



# A new modification of tubeless cutaneous ureterostomy following radical cystectomy

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## Abstract

**Purpose** Cutaneous ureterostomy is a well-established surgical technique of incontinent urinary diversion treatment. However, stoma stenosis limits widespread utilization of this technique. We present our modification of constructing single-site tubeless cutaneous ureterostomy aiming to reduce stomal complications and improve catheter-free rate of those patients.

**Materials and methods** In 2016–2017, 30 patients with 60 renal units underwent modified and 30 patients with 60 renal units standard technique. The main differences of our method from previously described techniques were the preservation of parietal peritoneum and fixation of ureteral orifices one to another. Catheter-free rate was calculated in all patients with a minimum follow-up period of 12 months. In total, 52 patients, 26 from the modified cutaneous ureterostomy group, and 26 from the standard cutaneous ureterostomy group were available for the final analysis.

**Results** The patients' mean age was 63.1 years. The median follow-up period was 25.8 months (ranging from 1–37 months). The catheter-free rate was achieved 76.9% (20 patients) in the modified group compared to 42.3% (11 patients) in the standard group ( $P$  value = 0.013). No statistically significant differences were observed between two groups for late complications and readmission rates.

**Conclusions** Our technique of single-site-modified cutaneous ureterostomy is a safe and simple surgical technique with similar postoperative complications rate and better catheter-free rate compared to standard cutaneous ureterostomy. We believe that this technique could be a method of choice not only for candidates for cutaneous ureterostomy but also for selected patients for ileal conduit.

**Keywords** Cutaneous ureterostomy · Radical cystectomy · Urinary diversion · Ureteroureterostomy · Ileal conduit

## Introduction

Bladder cancer is the ninth most common malignancy worldwide [1]. Currently, the gold standard for local control of muscle invasive bladder cancer remains radical cystectomy with extended lymph node dissection [2]. The surgery has a high incidence of both early and late complications, most of which are associated with the type of urinary diversion [3–6]. Continent and conduit urinary diversions are

associated with bowel resection and pouch formation or bowel interposition, subject to early complications specific to these methods. Particularly, early bowel-related complications, i.e., bowel obstruction, prolonged ileus, and anastomotic leak, are mainly associated with bowel resection and anastomosis. Late complications comprise ureteroenteric stricture, urinary fistula, and urolithiasis [3]. In addition, the functional complications including voiding dysfunction and incontinence are specific to orthotopic urinary diversion [4, 6]. Conduit urinary diversion itself is associated with stomal site complications in 25–60% of patients, including stomal stenosis, retraction, prolapsed, and parastomal herniation [3, 7]. Currently, the simplest and safest way for incontinent urinary diversion is cutaneous ureterostomy (CU), which can reduce the rate of postoperative gastrointestinal and metabolic complications and is more time-saving compared to ileal conduit [8]. CU may represent a method of choice for elderly and otherwise morbid patients

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[9]. However, its use is limited because of the high rate of stomal stenosis, making ileal conduit (IC) the standard method for incontinent urinary diversion [10]. It is believed that decrease in blood supply of distal end of the ureters is one of the main factors leading to the development of UC stomal stenosis. Several authors have proposed their modification of standard technique of CU reducing stomal site stenosis and achieving tubeless cutaneous ureterostomy. The authors have highlighted the following factors: decreasing the length of abdominal wall tunnel, preservation of the fascia between spermatic cord and ureter, and several modifications directly at the stomal site [11–13]. The aim of our paper is to present our technique of constructing single-site tubeless CU with preservation of parietal peritoneum covering the ureters and to compare the results with the standard CU technique.

