

Distal ureterectomy techniques in laparoscopic and robot-assisted nephroureterectomy: Updated review

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Abstract

Controversies exist about the best method for managing the distal ureter during the laparoscopic (LNU) and robot-assisted nephroureterectomy (RANU). Therefore, PubMed, Scopus and Web of Science databases were searched in order to identify articles describing the management of distal ureter during LNU or RANU in patients suffering from upper urinary tract urothelial cell carcinoma. Forty seven articles were selected for their relevance to the subject of this review. The approaches that are usually performed regarding the distal ureter management are open excision, transurethral resection of ureteral orifice (Pluck Technique), ureteric intussusception and pure LNU or pure RANU. Pure LNU and RANU with complete laparoscopic dissection and suture reconstruction of ureter and bladder cuff seems to be better tolerated than open nephroureterectomy providing equal efficacy, without deteriorating the oncological outcome, however evidence is poor. Transurethral resection of the ureteric orifice and the bladder cuff after occlusion of the ureter with a balloon catheter seems to be an attractive alternative option for low stage, low grade tumors of the renal pelvis and the proximal ureter, while stapling technique is correlated with the increased risk of positive surgical margins. The open resection of the distal ureter in continuity with the bladder cuff is considered the most reliable approach, preferred in our practice as well, however the existing data are based on retrospective and non-randomized studies.

Key Words: Laparoscopy approach, nephroureterectomy, robotics, upper urinary tract urothelial cell carcinoma

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INTRODUCTION

Upper tract transitional cell carcinoma (UT-TCC) accounts for approximately 5% of all kidney tumors and 5% of all urothelial carcinomas.^[1] It is frequently multifocal, often associated with high grade disease, and has an increased rate of ipsilateral ureteral recurrence.^[2] Therefore, the standard treatment of UT-TCC is open nephroureterectomy (ONU)

with ipsilateral bladder cuff excision regardless the tumor location.^[3]

Laparoscopic nephroureterectomy (LNU) was first reported as an alternative to open approach.^[4] Though, LNU has been reported to be equivalent to ONU controversy still exists about the best method for managing the distal ureter and bladder cuff during the laparoscopic and robot-assisted approach.^[5] To date, no technique has been shown to distinguish itself as being significantly better than another in terms of perioperative or oncologic outcomes, thus surgeon preference has generally dictated how the distal ureteral and bladder cuff is managed.^[6]

This review article describes the surgical steps and compares the benefits and disadvantages of several techniques which are

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used for ureter and bladder cuff resection during LNU or robot-assisted nephroureterectomy (RANU).

MATERIALS AND METHODS

For this publication, a search of the PubMed, Scopus, and Web of Science databases using the terms “distal ureter,” “robotic nephroureterectomy,” “urothelial cell carcinoma,” and “laparoscopy nephroureterectomy” was conducted. The research was focused only in articles describing the management of distal ureter in patients suffering from upper urinary tract urothelial cell carcinoma.

Two review authors independently screened the titles and abstracts of the articles identified from the search for relevance. Outcome parameters were the several surgical techniques performed in the management of distal ureter, focusing in techniques that have been used during LNU or RANU. The research was limited to the period from 1980 to 2013. Only peer-reviewed studies published in English were included.

Manuscripts that were irrelevant to the objective of this review were excluded. Any disagreement was resolved by discussion and final decision was based on a consensus. Finally, forty-seven manuscripts were selected for their relevance to the subject of the review.

Advantages of laparoscopic nephroureterectomy robot-assisted nephroureterectomy

Both LNU and RANU offer the benefits of minimally invasive surgery, including less blood loss, decreased postoperative narcotic use, and shorter hospital stay.^[7] Moreover, the Da Vinci Robot System was introduced with the goal of decreasing the technical difficulty of intracorporeal suturing, cause of its advantages such as 7° of freedom, three-dimensional vision, movement scaling, and tremor control. The EndoWrist of robotic instruments (Intuitive Surgical, Sunnyvale, CA, USA) are especially suited for the dissection of the distal ureter and bladder cuff, which are difficult to access in the narrow confines of the pelvic cavity. Although robotics has enhanced the feasibility of performing a distal ureterectomy and proper bladder cuff, the re-positioning, re-docking of the robot and in some instances, re-preparing the patient, all adds to a lengthy operation.

