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Long-Term Urinary Bladder Function Following Unilateral Refluxing Low Loop Cutaneous Ureterostomy

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Purpose: Unilateral low loop cutaneous ureterostomy (LLCU) has been offered as the preferred method of temporary urinary diversion in cases of massively dilated and refluxing ureters. We sought to explore whether LLCU is effective in preserving urinary bladder function in the long term.

Materials and Methods: The charts of all patients who had undergone temporary unilateral LLCU as newborns in the presence of massive vesico-ureteric reflux were retrospectively reviewed. Demographic data, follow-up length, and presence of incontinence were recorded. Patients were interviewed regarding lower urinary tract symptoms (LUTS), and their urination patterns were recorded by using uroflow and post-void residual (PVR) measurements.

Results: Between 1972 and 2003, a total of 24 patients underwent unilateral LLCU in the presence of massively refluxing ureters. Eight patients were included in the final analysis. The median age at diversion was 12 days, the median time to closure was 22.5 months, and the median follow-up was 12.5 years. Urinary bladders showed normal contour, normal capacities, and minimal PVRs in most cases. None of the patients required augmentation cystoplasty. One patient suffered from urinary leakage and few demonstrated minimal LUTS.

Conclusions: Unilateral refluxing LLCU is an effective method of urinary diversion that preserves urinary bladder function for the long term. Larger studies are required to confirm this finding.

Key Words: *Ureteral reflux; Ureterostomy; Urinary bladder function*

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INTRODUCTION

A massively dilated urinary tract in a newborn can result in life-threatening medical conditions such as metabolic disturbances and urosepsis. Posterior urethral valve (PUV), uretero-vesical junction (UVJ) stenosis, and massive vesico-ureteral reflux (VUR) are possible etiologies of this potentially lethal condition.

Although primary reconstruction is the preferred definitive treatment, cutaneous urinary diversion may be required before an ultimate surgical correction. Accordingly, cutaneous pyelostomy, percutaneous nephrostomy, end cutaneous ureterostomy, proximal loop ureterostomy, and

cutaneous vesicostomy are reported in the literature as possible methods of drainage [1-4].

Unilateral refluxing low loop cutaneous ureterostomy (LLCU) has been proposed as an alternative method of urinary diversion that provides effective drainage of the bladder and both collecting systems through a single stoma. As illustrated in Fig. 1, the drainage of one kidney to the skin is achieved directly via the proximal segment of its associated ureter, whereas the drainage of the contralateral kidney is achieved by urine passage through the bladder and from there by the vesico-cutaneous reflux via the distal portion of the diverted ureter [5].

