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The First 100 Consecutive, Robot-assisted, Intracorporeal Ileal Conduits: Evolution of Technique and 90-day Outcomes

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Abstract

Background: Robot-assisted radical cystectomy (RARC) has evolved over the last few years to become an acceptable alternative option to open radical cystectomy. Most series of RARC used an open approach to urinary diversion. Even though robot-assisted intracorporeal urinary diversion (RICUD) is the natural extension of RARC, few centers have reported their experiences with RICUD in general, and in particular, of robot-assisted intracorporeal ileal conduits (RICIC).
Objective: To report our experience with RICIC using the *Marionette* technique.
Design, setting, and participants: The first 100 consecutive patients who underwent RARC and RICIC, and had ≥3 mo of postoperative follow-up were included in this study. Patients were divided into four groups of 25 patients each to study the evolution of our surgical technique.
Intervention: RICIC.
Outcome measurements and statistical analysis: Intraoperative, pathologic, and 90-d postoperative outcomes for the four groups and the overall cohort were compared using the Fisher exact test (categorical variables) and the Kruskal-Wallis test (continuous variables). Continuous variables were reported as median (range) and categorical variables were specified as frequency (percentage).
Results and limitations: Overall operative and specific diversion times were 352 and 123 min, respectively. Estimated blood loss was 300 ml, lymph node yield was 24, and positive surgical margin rate was 4%. Length of hospital stay increased from 7 d for group 1 to 9 d for group 4. The overall 90-d complication rate was 81%; 19% of complications were high grade. Infections were the most common complications, representing 31% of all complications. There were no statistically significant intergroup differences except in diversion time, intraoperative transfusions, and length of stay.
Conclusions: RICIC diversion is safe, feasible, and reproducible. Larger series with longer follow-up are needed to validate the procedure and define its place in the minimally invasive urologic armamentarium. Quality of life studies need to be conducted to compare benefits of intracorporeal urinary diversion.

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1. Introduction

Robot-assisted radical cystectomy (RARC) has evolved over the last few years to become an acceptable alternative option to open radical cystectomy (ORC) with similar short-term and intermediate-term oncologic outcomes [1–4]. After establishment of the robot-assisted surgery program at Roswell Park Cancer Institute in 2004, RARC was

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incorporated into the program in 2005. Our original technique and initial experience with the *Marionette* robot-assisted intracorporeal ileal conduit (RICIC) diversion were previously reported [5]. In this series, we describe modifications to the original technique and outcomes of our first 100 consecutive patients who underwent RARC and RICIC diversion with a minimum of 90-d postoperative follow-up.

2. Materials and methods

From May 2009 to February 2012, the *Marionette* technique of RICIC diversion was performed on 121 consecutive patients with bladder cancer who underwent RARC by a single surgeon (KG). Clinical and pathologic information for these patients was retrieved from our institutional review board–approved, prospectively maintained, quality assurance bladder cancer database. The first 100 consecutive patients who had a minimum of 90-d postoperative follow-up were included in this study. This cohort was divided into four groups (25 patients each) to facilitate comparison in terms of demographics, and pathologic, perioperative, and 90-d postoperative outcomes. Postoperative complications were divided into early ($\leq$30 d) and late ($\leq$90 d) and categorized using the modified Clavien system [6]. Minor complications were placed in Clavien category 1–2 and major complications were placed in category 3–5. Two patients were lost to follow-up within 90 d postoperatively and were excluded from analysis.

Statistical analysis for comparing groups in regard to categorical variables was performed using the Fisher exact test. Similar comparisons for continuous variables were done using the Kruskal-Wallis test. Values for continuous variables are given as median (range). Values for categorical data are specified as frequency (percentage). Statistical analysis was performed using SAS v.9.3 (SAS Institute Inc., Cary, NC, USA).

2.1. Overview of the Marionette technique

A detailed description of the initial Marionette technique was published previously [7]. A standard, six-port, transperitoneal approach in steep Trendelenburg position, similar to robot-assisted radical prostatectomy, is used. An additional 12-mm, short (75 mm long) suprapubic port is placed for bowel reanastomosis toward the end of surgery. Port placement is modified by moving the ports more cephalad for ease in performing the intracorporeal urinary diversion (ICUD). RARC and extended pelvic lymphadenectomy are performed in a standard fashion.

