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Robot-assisted Vescica Ileale Padovana: A New Technique for Intracorporeal Bladder Replacement Reproducing Open Surgical Principles

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Abstract

Background: The Vescica Ileale Padovana (VIP) was first described in 1989 as a technique for total bladder replacement, and gained popularity due to technical simplicity and functional advantages.
Objective: To report preliminary results and a detailed step-by-step surgical technique description of robot-assisted VIP (ra-VIP) that replicates the open technique principles.
Design, setting, and participants: We report the data of 15 consecutive patients who underwent robot-assisted radical cystectomy (RARC) and totally intracorporeal ra-VIP at our institution from April 2015 to March 2017.
Surgical procedure: RARC, extended pelvic lymph-node dissection, and totally intracorporeal ra-VIP. An enhanced recovery after surgery (ERAS) protocol was adopted in most cases.
Measurements: Perioperative outcomes (operating time, blood loss, transfusion rate, and hospital stay), readmission for early (30 d) and late (90 d) postoperative complications, pathological and oncological outcomes, and overall/cancer-specific survival were reported.
Results and limitations: The median (interquartile range) age was 60 (54–66) yr. The median body mass index was 24 (24–25). The median American Society of Anesthesiologists score was 2 (2–2). The operative time was 390 (284–470) min and the estimated blood loss was 300 (50–900) ml. No conversion to open technique was reported. The median hospital stay was 17 (12–23) d. Three patients received postoperative transfusions. Six patients had 90-d major complications. One patient was readmitted after discharge and reported a long-term sequela. One positive margin was reported. At a mean follow-up of 17 (13–25) mo, 14 (93%) patients were alive: one patient died from disease progression. Daytime continence rate at 12 mo was 62%.
Conclusions: Our preliminary results showed that ra-VIP appears to be a feasible technique for robot-assisted totally intracorporeal bladder replacement following robotic radical cystectomy.
Patient summary: Vescica Ileale Padovana (VIP) was first described almost 30 yr ago for bladder replacement after radical cystectomy. We report a step-by-step technique of robot-assisted VIP that follows the open surgical principles of detubularization and double folding, mixing the advantages of VIP with the benefits of the robotic approach.

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1. Introduction

Radical cystectomy (RC) is the gold-standard treatment for muscle-invasive bladder cancer; however, it is a complex procedure that frequently involves complications, resulting in increased hospital stay and readmission [1]. RC with urinary diversion (UD) is considered one of the most challenging procedures due to technical complexity [2,3]. The type of UD performed depends on patient's factors, disease staging [4], and surgeon preferences. The Vescica Ileale Padovana (VIP) was first described in 1989 as a technique for total bladder replacement [5]. It represents the second most commonly performed neobladder technique in Italy [6], and it has gained popularity also in Poland, Spain, and elsewhere due to its simplicity, technical advantages, and functional outcomes. The use of robot-assisted RC (RARC) is rapidly increasing; it can result in decreased postoperative pain, reduced incisional morbidity, reduced blood loss and transfusion rate, reduced ileus, and decreased hospital stay with rapid postoperative convalescence [7–9].

Intracorporeal, extracorporeal, and hybrid techniques of UD after RARC have been reported for both continent and incontinent diversion [10]. Despite the rise of RARC cases from 0.6% in 2004 to 31.3% in 2017 [9], only few centers perform intracorporeal orthotopic neobladder (ICONB) techniques [11–13].

Herein, we report the step-by-step detailed surgical technique description of totally intracorporeal orthotopic robot-assisted (ra-)VIP that replicates open technique principles and initial experience.

2. Patients and methods

From April 2015 to March 2017, a total of 15 consecutive patients were identified from our collated database, who underwent RARC, extended pelvic lymph node dissection (ePLND), and intracorporeal orthotopic ra-VIP for the intent to cure bladder cancer. Exclusion criteria were prostatic stromal tumor invasion, urethral tumor, inflammatory bowel disease, impaired renal (serum creatinine >2.0 mg/dl) and liver functions, poor physical condition, salvage cystectomy, extensive local tumor burden, cognitive incapability, and lack of motivation or physical inability to perform intermittent catheterization [4]. An enhanced recovery after surgery (ERAS) protocol was followed in most patients, when applicable. Exclusion from the ERAS protocol were an American Society of Anesthesiologists (ASA) score of >3, presence of malnutrition according to the Mini Nutritional Assessment-Short Form criteria, and presence of inflammatory bowel diseases [14,15]. All data were entered consecutively into an institutional review board–approved database and queried retrospectively. Each patient signed an informed consent form. The IDEAL Collaboration guidelines were followed, and the present study shows the results of the phase IIb trial [16] (see Figs. 1 and 2, Table 1, and the Supplementary material for more details).

All patients were followed for ≥12 mo. Preoperative data collected included age, gender, body mass index (BMI), ASA score, Charlson comorbidity index, prior pelvic surgery, and administration of neoadjuvant chemotherapy. Perioperative data comprised operative times, estimated blood loss (EBL), perioperative transfusions rate, intraoperative complications, total number of lymph nodes removed, length of hospital stay, 30- and 90-d postoperative complications classified according to the Clavien-Dindo classification [17] and reported according to the European Association of Urology Complication Panel recommendations [18], and readmission rate. Oncological outcomes recorded were urothelial (urethral and ureteral) and soft tissue positive margins, histology, pathological tumor stage (TNM), positive lymph nodes, and clinical recurrence. Local and distal recurrences were defined as clinical relapse in soft tissue or presence of lymph nodes confirmed by imaging [19]. Cancer-specific survival and overall survival were recorded. Daytime continence was defined as the complete absence of involuntary loss of urine, of any entity, both at rest and under stress, and the lack of a need for sanitary pads for protection. Nocturnal continence was defined as the absence of involuntary losses of urine during sleep with a maximum of two micturitions per night (either with spontaneous awakening due to voiding desire or at scheduled wakening hours), considering dry sleep for 6–7 h. The dataset includes the entire learning

