



Original Article

# Robot-assisted laparoscopic ureteroneocystostomy in adults: A single surgeon experience and literature review



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## KEYWORDS

Outcomes;  
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**Abstract** *Objective:* To present our experience and technique with robot-assisted ureteroneocystostomy (RAUN) procedure in adults.

*Methods:* Between February 2015 and August 2018, a total of 30 (34 ureters) patients who underwent RAUN surgery under a single surgeon were retrospectively reviewed. Perioperative data such as age, sex, body mass index (BMI), American society of anesthesiologists score, estimated blood loss, surgical technique, operative time, complications, length of hospital stay, and stent removal time were recorded. During the follow-up, patients underwent renal function test, urinalysis, and renal ultrasound examination for evaluation. Success was defined as symptomatic and radiologic relieve. Lastly, a literature search was conducted to review all published articles regarding RAUN surgery in adults.

*Results:* The patients' mean age, BMI, EBL, operative time, and follow-up period were 45.4 years, 23.1 kg/m<sup>2</sup>, 65.6 mL, 182.9 min, and 21.3 months, respectively. The two most common indications for the surgery were benign ureteral strictures and ureteric injuries secondary to a previous radical hysterectomy. Of the 34 cases, 26 (76.5%) and 8 (23.5%) patients received primary RAUN and RAUN with psoas hitch technique, respectively. Refluxing RAUN method was performed in all cases. No intraoperative complications were found. Two patients had a radiologic and symptomatic recurrence; one was managed with a repeat surgery while the other received ureteral dilatation treatment.

*Conclusion:* Both our study and the published literature showed that RAUN is a safe, less invasive, and effective surgical technique that can easily replicate the open ureteroneocystostomy for managing lower ureteral diseases.

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## 1. Introduction

Several conditions necessitate ureteroneocystostomy as a definitive surgical treatment such as vesicoureteral reflux, congenital megaureter, impacted ureter stone, ureteral stricture after endoscopic procedures, ureteric injuries during pelvic surgeries, and lower ureteric tumors. Ureteral strictures secondary to gynecologic procedures account the majority [1,2]. The extensive use of lasers and ureteroscopes in recent years has also contributed to a higher incidence of stricture formation [3]. Ureteroneocystostomy surgery can be accomplished using a variety of techniques including open, laparoscopic or robot-assisted approach. Smaller strictures at the distal ureter can be easily managed with primary ureteral reimplantation procedure while longer strictures require techniques involving bladder mobilization such as psoas hitch or Boari flap to accommodate the ureteral length shortage [4].

Open ureteroneocystostomy is still the golden treatment approach. Unfortunately, this method is linked with increased estimated blood loss (EBL) and analgesic requirement as well as slower recovery period compared with laparoscopic technique [5]. These disadvantages made open procedure a less favorable technique for modern day urologists. On the other hand, the longer learning curve, lack of depth of perception, and intracorporeal suturing challenges during laparoscopic reconstructive surgeries are the main drawbacks of the traditional two dimensional (2D) laparoscopy.

Fortunately, the birth of robotics has revolutionized surgery in general, particularly in the urological practice where the majority of the cases are appropriate to use robotics. Da Vinci® robotic system (Intuitive Surgical Inc, Sunnyvale, CA, USA) has gained popularity among the urologists for their excellent three dimensional (3D) camera vision, convenient ergonomic design, and its EndoWrist® instrument which can rotate up-to seven degrees and at the same time able to reduce hand tremors.

Robot-assisted ureteroneocystostomy (RAUN) is an excellent surgical choice that allows hand-like suturing ability permitted by the robotic EndoWrist® instrument (Intuitive Surgical Inc, Sunnyvale, CA, USA) plus the benefits of the minimally invasive techniques. In this study, we present our experience regarding RAUN surgery and also summarize and compare the existing literature on this topic with our findings.

