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Original Research Article

Presentation of Posterior Urethral Valve and Outcome After Complete Valve Ablation Among Under Five Baby Boys in a Tertiary Care Hospital: An Observational Study

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Conflict of interest: Nil

Abstract

Introduction: Posterior urethral valve (PUV) is the most common cause of lower urinary tract obstruction in male infants and young children. If not diagnosed and managed timely, it can lead to significant morbidity including urinary tract infections, renal insufficiency, and long-term chronic kidney disease. Early detection, stabilization, and surgical intervention are critical for optimal outcomes.

Aims: This study aimed to evaluate the presentation of posterior urethral valve among under five baby boys and outcome after complete valve ablation.

Methods: The present study was a Prospective Interventional study. This Study was conducted from September' 2021- July' 2022. Department of Paediatric Surgery, IPGME&R/SSSKM Hospital-the Centre of excellence. Study population 52.

Results: In 52 male infants with PUV, complete valve fulguration significantly improved outcomes. Mean BMI increased from 15.53 to 16.87 ($p < 0.001$). Right kidney APD decreased from 23.24 mm to 15.71 mm ($p < 0.001$), bladder wall thickness from 5.24 to 3.7 mm ($p < 0.001$), PVRU from 34.06% to 13.02% ($p < 0.001$), right DRF from 30.12% to 37.47% ($p < 0.001$), and VUR decreased from 32.69% to 11.54% ($p = 0.002$), demonstrating improved growth, bladder function, and renal outcomes.

Conclusion: In 52 male infants with PUV, complete valve fulguration significantly improved growth, bladder function, renal drainage, and renal function. Early and complete intervention effectively alleviates obstruction and preserves renal function, underscoring the importance of timely diagnosis and close follow-up.

Keywords: Posterior urethral valve, under-five children, hydronephrosis, bladder dysfunction, valve ablation, renal function.

Introduction

Lower urinary tract obstruction in male infants, particularly due to posterior urethral valves (PUV), remains a significant challenge in paediatric urology. PUV is characterized by abnormal membranous folds in the posterior urethra, which impede urinary flow and lead to varying degrees of bladder dysfunction, hydroureteronephrosis, and renal impairment [1]. Early diagnosis and timely management are crucial, as delayed intervention can result in chronic kidney disease, recurrent urinary tract infections, and long-term bladder dysfunction [2]. PUV is the most common congenital cause of bladder outlet obstruction in male infants, with an incidence estimated at 1 in 5,000 to 8,000 live male births [3]. The condition may present variably, from severe antenatal hydronephrosis and oligohydramnios to postnatal manifestations such as poor urinary stream, urinary retention, failure to thrive, and recurrent urinary tract infections [4]. These clinical features not only

threaten renal function but also contribute to significant morbidity in this vulnerable age group.

The standard diagnostic approach for PUV involves imaging studies such as ultrasonography, which can detect hydronephrosis and bladder wall thickening, and voiding cystourethrogram (VCUG), which remains the gold standard for confirming the presence and type of urethral obstruction [5]. Early postnatal identification allows for prompt stabilization, including urinary drainage via catheterization and correction of electrolyte imbalances, followed by definitive surgical intervention such as endoscopic valve ablation [6].

While endoscopic valve ablation is considered the treatment of choice, the timing and adequacy of intervention significantly influence renal and bladder outcomes. In addition, some infants may require temporary diversion procedures such as vesicostomy to relieve obstruction and preserve renal function [7]. Postoperative follow-up is essential to monitor renal function, assess bladder dynamics, and prevent long-term complications including persistent bladder dysfunction and recurrent infections [8]. Despite advancements in surgical techniques and perioperative care, a subset of infants continues to experience progressive renal impairment, highlighting the need for early recognition, individualized management, and long-term monitoring [9]. In tertiary care settings, where complex paediatric cases are managed, evaluating the presentation, intervention strategies, and outcomes of PUV in under-five male babies is crucial for optimizing care. This prospective observational study aims to systematically assess the clinical presentation, diagnostic findings, surgical interventions, and short- and intermediate-term outcomes of PUV among male baby boys under five years. By focusing on this specific population, the study seeks to address existing gaps in paediatric urology literature, provide insights into prognostic factors, and inform best practices for managing PUV in young children. The findings could enhance early detection strategies, optimize surgical management, and improve overall renal and bladder outcomes in this high-risk group [10].