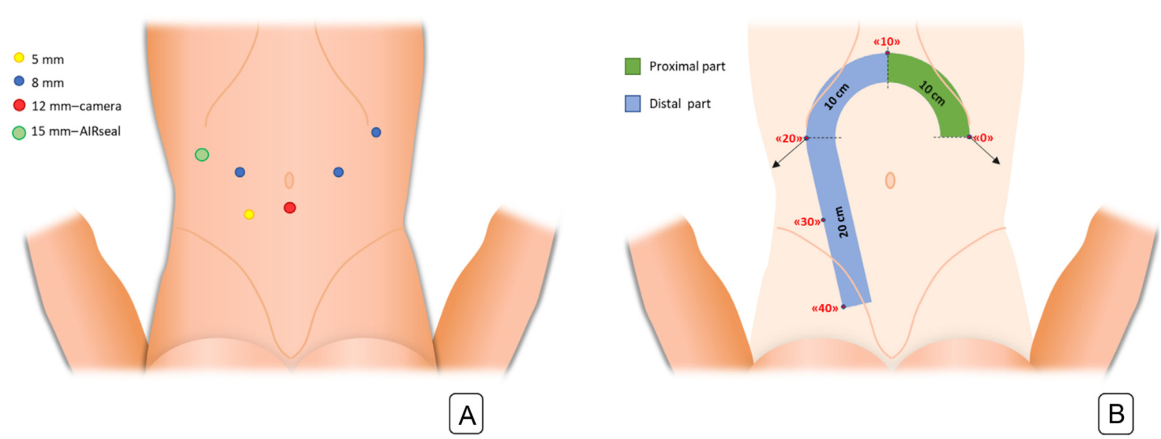

Fig. 1 – Trocar configuration for robot-assisted radical cystectomy and ra-VIP. (A) Trocar Placement: the 12-mm camera port is placed 3 cm above the umbilicus. Two 8-mm robotic ports are placed 1 cm cranially to the midline between umbilicus and anterior superior iliac spine, laterally to the camera port. The other 8-mm robotic port is placed 2 cm cranially to the right anterior superior iliac spine. A 12-mm assistant port is placed 2 cm cranially to the left anterior superior iliac spine. A 5-mm assistant port for suction is placed at the left between the camera and the robotic art port, above the umbilicus line. The Air Seal insufflation system is routinely used. (B) Ileal loop positioning: the 40-cm ileal loop is now ready for reconstruction. For better understanding, you can ideally divide the loop into 20 cm distal and 20 cm proximal. The distal loop is anchored in the middle, as already described, to the fibrous tissue posterior to the urethra. Two anchorage stitches are placed: one on the right side (point "0") at the proximal end of the ileal loop to the right psoas and one on the left side, 10 cm caudally from the UIA site (point "20") to the left psoas. The goal of these lateral anchorage stitches together with the anchorage in the deep pelvis is to maintain the distal loop in a fixed position during detubularization and reconstruction. ra-VIP = robot-assisted Vescica Ileale Padovana; UIA = urethroileal anastomosis.

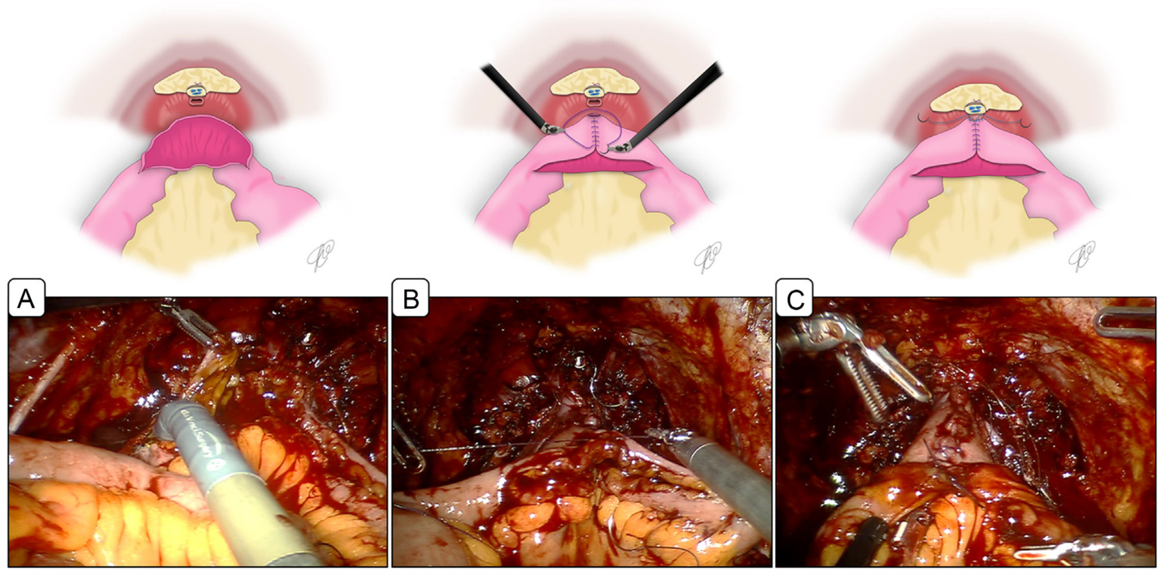

Fig. 2 – Bladder neck construction and urethroileal anastomosis (UIA). (A) Using Endowrist scissors, a 10-cm antimesenteric opening of the distal ileal segment is performed. A 5-cm distal funnel is created using an anterior 3-0 Quill running suture. (B) The ileal anastomotic orifice is created at the inferior apex of the funnel's anterior suture. (C) The UIA is performed according to the Van Velthoven technique using 3-0 Quill barbed sutures. Running suture is started by placing both needles outside in through the anastomotic ileal orifice made on the distal funnel, which will be the neobladder neck. One needle is placed at the 5:30 o'clock position and the other needle at the 6:30 o'clock position, and in doing so, the middle knot sits at the 6 o'clock position on the posterior neobladder neck. The urethral "bites" are made inside out, at the corresponding sites. The right suture is run counterclockwise back to the 1 o'clock position, passing the needle from outside in at the neobladder neck to inside out at the urethra side. The same procedure is completed for the left running suture from the 7 to 12 o' clock position. As UIA was performed as one of the first step of the procedure, the ileal loop is secured deep in the pelvis, making the detubularization of the intestinal segment easier and maintaining its fixed position during the posterior plate reconstruction.

Table 1 – Equipment for RARC and ra-VIP

Robotic equipment (Da Vinci, Intuitive Surgical System)	Three 8-mm trocars 0° and 30° laparoscopic 3D optics Endowrist monopolar curved scissors Endowrist Bipolar Maryland Endowrist Cadiere grasp Endowrist needle holder Endowrist proGrasps
Laparoscopic equipment	Two 12-mm trocars One 5-mm trocar One long suction irrigator (45 mm) One 5-mm endoscopic grasper One 10-mm Endobag Clipper 10 mm Hem-O-lok (Weck closure system) Laparoscopic staplers (60 mm × 3 mm) Endo GIA
Sources of energy and cautery	Monopolar and bipolar electrocautery Hem-O-lok 10 mm
Sutures	3-0 Quill barbed suture 4-0 Monocryl suture

RARC = robot-assisted radical cystectomy; ra-VIP = robot-assisted Vescica Ileale Padovana.

curve of the participating surgeon (W.A.) who has previous experience in robotic surgery (>1500 robotic procedures) and open VIP technique (>700 cases). No patient was excluded.

2.1. Preoperative recommendations and patient positioning

Antibiotic prophylaxis using Augmentin (amoxicillin) 4 g was administered 2 h before surgery. The patient is positioned in the Trendelenburg position with 30° inclination. Prior to the start of the robotic procedure, a 16-Ch Foley urethral catheter is placed in order to drain the bladder. The equipment used during RARC and ra-VIP is given in Table 1. Port placement is presented in Fig. 1A.

