Single-port Robotic Intracorporeal Ileal Conduit Urinary Diversion During Radical Cystectomy Using the SP Surgical System: Step-by-step Technique

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OBJECTIVE To describe the step-by-step technique for robotic intracorporeal ileal conduit urinary diversion (ICUD) following radical cystectomy performed by using the novel da Vinci SP surgical system (Intuitive Surgical, Sunnyvale, CA).

METHODS Four consecutive patients (2 males and 2 females) were initially counseled for robotic cystectomy with ICUD performed by using the da Vinci SP surgical system. Surgeries were performed by duplicating the steps of the institutional approach for intracorporeal ICUD performed with the multiarms robotic platform. Perioperative outcomes were analyzed. Data were collected under institutional review board approval (IRB 13-780).

RESULTS Single-port robot-assisted radical cystectomy with ICUD was successfully completed in 3 patients (2 males and 1 female). Mean robotic operative time for ICUD was 75 minutes (range 67-90). There was no conversion to standard multiarms robotic approach. One patient needed to be converted to extracorporeal urinary diversion due to severe adhesions of small bowels. No additional ports were placed. Neither transfusions nor intraoperative complications occurred. All patients were discharged on postoperative day 5. One patient reported self-limited nausea and vomiting after discharge (Clavien grade I).

CONCLUSION In our preliminary experience, ICUD after robot-assisted radical cystectomy is feasible using the da Vinci SP surgical system. Further comparative studies with open and multiarms robotic approaches are warranted. UROLOGY 130: 196–200, 2019. © 2019 Published by Elsevier Inc.

Bladder cancer is the ninth most common cancer worldwide with an incidence of 430,000 cases per year.[1] Approximately 25% of patients with bladder cancer have muscle-invasive disease and often undergo open radical cystectomy that still represents the gold standard treatment[2] (ORC). However, since its first description in 2003, several studies have reported the feasibility of robotic approach for radical cystectomy.[3,4] During the last decade, robot-assisted radical cystectomy (RARC) has been progressively adopted as a reliable and reproducible surgical alternative to ORC. Moreover, the recent outcomes on the RAZOR trial reported a 2-year progression-free survival of 71.6% (95% CI 63.6-78.2) and 72.3% (95% CI 64.3-78.8) in the ORC and RARC groups, respectively demonstrating the noninferiority of the last one.[5] Lower urinary tract reconstruction is an essential step after completing the extirpative phase of RARC, being the extracorporeal approach for urinary diversion (ECUD) the most common conducted. With the goal of reducing the surgery-related morbidity and the hospital stay, tertiary care centers have developed the surgical technique for a totally intracorporeal urinary diversion (ICUD) following RARC, with promising perioperative outcomes.[6,7] Ahmed et al analyzed surgical data from the international robotic cystectomy consortium comparing 768 ECUD and 167 ICUD procedures.[8] The study showed a reduction in perioperative blood transfusions (7% vs 16%), 90-days rates of hospital readmission (12% vs 19%) and postoperative mortality (1.6% vs 4.9%) favoring ICUD over ECUD.

Robotic technology has progressed seeking to further reduce its invasiveness. Recently, the Food and Drug

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Administration approved the da Vinci SP (Intuitive Surgical, Sunnyvale, CA). This novel purpose-built single port robotic system has a mobile instrument arm, attached to the patient side cart containing 3 instruments drives and an 8-mm articulating camera emerging through a 25-mm single multichannel port. Furthermore, an instrument guidance system and a high-definition 3D camera enhance the experience of the surgeon with potential improving in the perioperative outcomes.[9]

In this report, we described the step-by-step technique for single-port intracorporeal ileal conduit urinary diversion performed by using the da Vinci SP surgical system.

MATERIALS AND METHODS

Between September and November 2018, 4 patients were initially counseled for single port RARC with intracorporeal ileal conduit urinary diversion. Surgeries were performed by the same surgical team by using the da Vinci SP Surgical System. Perioperative outcomes were prospectively collected under institutional review board approval (IRB 13-780). No specific inclusion/exclusion criteria were considered.