## 2. Materials and methods

First, we obtained an approval letter from our institution's ethical committee (Tongji Hospital, Institutional Review Board, IRB ID: TJ-C20180901) to conduct our study. All adult patients who underwent RAUN in our tertiary referral

center under a single surgeon were retrospectively reviewed in our study. Before surgery, patients underwent intravenous urography (IVU), multislice enhanced computed tomography urography (CTU) or/and magnetic resonance urography (MRU) to localize the ureter pathology. Diuretic  $^{99m}\text{Tc}$ -mercaptoacetyltriglycine (MAG3) renography examination was performed when renal function loss or renal atrophy is suspected due to the severity of hydronephrosis. Of those patients who had nephrostomy tube in place, an antegrade urography examination was performed while other patients with reduced renal function who were unable to undergo enhanced CTU or IVU received a retrograde urography.

Perioperative data such as age, sex, body mass index (BMI), American Society of Anesthesiologists (ASA) score, presented symptom, ureter pathology side, estimated blood loss (EBL), surgical technique, operative time, complications, length of hospital stays (LOS), and ureter stent removal time were collected. Patients who had at least 3 months follow-up period were selected for this study. During the follow-up period, patients underwent renal function test, urinalysis, renal ultrasound or CTU to evaluate success after the surgery. Success was defined as symptomatic and radiologic relieve. Lastly, a literature search was conducted using the PubMed database to summarize all previously published articles regarding RAUN surgery in adults to compare with our findings.

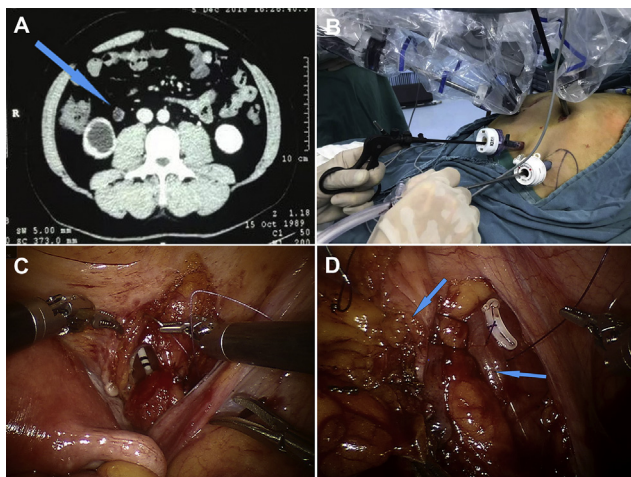
### 2.1. Operative technique

Other investigators previously well described the surgical technique [6,7].

#### 2.1.1. Ureteroneocystostomy technique

A Foley catheter was placed before the beginning of each surgery. All operations were carried out under general anesthesia. Patients undergoing ureteroneocystostomy were placed in a steep Trendelenburg position (the head was lowered at 30°) with their legs apart while lying in a supine position. Rear docking technique was applied utilizing da Vinci® S; (Intuitive Surgical Inc, Sunnyvale, CA, USA) robotic system. A 12 mmHg of pneumoperitoneum was established in all patients. Five access ports were placed, one port for the camera, two for the robotic arms, and two for the assistant (Fig. 1A and B).

The Trendelenburg position with the head down and the counter-traction of the assistant helps the colon and small intestines to fall cranially and out from the operative site. We released the colon and retracted it medially; the peritoneum was then opened at the lateral side above the external iliac vessels. The area was then inspected visually using the robotic 3D camera to identify the diseased segment of the ureter. Depending on the severity of the hydronephrosis, markedly thickened of the ureter was noticed



**Figure 1** Robot-assisted ureteroneocystostomy (RAUN) procedure. (A) CT showing dilated upper urinary tract (arrow shows hydronephrotic ureter); (B) Five ports: Two for the assistant and three for the robotic arms; (C) Primary RAUN anastomosis on a female patient; (D) Psoas hitch technique (arrows showing psoas muscle and a mobilized bladder).

in most of the cases just above the obstructed segment. The ureter was carefully dissected from the surrounding tissues. Great care was always given during the dissection of the periureteral fat to preserve the blood supply to the distal ureter.