## Materials and methods

### Patients

Overall, 60 patients were included in the study from January 2016 to December 2017. Thirty patients with 60 renal units underwent modified and 30 patients with 60 renal units' standard technique of CU following radical cystectomy for bladder cancer. The advantages and disadvantages of existing urinary diversion techniques were explained to all patients and written consents were obtained from them. The proposed modified UC technique was used in three patients in 2015. Their data were not included in the study. The data of four patients with prior or simultaneous nephrectomy and two female patients were also excluded from the current study aiming to have better comparable groups. All surgical procedures were performed in two hospitals by the same single-expert surgeon. All patients received intra-operative antibiotic injection 1 h prior to surgery (Ceftriaxone 1 g i.v.). Subcutaneous low-molecular heparin [Fraxiparin (nadroparin) 0.4 ml] was administered starting on the day of surgery and continued until discharge. Complications developed during hospital stay and the first 30 days of postoperatively were considered as early complications, while those occurring later than 30 days were considered as late complications [6]. Catheter-free rate was calculated in all patients who had a minimum follow-up period for more than 12 months. From 60 initial patients the data of 52 patients were available for analysis. Out of 52 patients, 26 were in modified UC and 26 in standard UC group.

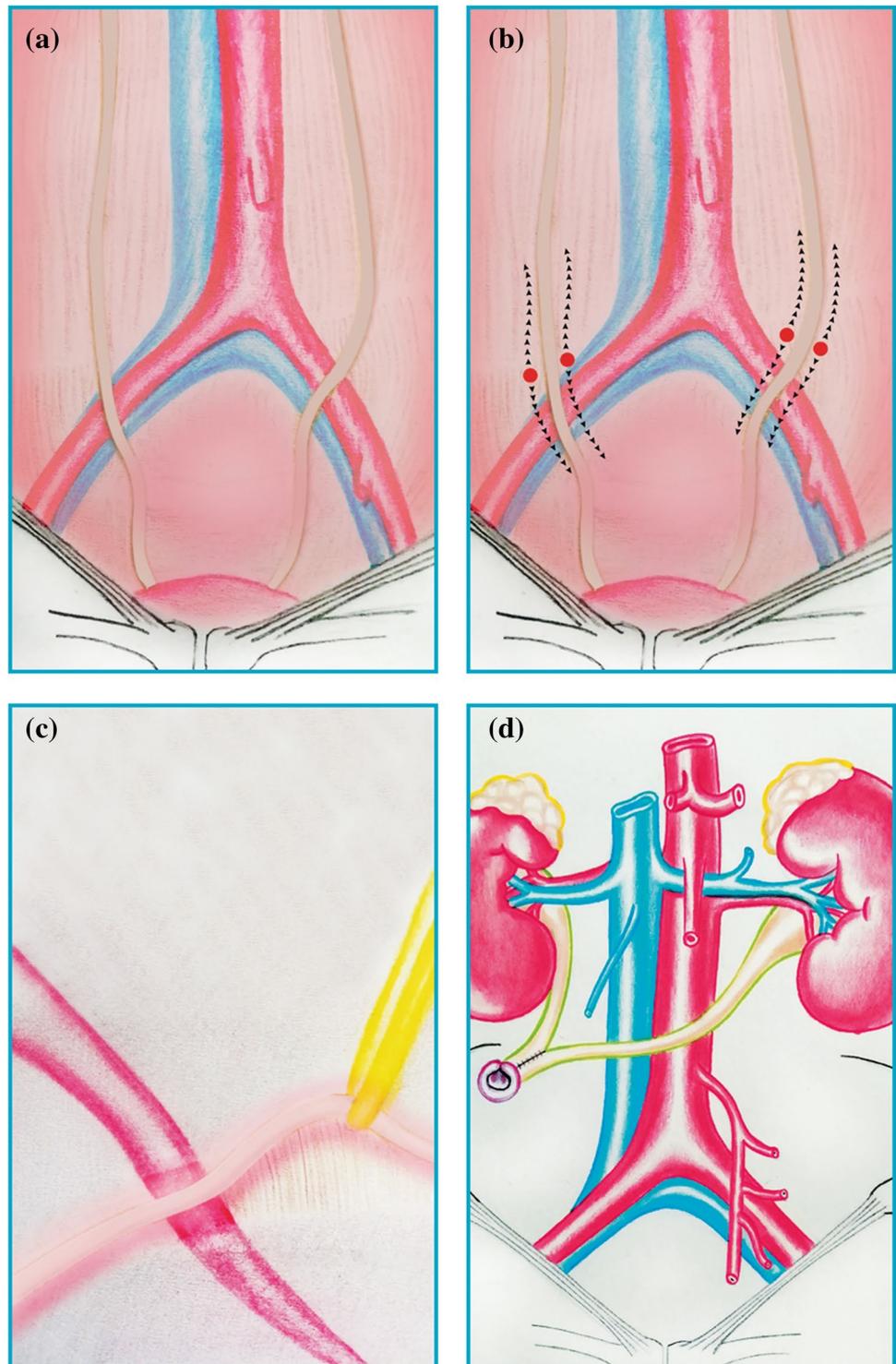
In the absence of any concern, the patients were contacted and invited to the regular follow-up visits every third month during the first 1.5 years and every sixth month thereafter. In the absence of specialized personnel (diversion-nurses, social workers), postoperative follow-up was carried out

