American Journal of Medicine and Medical Sciences 2025, 15(7): 2355-2357
DOI: 10.5923/j.ajmms.20251507.56

Long-Term Outcomes of Surgical Treatment of Posterior Urethral Valves in Children

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Abstract **Background:** Posterior urethral valves (PUV) are the most common cause of lower urinary tract obstruction in male newborns, occurring in approximately 1 in 8,000 births. They are associated with significant morbidity, including recurrent urinary tract infections, hydronephrosis, and chronic kidney disease (CKD) in 12–26% of cases. **Objective:** To evaluate long-term outcomes of surgical treatment of PUV in children, focusing on renal and bladder function. **Methods:** A retrospective analysis was performed on 78 patients treated for PUV from 2016 to 2022 at two tertiary centers. Patients were divided into two groups: primary valve ablation (n=44) and initial vesicostomy (n=34). Data included clinical presentation, laboratory tests, ultrasound and cystoscopic findings, and follow-up assessments for up to 50 months (mean 4.1±1.8 years). Renal function was assessed using serum creatinine, urea levels, and estimated glomerular filtration rate (eGFR). Bladder function was evaluated with urodynamic studies and clinical parameters. **Results:** Initial creatinine levels were higher in the vesicostomy group (P<0.001). However, no significant differences in long-term renal outcomes or bladder dysfunction were observed between groups. CKD developed in 19.2% of patients, with three requiring dialysis. Vesicostomy showed favorable bladder dynamics without increasing incontinence risk. Two patients died from end-stage renal disease. Delayed diagnosis (91% postnatal) negatively affected prognosis. **Conclusion:** Vesicostomy may be a reliable alternative to primary valve ablation in children with severe renal dysfunction. It provides effective urinary diversion, preserves renal function, and supports adequate bladder development, especially in complex cases.

Keywords Posterior urethral valve (PUV), Children, Urinary tract obstruction, Vesicostomy, Primary valve ablation, Chronic kidney disease (CKD), Early diagnosis, Long-term outcomes

1. Introduction

Posterior urethral valve (PUV) is the most common cause of lower urinary tract obstruction, occurring in approximately 1 in 8,000 newborns. It remains a pressing clinical issue due to the high rate of complications such as recurrent pyelonephritis and urosepsis, as well as the frequent development of chronic kidney disease (CKD), which is reported in 12–26% of cases [3,4,7]. Surgical management of PUV is typically multistage and includes valve ablation, prolonged urinary diversion, and nephrectomy when indicated. In the initial phase, particularly in critically ill children with complicated PUV, long-term decompression of the urinary system is essential to control pyelonephritis exacerbations, improve renal function, and restore ureteral tone. Both drainage (e.g., bladder catheterization, nephrostomy, pyelostomy) and non-drainage methods (e.g., ureterocutaneostomy, vesicostomy) are considered as urinary diversion strategies [1,8].

Many studies emphasize the necessity of long-term urinary diversion in cases of severe ureterohydronephrosis and favor non-drainage methods as more reliable, effective, and free from the complications associated with foreign bodies in the urinary tract [6,9,10]. However, opinions vary regarding the indications and techniques for these non-drainage procedures.

In patients with PUV, primary valve ablation is considered the standard treatment. However, temporary vesicostomy followed by delayed ablation may be considered depending on the clinical status. A significant number of patients with PUV present with renal insufficiency secondary to bladder dysfunction. Nonetheless, few studies have evaluated long-term renal and lower urinary tract function following surgical treatment of PUV.

Objective. To assess the long-term outcomes of surgical treatment of posterior urethral valves in children.

2. Materials and Methods

We conducted a retrospective analysis of medical records of patients treated in the urology departments of the Tashkent Pediatric Medical Institute and the National Children's Medical Center between 2016 and 2022. The review included evaluation of complaints, medical history, physical examination findings, and instrumental investigations. Data analysis covered the initial evaluation and follow-up outcomes from 6 to 50 months (mean 4.1 ± 1.8 years). Patient

Received: Jun. 27, 2025; Accepted: Jul. 19, 2025; Published: Jul. 24, 2025
Published online at http://journal.sapub.org/ajmms

outcomes were determined in all cases through follow-up telephone interviews with the patients or their relatives.

A total of 78 patients with posterior urethral valves (PUV) were included in the study. The main presenting symptoms were dysuria (n = 48; 61.5%), fever (n = 21; 27.0%), urinary retention (n = 29; 37.0%), and abdominal pain (n = 22; 28.2%). On physical examination, a distended, palpable bladder was detected in 13 children (16.6%).

The most common complications were ureterohydronephrosis (n = 25; 32.0%), urinary tract infections (UTIs) (n = 42; 53.8%), vesicoureteral reflux (n = 17; 21.7%), urolithiasis (n = 9; 11.5%), and renal failure (n = 6; 7.6%). Elevated serum creatinine levels (>58 mg/L) and urea levels were observed in 35 children (44.8%).

All patients underwent urine cytobacteriological analysis, which identified *Escherichia coli*, *Klebsiella*, and *Pseudomonas aeruginosa*. Ultrasound of the bladder and kidneys was performed in all cases. In our series, two deaths (2.5%) due to chronic kidney disease (CKD) were recorded.

