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CHAPTER 9

SINGLE PORT LAPAROSCOPIC SURGERY IN UROLOGY: INITIAL EXPERIENCE


ABSTRACT

Objectives
To present our initial experience with single-port laparoscopic urologic surgery using the Uni-X Single Port Access Laparoscopic System, a single port, multichannel cannula, with specially designed curved laparoscopic instrumentation.

Methods
We performed single-port laparoscopic surgery in 10 patients, including renal cryotherapy in 4, wedge kidney biopsy in 1, radical nephrectomy in 1, and abdominal sacrocolpopexy in 4. For the transperitoneal approach, the multichannel port was inserted transumbilically, and for retroperitoneoscopy, the port was inserted at the tip of the 12th rib. Data were collected prospectively into our institutional review board-approved data registry.

Results
Since September 25, 2007, a total of 10 patients have undergone single-port laparoscopic surgery for various upper abdominal and pelvic pathologic findings. All cases were completed successfully, without conversion to a standard laparoscopic approach. The total operative time for the various kidney procedures was 2.5 hours (range 2 to 3.2) and was 2.5 hours (range 2 to 3) for sacrocolpopexy. The mean blood loss was 100 mL for the renal procedures and 90 mL for sacrocolpopexy. The hospital stay was 2.8 days (range 1 to 8) for the kidney procedures and 2 days for sacrocolpopexy. One complication occurred in a patient with baseline congestive heart failure who underwent cryoablation and required oxygen mask ventilation postoperatively that delayed her hospital discharge for 1 week. The same patient, who was anemic preoperatively, was transfused with 3 U of packed red blood cells, although the postoperative computed tomography scan revealed a small perinephric hematoma.
Conclusions

Single-port laparoscopic renal cryotherapy, wedge kidney biopsy, radical nephrectomy, and abdominal sacrocolpopexy are safe and feasible. Additional experience and continued investigation are warranted.

INTRODUCTION

Laparoscopic surgery substantially reduces abdominal wall trauma compared with open surgery. This translates into less postoperative pain, a faster recovery, fewer wound complications, and improved cosmetic outcomes. Current laparoscopic techniques involve the use of three to six small skin incisions, depending on the complexity of the procedure.

The Uni-X Single Port Access Laparoscopic System (Pnavel Systems, Morganville, NJ) is a single port with multichannel access that has been recently developed. This new Food and Drug Administration-registered device has a unique multichannel port through which specially designed, curved laparoscopic instruments are deployed. This approach might allow for many common laparoscopic procedures to be performed entirely through the patient’s umbilicus and enable essentially scarless abdominal surgery with additional reduced wound morbidity. Importantly, the method allows a surgeon to “convert” a one-port transumbilical procedure to a conventional laparoscopic procedure at any point during the operation, if needed, by adding one or more conventional laparoscopic ports, thus preserving the existing standards of care.

Single-port laparoscopic surgery (SPLS) has been reported for cholecystectomy [1] and appendectomy [2] since 1998; however, the approach did not gain momentum because of technical challenges. These have been minimized by advancements in laparoscopic instruments, mainly the introduction of laparoscopic flexible 5-mm laparoscopes with excellent image display and flexible/bend instruments that allow laparoscopic dissection and intracorporeal suturing.

To our knowledge, we present the initial experience for urologic SPLS that includes the first ever performed retroperitoneal SPLS and also the first series of SPLS for sacrocolpopexy with intracorporeal free-hand suturing.

MATERIAL AND METHODS

Since September 25, 2007, SPLS has been performed in 10 patients, who underwent renal cryotherapy (n = 4), wedge kidney biopsy (n = 1), radical nephrectomy (n = 1), or abdominal sacrocolpopexy (n = 4). Data were collected prospectively into our institutional review board-approved data registry. Patient selection was determined by the renal and
pelvic pathologic findings for which laparoscopy is deemed appropriate as the standard of care in our practice. Exclusion criteria included patients who had undergone multiple abdominal procedures or a body mass index of more than 30 kg/m². All procedures were performed by a single surgeon (J.H.K.).