mainly by doctors of the surgical team. Most of the patients were from rural areas (difficult for access), and lived with their families. Training, including explanation of specific means for postoperative care of the stoma, was provided to family members before the discharge of the patient. The patients were advised to change the stomal pouches every 2–3rd day in warm weather and 3–4th day in cold weather. Thanks to the short inclusion period, no patient was lost during the follow-up.

### Surgery

All 60 patients underwent cyst-prostatectomy followed by uretero-ureterocutaneostomy. Extended lymph node dissection was performed in all patients. Bilateral ureters were used in all cases. A careful mobilization of ureters was done to preserve sufficient peri-ureteric connective tissue. A care was done to spare as much ureteral length as possible. Both the ureters were cut closest to the bladder and a frozen section was performed from the distal ends of the cut ureters at the time of the surgery. In standard technique, each of the ureters was brought to ipsilateral side and a cutaneous stoma was performed. The stoma formation was similar to Ariyoshi technique [14]. The skin was cut in triangular fashion and distal edges of the ureters were sutured to the formed skin incision after being spatulated. This resulted in a nipple stoma formation in each side. Both the ureters were stented and ureteric stents were removed 4–8 weeks after the surgery. This technique has been standardized and implemented in clinical practice at our department since 2003. Modified UC included also preservation of parietal peritoneum covering the ureters. The course of the ureters was identified intraperitoneally, after retracting the bowels cranially and bladder caudally. The parietal peritoneum overlying the ureters was marked and incised in such a manner leaving about 1 cm attached to the ureters. The ureters were dissected and mobilized together with peri-ureteric connective tissue and parietal peritoneum (Fig. 1). The stoma was generated at the right side. The left ureter was directed to the right side via a retroperitoneal cavity above the mesenteric inferior artery. In case of tension on the ureters, their mobilization, together with peri-ureteric fat, was continued cranially closer to the kidneys. When required, parietal peritoneum covering the ureters was additionally cut at proximal ends providing more mobility. In the later case, the parietal peritoneum remained attached to the ureters at most of their length, being further used for fixation to the abdominal wall tunnel. Skin excision was performed at the right side according to the ureter diameters, but not less than 1.5 cm. The fatty subcutaneous tissue was excised and a cross-like incision was made on the anterior rectus sheath. The rectus muscle was separated bluntly and a cross-like incision of the posterior rectus sheath and the peritoneum

**Fig. 1** Schematic steps of ureteral mobilization: **a** ureters covered by parietal peritoneum; **b** point and course of dissection of the ureters; **c** mobilization of the ureter together with attached parietal peritoneum; **d** final stoma site



was performed on the tip of the underlying finger. Anterior and posterior rectus muscle sheaths were sutured together to fix the tunnel length. Both ureters together with preserved parietal peritoneum were pulled through without tension and distortion at least 1.5–2 cm above skin level. The ureters were spatulated enough to accommodate the skin opening.

The parietal peritoneum was sutured and fixed to the formed tunnel wall. The inside edges of the ureters were then conjoined in a side-by-side fashion. The outside (external) edge of ureteral flap reached up a length of 1.0 cm, whereas the inner edge of the ureteral flap was formed up to 2 cm, thus creating oval-shape stoma 1.0 cm in size. Oval-shape ureters

were fixed with 6–8 interrupted sutures to the aponeurosis and epidermis adapting everted cutaneous ureterostomy (Fig. 2). Two 6–7 French catheters were inserted and fixed to the skin, and a stoma bag was applied. Ureteric stents were removed 4–8 weeks following the surgery and the stoma got its final appearance. In the standard technique group, ureteric stents were removed 4–8 weeks after the surgery, either. Re-stenting of the ureters was performed when moderate or severe hydronephrosis was noticed (asymptomatic) or in case of symptomatic concern. If there was need for re-stenting in patients of the standard UC group, re-stenting of both the ureters was performed.