Because urine cycling through the bladder is preserved

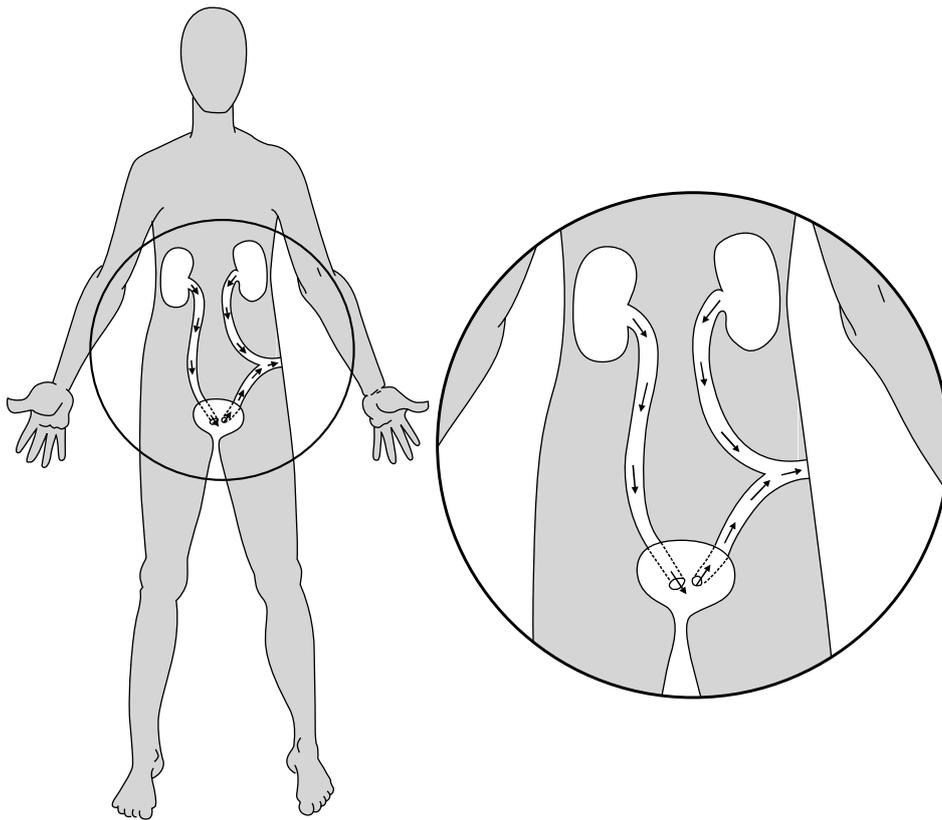


FIG. 1. Unilateral low-loop cutaneous ureterostomy. The drainage of one kidney to the skin is directly achieved through the proximal segment of its associated ureter, whereas the drainage of the contralateral kidney is achieved by urine passage through the bladder and from there via vesico-cutaneous reflux through the distal portion of the diverted ureter.

by use of this method, bladder defunctionalization can potentially be avoided, namely, the development of a permanently and severely contracted urinary bladder, which is often seen following diversion by bilateral cutaneous ureterostomies or vesicostomy [6].

In this study, we evaluated the late implications of unilateral refluxing LLCU on final urinary bladder function.

MATERIALS AND METHODS

Following approval by our Institutional Review Board, we retrospectively reviewed the charts of all patients who had undergone unilateral refluxing LLCU as neonates in our medical center.

We included all cases in which massively refluxing ureters existed before surgery. Cases of unilateral refluxing LLCU performed for UVJ stenosis were excluded.

Demographic data, indications for urinary diversion, and time to stomal closure and ureteral re-implantation were recorded. Outpatient clinic charts were reviewed for urination habits, urinary continence status, and overall follow-up length.

Next, all patients were contacted and invited for another follow-up meeting. Herein, they were interviewed regarding their urination habits in order to estimate voiding dysfunction, if existed. In accordance, they were asked questions regarding obstructive urinary symptoms (feeling of incomplete bladder emptying, weak urinary stream), irritative urinary symptoms (urinary frequency or urgency, if

existed, and nocturia), and some other general questions such as the existence of urinary leak, number of daily urinations, and the need for anti-cholinergic drugs or protecting devices (e.g., diapers, pads). Thereafter, they were asked to fill their bladders, and when full enough as shown by a bladder scan, ultrasound imaging was carried out to estimate bladder capacity, shape, wall thickness, and trabeculations. Finally, uroflow and post-void residual (PVR) measurements were recorded.

RESULTS

Overall, 24 patients (21 boys, 3 girls) with massively dilated and refluxing ureters underwent unilateral LLCU between 1972 and 2003.

Given the relatively long time that had passed since most of the surgeries, we were able to get in touch with 13 male patients. Six patients refused to participate in our study, whereas the other seven eventually underwent full evaluation. There was another male patient who met inclusion criteria but unfortunately passed away at the age of 12 years due to acute renal failure. He had a consecutive 11 years of reliable follow-up, therefore we decided to include him in this study. This resulted in a series of 8 male patients. Demographics, bladder volume, uroflow, and PVR data are summarized in Table 1.

Overall, the measured volumes were within the normal calculated age-related ranges, and none of the patients had required augmentation cystoplasty at any time during fol-

TABLE 1. Demographic data and urination patterns as recorded by US and uroflow studies

Patient No.	Diagnosis	Age at 1st operation (d)	Time from 1st to 2nd operation (mo)	Follow-up (yr)	Volume (ml)	Qmax (ml/s)	Qav (ml/s)	PVR (ml)
1	Bilateral VUR	13	25	9	364	20.9	12.5	65
2	Bilateral VUR, PUV	11	16	16	433	21.4	12	0
3	Bilateral VUR	23	22	9	287	12.8	9.5	0
4	Unilateral VUR	21	23	14	639	24.4	17.1	10
5	Unilateral VUR	11	31	20	306	15.4	9.4	80
6	Bilateral VUR	24	0.8	21	375	36.3	18.1	0
7	Bilateral VUR, PUV	7	17	5	273	9	3.8	100
8	Bilateral VUR, PUV	7	27	11	-	-	-	-
Median (range)		12 (7-24)	22.5 (0.8-27)	12.5 (5-21)	364 (273-639)	20.9 (9-36.3)	12 (3.8-18.1)	10 (0-100)