Step-by-step Surgical Technique

Patients were placed in dorsal lithotomy position with adequate padding of all extremities. During the urinary diversion step, the steep Trendelenburg position used during the cystectomy was reduced to 10°-15° or less. The maneuver allows for the small bowel to descend back into the lower abdomen facilitating the manipulation for the intracorporeal diversion. Patients were prepped and draped in the usual sterile fashion by prepping the patient's penis (vagina in female), perineum and proximal thighs up to the infra-xiphoid abdomen. A 3-cm midline incision was made 3 fingerbreadths above the belly button. The dissection was carried through the subcutaneous tissue and the fascia until gaining the access into the abdominal cavity. A GelPOINT mini advanced access platform (Applied Medical, Rancho Santa Margarita, CA) was placed. The SP Cannula was introduced through the GelPOINT membrane. For the urinary diversion, a 12-mm AirSeal (SurgiQuest Inc., Milfort, CT) port was placed at the preplanned, premarked site for maturing the stoma (Fig. 1). In the female case, an additional 12-mm assistant port was introduced through the vaginal opening. This port enables the placement of endovascular gastrointestinal anastomosis staplers facilitating the bowel manipulation and avoiding an acute-angle stapling. All procedures were performed under general anesthesia with the SP robotic platform side-docked[10] (Fig. 2). Cystoprostatectomy or anterior pelvic exenteration with bilateral pelvic lymph-nodes dissections were performed by a transperitoneal approach. Specifically for the purpose of the study, we described the step-by-step technique for intracorporeal ileal conduit.

Step 1—Retrosigmoid Transposition of Left Ureter

A mesenteric window was developed under the sigmoid mesocolon. The right robotic arm was introduced through the window to transpose the left ureter retroperitoneally under the colon.

Step 2—Harvesting Bowel Segment in Male

A 15-cm length of preterminal ileum located 15-20 cm proximal to the ileo-cecal valve was identified. The distal and the proximal ends of the small bowel segment were marked with 3-0 silk and 3-0 dyed Polysorb stay sutures. The ileum segment was transected on either side by using a 45-mm laparoscopic stapler maneuvered through the AirSeal trans-abdominal assistant port (Supplemental Fig. 1). Thereafter, the mesentery of the ileal segment was sequentially divided using an additional white vascular load to allow for proper mobilization of the ileal conduit.

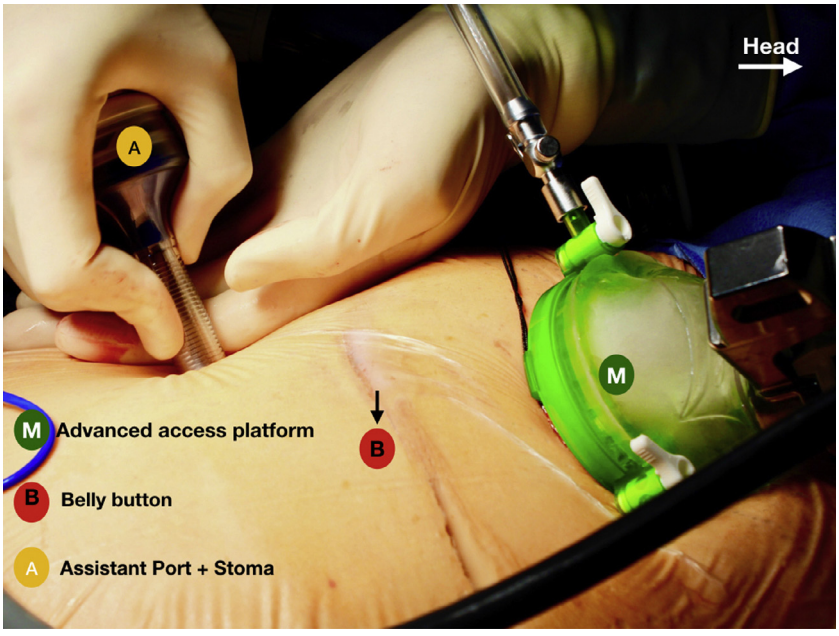

Figure 1. An advanced access platform (Gelpoint, Applied Medical Rancho Margarita, CA) was placed. The dedicated 25-mm multichannel port is introduced through the GelSeal cap. An additional 12-mm port for the bedside assistant was placed in the premarked stoma area. (Color version available online.)