### Statistical analysis

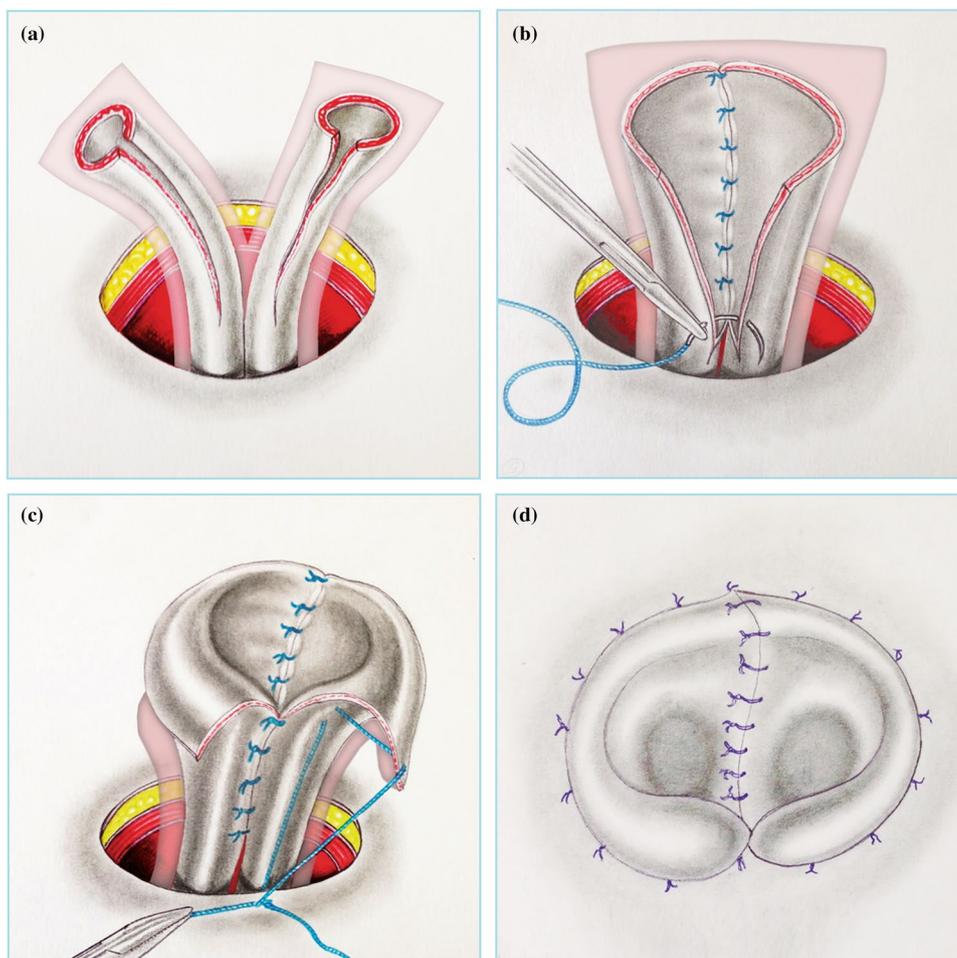
Statistical analyses were performed using SPSS 21.0 (SPSS Inc. Released 2012. SPSS Statistics for Windows, Version 21.0. Chicago: SPSS Inc.) and Stata 10 statistical software (StataCorp. 2013. Stata Statistical Software: Release 13. College Station, TX: StataCorp LP). Student's *t* test and  $\chi^2$  test were used for continuous and categorical variable, respectively. Final analysis was performed

using multivariable logistic regression. *P* value < 0.05 was considered as statistically significant.