DISTAL URETERECTOMY TECHNIQUES

In surgical oncology, en bloc dissection of the kidney, the distal ureter and bladder cuff is the preferred method for treating UT urothelial cancer, whether LNU, RANU or ONU is performed.^[8] In addition, when the tumor is located in the renal pelvis or the proximal ureter, the distal ureter should be occluded before ureterectomy in order to prevent spillage of UT cancer cells into the perivesical space.^[9] Total excision of the entire ureter, including the distal ureter with its intramural

portion, the ipsilateral ureteral orifice and bladder cuff is mandatory due to the increased risk of tumor recurrence.^[2,10]

Multiple techniques for ureter and bladder cuff resection have been described during LNU or RANU, including open excision, transurethral resection (TUR) of ureteral orifice (pluck technique), ureteric intussusception, and pure laparoscopy or pure RANU^[11] [Table I].

The oncologic outcomes of the above procedures are summarized in Table 2.

Open resection technique

The open resection technique forms the standard against which all other techniques are compared. It is typically performed after nephrectomy. The patient is moved into a standard supine position and a modified Pfannenstiel or Gibson incision is performed. The lower ureter is clipped, dissected free, and removed in continuity with the bladder cuff. The bladder cuff may be secured extravesically or via an anterior cystotomy, but the transvesical approach is considered the most reliable approach for ensuring complete ureteral excision. The bladder is then sutured in two layers with running suture and the specimen is delivered through the same incision.^[8,12]

The specific technique is an excellent procedure to perform when there is a distal ureteral tumor location, while it enables accurate histological examination. Patient repositioning is not always mandatory. Caution must be taken when “blind” extravesical clamping of the distal ureter is performed since it may compromise the contralateral ureteral orifice and does not ensure complete bladder cuff retrieval.^[5]

The open transvesical approach guarantees precise distal ureter and bladder cuff excision after preventive ureteral occlusion but violates bladder integrity in both cystotomy and bladder cuff excision site in a patient with a UT-TCC. Therefore, an anterior cystotomy must be eschewed when there is an active bladder TCC.

Transurethral resection of ureteral orifice (pluck technique)

Ureteral endoscopic surgery has been proposed as a complementary step in nephroureterectomy, either open or laparoscopic, in order to obviate the low abdominal incision.^[13] It is accomplished either by resecting transurethrally the ureter itself, in the line of its intramural segment with a resectoscope loop or by circumcision of the ureteric orifice and intramural ureter usually with a Collins knife. The ureteric orifice is resected deep into extravesical fat allowing subsequent “plucking” of the entire ureter from above. It is often performed prior the laparoscopic or robotic nephrectomy, while the patient is afterward removed in the flank position for the subsequent nephrectomy.

Table 1: Several approaches on management of distal ureter during laparoscopic nephroureterectomy or robot-assisted laparoscopic nephroureterectomy