Materials and Methods

Study design: It was an Observational and Prospective study.

Place of study: The study has been done from surgical out patients and in patients of department of Paediatric Surgery, IPGME&R/SSSKM Hospital-the Centre of excellence.

Period of study: September 2021- July 2022.

Study Population: All PUV babies attending OPD and admitted at IPD departments of this hospital. Babie with complications of PUV were first stabilized at hospital and then taken for valve fulguration.

Study Variables

- Age
- Religion
- Place of Birth
- Type of Delivery
- Birth Complications
- BMI
- Birth weight
- Maturity during Delivery
- Chief complaints at OPD
- Antenatal US scan
- APD Right Pelvis
- APD Left Pelvis
- Bladder wall thickness
- PVRU in bladder
- DRF Right kidney
- GFR Right Kidney
- Type of PUV
- Trabeculation

Sample size: 52 baby boys under five years of age with posterior urethral valve.

Inclusion Criteria

- Symptoms of poor urinary flow from birth due to PUV.
- History of recurrent urinary infectionsdue to PUV.

Exclusion Criteria

- Age > 60 months,
- History of previous interventions like Supravesical diversion or Vesicostomy done.
- Presenting with firm, distended bladder
- Abdominal distension due to urinary ascites,
- Parents are not well motivated to follow drug advices or to attend on follow up regularly.
- Severe degree of RD

Statistical Analysis: Data collected from the study were entered into Microsoft Excel and analyzed using SPSS version 26.0.

Continuous variables, such as age, urinary frequency, and post-void residual volume, were expressed as mean ± standard deviation, while categorical variables, such as presence of incontinence or adverse effects, were presented as frequencies and percentages. Comparisons of pre- and post-therapy outcomes were performed using paired t-tests for normally distributed continuous data and Wilcoxon signed-rank tests for non-normally distributed data. Associations between categorical variables were assessed using the chi-square test or Fisher's exact test, as appropriate. A p-value of <0.05 was considered statistically significant, and all tests were two-tailed. Graphical

representations, including bar charts and line diagrams, were used to illustrate trends and treatment effects.

Result

Table 1: Demographic and Perinatal Characteristics of the Study Population

Demographic and Perinatal Characteristics		Number	Percentage
Age Group	1-6 m	8	15.39
	6-12m	9	17.3
	12-24m	11	21.15
	2-3 yrs	8	15.39
	3-4 yrs	6	11.54
	4-5 yrs	10	19.23
	Total	52	100
Religion	Hindu	30	57.69
	Muslim	22	42.31
	Christian	0	0
	Others	0	0
	Total	52	100
Place of Birth	Hospital	49	94.23
	Home	3	5.77
	Total	52	100
Type of Delivery	Vaginal	39	75
	Caesar	13	25
	Total	52	100
Birth Complications	Preeclampsia/Eclampsia	4	7.69
	Prolonged labour	2	3.85
	Others	0	0
	No complications	46	88.46
	Total	52	100

Table 2: Antenatal, Perinatal, Anthropometric, and Clinical Characteristics of the Study Population

Antenatal, Perinatal, Anthropometric, and Clinical Characteristics		Number	Percentage
Antenatal US scan	Normal	18	34.62
	Unilateral HDN	20	38.46
	Bilateral HDN	13	25
	HDN with Oligohydramnios	1	1.92
	Total	52	100
Maturity during Delivery	Preterm, < 37 weeks	6	11.54
	Term >= 37 weeks	46	88.46
	Total	52	100
Birth weight	VLBW <1.8 Kg	1	1.92
	LBW 1.8-<2.5Kg	12	23.08
	Normal 2.5-3.5 Kg	36	69.23
	Overweight >3.5 kg	3	5.77
	Total	52	100
BMI	<15	16	30.77
	15-18	34	65.39
	18-25	2	3.84
	>25	0	0
	Total	52	100
Chief complaints at OPD	Narrow stream	45	86.54
	Dribbling	32	61.54
	Lump abdomen	22	42.31
	Pain abdomen	2	3.85
	Urosepsis	23	44.23
	Metabolic acidosis	8	15.39
	Hypertension	2	3.85
	ARF	3	5.77
	Urinary ascites	1	1.92