### Results

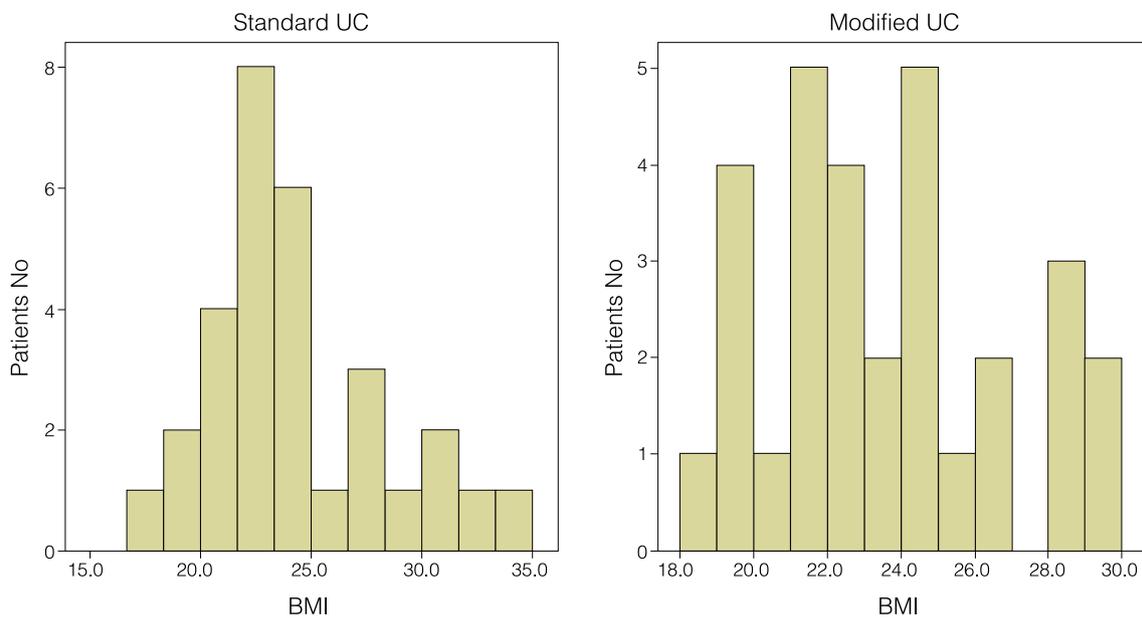
Table 1 presents the baseline and operative characteristics of the study population. All patients were male who underwent the surgery for bladder cancer. The patients' mean age at the time of surgery was 63.1 years for both groups. Although mean body mass index (BMI) was close in both groups, 24.3 in standard and 23.5 in modified CU, more patients appeared to be overweight in standard UC (nine patients) compared to modified UC (seven patients) (Fig. 3). Preoperative uretero-hydronephrosis was found in 16 (26.7%) patients, 9 (30.0%) patients (13 ureters) in the standard technique group and 7 (23.3%) patients (eight ureters) in the modified technique group. In about 50% of cases, cancer was confined within bladder. American Society of Anesthesiologists (ASA) score 3 or 4 was present in 13 patients (43%) in standard UC and 12 patients (40%) in modified UC. Average blood loss was about 500 ml. Intra- and postoperative blood transfusion was

**Fig. 2** Schematic steps of modified CU: **a** ureters brought through skin incision together with peritoneum; **b** internal edges of ureters sutured together; **c** oval-shape stoma formation; **d** final appearance of the stoma



**Table 1** Baseline and operative characteristics of study population

Patients	Surgical technique		P value
	Standard (n=30)	Modified (n=30)	
Age (years), mean (sd)	63.3 (6.7)	62.8 (8.4)	0.80
BMI (kg/m <sup>2</sup> ), mean (sd)	24.3 (4.0)	23.5 (3.1)	0.37
Preoperative hydronephrosis, n (%)	9 (30)	7 (23.3)	0.56
Diabetes, n (%)	3 (10)	4 (13.3)	0.78
Cancer stage, n (%)			0.83
Bladder confined (pT1-2, N0, M0)	8 (26.7)	9 (30)	
Locally advanced (pT3-4a, N0, M0)	14 (46.7)	15 (50)	
Extravesical (pT4b/any pT with N1–N3 or M1)	8 (26.7)	6 (20)	
Operative time (min), mean (sd)	194.3 (24.7)	201.7 (23.2)	0.24
Blood loss (ml), mean (sd)	532.4 (125.8)	510.8 (109.0)	0.32
ASA score (3 + 4) (%)	13 (43.3)	12 (40.0)	0.79
Follow-up (months), mean (sd)	24.3 (9.4)	22.4 (9.8)	0.46