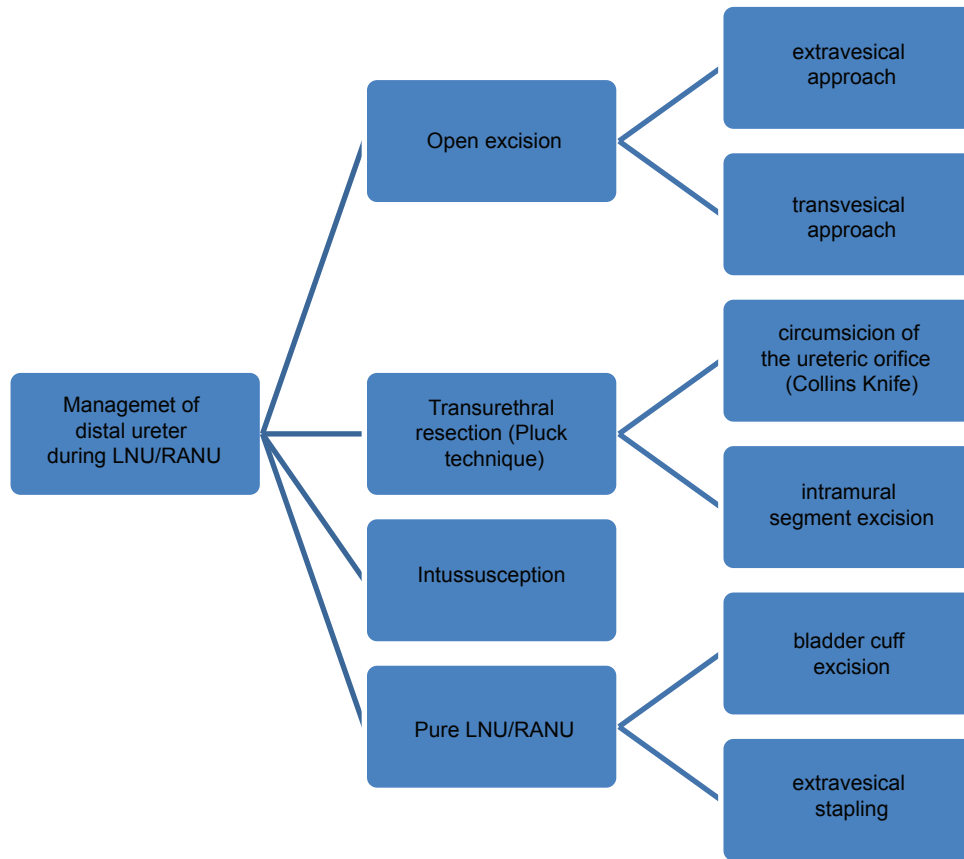


Table 2: Summary of noncomparative case series regarding basic outcomes in several distal ureterectomy techniques in patients who underwent laparoscopic or robotic nephroureterectomy

Author	Years	f/u (m)	n	PM (%)	BR (%)	PR (%)	Median hospital stay (days)	PT
Wong <i>et al.</i> ^[22]	2002	8	14	ND	14.2	0	2	LNU: Pluck without repositioning
Klingler <i>et al.</i> ^[8]	2003	22.1	19	0	10.5	5	8.1	LNU: Open excision
Nanigian <i>et al.</i> ^[24]	2006	6	10	0	16	0	3	pRANU: Transvesical approach
Tsivian <i>et al.</i> ^[25]	2007	11.6	13	0	0	0	3.8	LNU: Ligasure stapling
Agarwal <i>et al.</i> ^[16]	2008	15	13	0	38	0	7.3	LNU: Pluck/Endoloop
Park <i>et al.</i> ^[26]	2009	ND	5	0	ND	ND	8.4	pRANU with hybrid port: No repositioning
Zou <i>et al.</i> ^[17]	2011	18	6	0	0	0	8	LNU: Pluck/ureteral occlusion
Hemal <i>et al.</i> ^[27]	2011	Short term	15	0	0	0	2.7	pRANU: No repositioning or undocking
Giannakopoulos <i>et al.</i> ^[28]	2012	31	10	ND	30	0	ND	LNU: Transvesical approach

f/u: mean follow-up, n: Number of patients, PM: Positive margins, BR: Bladder recurrence, PR: Pelvic recurrence, PT: Procedure type and technical aspects, ND: No data, LNU: Laparoscopic nephroureterectomy, pRANU: Pure robot assisted nephroureterectomy

The so-called “pluck” technique has been suggested to be oncologically safe in patients with proximal, low grade tumors.^[14] This technique is not suitable for tumors or multifocal disease involving the lower ureter or the uretero-vesical junction or widespread carcinoma *in situ* due to the likelihood of tumor seeding, risk of local recurrence, and positive surgical margins.^[15] Patients with previous pelvic irradiation and active inflammatory conditions of the bladder are not ideal candidates for endoscopic procedures, also.