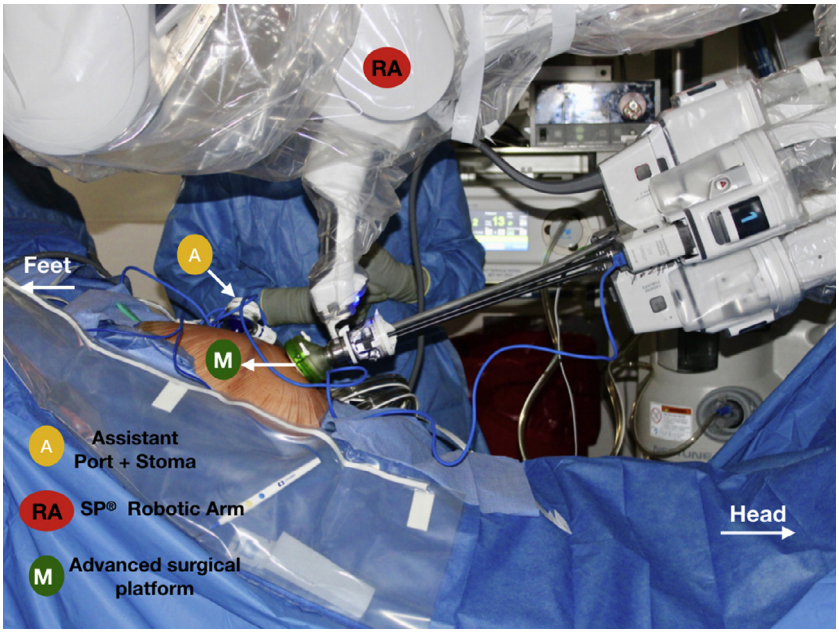

Figure 2. SP robotic system docked aside with the patient in slight Trendelemburg. (Color version available online.)

Harvesting Bowel Segment in Female

The specimen was placed in an endo-catch bag and retrieved through the vaginal opening. A partial approximation in a T-shaped configuration of the vagina was performed using a 2-0 barbed suture. A space was left for the 12-mm assistant port allowing the introduction of the laparoscopic staplers for harvesting the ileal conduit segment in the same sequence as aforementioned.

Step 3—Side-to-side Bowel Anastomosis

The small bowel segments were aligned together. A 3-0 silk stay sutures was used to secure the segments. Two small enterotomies were created proximal to the staple lines. Through the 12-mm abdominal port, a laparoscopic stapler with 45-mm bowel loads was inserted into the bowel segments to perform a side-to-side bowel anastomosis. In females, the laparoscopic staplers were inserted using the 12-mm vaginal port (Supplemental Fig. 2). Thereafter, to close the top of the bowel anastomosis, a final 45-mm bowel load was used proximal to the original staple lines.

Step 4—Uretero-Ileal Anastomosis (Bricker Technique)

In the proximal end of the conduit, 2 small enterotomies were made for the ureteral anastomoses.

Each ureter was spatulated and separate ureteroenteric anastomoses were performed according to the Bricker technique by using 2 4-0 Polysorb running sutures (Supplemental Fig. 3). A double-J ureteral stent (6F × 30 cm) was introduced in each ureter prior to completing the ureteroileal anastomoses by the bedside assistant through the abdominal assistant port.

Prior to undocking the robot, the 12-mm vaginal assistant port was removed and the vagina was completely closed. Through the 12-mm assistant abdominal port, the 3-0 silk suture placed in the distal end of the conduit was grasped with a laparoscopic needle driver for its further extracorporeal mobilization. As a final step, the port was removed and the incision prepared for maturing the stoma. The fascia was incised in a cruciate fashion with the rectus muscle split and the abdomen entered. The distal end of the conduit was brought through the stoma site, and the stoma was matured with a 3-0 Polysorb suture (Supplemental Fig. 4). The ureteral stents were secured with a 3-0 silk suture onto the skin and a Foley was inserted into the conduit.

RESULTS

Single-port RARC with ICUD was successfully completed in 3 of the 4 patients (2 males and 1 female). Intracorporeal ileal conduit urinary diversion mean operative time was 75 minutes (range 67-90 min). One patient with a previous history of diverticulitis needed to be converted to ECUD due to several small bowel adhesions. No intraoperative complications occurred. All patients were discharged on postoperative day 5. One patient reported self-limited nausea and vomiting after discharge, managed by antiemetic medications (Clavien grade I). Patient characteristics and perioperative data are shown in Table 1.