**Fig. 3** Body mass index (BMI) distribution in patients treated with standard and modified CU. The bar represents the number of patients treated in each surgical technique group

required in 7 (11.7%) patients, 4 (13.3%) in standard and 3 (10.0%) in modified CU groups. Most of the patients (81.7%) were discharged on the 10th day following the surgery.

### Early and late postoperative complications

In total, 16 patients (26.7%) experienced early postoperative complications following radical cystectomy with either standard or modified CU. Seven patients (23.3%) were included in modified and 9 (30.0%) in standard group ( $P$  value = 0.59). Re-laparotomy was required only for one patient with postoperative prolonged ileus. All other complications were treated with conservative treatment. Two

patients in the standard group developed myocardial infarction, one patient on the fourth postoperative day, the other during the first month. Other complications included upper urinary tract infection, wound infection and pneumonia. The detailed list of early postoperative and late diversion related complications is provided in Table 2.

### Follow-up

By January 2019, postoperative death was declared in eight patients (26.7%) in modified and nine patients (30.0%) in standard CU groups. Eight out of 17 deaths were due to metastatic disease. One patient from standard

**Table 2** Early and late postoperative complications

	Surgical technique	
	Standard CU (n=30)	Modified CU (n=30)
Early postoperative complications		
Upper urinary tract infection	5	4
Pneumonia	0	1
Postoperative prolonged ileus	0	1
Myocardial infarction	2	0
Wound infection	2	2
Late complications		
Acute pyelonephritis	7	4
Renal colic	2	2
Stone formation	1	1
Stomal stricture	3	1
Postoperative death (yes)	9	7

CU died during the first postoperative month from myocardial infarction. All the remaining patients were available for follow-up. The data of all patients who died during the first 12 months were further excluded from the final analysis. Median follow-up period was 25.8 months, ranging from 1 to 37 months. Documented late postoperative complications occurred in 13 patients in standard CU and 8 in modified CU group ( $P=0.18$ ). In postoperative late period, pyelonephritis developed in 7 (23.3%) and 4 (13.3%) patients in standard and modified CU groups, respectively. Readmission rates were more common in

standard group 36.7% (11/30) compared to 20.0% (6/30) the modified group although statistically not significant ( $P=0.15$ ) (Table 3). Most of the patients in both groups with upper urinary tract infection were treated with antibiotic administration based on urine culture. Patients were hospitalized if they had temperature higher than 38.0 °C longer than 1 day. In any case, patients were advised to stay at the hospital for 1 or 2 days if they had any concern. One patient in the modified group developed stricture of the stoma and underwent reconstructive surgery forming new stoma. In another patient in modified CU group, orthotopic neobladder reconstruction was performed 15 months later following modified CU. A stricture of the stoma occurred in three patients in standard UC group. In one patient, permanent percutaneous nephrostomy was performed, while two others underwent revision forming new cutaneous ureterostomy. Stone formation was observed in two patients, one in modified group and one in standard group (Table 2). Importantly, catheter-free rate was found to be significantly higher in modified group. From all 26 patients with 52 renal units, catheter-free state was achieved in 20 patients (79.2%), whereas in standard group only in 11 patients (42.3%) ( $P=0.011$ ) (Table 3). After adjusting for other variables (presence of preoperative hydronephrosis, age at surgery, cancer stage), difference in catheter-free survival between the groups remained statistically significant ( $P=0.013$ ) (Table 4). The odds ratio of patients being catheter-free in modified CU group was 5.13 times higher compared to standard CU group (OR = 5.13; 95% CI = 1.42–18.55).