2.2. Robot-assisted RC

All RARC procedures with ra-VIP were performed on the Da Vinci Robotic System SI (Intuitive Surgical, Sunnyvale, CA, USA). Bilateral ePLND is performed according to a template including routine external iliac, Cloquet's nodes, obturator fossa, Marcille's fossa, internal and common iliac nodes, and presacral nodes. Specimens are sent as separate packets. Posterior dissection is performed to identify the seminal vesicles in the male and vault of vagina in the female. Ureters are sectioned at the level of their juxtavesical portion. A distal ureteral segment, 1–2 cm long, is usually sent for a frozen section. Mobilization of the ureter is then extended to the entire iliac segment, by lifting the peritoneal edge. Ureters are left in their natural position without any modification of their normal anatomy. In more detail, the left ureter is not passed behind the sigmoid colon but maintains its position lateral to the colon. The lateral pedicles are then ligated and divided with the aid of hem-o-lok clips and a vessel-sealing device. The dissection is continued posteriorly to the apex of the prostate in male and to the urethra/proximal anterior vaginal wall in female. The bladder is then dropped, endopelvic fascia incised, and urethra divided after careful clipping to avoid urine spill. The specimen is positioned in an Endocatch bag (removed vaginally in the female case). Prior to the start of the reconstructive part of the procedure, the patient is positioned in a lesser Trendelenburg position with 20–15° inclination, in order to allow the bowel to descend into the pelvis and facilitate bringing the ileal loop down to the urethral stump.

2.3. *Ileal loop isolation and re-establishment of intestinal continuity*

Grasping gently with robotic Cadiere, an ileal loop of 40 cm in length, at least 20 cm away from the ileal-cecum valve is selected and brought down to the urethra. Eventual adhesions that make ileal mobilization challenging are recognized and dissected sharply. The ileum is adequately mobilized to accomplish a tension-free urethroileal anastomosis (UIA). The posterior wall of the lower part of the ileal loop where the UIA will be performed is now fixed with a 3-0 Quill (Angiotech Pharmaceuticals, Inc., Vancouver, BC, Canada) deep in the pelvis to the fibrous tissue posterior to the urethral stump to establish a fixed point, facilitating the performance of enteral resection and the following steps till the anastomosis.

The Endo GIA 60-mm stapler is inserted through the left 12-mm trocar. In order to cut the ileum properly, once the designated point is established, the bowel is grasped by the robotic Cadiere forceps and pushed against the Endo GIA 60-mm stapler. After performing the distal and proximal ileal sections, the isolated ileal segment is placed downward. Subsequently, the ileal-ileal latero-lateral anastomosis and an accurate mesenteric suture are carried out. Monopolar Endowrist scissors are used to excise the staple line of both the edges of the sectioned ileum, and the continuity of the ileum is restored by stapling the proximal and distal ends of the ileal loop side to side on their antimesenteric border. A transverse Endo GIA 60-mm stapler is used to close the open ends of the ileal extremities.

2.4. *Robot-assisted VIP configuration*

After ileal loop isolation (Fig. 1B), the reconstruction takes place as follows. A 10-cm antimesenteric opening of the distal ileal segment is performed (Fig. 2A), and a 5 cm distal funnel is created (Fig. 2B). The ileal orifice is created at the inferior apex of the funnel, and the UIA is performed (Fig. 2C). The ileal segment is totally open on the antimesenteric border to obtain full detubularization. The posterior plate configuration is carried out by folding the proximal ileal loop medially in a “U shape” (Fig. 3A–C). To perform the anterior plate, the superior margin of the posterior plate is folded up-down with the first stitch in the middle of the anterior wall of the distal funnel (Fig. 4A–C). The right and left ureters are generously spatulated and then separately anastomosed directly to the lateral horns of the reservoir, previous ureteral catheter positioning (Fig. 5A–C). A watertight test is performed with 150 ml of saline solution. Ureteral stents are brought outside the abdominal wall through a single small incision. A drain is placed in the front of the reservoir. Detailed descriptions of the aforementioned steps are provided in the figure legends.

2.5. *Postdischarge patient care*

The drain is removed as soon as possible (24–48 h). Ureteral catheters are removed during the hospital stay between 8 and 12 d after the procedure. At 2 wk, a retrograde radiological control of the reservoir is performed and, if no leakage is seen, the indwelling catheter is removed (Fig. 6). Otherwise, patients are discharged with an indwelling catheter for additional 10 d.

2.6. *Statistical analysis*

Demographic data, operative and postoperative clinical variables were collected in a database. Continuous variables were shown as median and interquartile ranges (IQRs). Categorical variables were shown in frequencies and percentages.