US, Ultrasound; Qmax, maximal flow rate; Qav, average flow rate; PVR, post-void residual; VUR, vesico-ureteral reflux; PUV, posterior urethral valve.

low-up.

Six out of the first seven patients demonstrated a normal urination pattern, whereas patient number 7 demonstrated an obstructive pattern per uroflow.

All patients demonstrated urinary bladders with a normal shape in ultrasound imaging without evidence of wall thickening or trabeculations. Patient number 8 had a urinary bladder ultrasound 10 years following diversion and a year before his death. This demonstrated an elongated urinary bladder with slight trabeculations and no PVR.

Regarding lower urinary tract symptoms, most patients had mild or no complaints as shown in Table 2.

DISCUSSION

The term *massively dilated ureter* in the newborn was applied to a ureter with a transverse diameter that exceeded 2 cm [2] which may represent a primary anomaly of the UVJ, or develop secondary to infravesical obstruction. Ideally, correction of the primary etiology is the ultimate solution; however, temporary urinary diversion may be inevitable in certain circumstances such as sepsis and azotemia as well as in technically challenging situations such as ureteral tortuosity and redundancy or when there is any doubt as to the functional capacity of the associated renal unit [2].

Nowadays, urinary diversions are usually limited to the rare cases of PUVs that for some reason cannot be primarily resected. In the past, however, it was a legitimate common practice to perform temporary urinary diversion in cases of complicated massive VUR, and the present article is based on data obtained from such historical series.

Throughout the years, variable methods for urinary diversions have been suggested, among which are cutaneous vesicostomy [3], supra-pubic cystostomy [3], terminal or loop cutaneous ureterostomy [1], Y ureterostomy [6], cutaneous pyelostomy [7,8], and percutaneous nephrostomy [9]. Though technically feasible at the time of the surgery, the main concern with both vesical and supra-vesical urinary diversion is the long-term preservation of urinary

TABLE 2. Lower urinary tract symptoms as experienced by the patients

	No. of patients	Comments
Feeling of incomplete emptying		
No	4	
Sometimes	1	
Always	2	
Urinary frequency		
Yes	1	Mostly due/to increased fluid consumption
No	6	
Urinary urgency		
Yes	1	Mostly due/to increased fluid consumption
No	6	
No. of daily urinations		
2-3	3	
4-5	3	
6-10	1	
Nocturia		
0	5	
1	2	Mostly due/to increased fluid consumption before bed time
Weak stream		
Yes	0	
No	7	
Urinary leak		
Yes	1	
No	6	2 patients suffered from enuresis by age 6 years one of them used anti-cholinergic drugs
Medication or urinary devices use		
Yes	0	
No	7	

bladder function.

One study explored the long-term urinary continence in neonates with PUV [10]. Fifty male infants with an established diagnosis of PUV underwent initial bladder decompression with a urethral catheter. Subsequently, 24 patients underwent valve ablation alone, 8 patients underwent cutaneous vesicostomy and a later valve ablation, 14 patients underwent valve ablation and a later upper urinary tract reconstruction, and 4 patients underwent loop cutaneous ureterostomy for either urosepsis or metabolic disturbances. In this series, incontinence, namely, the inability to remain dry for at least 3 hours, occurred in 8 patients of 42 assessed (19%), 6 of whom eventually underwent augmentation cystoplasty.

Concerning urinary bladder dysfunction and urinary incontinence in patients with PUV, these have been attributed to either primary sphincteric maldevelopment or iatrogenic injury caused during the ablation of the valve, irreversible changes in the function of the detrusor following the fetal urethral obstruction, or decreased bladder volume following a period of bladder defunctionalization [11].