Concerns remain if the ureter is not occluded before resection, due to the risk of tumor spillage or retroperitoneal recurrences. To avoid such drawback, various modifications of ureteral occlusion have been suggested^[16-23] [Table 3].

Intussusception (stripping) technique

Several modifications of this procedure have been described.^[29-31] In general, a bulb-tipped ureteral catheter is placed endoscopically at the beginning of the procedure, nephrectomy is then performed, the ureter is dissected

downward to the bladder, ligatures are placed above and below the bulb so that the catheter is well-secured and afterward the ureter is divided above the catheter. Afterward, the patient is moved to the lithotomy position and the ureter is intussuscepted into the bladder with retrograde traction on the ureteric catheter, while a resectoscope is passed alongside the inverted ureter to excise the attached orifice.

The intussusception technique is contraindicated for ureteral tumors and primarily confined to low-grade renal pelvic tumors.

Pure laparoscopy or pure robot-assisted nephroureterectomy

Pure laparoscopy and RANU includes the technique of laparoscopic dissection with either extravesical stapling of the distal ureter or complete laparoscopic dissection and suture reconstruction of ureter and bladder cuff. The trocar configuration is identical to laparoscopic nephrectomy trocar deployment pattern, except that all the trocars are moved slightly caudal for better access to the distal ureter and bladder cuff.

The extravesical laparoscopic stapling technique (EndoGIA tissue stapler – Covidien company, USA or large Hem-o-lock clip – Teleflex company, USA) has been suggested in order to reduce operative time and maintain a closed urinary tract, thus preventing tumor spillage. In addition, cystoscopic unroofing and fulguration of the ipsilateral ureteral orifice may be performed.^[32] Similarly, the bladder cuff can be excised laparoscopically using the LigaSure without the need for staples.^[25] During the stapling procedure, the surgeon must pay attention in order not to leave part of the intramural ureter behind or to avoid injury to the contralateral ureteric orifice.

Simplest variety of the stapling technique is the hand-assisted laparoscopic (HAL) en bloc distal ureterectomy with bladder

cuff excision (without cystoscopy) using a harmonic scalpel, which seems to reduce the operative time.^[33]

Several techniques have been described for the complete dissection and suture reconstruction of ureter and bladder cuff. Various combinations such as pure LNU or laparoscopic nephrectomy and robotic excision of the bladder cuff or total RANU with or without repositioning the patient and with or without undocking the robot have been introduced in order to shorten the operative time without deteriorating the exposure of the distal ureter and the closure of the bladder cuff.^[24,26,27,34] Namely, these techniques are used to treat UT-TCC, which is either high-grade disease or bulky, low-grade disease that is deemed not amenable to endoscopic management.

Nanigian *et al.* described a transvesical technique using the robot to complete the distal ureterectomy in an attempt to replicate the open approach.^[24] “According to this procedure, the laparoscopic method was used firstly for the nephrectomy and afterward and intravesical incision of the ureteric orifice was performed robotically to manage the bladder cuff.” Similar techniques have been also described in pure LNU.^[28,35]

Tracy CR described pure RANU technique in which, after completion of nephrectomy, the robotic arms were undocked without moving the patient cart.^[34] [Figure I]. A similar novel technique, using a dual-hybrid port, was reported by Park *et al.*^[26] [Figure 2] according to the authors, the total operative time was reduced by 50 min in comparison with patients who need repositioning from flank to lithotomy position while the exposure of the distal ureter and closure of the bladder cuff was improved.

Hemal *et al.* presented surgical tips and described their technique for successful performance of total robotic nephroureterectomy with bladder cuff excision, without repositioning the patient and redocking of the robot.^[27] According to the authors, surgical

