three 8-mm ports and two 12-mm ports. Single-port laparoscopy, also known as Laparo-Endoscopic Single Site (LESS) surgery, is an attempt to further enhance cosmetic benefits and reduce morbidity of minimally invasive surgery. We present our initial clinical experience and technique with robotic-assisted single-port surgery in gynecology. Journal of Minimally Invasive Gynecology (2009) 16, 589–91 © 2009 AAGL. All rights reserved.

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Minimally invasive surgery has substantially decreased length of hospital stay, decreased the need for postoperative analgesia, and improved recovery time. The first documented procedures were reported in the late 1990s [1,2]. However, few modifications have been made in peritoneal access in the last decade that would lead to further improvement in postoperative recovery and cosmesis. Robotic surgery has greatly improved surgeon dexterity and ergonomics but has substantially increased the number and size of ports required. The typical robotic surgical procedure will include three 8-mm ports and two 12-mm ports. Single-port laparoscopy (SPL), also known Laparo-Endoscopic Single Site (LESS) surgery, is an attempt to further enhance cosmetic benefits and reduce morbidity of minimally invasive surgery. While this approach is innovative and perhaps the newest frontier in laparoscopic surgery, it presents some unique challenges such as instrument crowding, loss of perception depth, and need for advanced laparoscopic skill. Herein, we describe our initial clinical experience and technique with robotic-assisted single-port surgery in gynecology.

Case Report and Technique

A 60-year-old woman who tested positive for the BRCA gene had recently undergone a right-sided modified radical mastectomy secondary to a diagnosis of infiltrating ductal carcinoma, nuclear grade 3, estrogen receptor–positive/progesterone receptor–negative. Because of her genetic susceptibility for ovarian cancer and her personal history of breast cancer, she opted to undergo risk-reducing bilateral salpingo-oophorectomy and total hysterectomy. The hysterectomy was recommended because the patient’s breast cancer treatment regimen included long-term tamoxifen therapy.

The patient’s favorable body mass index (26), excellent physical status, and history of 2 births via cesarean section made her an appropriate candidate for a minimally invasive procedure. Robotic-assisted hysterectomy and bilateral salpingo-oophorectomy were planned. Our conventional robotic hysterectomy procedure requires placement of 4 abdominal trocars with a 12-mm supraumbilical port, two 8-mm robotic ports, and an additional 12-mm lower quadrant accessory port. In this case, one 3-cm incision was made in the umbilicus, and the procedure was performed through a multichannel single port.
After the patient was anesthetized, she was placed in the low lithotomy position in yellowfin-style stirrups, and her arms were tucked at her sides. After preparing and draping the patient, a standard V-Care Uterine Manipulator (Conmed Endosurgery, Utica, New York) was placed, and a Foley catheter was inserted into the bladder. Using an open Hasson technique, a 3-cm incision was made at the umbilicus and a GelPort was inserted into the incision. A blunt 12-mm sheath was placed at the most caudal aspect of the port (Fig. 1). Through this port, the abdomen was insufflated to 15 mm Hg with carbon dioxide, and a pneumoperitoneum was established. Two standard robotic trocars (5 and 8 mm, respectively) were then placed through the port in a triangulated distribution.

The patient was then placed in the steep Trendelenberg, low-lithotomy position, and the da Vinci S robot (Intuitive Surgical, Inc, Sunnyvale, California) was docked between her legs. A 12-mm robotic 30-degree scope was used through the 12-mm port, and monopolar Hook and bipolar Maryland instruments were used through the robotic ports to perform the procedure. Because the GelSeal Cap (Applied Medical Resources Corp, Rancho Santa Margarita, CA) on the multichannel port enables unlimited hand and instrument exchanges without the loss of pneumoperitoneum, an endoscopic suction device and a standard atraumatic laparoscopic grasper were intermittently placed directly through the port by the surgical assistant to facilitate surgical exposure. The ovaries were examined and appeared grossly normal. The round ligaments were ligated bilaterally, and the retroperitoneal spaces were developed. After identification of the ureters, the infundibulopelvic ligaments were skeletonized, coagulated, and ligated. A bladder flap was developed using monopolar energy, and the uterine arteries and their tributaries were skeletonized and ligated. After the bladder was dissected below the colpotomy cup, a circumferential colpotomy was performed using the monopolar Hook instrument. The uterus, cervix, and bilateral fallopian tubes and ovaries were removed through the vagina, and the vaginal cuff was closed using interrupted 0-Vicryl sutures. The ovaries were examined intraoperatively by a gynecologic pathologist and found to be normal at gross evaluation. No abnormal pathologic findings were noted in the uterus, fallopian tubes, or ovaries on permanent section. Operative time was 168 minutes, with 80 mL of estimated low blood loss. The postoperative course was uneventful.