3. Results and Discussion

All patients were divided into two groups: the first group included patients who underwent primary valve ablation, and the second group consisted of children who underwent vesicostomy. Primary valve ablation was performed using a 10-Fr pediatric resectoscope with a cold knife or Bugbee electrode after cystoscopic examination of obstructive urethral lesions using a 7.5-Fr pediatric cystoscope. The urethral valves were incised at the 5, 7, and 12 o'clock positions. An additional vesicostomy could be performed if urethral drainage was deemed insufficient after the procedure.

Vesicostomy was performed via a midline skin incision between the umbilicus and pubic symphysis (Blocksom vesicostomy). The bladder dome was mobilized through this incision, and a second incision was made to suture the dome to the skin. The typical vesicostomy opening measured 14 Fr. Urine was effectively drained, and prolapse of the posterior bladder wall was prevented.

Renal function was assessed by comparing serum urea, creatinine levels, and estimated glomerular filtration rate (eGFR). Chronic kidney disease (CKD) was defined as eGFR <60 mL/min/1.73 m², and end-stage renal disease (ESRD) as eGFR <15 mL/min/1.73 m² or the need for renal replacement therapy.

Bladder capacity was estimated using the formula (age in years + 1) × 30 mL. A reduced bladder capacity was defined as a >65% decrease from the expected bladder volume based on a voiding diary or uroflowmetry results.

Patients were quantitatively assessed based on the International Children's Continence Society guidelines. Detrusor overactivity was defined as increased detrusor pressure >15 cm H_2O. Urinary continence was defined as complete dryness during day and night without the use of diapers, based on parental reporting. Follow-up was conducted to assess voiding dysfunction, including spontaneous voiding and urinary incontinence.

Among the 78 patients included in the study, the diagnosis of PUV was made prenatally using ultrasound in 7 cases (8.9%). Vesicostomy was performed in 34 patients (43.5%), and primary valve ablation in 44 patients (56.5%) as the initial intervention. Initial serum creatinine levels were significantly higher in the vesicostomy group compared to the ablation group ($P<0.001$). However, no significant differences in serum creatinine (sCr) or eGFR were observed between the groups at the end of the follow-up. Although sCr levels decreased, this was not statistically significant. Similarly, there were no significant differences between the groups in terms of bladder volume reduction or urinary incontinence. Urodynamic studies showed no statistically significant differences in post-void residual urine volume between the vesicostomy and ablation groups.

During the follow-up period, 15 patients (19.2%) developed CKD. Of these, 9 patients (60.0%) were in the vesicostomy group, and 6 (40.0%) were in the ablation group. Three vesicostomy patients required renal replacement therapy and hemodialysis due to ESRD. Two children in the ablation group required clean intermittent catheterization. The average follow-up period was 50 months.

The prognosis for patients with PUV has significantly improved due to early diagnosis via prenatal ultrasound screening. However, in follow-up, 3 patients with vesicoureteral reflux (VUR) who had undergone primary valve ablation and were observed for up to two years developed stage 4 CKD (n=2) and ESRD (n=1).

Children who underwent vesicostomy showed better bladder function, including lower detrusor pressures and reduced post-void residual urine volumes on urodynamic testing, compared to the primary ablation group. This suggests that vesicostomy did not negatively impact long-term bladder function.

The main therapeutic goal for PUV patients was to relieve urinary tract obstruction and reduce the risk of complications associated with bladder and renal dysfunction. However, the relevance of vesicostomy is diminishing, as effective bladder drainage and primary valve ablation are increasingly feasible.

Primary valve ablation remains the preferred initial treatment for PUV. Early urinary diversion has been associated with bladder dysfunction and disruption of the physiological micturition cycle, along with complications related to the stoma. Nevertheless, the value of primary valve ablation versus temporary vesicostomy followed by delayed ablation remains controversial. High urinary diversion showed greater efficacy in stabilizing blood biochemical parameters than urethral or suprapubic catheters, improving outcomes even in cases with upper urinary tract involvement.

Among five patients who underwent both primary valve ablation and temporary vesicostomy with delayed ablation, favorable outcomes were observed based on serum creatinine and eGFR. In seven boys with PUV, deterioration in renal function due to bladder dysfunction occurred, although they had undergone successful primary ablation. Bladder dysfunction after valve ablation was attributed to progressive impairment of bladder contractility due to secondary lower urinary tract

obstruction and subsequent sclerosis of the bladder wall.

This study has several limitations, including its retrospective design and relatively small sample size, which limit generalizability. Furthermore, long-term comparative analysis was not conducted between patients who underwent vesicostomy (n=7) and those who had primary ablation (n=4). Although patients in the ablation group had higher serum creatinine and urea levels and a more rapid progression to stage 3 CKD, no conclusions can be drawn regarding causality, as their baseline clinical status was more severe.

PUV remains one of the most common obstructive uropathies of the lower urinary tract, though it is a rare condition. In our study, 71 cases (91.0%) were diagnosed postnatally, contributing to delayed treatment. When diagnosed late, this condition can lead to ESRD. Despite advances in treatment, traditional methods of valve elimination are still used without precise localization or visual guidance. These outdated techniques were introduced when miniature endoscopic tools were unavailable. Endoscopic valve ablation should be the first-line surgical treatment, as it is currently the most widely used and globally accepted gold standard.

4. Conclusions

In conclusion, vesicostomy appears to be more beneficial for the restoration of renal function and is not inferior in terms of bladder function, particularly in children with severe renal impairment. Even in patients with advanced forms of posterior urethral valves (PUV), vesicostomy represents a reliable alternative approach that can preserve kidney function and ensure adequate long-term urinary diversion.

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