Table 3: Modifications of pluck technique

Author	Year	Description of the technique
Cormio <i>et al.</i> ^[18]	2013	Ureter is endoscopically occluded with a 5F Fogarty balloon catheter before the transurethral circumferential resection of the bladder cuff
Zou <i>et al.</i> ^[17]	2011	Pneumovesicum (10-12 mmHg) is established through a resectoscope and Collins knife is used to incise the ureteric orifice circumferentially. A 10-mm trocar is then inserted into the bladder under direct vision with the resectoscope and Hem-o-lok clips are placed across the bladder cuff
Agarwal <i>et al.</i> ^[16]	2008	After partial circumscribing of the bladder cuff with a Collin's knife, a PDS Endoloop is passed through the cystoscope to occlude the ureteral orifice and finally, the bladder cuff is completely circumscribed
Vardi <i>et al.</i> ^[23]	2006	A flexible cystoscope with a 5F electrode is inserted via the urethra to perform bladder cuff excision in order to avoid patient repositioning
Tan <i>et al.</i> ^[20]	2005	Clipping of the ureter during LNU, and afterwards, the Pluck technique using Collins knife
Wong <i>et al.</i> ^[22]	2002	The ureter is clipped and dissected prior to the kidney dissection in a HAL nephrectomy. Then, nephrectomy is performed and afterward, the remaining dissection is completed intravesically under cystoscopic guidance, without suturing the bladder
Gill <i>et al.</i> ^[19]	1999	Endoloop is placed through 2 transvesically placed laparoscopic ports in order to ligate the orifice before complete detachment of distal ureter and bladder cuff

LNU: Laparoscopic nephroureterectomy, HAL: Hand-assisted laparoscopic

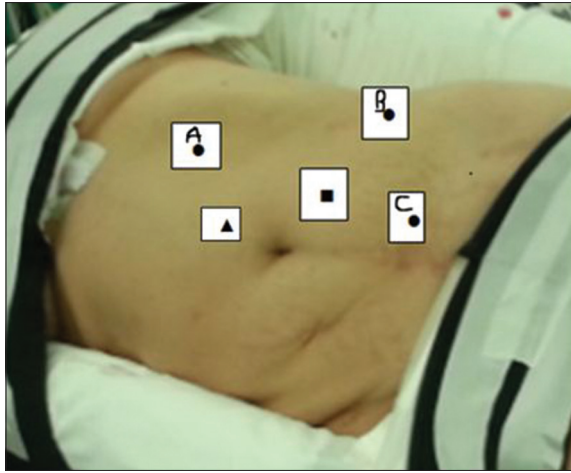


Figure 1: Configuration of robotic arms according to Tracy CR description, which allows to complete left robot-assisted nephroureterectomy without repositioning the patient. A 12-mm camera port (■) is placed at the level of umbilicus and three 8-mm robotic trocars (●) are placed in the mid-clavicular line 2–3 cm below the costal margin (a), laterally along the anterior axillary line at the level of the camera port (b) and in the mid-clavicular line about 8 cm below the camera port (c), respectively. A fifth 12-mm assistant port (▲) is placed in the midline 5–8 cm above the umbilicus. After completion of nephrectomy, the robotic arms are undocked without moving the patient cart and a change in the instruments is made afterward, so in case of left ureterectomy Port B carries bipolar forceps and becomes the surgeon's left arm, while port C carries monopolar scissors and becomes the surgeon's right arm. Port A can be used as a fourth arm to assist in cystostomy and final repair

tips for successful operation are the strategic configuration of the ports to allow access to the kidney, ureter, and bladder, the early placement of clips to ureter, immediately after ligating the renal hilum to minimize the risk of tumor seeding resulting from manipulation of the kidney, the wide dissection of the ureter in cases of ureteric tumors, while bladder stay sutures can be placed lateral to the uretero-vesical junction to prevent retraction of the bladder once the bladder cuff is excised. The configuration of the ports was similar to Tracy description. The authors concluded that they had excellent short-term oncological outcomes and less operative time.

COMPARISON OF SEVERAL TECHNIQUES

The ideal nephroureterectomy procedure is to remove the entire ipsilateral UT in continuity while avoiding extravascular transfer of tumor-containing urine during bladder surgery, in an acceptable operative time with the least surgical complications. Less radical treatment leaving the ureteral stump is associated with recurrence in a third to half of all patients.^[36] All techniques should be compared with the open distal nephroureterectomy, which remain the gold standard technique.