**Table 3** Early and late postoperative results by surgical techniques

Patients	Surgical technique		P value
	Standard CU (n=30)	Modified CU (n=30)	
Early postoperative complications, n (%)	9 (30.0)	7 (23.3)	0.59
Late complications, n (%)	13(43.3)	8 (26.7)	0.18
Readmission rate, n (%)	11 36.6)	6 (20.0)	0.15
Patients	Surgical technique		P value
	Standard CU (n=26)	Modified CU (n=26)	
Catheter-free state, n (%)	11 (42.3)	20 (76.9)	0.011

**Table 4** Final multivariable analysis for catheter-free state

Factor	Odds ratio	Confidence interval	P value
Surgical technique (ref. standard CU)	5.13	1.42–18.55	0.013
Age	0.96	0.88–1.05	0.373
Preoperative hydronephrosis (ref. no)	0.35	0.08–1.61	0.177
Cancer stage (ref. T1-2N0M0)			
T3-4aN0M0	3.15	0.67–14.81	0.147
pT4b/any pT with N1–N3 or M1	2.30	0.44–12.04	0.321

## Discussion

Our current study presents a new technique of modified CU with improved catheter-free rate and probable less stomal stenosis.

Not only does CU represent the simplest urinary diversion following radical cystectomy, it does not require intestinal violation, minimizes the operating time and intra-operative blood loss, thus reducing early postoperative complications [8]. However, the use of CU is limited due to formation of stomal stenosis and has been preserved for morbid patients. First CU were performed in children for elimination of congenital urinary obstruction. More than 50% of these patients with CU developed stomal strictures [15, 16].

Several authors have described and proposed their modification of tubeless CU aiming to improve the outcome of CU. The first tubeless CU were described by Ariyoshi and Toyoda in 1975 and 1977, respectively [14, 17]. According to Ariyoshi et al., an everted ureteral nipple formation combined with triangular skin flap was essential for maintaining a tubeless ureterostomy, while Toyoda reported that firm fixation of ureters to the skin without a nipple formation was the key for permanent stoma [14, 17]. Toyoda modification comprised longitudinal incision of the distal ends of both ureters and suturing each edge of the ureter to the corresponding skin area. Despite good results, further modifications of the of the Toyoda's technique were published. Another technique was proposed by Jilling and Frang in 1986 [18]. They reported results of 9 patients among whom unintubated CU was constructed. In two of the patients, the drainage of urine was restored due to complications. They also concluded that their proposed technique could be successfully performed in short and wide ureters [18].

Chitale et al. suggested a modification of tubeless CU [19]. The surgery was performed among 4 children aging from 2 to 16 years. Despite aging of the patients no retraction or stricture of the stomas were reported. The authors suggested cutting the skin in rectangular fashion. After suturing the edges of ureters to rectangular skin flaps, a nipple stoma was achieved [19].

In 2006, Terai et al. further investigated the Toyoda's method of CU and presented their outcomes [12]. They reported that sufficient enlargement of abdominal wall tunnel was critical for avoiding failure in most of the cases. Ninety-five patients had undergone the surgery with a catheter-free rate of 82% at median follow-up of 23 months [12]. In addition, the length of abdominal tunnel was found to be an important factor by Kim et al. [11]. They applied Toyoda's technique with fixation of the anterior and posterior sheaths of rectus muscle, which improved the

catheter-free rate from 60.5 to 89.9%. The main cause for postoperative stenosis was the compression of ureters in the abdominal wall, thus decreasing their blood supply and creating a mechanical obstruction [11]. We also believe that the length and sufficient enlargement of abdominal tunnel play an important role and, therefore, were used in our cases. Unlike Toyoda's method and its modifications, our method involved an everted nipple formation similar to IC.

Wada et al. described their technique for maintaining ureteral blood preservation [13]. They implemented the technique of Ariyoshi et al. with a preservation of the fascia between spermatic cord and ureter. According to the authors, this maneuver played a significant role with an improvement of catheter-free rate from 26 to 92% [13]. Importantly, authors stated that patients BMI was not a cause of ureter stenosis [13], which was assumed to be in earlier study [20]. In our study, we did not find any statistically significant association between patients BMI and CU technique. However, we preferred using standard bilateral CU in highly overweight patients to avoid stretching of the ureters.