Table 3: Ultrasonographic and MCU Parameters of the Study Population

Ultrasonographic Renal Functional Parameters		Number	Percentage
APD Right Pelvis	Mild HDN <20 mm	38	73.08
	Moderate 20-30mm	1	1.92
	Severe > 30mm	13	25
	Total	52	100
APD Left Pelvis	Mild HDN <20 mm	33	63.46
	Moderate 20-30mm	19	36.54
	Severe, > 30mm	0	0
	Total	52	100
Bladder wall thickness	<= 3mm	0	0
	> 3-5mm	34	65.38
	> 5mm	18	34.62
	Total	52	100
PVRU in bladder	< 10% capacity	0	0
	10-25% capacity	21	40.39
	>25% capacity	31	59.61
	Total	52	100
VUR Grade on MCU	0	35	67.31
	I	0	0
	II	2	3.85
	II	4	7.69
	IV	1	1.92
	V	10	19.23
	Total	52	100

Table 4: DTPA-Diuretic Renal Scan, and Cystoscopy Findings

DTPA- Diuretic Renal Scan, and Cystoscopy Findings		Number	Percentage
GFR right Kidney	<20ml/min	10	19.23
	20-40ml/min	23	44.23
	>40ml/min	19	36.54
	Total	52	100
GFR left Kidney	<20ml/min	1	1.92
	20-40ml/min	15	28.85
	>40ml/min	36	69.23
	Total	52	100
D T1/2 Right Kidney	< 10 min	0	0
	10-20 min	36	69.23
	>20min	16	30.76
	Total	52	100
D T1/2 Left Kidney	< 10 min	0	0
	10-20 min	34	65.39
	>20min	18	34.61
	Total	52	100
DRF Right kidney	< 10%	2	3.85
	10-20%	6	11.53
	20-30%	9	17.31
	30-40%	34	65.39
	40-50%	1	1.92
	> 50%	0	0
	Total	52	100
Trabeculation	Absent	0	0
	Mild	22	42.31
	Marked	30	57.69
	Total	52	100
Bladder Capacity	Markedly reduced	30	57.69
	Mild reduced	22	42.31
	Normal	0	0

	Total	52	100
Type of PUV	Type I	52	100
	Type II	0	0
	Type III	0	0
	Total	52	100

Table 5: Comparative analysis of children with PUV as per their average baseline and follow up parameters (2nd visist) after Complete valve fulguration

Sl. No.	Parameter	Baseline	Follow-up	P value	Significance
1	BMI	15.53	16.87	<0.001	Significant
2	APD of Right Kidney (mm)	23.24	15.71	<0.001	Significant
3	APD of Left Kidney (mm)	17.27	20.56	0.012	Significant
4	Bladder Wall Thickness (mm)	5.24	3.7	<0.001	Significant
5	PVRU (% of normal bladder capacity)	34.06	13.02	<0.001	Significant
6	Bladder Capacity (% of normal)	57.02	74.06	<0.001	Significant
7	DRF of Right Kidney (%)	30.12	37.47	<0.001	Significant
8	GFR of Right Kidney (ml/min)	32.6	39.01	<0.001	Significant
9	GFR of Left Kidney (ml/min)	40.04	45.16	<0.001	Significant
10	DT1/2 of Right Kidney (min)	16.83	10.86	<0.001	Significant
11	DT1/2 of Left Kidney (min)	17.58	10.56	<0.001	Significant
12	VUR Resolution (%)	32.69	11.54	0.002	Significant