The dissection was particularly challenging when dealing with patients who had previous gynecologic surgeries due to fibrotic tissues formed around the diseased ureter. After the ureter is freed from its surroundings, a laparoscopic Hem-O-lok clip was applied to secure the distal end of the ureter. We spent some time releasing the ureter to the cephalad direction to give enough length in order to ensure tension-free anastomosis. Finally, we transected the ureter and ultimately freed from its attachment at the distal end. Clear urine from the decompressed upper urinary tract was noticed in most of the cases except with those patients who had preoperative nephrostomy tube in place. The ureter was then mobilized towards the bladder dome to evaluate the possibility of primary simple ureter reimplantation.

### 2.1.2. Primary ureter reimplantation

In this technique, the opening of Retzius space and bladder mobilization was not required to accommodate the ureter length. The distal end of the ureter was spatulated at 6-o'clock position, followed by a 2 cm vertical incision at the posterior wall of the bladder until clear urine runs out from the bladder; at this step the circulating nurse is asked to release the catheter lock to empty the bladder. A 4-0 Coated Vicryl absorbable suture was first placed at 6-o'clock where we spatulated the ureter, and then sutured to the bladder wall in a reflexing anastomotic fashion. Another two interrupted sutures were placed at 3- and 9-o'clock positions in a similar manner (Fig. 1C). A 7.5 Fr double-J stent was inserted into the ureter towards the upper urinary tract and into the bladder. Lastly, one final suture was placed at 12-o'clock to complete the anastomosis. The bladder was then filled

with normal saline to test the integrity of the anastomosis for any leakage.

### 2.1.3. Ureteroneocystostomy with psoas hitch technique

This technique is indicated when the remaining ureter after the resection cannot easily reach the bladder wall for tension-free anastomosis. Psoas hitch technique starts by entering the Retzius space, similar fashion to that of retropubic prostatectomy. The peritoneum is incised lateral to the umbilical ligaments; the urachus is then released to drop the bladder from the anterior abdominal wall. The bladder is mobilized to a cephalad direction towards the ipsilateral psoas muscle. The psoas muscle and the bladder wall are sutured together using 2.0 Polydioxanone absorbable suture. After the psoas hitch completion, the ureter reimplantation technique is carried out similarly as explained in the above section (Fig. 1D).

## 3. Results

In our institute of urology of Tongji hospital, a total of 34 ureters from 30 patients were re-implanted into the bladder using robot-assisted laparoscopy between February 2015 and August 2018. Of these, 26 of them (76.5%) received primary ureteroneocystostomy while eight (23.5%) of the ureters required RAUN with psoas hitch. The two most common indications for the surgery were ureteral strictures after ureteroscopic laser surgery and ureteric injuries secondary to a previous abdominal hysterectomy, 11 (36.7%), and eight (26.7%) respectively in our study. There was one patient whom we performed simultaneous RAUN and robot-assisted laparoscopic abdominal hysterectomy in one session with the help of gynecologic surgeons (the total operative time was 336 min). Patient demographics such as age, sex, BMI, ASA score, presented symptoms, ureter obstruction side are shown in Table 1.

Intraoperative and postoperative interested parameters are also shown in Table 2. Two patients had a postoperative fever which was managed with a full course of antibiotics. Two more patients were readmitted for a fever after the stent removal; a new stent was introduced, and antibiotics were administered. The mean follow-up time was 21.3 months (ranging between 4 and 44 months). The surgical and clinical outcomes of the existing literature regarding RAUN techniques are summarized in Table 3. Unfortunately, the follow-up of two patients were lost. And of the remaining 32 ureter units, two had a recurrence; one patient required a repeat surgery while the other patient was managed by ureter dilatation and inserting two 7.5 Fr ureter stents for 6 months period.