The multichannel port and bent laparoscopic instruments are shown in Figure 1 and Figure 2, respectively. For the retroperitoneal approach, the multichannel port was inserted at the tip of the 12th rib using an open Hassan technique, as described previously [3]. For the transperitoneal approach, the multichannel port was inserted through a 1.5-cm semicircular incision at the inner edge of the umbilicus (Figure 3). The anterior rectus fascia was sharply incised, and four corner fascial stay sutures were placed and used to fix the port in place and prevent subcutaneous emphysema. A 5-mm laparoscope with a flexible, steerable tip was used (Olympus Surgical, Orangeburg, NY). This laparoscope has an incorporated light source within the camera head that does not compete for the very limited space at the port site. Moreover, the surgical field is centered by steering the tip of the laparoscope while keeping the straight segment of the laparoscope outside the port in a location away from the surgeon’s instruments to avoid clashing and maximizing surgical movement.

In 2 patients, retroperitoneal SPLS was used during cryoablation of renal tumors. After developing the retroperitoneal space, Gerota’s fascia was incised and the tumor exposed. Intraoperative biopsy was performed, and a 3.8-mm cryoprobe (Endocare, Irvine, Calif) was inserted under ultrasound guidance. The 10-mm flexible, steerable ultrasound

Figure 1: Pnavel Uni-X Single Site Laparoscopic System. Pnavel umbilical port provides single point of access to abdominal cavity for two 5-mm laparoscopic instruments and one laparoscope. Recommended placement is through patient’s umbilicus, although it can be placed elsewhere for alternate access to surgical site. Pnavel system uses curved instrumentation and the Olympus Imaging System to facilitate surgical access and provide improved ergonomics. It is compatible with all traditional 5-mm laparoscopic instruments and laparoscopes.

Figure 2: Bent laparoscopic instruments with rotational mid-shaft and instrument tip. Using front knob on handle, curved shaft can be positioned in desired orientation. Front shaft can be locked in place by pulling trigger down toward handle.
probe was inserted alongside the single port through the same skin and fascial opening and kept in position for the entire operation. Cryoablation was performed, with the ice ball monitored using ultrasonography, as described previously. In 1 case of a renal tumor larger than 2 cm, an additional cryoprobe was inserted percutaneously through the skin without the need for an additional port. The initial cryoprobe was inserted through the single port.

The transperitoneal SPLS approach was used during renal cryoablation in 2 patients, wedge biopsy of the kidney in 1, and left radical nephrectomy in 1. A wedge biopsy was indicated in 1 patient with multiple bilateral solid renal masses who had undergone inconclusive percutaneous renal biopsy on three separate occasions with results suspicious for oncocytosis. The wedge kidney biopsy was obtained using flexible scissors; hemostasis was achieved using manual pressure and biologic hemostatic agents (FloSeal, Baxter Deerfield, Ill). SPLS radical nephrectomy was done for a 5-cm left renal mass. The renal hilum was controlled by stapling the renal artery and vein individually using a vascular laparoscopic stapler introduced through a 10-mm port inserted at the site of a low Gibson incision that was later extended to 4 cm for intact specimen extraction using an EndoCatch bag (U.S. Surgical, Norwalk, Conn).

SPLS transperitoneal abdominal sacrocolpopexy was performed successfully in 4 consecutive patients with vaginal prolapse. The technique of laparoscopic sacrocolpopexy has been previously described [5]. After placement of the umbilical multichannel port, the bowel was retracted using stay sutures to the abdominal wall, the sacrum was identified, and the peritoneum reflection was incised toward the vaginal vault. On exposure of the pelvis, two polypropylene meshes were passed perivaginally under direct visualization both laparoscopically and vaginally. These were placed at the 3-o'clock and 9-o'clock positions from the level of the perineal body, alongside the vagina, to the apex of the vagina. The meshes were sutured to the vaginal apex using 0-Ethibond sutures and subsequently secured to the sacrum with a 5-mm Pro-Tack tacking device (U.S. Surgical). The peritoneum was then sutured with a running 3-0 Vicryl suture to cover the mesh completely using free-hand intracorporeal suturing.
RESULTS