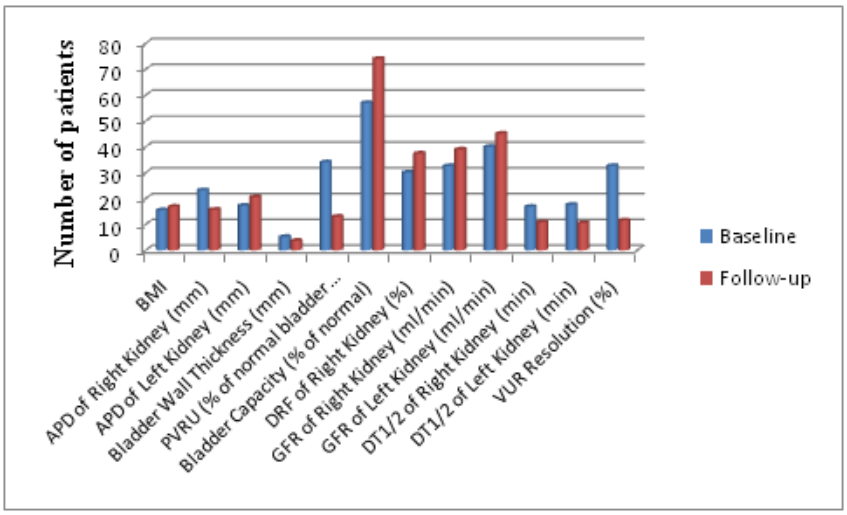

Figure 1: Comparative analysis of children with PUV as per their average baseline and follow up parameters (2nd visist) after Complete valve fulguration