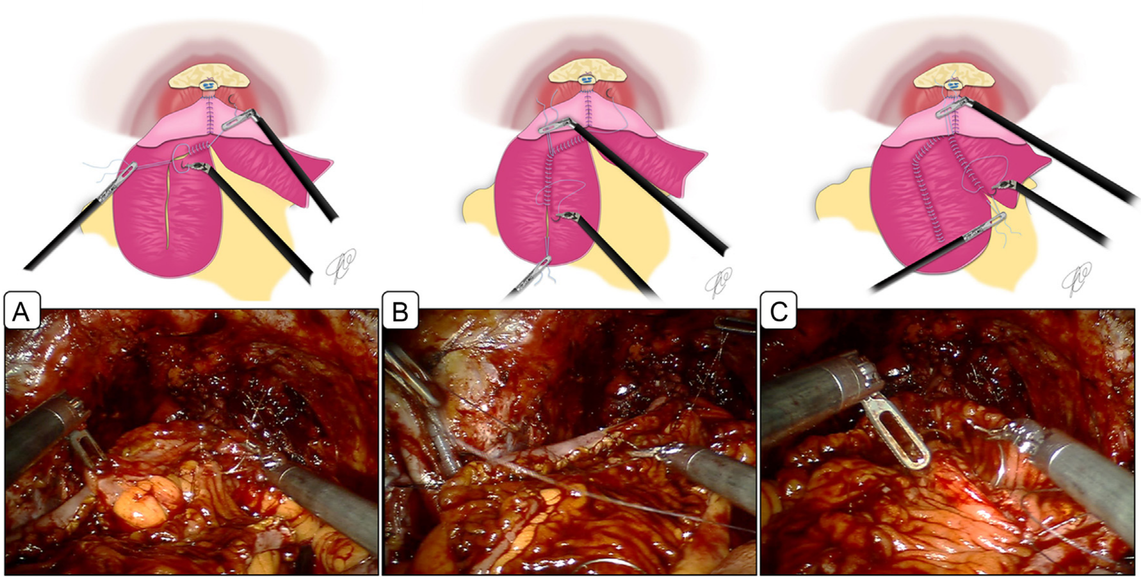

Fig. 3 – Posterior configuration of ra-VIP. The ileal segment is now totally open on the antimesenteric border to achieve full detubularization. The monopolar Endowrist scissor is used to excise the staple line of both the edges of the ileal loop. The first step of posterior reconfiguration is represented by the medial folding “U” shape of the proximal ileal loop. (A) Barbed sutures are used to approximate the internal margin of point “10” cited on the opposite side of the UIA with the medial margin of the distal edge of the proximal ileal segment. A second stitch approximates the medial margin of the proximal 20 cm of the loop. This “tension” stitch is grasped by the bed assistant with Joan forceps. The suture previously placed at the internal point “10” is held using the Prograsp on the fourth robotic arm. By softly pulling these stitches, the medial margins of the proximal medially folded loop are brought together and exposed, in order to allow an easier and more precise running suture between the internal point “10” and the cranial tension stitch. (B) Lock-stitch sutures are placed with a 3-mm interval between contiguous stitches, biting the ileal wall at full thickness, and a running suture is completed. A “tension” stitch is placed to bring the apex of the medially folded proximal loop to the right edge of the distal loop. This “tension” stitch is grasped and gently pulled cranially by the bed assistant with a Joan forceps in order to expose the margins of the right suture of the posterior plate. (C) A running suture is performed. The posterior plate is now completed. ra-VIP = robot-assisted Vescica Ileale Padovana; UIA = urethroileal anastomosis.

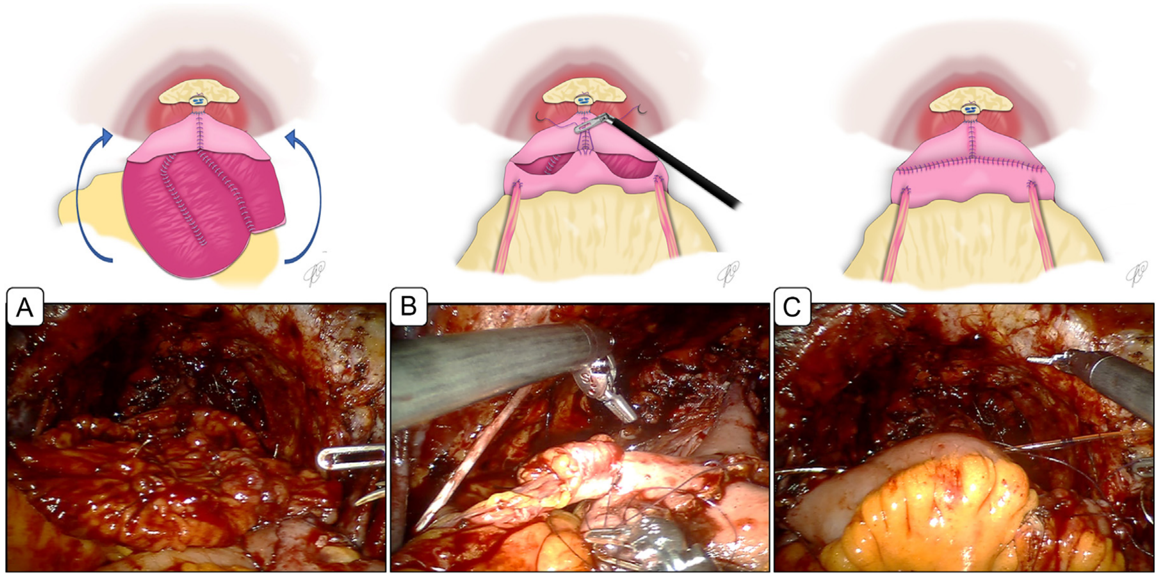

Fig. 4 – Anterior plate construction of ra-VIP and ureteroileal anastomosis. (A) The superior margin of the posterior plate is folded up-down with a first stitch in the middle to the anterior wall of the distal funnel. (B) Running sutures are placed from the center to the left and the right lateral horn, leaving the most lateral segments uncompleted. After completion of the ureteroileal anastomosis (for more details, please see Fig. 5), ureteral stents are crossed and brought outside the neobladder. (C) The suture of lateral segments of the anterior plate is completed. The final shape of the reservoir results in a geometric cardioid. The 14 Ch catheter is placed into the neobladder with the balloon filled with 7 cc of saline. A watertight test is performed with 150 ml of saline solution. Ureteral stents are brought outside the abdominal wall through a single small incision. A single drain is placed in front of the reservoir. ra-VIP = robot-assisted Vescica Ileale Padovana.

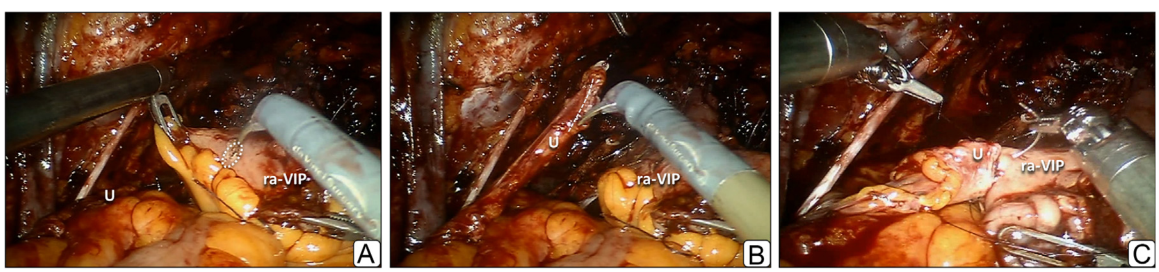

Fig. 5 – Ureteral-ileal anastomoses. (A) A 5-mm opening is made on the left and right sides of the neobladder dome. (B) The right and left ureters are generously spatulated and (C) then separately anastomosed directly to the lateral horns of the reservoir by means of two running 4-0 monofilament sutures. Two 8 Ch ureteral stents are used. Both ureters maintain the normal anatomical position. A rotation of the ureter on its axis must be carefully avoided. During the isolation of the distal ureter, particular attention is given to not damage its blood supply, accurately preserving the adventitia. ra-VIP = robot-assisted Vescica Ileale Padovana.

Fig. 6 – Postoperative cystogram showing the spherical double-folded shape of ra-VIP. No extravasation or ureteral reflux is demonstrated. ra-VIP = robot-assisted Vescica Ileale Padovana.

Table 2 – Preoperative characteristics

Patients, *n*	15
Age (yr), median (range)	60 (54–66)
BMI (kg/m^2), median (range)	24 (24–25)
Gender	
Male, *n* (%)	14 (93)
Female, *n* (%)	1 (7)
ASA score, median (range)	2 (2–2)
≤II, *n* (%)	13 (87)
≥III, *n* (%)	2 (13)
CCI, median (IQR)	5 (3–6)
<4, *n* (%)	9 (60)
≥4, *n* (%)	6 (40)
NACH, *n* (%)	1 (7)
Prior pelvic surgery, *n* (%)	1 (7)

ASA = American Society of Anesthesiologists (classification); BMI = body mass index; CCI = Charlson Comorbidity Index; IQR = interquartile range; NACH = neoadjuvant chemotherapy.