SPLS surgery was successfully completed in all 10 patients. The intraoperative and early postoperative data are summarized in Table 1. Surgical exposure was adequate in all cases, and standard laparoscopic surgical steps were duplicated through the single port. The radical nephrectomy case required a 4-cm extraction incision that was used to pass the 10-mm vascular staplers. All other procedures were performed through a single port exclusively. No additional 2 or 3-mm ports were used in any case. No intraoperative complications developed. The mean operative time for the various kidney procedures was 2.5 hours (range 2 to 3.2) and was 2.5 hours for sacrocolpopexy (range 2 to 3). The mean blood loss was 100 mL for the renal procedures and 90cc for sacrocolpopexy. Hospital stay was 2.8 days (range 1 to 8) for the kidney procedures and 2 days for the sacrocolpopexy procedures. A postoperative complication developed in 1 patient with baseline congestive heart failure who had undergone cryoablation. She required oxygen mask ventilation postoperatively that delayed her hospital discharge for 1 week. The same patient, who was anemic preoperatively, was transfused with 3 U of packed red blood cells, although a postoperative computed tomography scan revealed a small perinephric hematoma.

COMMENT

In laparoscopic surgery, optimizing the distance between various ports is essential to enable a free range of motion and avoid the clashing of instruments. This also serves to provide triangulation between the right and left hand instruments and the laparoscope, which is essential for performing surgical dissection. The introduction of the 5-mm flexible steerable laparoscopes and instruments has helped to partially offset this technical difficulty, even if the instruments are introduced adjacent and parallel to each other through a single port. A multichannel port that allows two instruments and a laparoscope to be inserted at the same time and through which carbon dioxide insufflation can also be accomplished is now available for performing single-port surgery.

In standard laparoscopic surgery, three to six laparoscopic ports are needed. Although only skin incisions are made and the ports are introduced bluntly, patients have temporary incision pain and muscle spasms, especially for ports close to the costal margin.

<table>
<thead>
<tr>
<th>Table 1. Intraoperative and Postoperative Data</th>
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<tr>
<td>Surgery</td>
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<td>OR Time (hr)</td>
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<td>EBL (mL)</td>
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<td>Hospital Stay (days)</td>
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<td>Convalescence (wk)</td>
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<td>Complications</td>
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OR = Operating Room; EBL = estimated blood loss
*Radical nephrectomy in 1 patient, kidney wedge biopsy in 1, and cyobleph in 4.
†Cryoablation patient required oxygen mask ventilation and 3-U blood transfusion postoperatively.
‡Abdominal sacrocolpopexy in 4 patients.
During pelvic surgery, epigastric vessel injury at the site of lateral port insertion is not uncommon, especially with bladed trocars. In retroperitoneal surgery, limiting the incision to the port of retroperitoneal access at the tip of the 12th rib avoids accidental peritoneal entry when inserting the anterior accessory port.

Single-port surgery can be performed through one incision that can be hidden within the umbilicus, rendering select transperitoneal procedures scarless. In addition to the superior cosmetic result, the potential other advantages of minimizing skin incisions also apply.

Although all procedures were successful and reasonably time efficient, even in our initial experience with this new technique, confident multiport laparoscopic skills are critical for safe and effective SPLS. Flexible instruments do have a learning curve for which dry laboratory training is beneficial. The clashing of instruments and the laparoscope is common and, as such, significant coordination between the surgeon and the camera person is essential.

The margin for instrument modification and improvement is vast to optimize the instruments’ range of motion. Specifically, instruments that allow mechanical suturing rather than free-hand suturing will minimize the challenges of reconstructive SPLS.

CONCLUSIONS

In this initial experience with urologic SPLS, various abdominal and pelvic procedures were performed safely and effectively. Furthermore, the feasibility of single-port surgery for reconstructive procedures requiring free-hand suturing exists. Additional instrument improvement is needed to move toward more complex procedures.

REFERENCES