## 4. Discussion

The literature concerning ureteroneocystostomy approach in the pediatric population is well established compared to that of the adults, perhaps due to the rarity of the lower ureteral pathologies in the adult population [8]. Nevertheless, ureteroscopic laser surgeries and laparoscopic gynecological procedures have been associated to increase the incidence of ureteral injuries leading to distal ureteral

obstructions in the adults [2,3]. For instance, a 0.5% of ureteric injuries were found in a large cohort study comprising 377 073 women who underwent hysterectomy. Of these cases, the laparoscopic approach was significantly associated with higher ureteric injuries than open hysterectomy [2]. In line with the above study, up to 26.7% of our patients developed distal ureteral obstructions after a laparoscopic abdominal hysterectomy, making it the second most common indication for the surgery in our study after ureteric strictures secondary to ureteroscopic laser surgeries.

#### 4.1. Open ureteroneocystostomy

Open technique for reconstructive surgery is the preferred method for many surgeons around the world. The technique allows the surgeons to use their own hands to handle the complex maneuvers required during the ureter reimplantation surgery; unfortunately, there are many unwanted morbidities related to the open technique. Using the National Surgical Quality Improvement Program (NSQIP), Packiam et al. [9] conducted a study containing more than

**Table 1** Patient demographic.

Parameters	Value
Patients, <i>n</i>	30
Ureters, <i>n</i>	34
Gender, <i>n</i> (%)	
Male	14 (46.7)
Female	16 (53.3)
Mean age (year)	
Male	41.5
Female	48.8
Mean BMI (kg/m <sup>2</sup> )	23.1
ASA score, <i>n</i> (%)	
I	12 (40)
II	16 (53.3)
III	2 (6.7)
Presented symptom, <i>n</i> (%)	
Flank pain	18 (60)
Asymptomatic HUN	4 (13.3)
Urinary incontinence	1 (3.3)
Other	7 (23.4)
Obstruction side, <i>n</i> (%)	
Left	11 (36.7)
Right	15 (50)
Bilateral	4 (13.3)
History of ureter stone, <i>n</i> (%)	
Yes	13 (43.3)
No	17 (56.7)
Etiology of the ureter obstruction, <i>n</i> (%)	
Ureteroscopic surgery	11 (36.7)
Radical hysterectomy	8 (26.7)
Ureter malignancy	1 (3.3)
TURBt procedure	3 (10)
Open lithotomy	1 (3.3)
Idiopathic	6 (20)

ASA, American Society of Anesthesiologists; BMI, body mass index; HUN, hydronephrosis; TURBt, transurethral resection of bladder tumors.

**Table 2** Intra- and postoperative outcomes.

Parameters	Value
Procedure, <i>n</i> (%)	
Primary ureteroneocystostomy	26 (76.5)
Psoas hitch	8 (23.5)
Technique, <i>n</i> (%)	
Reflexing	34 (100)
Non-reflexing, <i>n</i> (%)	0 (0)
Preoperative Mean Cr level (μmol/L)	
Male/Female	117.3/73.4
Postoperative Mean Cr level (μmol/L)	
Male/Female	118.2/67
Mean operative time (min)	182.9
Mean EBL (mL)	65.6
Intraoperative complications	0
Postoperative fever, <i>n</i> (%)	2 (6.7)
Mean LOS (day)	7.9
Mean stent removal time (month)	2.3
Mean follow-up (month)	21.3
Recurrence rate, <i>n</i> (%)	2 (6.2)

Cr, creatinine; EBL, estimated blood loss; LOS, length of hospital stay; UTI, urinary tract infection.

500 patients. In the study, they compared laparoscopic with open techniques during ureteroneocystostomy surgeries. The investigators found a short hospitalization period, and lower transfusion rates, urinary tract infections (UTIs), and superficial wound infections in the laparoscopic group compared to the open approach. In the same study, reoperation rates were higher in the laparoscopic surgery group than those treated with the open technique.