Table 4 – Pathological characteristics

pT stage, *n* (%)	
pT0	2 (13)
pTIS	2 (13)
pTa	0 (0)
pT1	3 (20)
pT2a	2 (13)
pT3a	2 (13)
pT4a	4 (27)
pN stage, *n* (%)	
pN0	12 (80)
pN1	1 (7)
pN2	2 (13)
pM stage, *n* (%)	
pM0	0 (0)
Positive margins	1 (7)
Urethral margins	0 (0)
Soft tissue margins	0 (0)
Ureteral margins	1 (7)

3. Results

Baseline characteristics are shown in Table 2. The median (IQR) age was 60 (54–66) yr and median BMI was 24 (24–25) kg/m^2. ASA scores ≤II and ≥III were reported in 13 (87%) and two (13%) patients, respectively. One patient was female and one (7%) underwent prior pelvic surgery.

Peri- and postoperative data are summarized in Table 3. The median (IQR) operative time was 390 (284–470) min and EBL was 300 (50–900) ml. The median (IQR) number of yielded lymph nodes was 30 (26–34). No intraoperative complications, transfusion, and conversion to open technique were reported. A total of three (20%) patients received transfusion during the hospital stay. No postoperative active bleeding was reported. Early complications were reported in seven (47%) patients. Late complications (within 90 d) were reported in one (7%) patient who was readmitted for sepsis and lymphocele that required surgical drainage. One patient reported long-term sequela due to loss of the right kidney secondary to ureteral benign stricture. At a median (IQR) follow-up of 17 (13–25) mo, one patient died from disease progression due to tumor seeding (intestinal metastases). One patient was lost to 12-mo follow-up.

Pathological outcomes are shown in Table 4. Pathology confirmed organ-confined disease in nine (60%) patients and locally advanced disease in six (40%). Three patients had lymph-node disease. Regarding pathological outcomes, only one (7%) patient reported left ureteral positive margin (focal nests of carcinoma in situ). At 3-yr follow-up, no ureteral recurrence was noted.

Functional outcomes are reported in Table 5. Continence status was assessed as previously indicated. At 3-mo follow-up, nine (60%) and one (7%) of the patients reported day- and night-time continence, respectively; however, eight (62%) and five (38%) patients, respectively, reported day- and night-time continence 12 mo after the procedure. Evaluating the median (range) number of pads worn at 3- and 12-mo follow-up, daytime usage decreased from 1.6 (1–3) to 0.42 (0–1), while the use of night-time pads reduced from 1.3 (1–2) to 0.72 (0–2). One patient developed chronic urinary retention and clean intermittent catheterization was needed.

Table 3 – Perioperative characteristics

Operative time (min), median (range)	390 (284–470)
EBL (ml), median (range)	300 (50–900)
Conversion rate, *n* (%)	0 (0)
Intraoperative complications, *n* (%)	0 (0)
Perioperative transfusions, *n* (%)	3 (20)
Intraoperative transfusions, *n* (%)	0 (0)
Postoperative transfusion, *n* (%)	3 (20)
Hospitalization time (d), median (range)	17 (12–23)
30-d postoperative complications, *n* (%)	7 (47)
Minor (Clavien-Dindo <III), *n* (%)	2 (13)
Fever	1 (7)
Ileus	1 (7)
Major (Clavien-Dindo ≥III), *n* (%)	5 (33)
Anemia requiring transfusion	3 (20)
Urinary Leak edge	2 (13)
90-d postoperative complications, *n* (%)	1 (7)
Minor (Clavien-Dindo <III), *n* (%)	0 (0)
Major (Clavien-Dindo ≥III), *n* (%)	1 (7)
Right ureteric benign stricture	1 (7)
90-d readmission, *n* (%)	1 (7)
Late sequelae, *n* (%)	1 (7)
Follow-up (mo), median (range)	17 (13–25)
Recurrence-free survival, *n* (%)	14 (93)
Overall survival, *n* (%)	14 (93)

EBL = estimated blood loss.

Table 5 – Functional outcomes

	3 mo	6 mo	12 mo
No. of patients at F-U	15 (100)	15 (100)	13 (82)
Daytime continence	9 (60)	8 (53)	8 (62)
Night-time continence	1 (7)	3 (20)	5 (38)
CIC	0 (0)	1 (7)	1 (7)
Pad/die (daytime)	1.6 (1–3)	0.85 (0–3)	0.42 (0–1)
Pad/die (night-time)	1.3 (1–2)	1 (1–2)	0.72 (0–2)

CIC = clean intermittent catheterization; F-U = follow up.

4. Discussion

The robotic approach to RC has risen from 0.6% in 2004 to 31.3% in 2017 in the USA [9]. It is gaining popularity as a feasible alternative to the open procedure and is beginning to be considered a “new reality” in the treatment of bladder cancer. Although functional and oncological outcomes are in line with contemporary open series [9,20,21], a recent systematic review and meta-analysis showed that RARC is a safe surgical procedure with acceptable perioperative outcomes, shorter length of hospital stay, and advantages in terms of blood loss, transfusion rates, and possibly postoperative complications [9]. Creation of the UD after RARC may represent a challenging step of the surgical procedure and the use of extracorporeal (ECUD), totally intracorporeal (ICUD), and hybrid UD has been described in the literature for both continent and incontinent diversion [10]. Despite the increasing use of RARC, a majority of centers perform ECUD due the difficulties with bowel reconfiguration and concerns about the time efficiency compared with the open approach [11,22]. Reservations regarding the use of ICUD approach include longer surgical times and increased complexity [7], but considering the advantages of the robotic surgery (wristed instrument, three-dimensional [3D] visualization, superior high-definition image quality, and ergonomic position), performing the entire procedure totally intracorporeally could lead to decreased bowel manipulation and exposure to the external environment, reducing fluid loss with consequently shorter time to oral intake and faster bowel function recovery [22,23]. The choice of the UD creation approach also influences the perioperative outcomes in open surgery [4] as well as in robotic approach. A broad range of ICONB techniques and different shapes have been proposed (Table 6), and the use of IDEAL guidelines during the experimental protocol has been reported [24]. However, only few followed a double-folding reconfiguration that represents ideal geometric and functional properties leading to a good-capacity low-pressure reservoir [22,25].