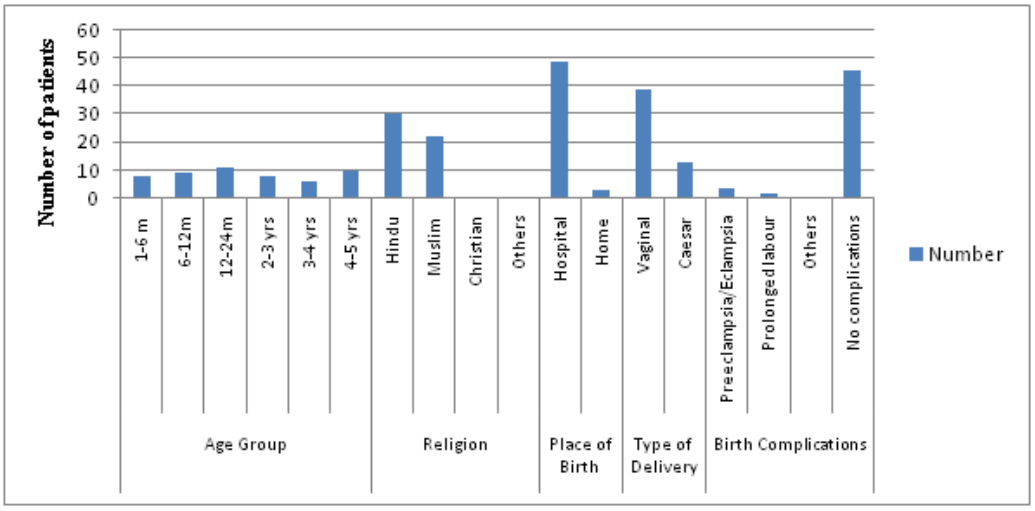

Figure 2: Demographic and Perinatal Characteristics of the Study Population

Among the 52 male infants included in the study, 8 (15.39%) were aged 1–6 months, 9 (17.31%) were 6–12 months, 11 (21.15%) were 12–24 months, 8 (15.39%) were 2–3 years, 6 (11.54%) were 3–4 years, and 10 (19.23%) were 4–5 years. The largest proportion of children belonged to the 12–24 months age group, while the smallest proportion was in the 3–4 years group. Regarding religious distribution, the majority of infants were Hindu, accounting for 30 children (57.69%), while 22 children (42.31%) were Muslim. No children in the study population belonged to Christian or other religious groups. Most of the infants (49, 94.23%) were born in a hospital setting, whereas only 3 children (5.77%) were born at home, highlighting a predominantly institutional delivery pattern in this cohort. In terms of delivery method, 39 infants (75%) were delivered vaginally, and 13 infants (25%) were delivered via caesarean section. Vaginal delivery was thus the more common mode among the study population. Birth complications were relatively uncommon in this cohort. Preeclampsia or eclampsia affected 4 infants (7.69%), prolonged labour was observed in 2 infants (3.85%), and no other complications were reported. The majority of infants, 46 (88.46%), had no birth complications. (Table 1)

Among the 52 infants, 18 (34.62%) had normal antenatal ultrasound scans. Unilateral hydronephrosis (HDN) was detected in 20 infants (38.46%), while bilateral HDN was seen in 13 infants (25%). Only 1 infant (1.92%) had HDN associated with oligohydramnios. These findings indicate that a significant proportion of infants had antenatal renal abnormalities. Most infants were delivered at term, with 46 (88.46%) being ≥37 weeks of gestation. Preterm delivery (<37 weeks) occurred in 6 infants (11.54%). The majority of infants had a normal birth weight between 2.5–3.5 kg, accounting for 36 infants (69.23%). Low birth weight (LBW, 1.8–<2.5 kg) was observed in 12 infants (23.08%), very low birth weight (VLBW, <1.8 kg) in 1 infant (1.92%), and overweight (>3.5 kg) in 3 infants (5.77%).

At baseline, 16 infants (30.77%) had a BMI <15, 34 infants (65.39%) had a BMI between 15–18, 2 infants (3.84%) had a BMI between 18–25, and no infants had a BMI >25. Most infants thus fell within the low-to-normal BMI range. The most common presenting complaint was a narrow urinary stream, reported in 45 infants (86.54%), followed by dribbling in 32 infants (61.54%). A palpable abdominal lump was noted in 22 infants (42.31%), and urosepsis was present in 23 infants (44.23%). Other complaints included metabolic acidosis in 8 infants (15.39%), abdominal pain in 2 infants (3.85%), hypertension in 2 infants (3.85%), acute renal failure in 3 infants (5.77%), and urinary ascites in 1 infant (1.92%).(Table 2)

On ultrasonography, mild hydronephrosis (HDN) of the right renal pelvis (<20 mm) was observed in 38 infants (73.08%). Moderate HDN (20–30 mm) was seen in 1 infant (1.92%), while severe HDN (>30 mm) was present in 13 infants (25%).For the left renal pelvis, mild HDN (<20 mm) was present in 33 infants (63.46%), and moderate HDN (20–30 mm) was noted in 19 infants (36.54%). No cases of severe HDN (>30 mm) were observed. None of the infants had a bladder wall thickness ≤3 mm. A thickness of 3–5 mm was seen in 34 infants (65.38%), and >5 mm in 18 infants (34.62%), indicating significant bladder wall thickening in a considerable proportion of the cohort. No infant had a PVRU <10% of bladder capacity. PVRU of 10–25% of bladder capacity was present in 21 infants (40.39%), while 31 infants (59.61%) had PVRU >25%, suggesting impaired bladder emptying in more than half of the study population. On micturating cystourethrogram (MCU), 35 infants (67.31%) had no VUR (grade 0). VUR grade II was observed in 2 infants (3.85%) and grade III in 4 infants (7.69%). Grade IV VUR was seen in 1 infant (1.92%), and grade V VUR was present in 10 infants (19.23%), indicating severe reflux in a significant minority. (Table 3)