Open resection of the bladder cuff can be performed extravascularly or transvesically. Li *et al.* compared these both approaches with the pluck technique and suggested that none

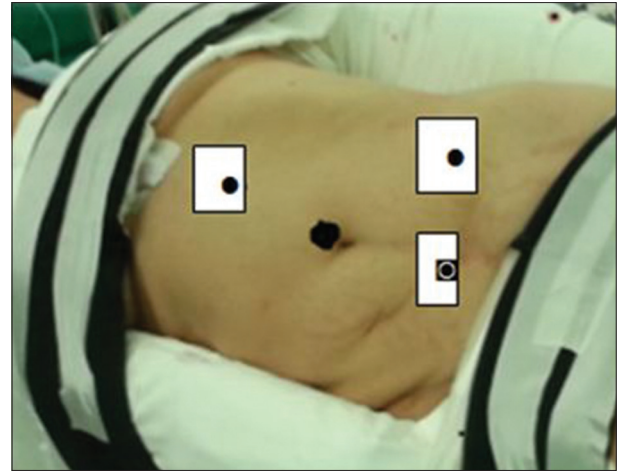


Figure 2: Robot-assisted nephroureterectomy without patient's repositioning, using a hybrid port. A 12-mm camera port (■) is placed at the superior umbilical region and two 8-mm robotic ports (●) are placed at the lateral rectus margin (first), 3–4 cm below the umbilicus and in the midline between the umbilicus and the xiphoid process (second). A dual 8–12-mm assistant hybrid port (■) is placed between the umbilicus and pubic symphysis, which allows to be intubated with an 8-mm robotic arm. After the robotic nephrectomy is completed, the robotic axis is switched for the distal ureterectomy and the configuration of robotic ports is changed. Thus, the port for first robotic instrument arm during nephrectomy becomes an assistant port during bladder cuff excision, the port for the second robotic instrument arm becomes the dominant hand and the assistant port is converted to the nondominant hand

of these techniques have demonstrated inferiority to excision of the bladder cuff.^[37]

It is unclear if TUR of the distal ureter allows for wide bladder cuff dissection, so as to prevent positive margins. Local recurrence following a pluck nephroureterectomy has been noted on many occasions.^[15,38,39] On the other hand, Palou *et al.* reported no local recurrences after an average follow up of 20 months in 31 patients with mainly high grade UT-TCC who had been operated with a transurethral approach for resecting the bladder cuff.^[13] The above results reveal the necessity to perform prospective randomized studies.

An interesting multi-institutional retrospective study was recently performed by Xylinas *et al.*^[40] The authors compared the results of 2681 patients who had undergone nephroureterectomy in order to estimate the oncologic outcomes when three different approaches (endoscopic, extravascular, transvesical) of bladder cuff management were used. The conclusions of this study were that the endoscopic management of distal ureter was associated with higher intravesical recurrence rates compared to the other methods which found to be equivalent. However, the overall survival and the cancer specific survival were the same regardless the approach used. Moreover, the same author reported that the laparoscopic approach constitutes an independent factor of intravesical recurrence.^[41]

Questions remain if cystotomy closure after bladder's cuff excision is necessary.^[42,43] Findings from Brown *et al.* raise concern about the oncological efficacy of leaving the cystotomy open, especially in patients who have distal ureteral disease or a history of bladder or contralateral UT tumor.^[43]

Comparing the pluck technique with the ureteral stripping procedure, Geavlete *et al.* claimed that there are no differences between the techniques with regard to operative time, complications, and oncologic outcome.^[31] These results were also reproducible by other authors.^[38]

Gill *et al.* announced the TUR of the intramural ureter technique assisted by two ports placed transvesically for early occlusion of the ureter.^[19] They suggested that this method is oncologically safer than transurethral distal ureter and bladder cuff detachment. However, concerns remaining for the possibility of portsite metastases. They also compared their novel technique with the laparoscopic stapling approach and announced that positive margins, rates of bladder recurrences (BRs), and distant metastasis were more common in the stapling group, but without statistical significance.^[44]