Another technique for improvement of ureteric blood supply was suggested by Lodde et al. [21]. Unlike our technique, the stoma incision was performed on the left side and right ureter was brought to the left through mesosigmoid and sutured to the skin without nipple formation. In addition, the ureters were wrapped with the greater omentum supposing to improve their blood supply. With a follow-up ranging from 6 to 24 months, all 15 patients were free of stents [21].

Zhang et al. in 2016 further examined the effect of omental wrapping in rabbits after ureterocutaneostomy [22]. Their study was conducted on 40 male New Zealand rabbits. On the left side (control), traditional CU was applied, whereas on the right side (experimental), ureter was wrapped by a flap of gastrocolic omentum together with an application of artificial external scaffold. The rabbits were killed a month later and a histological analysis of the kidneys was performed. The authors have found that ureter dilatation and collecting system separation, common consequences of stomal stenosis, were statistically significantly worse in control group. In contrast, the thickness of the renal cortex and microvessel density was superior in the experimental group. Hence, the authors concluded that stomal stenosis in rabbits after CU could be prevented with wrapping the ureters by omental flap [22].

In 2011, Rodriguez et al. published one of the largest data on occurrence of stomal stricture following tubeless CU [7]. The study included 272 patients enrolled in two groups based on the stent insertion period. In first group (161 patients), ureteral stents were removed during the first 3 months, whereas in the second group (111 patients), stents were removed after more than 3 months following CU. In total, stomal stricture was reported in 36 patients

(13.6%). Delayed stent removal decreased occurrence of the stomal stricture only at left side [7]. In our clinic, stents were removed 4–8 weeks following the CU and re-stenting was performed if needed.

Another important issue among these patients is the quality of life. Lately, several articles have been published comparing the quality-of-life patients treated with either bilateral CU, unilateral CU, or ileal conduits [7–9, 23]. A recently published article compared bilateral and unilateral stoma results of 114 patients. While associated with a similar postoperative complication rate, unilateral CU was associated with better quality of life [23]. Longo et al. compared the quality of life of patients with CU and IC [8]. Interestingly, CU with single stoma was superior comparing the complications without any negative impact quality of life in comparison with IC [8]. Authors concluded that single stoma CU could be an alternative to ileal conduit in selected patients [7–9, 23].

In our paper, the early postoperative complication rate for modified and standard CU was 23.3% and 30.0%, respectively, while ileal conduit comprises 20–56% early postoperative complication rate [3]. Importantly, the rate of early postoperative high-grade complications was even lower. Hence, the procedure is safe and well tolerated by the patients. Our modification of CU does not support the data of higher rate of late complications. In contrast, only one out of 26 patients (3.8%) developed stomal stenosis during the follow-up period and required revision of the stoma. In comparison, stomal stenosis following IC is reported in the literature from 2.8% to as high as 20% [3]. Therefore, we believe that the current modification of CU, possessing better early postoperative and comparable late results compared to IC, might be considered while suggesting urinary diversion to patients.

In our opinion, careful dissection with preservation of the parietal peritoneum attached to the ureters, adequate length of abdominal wall tunnel and nipple fashion stoma formation play key roles in tubeless CU outcome. In addition, preservation of parietal peritoneum eases transport of the ureter to the contra-lateral side and fixation of the ureter to the muscle aponeurosis. In our initial experience, the results have been promising, but indeed, larger patient cohorts with longer follow-up are necessary to further explore the pros and cons of this technique.

## Conclusion

Our technique of single-site-modified cutaneous ureterostomy is a safe and simple surgical technique with similar postoperative complications rate and better catheter-free rate compared to standard cutaneous ureterostomy. We believe that this technique could be a method of choice not only for

candidates for cutaneous ureterostomy, but also for selected patients for ileal conduit.

## Compliance with ethical standards

**Conflict of interest** The authors declare that they have no conflict of interest.

**Ethical approval** All procedures performed in this study were in accordance with the ethical standards of the institutional research committee and with the 1964 Helsinki.

**Informed consent** Informed consent was obtained from all individual participants included in the study.

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