The specimens from RARC and extended pelvic lymphadenectomy are placed in Endo Catch bags (Covidien plc, Dublin, Ireland), and positioned in the pelvis to allow room for conduit creation. The specimen is removed through the vagina in females, and through a transverse extension of the suprapubic port site (Pfannenstiel) at the end of the procedure in male patients. The left ureter is delivered under the sigmoid mesocolon to the right side.

A 60-in 1-silk suture on a Keith needle is introduced through the abdominal wall, passed through the distal end of the future conduit, and brought back outside. This stitch is not tied but controlled with an instrument to allow the distal end of the conduit to be raised and lowered, like a marionette. The marionette suture is placed lower than the actual stoma site for ease of robotic arm manipulation. A 12- to 15-cm ileal segment is harvested approximately 15 cm away from the ileocecal valve. The hook cautery is used to divide the peritoneum of the bowel mesentery, and two mesenteric windows are created. Bowel mesentery is controlled with electrocautery, Ligasure (Covidien plc, Dublin, Ireland), or the vascular stapler. The 45-mm Endo GIA stapler (Covidien plc, Dublin, Ireland) is passed through the 15-mm assistant port to divide the bowel proximally and distally. Bowel continuity (BC) is not reestablished at this point; instead, a single 0-silk suture is used to bring the two ends of ileum together, preventing malrotation and ensuring proper orientation.

The proximal staple line is not isolated from the remainder of the conduit. The marionette suture is lowered to gain access to the proximal end of the conduit to facilitate ureteroileal anastomosis (UIA). The distal end of the ureter is held in position using the fourth robotic arm to allow for UIA. Scissors or an electrocautery hook is used to make two small enterotomies in the proximal conduit on two opposite sides. The ureter is partially transected and spatulated using robotic scissors so the distal end can be used as a handle to facilitate the anastomosis. A Van Velthoven-type, double-armed, 4-0 Vicryl suture (5 cm long) is inserted at the angle of the ureteric spatulation and run along both sides. Once the posterior wall is anastomosed, ureteral stents are passed into the upper tracts. An opening is made in the distal conduit using the hook, and a metal laparoscopic suction tip is passed through the 15-mm assistant port into the distal conduit. The suction tip is gently advanced through the entire conduit and across the ureteral opening. A 90-cm, 8.5F, single-J ureteral stent with a guidewire is passed through the suction tip and fed gently into the ureteral opening. Once the single J stent is seen to pass into the upper ureter, the suction tip is withdrawn while the console surgeon controls the stent. The guidewire is left in the stent to allow easy identification of the stent inside the conduit. A 3-0 chromic suture is used to secure the stent to the conduit to prevent accidental dislodgement and the guidewire is removed.

The distal ureter is completely transected and sent for permanent pathologic examination. The UIA is then completed. The distal ends of the two stents are left in the 15-mm side port; the ex vivo portions of these stents should not be clamped to prevent accidental dislodgement while maneuvering the conduit inside the abdominal cavity. Subsequently, BC is reestablished. This is facilitated by insertion of the seventh, short, suprapubic port and by using the fourth arm to hold the silk suture in the two stapled ends of ileum. A 60-mm Endo GIA stapler is passed through the newly placed port straight into two enterotomies made in the two stapled ileal ends. After ensuring that the antimesenteric sides of the bowel are properly opposed, BC is reestablished. A second firing of the Endo GIA stapler, this time through the 15-mm assistant port, is used to close the enterotomy. The mesenteric window is closed using 3-0 silk sutures; reinforcement sutures can be placed if desired.

Finally, the marked stoma site is opened. A Babcock forceps is passed into the peritoneal cavity and used to grasp the marionette stitch and the ureteral stents and bring them out through the stoma site. Subsequently, the distal end of the conduit is gently externalized through the stoma site. The stoma is fashioned in the standard way.

3. Results

Patient demographics were similar across the four groups (Table 1). While overall operative time (OOT) remained unchanged, diversion time significantly improved from a median of 140 min in group 1 to 103 min in group 4 (Table 2). More intraoperative transfusions were noted in group 4 compared to the other three groups despite the median estimated blood loss being the lowest in group 4. Hospital length of stay (LOS) significantly increased from a median 7 d in group 1 to 9–10 d in the remaining groups. Twenty patients (20%) in this study received neoadjuvant chemotherapy and 4% received adjuvant chemotherapy. Lymph node yield and positivity, pathologic T stage, and margin status were similar across all groups (Tables 2 and 3).

The 30-d readmissions rate ranged from 12% to 20%, with an increasing trend that was not statistically significant. Reasons for 30-d readmissions included febrile urinary tract