Herein, we present the surgical technique and preliminary results of ra-VIP, a robotic surgical technique replicating the open surgical principle. VIP was first described in the early 1990s as a cardioid-shaped double-folded neobladder developed by mixing principles from the Camey reservoir, the clam cystoplasty, and the Kock pouch [5]. In consideration of its advantages [5], it became a broadly used orthotopic reservoir [6] in Italy and other European countries. Perioperative and functional outcomes have widely been evaluated, showing that VIP is a feasible and safe procedure [15,26,27].

The use of the robotic approach to perform the VIP has previously been described by Simone et al. [25]. Although several steps are common, the main difference is based upon the generous use of endoscopic staplers in order to save time to perform the posterior plate. Despite the authors reporting a low stone formation rate, albeit the application of an endoscopic stapler simplifies the surgical procedure [25,28], our and others’ experience in using staplers in bowel urinary reservoirs is that the risk of reservoir stone development can increase significantly [29]. Moreover, the use of “tension stitches” makes it easier to perform posterior plate sutures, making the suturing times competitive. In addition, exposure of the edges allows safer sewing and may help the surgeon to include in the suture the entire thinness of the bowel wall. Further investigations are needed in order to compare the two techniques in terms of perioperative outcomes.

In the described technique, replicating the open technique, staplers are avoided, and every suture is accomplished with reabsorbable sutures (barbed or non-barbed). Specific tricks were developed in order to facilitate suturing by means of putting stay sutures in axis and applying tension to the segment to be sutured. Up to the present time, no patient developed neobladder stones. Performing the UIA at the beginning of the reconstruction allows stabilization of the neobladder in the small pelvis, helping in subsequent reconfiguration steps.

It may be interesting to mention and compare the step sequence of the open versus robotic procedure. Steps in the open procedure are the following: complete detubularization, construction of the lower funnel and the anastomotic hole, posterior plate reconstruction, ureteroileal anastomoses, subcomplete anterior plate reconstruction, UIA, and completion of the anterior plate suture. Robot-assisted VIP steps are as follows: anchorage to perineum of the lowest part of the distal 20-cm loop, partial detubularization, construction of the lower funnel, UIA, posterior plate reconstruction, ureteroileal anastomoses, and anterior plate reconstruction.

In addition to the magnification, 3D visualization and manipulation using Endowrist permitted by the robotic technology, the advantages of our technique are the following. Compared with the other techniques described, we use a shorter ileal segment (40 vs 55–65 cm). This allows a reduction of the absorption surface and leads to a lesser postvoiding residual. The principles of detubularization and a double-folding reconfiguration are followed in order to create a low-pressure, good-capacity, and compliance reservoir. The “cardioid” shape of VIP is similar to that of the natural bladder, allowing it to fit perfectly in the small pelvis, becoming a real orthotopic neobladder. The lower funnel directs the voiding pressure toward the urethral conduit during abdominal straining. The anastomotic hole at the very end of the anterior suture constructing the lower funnel allows a perfect ileal-urethral anastomosis, without tension and with a well-vascularized ileal wall. Moreover, maintaining the left ureter in its anatomic native position, without the need of crossing from left to right side, the risk of stricture due to the left ureter isolation and devascularization is at least theoretically decreased.

Table 6 – Literature review

Study	Neobladder shape	No of patients	Patient positioning	Ileum length (cm)	Ileum length for NB (cm)	Bowel resection	Bowel reapproximation	ONB sutures	Urethroileal anastomosis (timing)	Urethroileal anastomosis (technique)	Left ureter	Ureteral stenting insertion	Ureteral stenting technique	Ureteroileal anastomosis
Case series														
Pruthi et al. [28]	Studer "U"	3	Flat	NR	NR	Endo GIA 60-mm stapler	Side–to-side fashion	Stapler + Vicryl 2-0, SH	End of reconstruction	2 running sutures	Transposed	Per urethra, internalized	Seldinger	Bricker
Jonsson et al. [30]	Studer "U"	36	Trendelenburg (10–15′)	50	40	Endo GIA 60-mm stapler	Side-to-side fashion	Biosyn 3-0	Beginning of reconstruction	Van Velthoven	Transposed	Per urethra, externalized	Seldinger	Wallace
Schumacher et al. [31]	Studer "U"	45	Trendelenburg (10–15′)	50	40	Endo GIA 60-mm stapler	Side-to-side fashion	Biosyn 3-0	Beginning of reconstruction	Van Velthoven	Transposed	Per urethra, internalized	Seldinger	Wallace
Canda et al. [32]	Studer "U"	23	Trendelenburg (5′)	50	40	Endo GIA 60-mm stapler	Side-to-side fashion	Polyglactin 2-0 RB and 3-0 poliglecaprone RB	Beginning of reconstruction	Van Velthoven	Transposed	Per urethra, internalized	Seldinger	Wallace
Goh et al. [22]	Studer "U"	8	Trendelenburg	60	44	Echlon 60-mm laparoscopic stapler	Side-to-side fashion	2.0 V-loc suture	After posterior wall completion	Van Velthoven	Transposed	Percutaneous, internalized	Seldinger	Bricker
Kang et al. [33]	Camey pouch	4	Trendelenburg	60	60	Endo GIA 60-mm stapler	Side-to-side fashion	Vicryl 3-0	Beginning of reconstruction	Van Velthoven	–	Percutaneous, internalized	–	Bricker
Tyritzis et al. [20]	Studer "U"	70	Trendelenburg (10–15′)	50	40	Endo GIA 60-mm stapler	Side-to-side fashion	Biosyn 3-0	Beginning of reconstruction	Van Velthoven	Transposed	Per urethra, externalized	Seldinger	Wallace
Desai et al[a] [34]	Studer "U"	132	–	50/60	40/44	–	–	–	After/beginning of reconstruction	Van Velthoven	Transposed	–	–	Wallace/ Bricker
Collins et al. [35]	Studer "U"	80	Trendelenburg (10–15′)	50	40	Endo GIA 60-mm stapler	Side-to-side fashion	3-0 V-Loc	Beginning of reconstruction	Van Velthoven	Transposed	Percutaneous, externalized	Seldinger	Wallace
Atmaca et al. [36]	Studer "U"	32	Trendelenburg (5′)	50	40	Endo GIA 60-mm stapler	Side-to-side fashion	Polyglactin 2-0 RB and 3-0 poliglecaprone RB	Beginning of reconstruction	Van Velthoven	Transposed	Per urethra, internalized	Seldinger	Wallace
Butt et al. [37]	Hautmann "W"	4	Trendelenburg	65	60	Endo GIA 60-mm stapler	Side-to-side fashion	Vicryl 3-0	End of reconstruction	–	Nontransposed	Percutaneous, externalized	Seldinger	Bricker
Koupparis et al. [38]	Studer "U"	11	–	–	–	–	–	–	–	–	–	–	–	Bricker
Schwentner et al[a] [39]	Studer "U"	62	Trendelenburg (5′)	50	40	Endo GIA 60-mm stapler	Side-to-side fashion	Polyglactin 2-0 RB and 3-0 poliglecaprone RB	Beginning of reconstruction	Van Velthoven	Transposed	Per urethra, externalized	Seldinger	Wallace
Sim et al[a] [40]	Studer "U"	73	Trendelenburg	50	40	Endo GIA 60-mm stapler	Side-to-side fashion	3-0 absorbable suture	Beginning of reconstruction	Van Velthoven	Transposed	Percutaneous, externalized	–	Wallace
Tan et al. [41]	Pyramid neobladder	20	Trendelenburg (10′)	50	50	Endo GIA 60-mm stapler	Side-to-side fashion	3-0 V-Loc and 2-0 Polyglactin	Beginning of reconstruction	–	Transposed	Percutaneous, externalized	–	Bricker
Almassi et al. [42]	Studer "U"	19	flat	45	30	Endo GIA 60-mm stapler	Side-to-side fashion	3-0 V-Loc and 2-0 Monocryl	After posterior wall completion	–	Transposed	Percutaneous, externalized	–	Wallace
Asimakopoulos et al. [43]	"Y"	40	Trendelenburg	40	40	–	–	–	–	–	–	–	–	–
Collins et al. [44]	Studer "U"	86	Trendelenburg (10–15′)	50	40	Endo GIA 60-mm stapler	Side-to-side fashion	3-0 V-Loc	Beginning of reconstruction	Van Velthoven	Transposed	Percutaneous, externalized	Seldinger	Wallace
Lamb et al. [45]	Pyramid neobladder	31	Trendelenburg (10′)	50	50	Endo GIA 60-mm stapler	Side-to-side fashion	3-0 V-Loc and 2-0 Polyglactin	Beginning of reconstruction	–	Transposed	Percutaneous, externalized	–	Bricker
Pyun et al. [46]	Camey pouch	11	Trendelenburg	60	60	Endo GIA 60-mm stapler	Side-to-side fashion	Vicryl 3-0	Beginning of reconstruction	Van Velthoven	–	Percutaneous, internalized	–	Bricker
Simone et al. [25]	PIB	45	Trendelenburg (20′)	42	42	Endo GIA 60-mm stapler	Side-to-side fashion	Staplers + absorbable suture	Beginning of reconstruction	2 running sutures	Nontransposed	–	–	Split-nipple technique
Minervini et al. [24]	Florin	18	Trendelenburg (20′)	50	50	Endo GIA 60-mm stapler	Side-to-side fashion	V-loc 3-0	Beginning of reconstruction	Van Velthoven	Nontransposed	–	–	Bricker
Current Series[b]	ra-VIP	15	Trendelenburg (30′)	40	40	Endo GIA 60-mm stapler	Side-to-side fashion	Quill 3-0	Beginning of reconstruction	Van Velthoven	Nontransposed	Percutaneous, externalized	Seldinger	Directc