On DTPA diuretic renal scan, 10 infants (19.23%) had a right kidney GFR of <20 ml/min, 23 infants (44.23%) had a GFR of 20–40 ml/min, and 19 infants (36.54%) had a GFR >40 ml/min. For the left kidney, 1 infant (1.92%) had a GFR <20 ml/min, 15 infants (28.85%) had a GFR of 20–40 ml/min, and 36 infants (69.23%) had a GFR >40 ml/min, indicating relatively better left renal function in most patients. No infants had a right kidney DT1/2 of <10 minutes. A DT1/2 of 10–20 minutes was observed in 36 infants (69.23%), while 16 infants (30.76%) had a DT1/2 >20 minutes, suggesting delayed drainage in nearly one-third of patients. Similarly, for the left kidney, 34 infants (65.39%) had a DT1/2 of 10–20 minutes, and 18 infants (34.61%) had a DT1/2 >20 minutes. No infant had a DT1/2 <10 minutes. DRF analysis showed that 2 infants (3.85%) had <10%, 6 infants (11.53%) had 10–20%, 9 infants (17.31%) had 20–30%, 34 infants (65.39%) had 30–40%, and 1 infant (1.92%) had 40–50%. No infant had DRF >50%. Cystoscopic evaluation revealed that none of the infants had absent trabeculation. Mild trabeculation was seen in 22 infants (42.31%), while marked trabeculation was present in 30 infants (57.69%). Bladder capacity was markedly reduced in 30 infants (57.69%) and mildly reduced in 22 infants (42.31%). No infant had a normal bladder capacity. All infants (52, 100%) had Type I PUV. No cases of Type II or Type III PUV were observed. (Table 4)

Following complete valve fulguration in the 52 male infants with PUV, significant improvements

were observed across most anthropometric, ultrasonographic, and renal functional parameters. The mean BMI increased from 15.53 at baseline to 16.87 at follow-up ($p < 0.001$), indicating improved nutritional and growth status.

Renal pelvis dilation showed a significant reduction on the right side, with APD decreasing from 23.24 mm to 15.71 mm ($p < 0.001$), whereas the left kidney APD increased slightly from 17.27 mm to 20.56 mm ($p = 0.012$), which was statistically significant. Bladder wall thickness decreased from 5.24 mm to 3.7 mm ($p < 0.001$), and post-void residual urine (PVRU) significantly reduced from 34.06% to 13.02% of normal bladder capacity ($p < 0.001$). Functional bladder capacity improved from 57.02% to 74.06% ($p < 0.001$).

Renal function parameters also demonstrated significant improvement. Differential renal function (DRF) of the right kidney increased from 30.12% to 37.47% ($p < 0.001$), while GFR improved from 32.6 to 39.01 ml/min on the right and from 40.04 to 45.16 ml/min on the left (both $p < 0.001$). Drainage half-times (DT1/2) decreased significantly for both kidneys, with the right kidney reducing from 16.83 to 10.86 minutes and the left from 17.58 to 10.56 minutes ($p < 0.001$ for both).

Finally, vesicoureteral reflux (VUR) resolution improved, with the proportion of affected children decreasing from 32.69% at baseline to 11.54% at follow-up ($p = 0.002$). Overall, these results indicate that complete valve fulguration leads to significant improvements in growth, bladder function, renal drainage, and renal function in children under five with PUV.(Table 5)

Discussion

The present study was a Prospective Interventional study. This Study was conducted from September' 2021- July' 2022. Department of Paediatric Surgery, IPGME&R/SSSKM Hospital-the Centre of excellence. Study population 52.

In this observational study of 52 male infants under five years of age with posterior urethral valves (PUV), the majority of patients presented between 12 and 24 months of age (21.15%), with fewer patients in the 3–4 years group (11.54%). This age distribution is consistent with findings from Nasir et al. [11], who reported that most children with PUV are diagnosed in infancy or early childhood. The predominance of institutional births (94.23%) and vaginal delivery (75%) reflects improved access to healthcare, though birth complications were relatively uncommon, occurring in only 11.54% of infants, which aligns with previous studies [Ansari MS et al 12, Sarhan O et al 13].