#### 4.2. Robotic ureteroneocystostomy

Though laparoscopy carries the benefits of minimally invasive procedures, it also has many challenges including limited motions of its instruments and extended learning period. The restricted motions of the laparoscopic instruments are particularly problematic during reconstructive surgeries. For the above reasons, in early 2000, da Vinci® robotics was introduced as a surgical device. Binder and Kramer [10] reported the first robot-assisted radical prostatectomy. Afterward, numerous urologists and institutions described their experience with robotic surgery for various urological procedures including ureteroneocystostomy [11]. According to Intuitive Surgical, Inc., of the 877 000 da Vinci® robotic procedures performed in 2017 alone, urological surgeries accounted 30.4% [12]; this indicates the substantial growth of robotic urological surgeries around the world. To investigate the efficacy and the safety of robotic surgery, many urologists compared the open technique in various procedures including RAUN. Kozzin and colleagues [13] compared RAUN with open ureter reimplantation technique; they found a significant increase of EBL and LOS in the open technique. Similarly, Isac et al. [14] compared RAUN with open ureteroneocystostomy (25 RAUN vs. 41 open); the operative time was significantly longer in RAUN compared with open approach while EBL, change in hematocrit, LOS and

**Table 3** Summary of existing literatures regarding RAUN in adults.

Author/year (ref)	Study design	Patients, <i>n</i>	Mean age (year)	Sex (male/female)	Surgical indication			Mean EBL (mL)	Mean operative time (min)	Intraoperative complication <sup>b</sup>	Mean LOS (day)	Surgical type, <i>n</i> (%)			Mean follow-up (month)	Recurrence rate, <i>n</i> (%)
					Stricture	Ureter tumor	Other					Primary reimplantation	Psoas hitch	Boari flap		
De Naeyer et al., 2007 [11]	Case report	1	35	0/1	0	1	0	120	None	7.00	0	1	0	2	0	
Patil et al., 2008 [18]	Retrospective	12	41.3	NA	10	0	2	48	208	None	4.30	0	12	0	15.5	0
Williams et al., 2009 [23]	Retrospective	7	43.9	1/6	6	0	1	109	247	None	2.00	7	0	0	18	1 (14.3)
Schimpf et al., 2009 [24]	Retrospective	10	64.7	8/2	2	6	2	82	189	3	2.40	5	3	2	18.3	0
Symons et al., 2009 [25]	Retrospective	6	39.3	3/3	4	0	2	NA	290	None	7.20	3	0	3	4	0
Eandi et al., 2010 [26]	Retrospective	4	73.5	1/3	0	4	0	200	311	NA	4.70	0	4	0	15.2	1 (25.0)
Hemal et al., 2010 [27]	Retrospective	18	NA	NA	2	5	11	98.2	137.9	1	2.40	17	1	0	13.5	0
Yang et al., 2011 [28]	Prospective	3	47.7	1/2	1	1	1	116.7	NA	1	4.70	0	1	2	NA	0
Musch et al., 2012 [29]	Retrospective	5	62	4/5	1	2	2	300	306	None	7.00	2	2	1	6	0
Baldie et al., 2012 [30]	Retrospective	13	41.8	5/8	11	0	2	187	266.8	3	2.78	5	7	1	4.4	0
Kozzin et al., 2012 [13]	Retrospective	10	49.3	5/5	5	0	0	30.6	306.6	None	2.40	4	4	2	24	0
Isac et al., 2013 [14]	Retrospective	25	49	8/17	20	0	5	100	279	None	3.00	11	4	10	11.6	1 (4.0)
Musch et al., 2013 [20]	Retrospective	14	64.3	7/7	7	4	3	NA	276.5	None	11.30	5	5	4	10.2	1 (7.1)
Lee et al., 2013 [6]	Retrospective	10	52.9	1/9	2	2	6	102.5	211.7	None	2.80	4	6	0	28.5	2 (20.0)
Fifer et al., 2014 [15]	Retrospective	55	52	22/33	45	10	0	50	233	2	1.60	10	35	9	6	3 (5.3)
Slater et al., 2015 [31]	Retrospective	13	39.8	1/12	1	0	12	40	286	1	2.30	10	0	3	20.7	0
Wason et al., 2015 [32]	Retrospective	13	46	2/11	12	0	1	123	282	None	2.50	13	NS	NS	10	0
Stolzenburg et al., 2016 [33]	Retrospective	11	49.9	NA	11	0	0	155.5	166.8	None	NA	0	0	11	12.5	0
Buffi et al., 2017 [16]	Retrospective	21	43	NA	10	0	11	NA	166	None	8.00	21	0	0	24	1 (4.8)
Kaouk et al., 2018 [22] <sup>a</sup>	Prospective	3	55.3	2/1	1	0	2	43.3	165	None	1.30	1	2	0	NA	NA
Current Study	Retrospective	30	45.4	14/16	21	1	10	65.6	182.9	None	7.90	22	8	0	21.3	2 (6.2)