Discussion

Laparoscopic surgery has become the preferred surgical approach for a variety of gynecologic conditions. Single-port laparoscopy is not a new concept in gynecologic surgery. In the 1960s, Wheeless [3] and Wheeless and Thompson [4] reported on more than 4000 women who underwent rapid, inexpensive, effective surgical sterilization at single-trocar laparoscopy. In 1991, Pelosi and Pelosi [5] performed the first complex procedure using a single-trocar technique, a hysterectomy. Gynecologic surgeons developed this technique almost 40 years ago; these were the first SPL and LESS procedures performed without multiple trocars. Despite these pioneer efforts, SPL did not become a standard surgical technique in gynecologic surgery for several reasons including lack of “triangulation,” need for special instrumentation, instrument crowding or clashing, challenging ergonomic positions, and need for advanced laparoscopic
skill. In the last decade, technology has advanced tremendously, and surgeons have overcome some of these limitations. For example, flexible endoscopes help to ameliorate the loss of depth perception that occurs when the camera lines up with the shaft of a working channel. Triangulation, which is easily accomplished in traditional laparoscopy with 3 or 4 ports, can now be achieved during SPL using flexible or curved laparoscopic instruments. Nevertheless, SPL currently is not user friendly or practical in the gynecologic surgical community. The primary disadvantage of single-port surgery without the robot is the collision of instruments and limited degrees of freedom of the instruments. Furthermore, the technique is not ergonomically friendly. The da Vinci robotic surgical system (Intuitive Surgical, Inc.) has gained tremendous popularity among gynecologists as an adjunctive tool for minimally invasive gynecologic surgery. Advantages such as 3-dimensional visualization and range of motion superior to that with conventional laparoscopy have increased the number of robotic procedures performed in gynecology during the last 2 or 3 years. Initial laboratory experience with robotic LESS was reported by Haber et al [6]. Subsequently, Kaouk et al [7] reported the first robotic single-port transumbilical surgery in urology by performing a successful radical prostatectomy and nephrectomy. The ability of the robotic arms to enable more degrees of freedom and triangulation at the surgical site, and the improved ergonomics facilitated the surgical success.

Some technical challenges merit further discussion. Triangulation is needed for proper dissection while providing effective traction and countertraction, a task that is difficult with SPL. Even though the da Vinci instruments are placed in parallel, the combination of a uterine manipulator with the superior range of motion of the robotic system arm wrist enables proper tissue dissection. Instrument crowding is perhaps the most frustrating aspect of SPL. This has improved somewhat with the development of streamlined-profile camera systems and by using instruments of different lengths. Several single-port devices are available including the SILS Port Multiple Instrument Access Port (Covidian, Mansfield, Massachusetts), GelPort (Applied Medical Systems, Boston, MA), Uni-X Single-Port System (Pavel Systems, Inc, Morganville, NJ), and ASC R-port laparoscopic access device (Advanced Surgical Concepts, Bray, County Wicklow, Ireland). The major problem with the various single-port devices is gas leaking and structural integrity in response to the movement of robotic arms. There are also some patient-related limitations. By selecting the umbilicus as the entry point, the surgeon limits patients who would be appropriate candidates for robotic-assisted SPL in gynecology. The adaptability of the current da Vinci system, and perhaps the best extraction incision (colpotomy) for LESS, makes robotic-assisted SPL surgery feasible. Instrument and robotic arms crowding can be overcome by using 5-mm rather than 8-mm robotic trocars and by using a 30-degree robotic camera down or up depending on the case. This modification enables spacing of the robotic arms as far possible from the camera arm. Nevertheless, the optimal technique continues to be a work in progress, and research is being done on flexible low-profile robotic systems and miniature deployable robots, which would make SPL and LESS more feasible in gynecology.

In conclusion, SPL is feasible in selected cases and is a safe cosmetic alternative to conventional multipor laparoscopy. Robotics may improve surgical capabilities during single-port laparoscopy.

References