Antenatal detection of hydronephrosis (HDN) was observed in a substantial proportion of infants, with 38.46% showing unilateral HDN and 25% bilateral HDN. Only one infant had HDN with oligohydramnios. These findings are in agreement with Psooy et al. [15], who emphasized the role of antenatal ultrasonography in early detection of urinary tract abnormalities. Most infants were term (88.46%) and had normal birth weight (69.23%), though a significant minority were low birth weight, reflecting the potential impact of urinary tract obstruction on fetal growth. Baseline BMI data indicated that most infants fell within a low-to-normal range, which may relate to chronic urinary morbidity prior to intervention [16].

Clinically, a narrow urinary stream was the most common presenting complaint (86.54%), followed by dribbling (61.54%), abdominal lump (42.31%), and urosepsis (44.23%). Less frequent presentations included metabolic acidosis, hypertension, acute renal failure, and urinary ascites. These findings mirror those reported by Shakya et al. [17] and Bomalaski et al. [19], who highlighted the varied clinical spectrum of PUV, ranging from mild lower urinary tract symptoms to severe renal compromise.

Ultrasonographic evaluation revealed mild right renal pelvis HDN in 73.08% of infants and moderate HDN in 1.92%, with severe dilation in 25%. The left renal pelvis showed mild HDN in 63.46% and moderate HDN in 36.54%, with no severe cases. Bladder wall thickening (>3 mm) was present in all babies, and post-void residual urine (PVRU) exceeded 25% of bladder capacity in 59.61% of patients, indicating impaired bladder emptying. Vesicoureteral reflux (VUR) was absent in 67.31% of infants, while 19.23% had grade V reflux. These findings are consistent with Routh et al. [14], who reported a high incidence of bladder dysfunction and VUR in PUV patients at presentation.

DTPA diuretic renal scan showed compromised right kidney function in a significant number of patients, with 19.23% having GFR <20 ml/min and 44.23% between 20–40 ml/min. Left renal function was comparatively better, with 69.23% showing GFR >40 ml/min. Drainage half-times (DT1/2) were prolonged (>20 minutes) in approximately one-third of infants for both kidneys, and differential renal function (DRF) of the right kidney was <30% in 36.69% of patients. Cystoscopy demonstrated trabeculation in all cases, with marked trabeculation in 57.69% and reduced bladder capacity in all infants. Type I PUV was universally observed, consistent with the reported predominance of Type I valves in the literature [McLorie et al. 18, Hodges SJ et al 20].Following complete valve fulguration, significant improvements were observed across anthropometric, ultrasonographic, and renal functional parameters. BMI increased significantly, reflecting better nutritional status post-intervention.

Right renal pelvis dilation reduced, bladder wall thickness and PVRU decreased, and functional bladder capacity improved. Renal function parameters also improved, with increased DRF and GFR and reduced DT1/2. VUR resolution was notable, with affected children decreasing from 32.69% to 11.54%. These findings reinforce the importance of early intervention and are comparable with the outcomes reported by Parkhouse et al. [16] and McLorie et al. [18], who emphasized that timely valve ablation can prevent progressive renal damage and improve long-term outcomes. Overall, this study highlights that early diagnosis and complete valve fulguration in male infants with PUV leads to significant improvements in bladder dynamics, renal drainage, and renal function. The findings underscore the importance of regular follow-up with ultrasonography, DTPA scans, and MCU to monitor recovery and prevent long-term complications.

Conclusion

In this prospective interventional study of 52 male infants with posterior urethral valves (PUV), complete valve fulguration resulted in significant improvements in growth, bladder dynamics, and renal function. Post-procedure, BMI increased, indicating better nutritional status, while right renal pelvis APD, bladder wall thickness, and post-void residual urine decreased, reflecting improved urinary drainage and bladder function. Differential renal function and GFR improved in both kidneys, and drainage half-times shortened significantly, demonstrating enhanced renal drainage. Vesicoureteral reflux also showed substantial resolution. These findings highlight that timely and complete valve ablation in children under five with PUV not only ameliorates lower urinary tract obstruction but also preserves renal function, emphasizing the importance of early diagnosis, intervention, and close follow-up to prevent long-term renal morbidity.

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