NA, not available; NS, not specified; LOS, length of hospital stay; RAUN, robot-assisted ureteroneocystostomy; EBL, estimated blood loss.

<sup>a</sup> Single port RAUN procedure.

<sup>b</sup> The details of the complications should be referred in the original articles.

narcotic requirement were all higher in the open ureteroneocystostomy.

To date, Fifer et al. [15] have reported the largest series about RAUN for both benign and malignant indications for the surgery. The median operative time and EBL were 233 min and 50 mL, respectively. Of the 55 cases they reported, only three (5.3%) patients required reintervention for unsuccessful treatment, and all the three failed cases were RAUN with Boari flap procedure. Likewise, Buffi et al. [16] reported 21 cases of RAUN, and they also found similar results to that of Fifer and colleagues [15]. Of the 34 RAUN in our study, the operative time, EBL, as well as the intraoperative complications, were consistent with that previously reported by other investigators (see the comparisons in Table 3).

Lack of tactile feedback is one of the main disadvantages of robotic surgery. Therefore, surgeons greatly depend on preoperative images and intraoperative visual inspections to correctly identify the obstructed site. The obstructed area identification can be very challenging, particularly when the ureter is not dilated. None of the series we reviewed in the literatures, as well as our data have shown any specific challenges for finding the obstructed ureter during RAUN. To help identify the obstructed site, Lee et al. [17] reported the use of off-label indocyanine green (ICG) dye which is directly injected into the ureter. The ICG can be visualized using near-infrared fluorescence (NIRF) with the help of a specialized camera inside the robotic machine (Firefly system). Unfortunately, the use of Firefly system and NIRF technology require the hospitals to upgrade their robotic machines; this effort increases the operational cost for both patients and the hospitals making RAUN procedure economically less favorable than the open approach.

#### 4.2.1. RAUN with psoas hitch and Boari flap techniques

Psoas hitch and Boari flap techniques are well described in the literature for their use in open surgery. De Naeyer et al. [11] explored the first case of RAUN with psoas hitch technique using da Vinci® robotics. The authors described their technique in detail; they concluded that robotic approach offers more significant advantages to the traditional laparoscopy such as minimized trauma to the mucosa, fewer challenges during ureter-bladder anastomosis, and better visibility due to the 3D camera technology mounted in the da Vinci® robotics system. Patil et al. [18] presented the data of 12 patients who have received RAUN with psoas hitch technique from three different institutions in three countries. According to the authors, the technique has simplified the submucosal tunneling of the ureter during non-refluxing ureteroneocystostomy which demands a good dissection and an excellent dexterity. Though the study was conducted in three different countries and health systems, their mean length of hospitalization was shorter compared to ours (mean LOS, 4.3 days vs. 7.9 days, respectively). However, the prolonged LOS in our study was mostly nonclinical reason, in which the patients electively choose to stay at the hospital for an extended period to recover.