DISCUSSION

We presented herein the first clinical description of the technique for a totally intracorporeal single-port robot-assisted ileal conduit urinary diversion after RARC. Gill et al was the first to report 2 cases of laparoscopic radical cystoprostatectomy with intracorporeal ileal conduit urinary diversion.[11] Technical challenges on laparoscopy demanded a long learning curve, restricting the wide diffusion of the procedure in the field. With the evolution of minimally invasive surgery, specifically robotic-assisted technology, the revolutionary features of these platforms facilitated the challenging steps of the urinary diversion. In this aspect, our group previously experienced the remarkable dexterity of the robotic instruments performing an intracorporeal ileal conduit urinary diversion using the SP1098, demonstrating the reproducibility of the technique on a preclinical model.[12] Likewise, in the

Table 1. Demographics, clinical data, perioperative and pathological data

Case	Case 1	Case 2	Case 3	Case 4
Age	70	70	70	71
Gender	Male	Female*	Male	Female*
Abdominal Surgery	No	No, Previous episode of diverticulitis	Yes	No
Type of Abdominal Surgery	No	No	Appendectomy and Cholecystectomy	No
Urinary Diversion	ICUD	ICUD	ICUD	ICUD
Conversion to ECUD	No	Yes	No	No
ICUD IntraOp Data (mins)**	90	89	76	67
Overall Operative Time (mins)***	496	475	420	425
30-Days Complications	None	Clavien I	None	None
Discharge	POD5	POD5	POD5	POD5

* **Anterior Pelvic Exenteration.**
** mins; POD = postoperative day; ICUD = Ileal Conduit Urinary Diversion; ECUD = Extracorporeal Urinary Diversion.
*** Time including RARC and urinary diversion.

current series described, we successfully completed three ICUD in patients using the novel da Vinci SP system. With this robotic platform, the instruments preserve the 7 degrees of freedom at the wrist joints facilitating the ureteroileal anastomosis. Moreover, the unique design of "elbow" joint enables the intracorporeal triangulation. The 2.5-cm single-incision port site concedes the duplication of the classic multiarms robotic triangulation via a single small incision eliminating the instrument clashing and allowing the operator work in small spaces.

Concerning the surgical technique, it is worth to mention that particularly for harvesting the bowel segment and performing the bowel anastomosis, the bedside surgeons needs to be familiar with the surgical system, anatomical landmarks, surgical steps, and utilization of the laparoscopic bowel to reduce possible complications. Certain solutions to shorten the learning curve for robotic intracorporeal bowel anastomosis could be the development of training models that may assist reinforcing the experience of the assistant.[13] Regarding the type of approach, ICUD mainly replicates the same surgical steps as ECUD. Nevertheless, the rate of ICUD has increased in the last decade due to its likely advantages over ECUD.[14] In a cohort comparing both approaches, Hussein et al demonstrated on a shorter operative time (357 vs 400 minutes), less blood loss (300 vs 350 mL) and fewer blood transfusions (4% vs 19%, all $P < .001$) favoring ICUD.[14]

In our early experience, the perioperative outcomes of our technique are encouraging. No intraoperative complications were reported. Our operative time was somewhat longer than that of the standard multiarms approach, possibly explained by the expected learning curve with the novel SP system. We took advantage of the 12-mm assistant port (placed on the planned site for the stoma) for instruments' insertion, aspiration and ureteral stenting. Also in the female patient, the vagina was used for extraction of the specimen maintaining a pure single site approach. We observe some potential advantages of performing the ICUD using the single-port robotic system. A 3-cm skin incision is needed to extract the specimen providing acceptable cosmetics results. In addition, with the depth perception and optical magnification provided by 3D vision of the SP robot, the surgical field is limited to the visual area of surgery limiting minimal handling of bowel. Notwithstanding the small sample size, our initial experience represents a step further into minimizing minimal invasive robotic surgery.

In this report we have demonstrated that the single-port intracorporeal ileal conduit urinary diversion is feasible using the SP surgical system. However, large series are required to establish the functional outcomes of the technique and compared with open or multiarm robotic system approach.

SUPPLEMENTARY MATERIALS

Supplementary material associated with this article can be found in the online version at https://doi.org/10.1016/j.urology.2019.03.023.

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