NR = not reported; ra-VIP = robot-assisted Vescica Ileale Padovana.
[a] Data from multicenter study.
[b] Values of heterogenic group.

5. Conclusions

These preliminary results showed that totally intracorporeal ra-VIP is feasible, reproducing the same advantages as those of open procedure. A wider series beyond the learning curve and with longer follow-up is needed to better evaluate long-term functional and oncological outcomes and to reduce operative time.

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Study concept and design: Artibani, Cacciamani.
Acquisition of data: Sebben, Rizzetto.
Analysis and interpretation of data: Artibani, Cacciamani, Porcaro.
Drafting of the manuscript: Artibani, Cacciamani.
Critical revision of the manuscript for important intellectual content: Artibani, Cacciamani, Cerruto, De Marco, Gill.
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Appendix A. Supplementary data

The Surgery in Motion video accompanying this article can be found in the online version at https://doi.org/10.1016/j.eururo.2018.11.037 and via www.europeanurology.com.

References

[1] Alfred Witjes J, Lebret T, Compérat EM, et al. Updated 2016 EAU guidelines on muscle-invasive and metastatic bladder cancer. Eur Urol 2017;71:462–75.
[2] Hautmann RE, Abol-Enein H, Lee CT, et al. Urinary diversion: how experts divert. Urology 2015;85:233–8.
[3] Faba OR, Tyson MD, Artibani W, et al. Update of the ICUD-SIU International Consultation on Bladder Cancer 2018: urinary diversion. World J Urol 2019;37:85–93.
[4] Hautmann RE, Abol-Enein H, Davidsson T, et al. ICUD-EAU International Consultation on Bladder Cancer 2012: urinary diversion. Eur Urol 2013;63:67–80.
[5] Pagano F, Artibani W, Ligato P, Piazza R, Garbeglio A, Passerini G. Vescica Ileale Padovana: a technique for total bladder replacement. Eur Urol 1990;17:149–54.
[6] Fontana D, Destefanis P, Cugiani A. [Evolution and progress in bladder replacement]. Urologia 2007;74:49–52.
[7] Patel R, Szymaniak J, Radadia K, Faiena I, Lasser M. Controversies in robotics: open versus robotic radical cystectomy. Clin Genitourin Cancer 2015;13:421–7.
[8] Smith AB, Raynor M, Amling CL, et al. Multi-institutional analysis of robotic radical cystectomy for bladder cancer: perioperative outcomes and complications in 227 patients. J Laparoendosc Adv Surg Tech A 2012;22:17–21.
[9] Gill I, Cacciamani G. LBA3 the changing face of urologic oncologic surgery from 2000-2018 (63 141 patients)—impact of robotics. J Urol 2018;199:e577–8.
[10] Chan KG, Guru K, Wiklund P, et al. Robot-assisted radical cystectomy and urinary diversion: technical recommendations from the Pasadena Consensus Panel. Eur Urol 2015;67:423–31.
[11] Ahmed K, Khan SA, Hayn MH, et al. Analysis of intracorporeal compared with extracorporeal urinary diversion after robot-assisted radical cystectomy: results from the International Robotic Cystectomy Consortium. Eur Urol 2014;65:340–7.
[12] Collins JW, Hosseini A, Sooriakumaran P, et al. Tips and tricks for intracorporeal robot-assisted urinary diversion. Curr Urol Rep 2014;15:457.
[13] Abreu AL, Chopra S, Azhar RA, et al. Robotic radical cystectomy and intracorporeal urinary diversion: the USC technique. Indian J Urol 2014;30:300–6.
[14] Cerruto MA, De Marco V, D'Elia C, et al. Fast track surgery to reduce short-term complications following radical cystectomy and intestinal urinary diversion with Vescica Ileale Padovana neobladder: proposal for a tailored enhanced recovery protocol and preliminary report from a pilot study. Urol Int 2014;92:41–9.
[15] Cerruto MA, De Marco V, D'Elia C, et al. Introduction of an enhanced recovery protocol to reduce short-term complications following radical cystectomy and intestinal urinary diversion with vescica ileale Padovana neobladder. Urol Int 2014;92:35–40.
[16] Barkun JS, Aronson JK, Feldman LS, et al. Evaluation and stages of surgical innovations. Lancet 2009;374:1089–96.
[17] Dindo D, Demartines N, Clavien PA. Classification of surgical complications: a new proposal with evaluation in a cohort of 6336 patients and results of a survey. Ann Surg 2004;240:205–13.
[18] Mitropoulos D, Artibani W, Graefen M, et al. Reporting and grading of complications after urologic surgical procedures: an ad hoc EAU Guidelines Panel assessment and recommendations. Eur Urol 2012;61:341–9.
[19] Giannarini G, Kessler TM, Thoeny HC, Nguyen DP, Meissner C, Studer UE. Do patients benefit from routine follow-up to detect recurrences after radical cystectomy and ileal orthotopic bladder substitution? Eur Urol 2010;58:486–94.
[20] Tyritzis SI, Hosseini A, Collins J, et al. Oncologic, functional, and complications outcomes of robot-assisted radical cystectomy with totally intracorporeal neobladder diversion. Eur Urol 2013;64:734–41.
[21] Parekh DJ, Reis IM, Castle EP, et al. Robot-assisted radical cystectomy versus open radical cystectomy in patients with bladder cancer (RAZOR): an open-label, randomised, phase 3, non-inferiority trial. Lancet 2018;391:2525–36.
[22] Goh AC, Gill IS, Lee DJ, et al. Robotic intracorporeal orthotopic ileal neobladder: replicating open surgical principles. Eur Urol 2012;62:891–901.
[23] Sim A, Balbay MD, Todenhöfer T, et al. Robot-assisted radical cystectomy and intracorporeal urinary diversion—safe and reproducible? Cent Eur J Urol 2015;68:18–23.
[24] Minervini A, Vanacore D, Vittori G, et al. Florence robotic intracorporeal neobladder (FloRIN): a new reconfiguration strategy developed following the IDEAL guidelines. BJU Int 2018;121:313–7.