#### 4.2.2. Refluxing and non-refluxing methods during RAUN

During vesicoureteral anastomosis, a refluxing or anti-refluxing method can be performed; both techniques are

well documented in the literature. It is believed that refluxing technique could increase the risk of upper tract infections and renal insufficiency through the vesicoureteral reflux (VUR). However, the current literature could not find any significant difference between refluxing and anti-refluxing techniques concerning renal function preservation [19]. Musch et al. [20] and Lee et al. [6] reported an anti-refluxing technique in 4/14 and 2/10 of RAUN cases respectively in their studies, both the operative time and the recurrence rate of the two techniques were similar, nevertheless, the authors did not present any comparison of the renal function between the two techniques. Most of the studies we reviewed including our data have performed refluxing anastomosis technique which is less technically challenging. None of the studies reported any clinical or surgical disadvantage regarding RAUN refluxing technique. Similarly, we did not find any significant renal function compromise in our patients after a mean follow-up of 21.3 months.

#### 4.2.3. Rear docking and side docking techniques during RAUN

Almost all pelvic robotic surgeries are carried out through the rear docking technique; in this approach abduction of lower limbs is required in order to dock the machine. In contrast to that, some investigators explored the use of the side-docking technique [21]. Investigators found that side-docking has more advantages than rear docking; full access to the perineum is one of the advantages; it allows urologists to perform simultaneous cystoscopy as well as vaginal or rectal examination to check if any injury during the surgery. Chan et al. [21] stated that side-docking technique avoids the extreme leg abduction required during rear docking approach; they added that the technique is particularly useful for the patients with muscle contracture and previous hip surgery.

#### 4.2.4. RAUN with single port approach

Da Vinci SP® (Single Port) surgical system is one of the newest advances in robotic surgery. The Food and Drug Administration (FDA) approved this new machine in May 2018. The device has three multi-joined wrist instruments and a 3D high definition camera; all these instruments pass through a single port to the patient, reducing the number of ports from five into one or two ports only. Kaouk et al. [22] reported the first single port RAUN in three patients with benign ureteral strictures; the surgical outcomes in this study such as operative time and EBL were comparable to that operated by the standard da Vinci® robotics system. The single arm of the da Vinci SP® surgical system enables the surgeons to rotate the machine up to 360° which is an excellent advantage as described by the authors.

### 4.3. Limitations

We should address the limitations such as the higher cost to purchase and maintain the robotic machine, lack of tactile feedback, and the prolonged set-up time during robotic surgery. Furthermore, the retrospective nature, smaller sample size, and the lack of ureter stricture measurements are some of the specific limitations of this study.

## 5. Conclusion

Although open ureter reimplantation is still the golden approach; unfortunately, the approach is associated with many unwanted morbidities. RAUN technique is a less invasive, safe and effective surgical method that can be used to manage all kinds of lower ureteral pathologies. RAUN approach can easily replicate the open ureter reimplantation surgery with an excellent surgical and clinical outcome. On the other hand, endourologists and gynecologic surgeons should use some preventive methods to avoid iatrogenic ureteral incidents during pelvic and ureteroscopic surgeries since they cause the majority of ureteral injuries in adults. Future well-designed prospective studies with larger sample size comparing RAUN with the open technique to assess the safety, efficacy, and cost difference between the two procedures are recommended to validate our claims.

## Author contributions

*Study design:* Shaogang Wang.

*Data acquisition:* Isse Dirie Najib.

*Data analysis:* Isse Dirie Najib.

*Drafting of manuscript:* Isse Dirie Najib.

*Critical revision of the manuscript:* Shaogang Wang.

## Conflicts and interest

The authors declare no conflict of interest.

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