Laparoscopic dissection with extravesical stapling of the distal ureter avoids cystotomy, thus hypothetically minimizes the risk of tumor spillage and pelvic recurrence (PR). However, this technique risks leaving viable ureteral mucosa and it may result in greater positive margin rate. In addition, staples may remain exposed within the bladder predisposing to stone formation, while the stapled margin cannot be assessed histologically.^[45-47] Several authors have compared the various methods to distal ureteral excision and reported a higher incidence of positive surgical margins and local recurrence in the laparoscopic stapling approach.^[43,48] Interestingly, Tsivian *et al.* described a variation on the laparoscopic stapling technique, using a 10-mm LigaSure Atlas instrument in 13 patients and reported that there was no local recurrence in a 1-year follow-up with this procedure.^[25]

Hand-assisted LNU is often seen as a compromise between the open and total laparoscopic technique. In a prospective study, patients undergoing a hand-assisted LNU could expect a quicker discharge from hospital and fewer complications with an equivalent oncologic safety compared to the open procedure.^[49] In a retrospective study, comparing HAL nephroureterectomy with TUR of the bladder cuff and stapled division technique, Brown *et al.* concluded that the operative time was 60-90 min longer and the estimated blood loss, open conversion rate, and indwelling catheterization time were two to three times greater for the cystoscopic ureteral disarticulation group, while the stapled division cohort had a greater positive margin rate than the other groups.^[43]

The safety of pure LNU has not yet achieved final proof. Port-site seeding following LNU remains a concern but is fortunately rare and referred only to case reports.^[50] Recent data, however, show equivalent oncologic results between LNU and open surgery with the benefits of a minimally invasive technique for LNU.^[8,51] LNU has been reported to be equivalent to ONU in margin-free rates, rates of local recurrence, metastases and cancer-specific survival rates after surgery.^[5] Ritch *et al.* performed a retrospective analysis on 36 patients comparing the open resection technique versus the laparoscopic extravesical stapling approach versus total laparoscopic dissection and suture reconstruction of ureter and bladder cuff.^[52] The results of this study showed that laparoscopic stapling and complete laparoscopic resection of distal ureter and suture reconstruction had significantly shorter operative times and length of stay compared with the open resection technique, while a cystoscopically appreciable remnant of the resected ureteral orifice was noted in 50% of the laparoscopic stapling cohort versus none with the open resection or complete laparoscopic resection of distal ureter and suture reconstruction cohorts. The authors concluded that all patients with bulky distal ureter disease must continue to be treated with an open bladder cuff resection technique, while patients with low-stage, low-grade disease are preferentially treated with a total laparoscopic resection.

According to our experience, the open transvesical management of ureteral cuff is the appropriate approach in case of suspicion of advanced disease, while the open or laparoscopic extravesical procedure may be selected in patients with lower stage tumors. We analyzed the data of 18 subjects who had undergone either laparoscopic or RANU with a mean follow-up of 14 months. In two patients, the management of the distal ureter had been performed with the pluck technique and both individuals presented a BR, although the initial tumors were in the renal pelvis. Eight patients were managed with the stapling technique and two of them (25%) developed BR and lung metastasis. The remaining eight subjects had undergone complete removal of the distal ureter and the surrounding bladder cuff with either extravesical or transvesical approach. Only one patient with a T4 tumor who was managed with the extravesical technique developed distal metastasis (DM) (12.5%), while none of the patients who were treated with the transvesical approach deployed metastases or recurrence although their disease was advanced.

The comparative studies of several ureterectomy techniques in patients who underwent laparoscopic or RANU are summarized in Table 4.

CONCLUSIONS

The existing data does not confirm the overwhelming superiority of one technique over the other regarding the management of distal ureter during nephroureterectomy.