[25] Simone G, Papalia R, Misuraca L, et al. Robotic intracorporeal Padua ileal bladder: surgical technique, perioperative, oncologic and functional outcomes. Eur Urol 2018;73:934–40.
[26] Novara G, Ficarra V, Minja A, De Marco V, Artibani W. Functional results following vescica ileale Padovana (VIP) neobladder: midterm follow-up analysis with validated questionnaires. Eur Urol 2010;57:1045–51.
[27] Giannini S, Nobile M, Sartori L, et al. Bone density and skeletal metabolism in patients with orthotopic ileal neobladder. J Am Soc Nephrol 1997;8:1553–9.
[28] Pruthi RS, Nix J, McRackan D, et al. Robotic-assisted laparoscopic intracorporeal urinary diversion. Eur Urol 2010;57:1013–21.
[29] Shao P, Li P, Ju X, et al. Laparoscopic radical cystectomy with intracorporeal orthotopic ileal neobladder: technique and clinical outcomes. Urology 2015;85:368–73.
[30] Jonsson MN, Adding LC, Hosseini A, et al. Robot-assisted radical cystectomy with intracorporeal urinary diversion in patients with transitional cell carcinoma of the bladder. Eur Urol 2011;60:1066–73.
[31] Schumacher MC, Jonsson MN, Hosseini A, et al. Surgery-related complications of robot-assisted radical cystectomy with intracorporeal urinary diversion. Urology 2011;77:871–6.
[32] Canda AE, Atmaca AF, Altinova S, Akbulut Z, Balbay MD. Robot-assisted nerve-sparing radical cystectomy with bilateral extended pelvic lymph node dissection (PLND) and intracorporeal urinary diversion for bladder cancer: initial experience in 27 cases. BJU Int 2012;110:434–44.
[33] Kang SG, Ko YH, Jang HA, et al. Initial experience of robot-assisted radical cystectomy with total intracorporeal urinary diversion: comparison with extracorporeal method. J Laparoendosc Adv Surg Techniques A 2012;22:456–62.
[34] Desai MM, Gill IS, Abreu ALD, et al. Robotic intracorporeal orthotopic neobladder during radical cystectomy in 132 patients. J Urol 2014;192:1734–40.
[35] Collins JW, Sooriakumaran P, Sanchez-Salas R, et al. Robot-assisted radical cystectomy with intracorporeal neobladder diversion: the Karolinska experience. Indian J Urol 2014;30:307–13.
[36] Atmaca AF, Canda AE, Gok B, Akbulut Z, Altinova S, Balbay MD. Open versus robotic radical cystectomy with intracorporeal Studer diversion. J Soc Laparoendosc Surg 2015;19, e2014.00193.
[37] Butt ZA, Forbes E, Zorn J, Martin BS. Robotic radical cystectomy with intracorporeal neobladder: Initial experience and outcomes. Can Urol Assoc J 2015;9:E156–9.
[38] Koupparis A, Villeda-Sandoval C, Weale N, El-Mahdy M, Gillatt D, Rowe E. Robot-assisted radical cystectomy with intracorporeal urinary diversion: impact on an established enhanced recovery protocol. BJU Int 2015;116:924–31.
[39] Schwentner C, Sim A, Balbay MD, et al. Robot-assisted radical cystectomy and intracorporeal neobladder formation: on the way to a standardized procedure. World J Surg Oncol 2015;13:3.
[40] Sim A, Todenhofer T, Mischinger J, et al. Y pouch neobladder—a simplified method of intracorporeal neobladder after robotic cystectomy. J Endourol 2015;29:387–9.
[41] Tan WS, Sridhar A, Goldstraw M, et al. Robot-assisted intracorporeal pyramid neobladder. BJU Int 2015;116:771–9.
[42] Almassi N, Zargar H, Ganesan V, Fergany A, Haber GP. Management of challenging urethro-ileal anastomosis during robotic assisted radical cystectomy with intracorporeal neobladder formation. Eur Urol 2016;69:704–9.
[43] Asimakopoulos AD, Campagna A, Gakis G, et al. Nerve sparing, robot-assisted radical cystectomy with intracorporeal bladder substitution in the male. J Urol 2016;196:1549–57.
[44] Collins JW, Adding C, Hosseini A, et al. Introducing an enhanced recovery programme to an established totally intracorporeal robot-assisted radical cystectomy service. Scand J Urol 2016;50:39–46.
[45] Lamb BW, Tan WS, Eneje P, et al. Benefits of robotic cystectomy with intracorporeal diversion for patients with low cardiorespiratory fitness: a prospective cohort study. Urol Oncol Semin Orig Invest 2016;34:417.e17–e.
[46] Pyun JH, Kim HK, Cho S, et al. Robot-assisted radical cystectomy with total intracorporeal urinary diversion: comparative analysis with extracorporeal urinary diversion. J Laparoendosc Adv Surg Techniques A 2016;26:349–55.