The impact of urinary diversion in patients with PUV remains controversial. Two studies have shown that urinary diversion obtained by ureterostomies does not have a negative influence on bladder function [12,13]. On the other hand, a retrospective study revealed that the long-term bladder function of patients with PUV treated with supra-vesical diversion was adversely affected [14].

Jayanthi et al. [15] have also evaluated the effect of temporary cutaneous diversion on the ultimate bladder function of patients with different underlying pathologies. In that study, urinary bladder function was assessed after it had been defunctionalized for a period by either vesicostomy or supra-vesical diversion. In this 75-patient series, 31 patients had PUV and 14 were diagnosed with primary VUR. The mean age at the time of diversion was 15 weeks, and the average period of diversion was 34 months. Follow-up ranged between 1 and 7 years. In the PUV group, eight patients (26%) required bladder augmentation at the time of initial closure, seven of whom initially underwent supra-vesical diversion. Eight patients (26%) did not void spontaneously and required clean intermittent catheterization (CIC), and the overall PVR for this group was 17% of the voided urine volume. In the VUR group, the numbers were two (14%) who required bladder augmentation, one of whom initially underwent supra-vesical diversion, and two (14%) who required CIC for not voiding spontaneously and with an overall PVR of 12% of the voided urine volume. The authors stated that relatively few patients with reflux required augmentation cystoplasty and concluded that later poor compliance of the urinary bladder was inherent in the detrusor owing to the underlying pathological condition and was not related to the temporary defunctionalization.

In contradiction, Duckett [16] in a comprehensive review published in 1997 stated that "the 'valve bladder' is an iatrogenic phenomenon due to the overuse of high urinary di-

version and prolonged dysfunctionalized bladder" and that "prolonged upper tract diversion is very detrimental to the bladder".

As our clinical impression was similar to the latter cited view, we sought how to better support this concept. In 1992, we published a paper summarizing our experience with LLCU for temporary urinary diversion [5]. The main advantage of the presented LLCU technique is the opportunity to simply achieve undiversion by resection of the distal ureteral limb and to perform simple ureteroneocystostomy by using the proximal limb. We thus believed that this method of drainage was superior to percutaneous nephrostomy, percutaneous vesicostomy, and supra-pubic cystostomy because it avoided recurrent urinary tract infections, did not involve handling and securing tubes, enabled adequate decompression of the upper urinary system, provided the opportunity to perform bilateral reconstruction at a single operation and through a single incision, prevented threatening complications such as ureteral slough or obstruction at the site of closure, and prevented UVJ stenosis. In this study, 19 patients (38%) underwent unilateral LLCU. Although renal function was well preserved in most cases, the effect of urine cycling on late bladder function has not been assessed.

The present study aimed to address this issue and to the best of our knowledge is the only one in the literature demonstrating satisfactory results for the long-term preservation of urinary bladder function following unilateral refluxing LLCU.

Though the indications for cutaneous urinary diversion are nowadays few, we believe that in those rare cases where it is required, urine cycling is an important factor that should not be overlooked when selecting the preferred diversion technique. Unilateral refluxing LLCU utilizes the reflux mechanism for urine evacuation, and in oppose to previous opinions [5] appears efficient also in cases of bilateral VUR.

Our study still has some limitations that should be addressed. The first limitation is the small number of patients evaluated and the lack of a matched control group. The second limitation is the fact that no urodynamic assessment has been performed to accurately determine maximal bladder capacity as well as filling and voiding pressures. Another limitation is the relatively small number of patients with primary diagnosis of PUV, which is suspected to be associated with inherent bladder pathologies. Nevertheless, none of our patients required augmentation cystoplasty, and we managed to demonstrate preserved bladder function and an excellent quality of life for all the patients evaluated, a fact that may support the concept that unilateral refluxing LLCU may be the preferred choice of diversion in cases of infravesical obstruction and massively refluxing ureters.

CONCLUSIONS

Although temporary urinary diversion is rarely required

in neonates nowadays, it might be inevitable in certain circumstances that do not enable primary surgical correction. Unilateral refluxing LLCU, which involves continuous urine cycling through the bladder, may preserve urinary bladder function in the long run and therefore may be considered as the preferred method of temporary diversion. Yet, larger studies are required to confirm this observation.

CONFLICTS OF INTEREST

The authors have nothing to disclose.

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