Table 4: Comparative studies of several distal ureterectomy techniques in patients who underwent laparoscopic or robotic nephroureterectomy

Author	Year	PT	f/u (m)	n	PM (%)	BR	PR/DM	Median hospital stay (days)
Shalhav <i>et al.</i> ^[21]	2000	ODU (vs.)	24	17	ND	0	2	12
		pLNU	24	25		2	2	6.1
						<i>P</i> =ND	<i>P</i> =ND	<i>P</i> =ND
Brown <i>et al.</i> ^[43]	2005	TUR (vs.)	24	16	0	ND	0	ND
		ODU (vs.)	24	3	0		0	
		Stapling (vs.)	24	7	29		0	
		HAL	24	29	10		1	
				<i>P</i> =ND		<i>P</i> =ND		
Matin and Gill ^[44]	2005	Pluck (vs.)	22	36	2.8	5	2	ND
		pLap stapling	19	12	25	5	1	
					<i>P</i> =0.096	<i>P</i> =0.99		
Geavlete <i>et al.</i> ^[31]	2007	Pluck (vs.)	44	72	ND	13	0	10
		Stripping	44	28		7	0	11
					<i>P</i> =ND		<i>P</i> =ND	
Romero <i>et al.</i> ^[48]	2007	pLap stapling (vs.)	54	12	25	6	3	3.8
		ODU	39	12	0	4	1	4.2
				<i>P</i> =0.1	<i>P</i> =0.23	<i>P</i> =0.24	<i>P</i> =0.56	
Ko <i>et al.</i> ^[39]	2007	ODU (vs.)	23	27	ND	6	0	7.8
		Pluck	22	19		5	0	7.3
					<i>P</i> >0.05	<i>P</i> >0.05	<i>P</i> >0.05	
Li <i>et al.</i> ^[37]	2010	ODU (transvesical) (vs.)	33	81	ND	19	6	ND
		ODU (extravesical) (vs.)	39	129		31	10	
		Pluck	30	91		16	5	
					<i>P</i> =0.48	<i>P</i> =0.79		
Ritch <i>et al.</i> ^[52]	2011	ODU (vs.)	16	10	10	2	ND	3.5
		Lap stapling (vs.)	21	14	14	4		2.7
		pLNU	7	12	0	0		2
				<i>P</i> =ND	<i>P</i> =ND		<i>P</i> <0.05	
Xylinas <i>et al.</i> ^[40]	2014	Pluck (vs.)	36	85	ND	29	18	ND
		Extravesical (vs.)	52	785		160	204	
		Transvesical	61	1811		388	526	
					<i>P</i> =0.02	<i>P</i> =ND		
Athens series	2013	Pluck (vs.)	18	2	ND	2	0	ND
		Stapling (vs.)	15	8		1	1	
		ODU (extravesical) (vs.)	10	6		0	1	
		ODU (transvesical)	12	2		0	0	
					<i>P</i> =ND	<i>P</i> =ND		

f/u: Mean follow-up, n: Number of patients, PT: Procedure type, PM: Positive margins, BR: Bladder recurrence, PR/DM: Pelvic recurrence or/and distal metastasis, ND: No data, ODU: Open distal ureterectomy, pLNU: Pure laparoscopic nephroureterectomy, TUR: Transurethral resection, HAL: Hand-assisted laparoscopic

Each technique has benefits and disadvantages, however, the majority of medical evidence to date are based on case reports or retrospective studies, thus there is necessity to perform prospective randomized studies. Moreover, the absence of studies comparing pure LNU versus RANU exists.

However, especially in the presence of bulky distal ureter disease, the open distal ureterectomy and bladder cuff excision is considered the most reliable approach, preferred in our practice as well. Pure LANU and RANU with complete laparoscopic dissection and suture reconstruction of ureter and bladder cuff seem to provide equal efficacy and are better tolerated than ONU, but comparative studies are scarce. The strategically configuration of the ports may allow the completion of the operation without repositioning the patient and/or redocking of the robot. Fortunately, port-site seeding has been only referred to few case reports.

The Pluck technique is associated with higher intravesical recurrence rates compared to transvesical or extravesical bladder cuff removal and should be used only for low grade, low stage tumors of the renal pelvis and proximal ureter. In addition, the stapling approach is correlated with very high risk of positive surgical margins, raising concerns about the oncological safety of the procedure.

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