Posterior Urethral Valve: Factors Affecting the Renal Outcome

Ipsita Biswas[1]*, Khondaker T[2], Chakraborty AK[3]

*[1]Associate Professor, Department of Urology, Bangladesh Shishu Hospital And Institute, Dhaka, Bangladesh.
Email: biswasipsita@yahoo.com
Orcid ID: 0000-0002-7272-701X
[2]Assistant Professor, Department of Paediatric Nephrology, Bangladesh Shishu Hospital and Institute, Dhaka, Bangladesh.
Email: tkrasha@gmail.com
Orcid ID: 0000-0003-2335-4672
[3]Associate Professor, Department of Pediatric Surgery, Shaheed Suhrawardy Medical College, Dhaka, Bangladesh.
Email: abhichakraborty@yahoo.com
Orcid ID: 0000-0002-8314-3212

*Corresponding author

Abstract

Background: Posterior urethral valve (PUV) is the most common cause of lower urinary tract obstruction in male children with associated sequlae. Different factors, such as age at presentation, initial and nadir serum creatinine, renal parenchymal echogenicity on initial USG, vesicoureteric reflux (VUR), recurrent UTI, bladder dysfunction and the presence or absence of pop-off mechanism like VURD have significant impact on ultimate renal outcome. The main aim of the study was to observe the effects of different prognostic factors like age of presentation and preoperative VUR of the PUV respondents on postoperative long term renal outcome as well as changes of renal function status on the basis of initial and postoperative serum creatinine level in our settings. **Material & Methods:** This was a quasi-experimental study and conducted in the Department of Pediatric urology of Bangladesh Shishu Hospital and Institute, Dhaka. We enrolled 58 male children of different ages having posterior urethral valve, who were admitted in the pediatric urology department from July,2018 to Dec,2021. **Results:** Total 58 patients included in our study. Among all patients 53.4% were aged between 1 month to 1 year, 39.7% of them were more than 1 year old and 6.9% of them were neonates. Among 31 respondents, 32.3 % had poor renal function & 35.5 % of them also had moderately impaired renal function. Again, out of 23 respondents, 30.4% had poor renal function & 6% had moderately impaired renal function. The relation between age category and postoperative renal function status (On the basis of postoperative eGFR) of the posterior urethral valve respondents were statistically not significant. Patients who had no VUR, 66.7% of them had normal renal function, 25% had moderately impaired renal function and 8.3% had poor renal function. Respondents who had bilateral VUR, 55% of them had poor renal function and 35% had moderately impaired renal function. Among respondents who had unilateral VUR, 28.6% of them had poor renal function and 28.6% had moderately impaired renal function but 42.9% had normal renal function. The relation between preoperative VCUG findings and postoperative long term renal function status of the PUV patients were statistically significant. 7 (100%) respondents who had preoperative abnormal renal function, more than 71.4% of them had returned to normal renal function after operative procedure. But abnormal renal function was present in 2 (28.6%) patients during follow up. In our study we found 29.3% of our patients had poor renal outcome and 29.3% patients had moderately impaired renal function within the mean follow up period of 19.33±12.38 months (ranges from 9months to 4 years). **Conclusion:** Our research highlights the significance of age at presentation, despite its statistically negligible effect on long-term renal outcomes. However, among the children with PUV following valve ablation and with a long-term follow-up, beginning serum creatinine and the presence of various types of VUR on initial VCUG had a significant effect (p.05) on postoperative renal function on the basis of serum creatinine.

INTRODUCTION

Posterior urethral valve is the most common cause of lower urinary tract obstruction in male children. It has a wide spectrum of disease severity and associated sequalae.[1,2] The mortality of these children has decreased significantly in recent decades, but 25-40% of PUV patients develops chronic kidney disease and end stage renal disease at varying age.[2,3,4] The main goal in treatment of posterior urethral valve patient is to preserve renal and bladder function which will affect the final outcome. Several studies have been done to evaluate the possible prognostic factors affecting the outcome of PUV patients. It is observed that different factors, such as age at presentation, initial and nadir serum creatinine, renal parenchymal echogenicity on initial USG, vesicoureteric reflux (VUR) , recurrent UTI, bladder dysfunction and the presence or absence of pop-off mechanism like VURD have significant impact on ultimate outcome.[5] The main aim of the study was to observe the effects of different prognostic factors like age of presentation and preoperative VUR of the PUV respondents on postoperative long term renal outcome as well as changes of renal function status on the basis of initial and postoperative serum creatinine level in our settings.

MATERIAL AND METHODS

This quasi-experimental study was conducted at Pediatric urology department, Bangladesh Shishu Hospital and Institute, Dhaka. We enrolled 58 male children of different ages having posterior urethral valve, who were admitted in the pediatric urology department from July, 2018 to Dec, 2021. Preoperative evaluation of each respondent was done by history, clinical examination and relevant investigation including serum creatinine, serum electrolytes and urine culture and sensitivity. Initial ultrasonography of KUB was also done to assess the structural and functional status of kidney. Diagnosis of PUVs was confirmed in all cases by using voiding cystourethrography (VCUG). The site and grade of VUR was also evaluated from the VCUG. After confirmation of diagnosis, cystoscopy and primary valve ablation was performed. After valve ablation, the urethral catheter was left in situ for 3 days to allow edema to subside. The patients were observed for voiding after the removal of the urethral catheter and at the follow-up visit at the outpatient clinic. Patients were discharged with antibiotic prophylaxis. Low-dose of either trimethoprim or nitrofurantoin, was administered to all patients. Follow up was done after 3 months of valve ablation and 6 monthly thereafter with clinical examination, urine analysis, urine culture, serum creatinine and Ultrasonogram. Follow-up VCUG was performed after 6 months postoperatively of each patient and then every 6 monthly in refluxing cases. Reflux was graded according to the international classification.[6] We studied certain parameters in relation to the final renal outcome, including age at presentation, initial serum creatinine, VUR on initial VCUG. Glomerular filtration rate (GFR) was calculated using the Schwartz formula.[7] In this study post operative long-term renal outcome was defined as normal renal function if GFR >90 ml/min per 1.73 m2, moderately impaired if GFR is from 60

to 89 ml/min per 1.73 m2 and poor if the patient had GFR <60 ml/min per 1.73 m2 [8, 9]. The mean follow-up time was 19.33 ± 12.38 months (range from 6 months to 4 years). Analysis was done by SPSS (version 24.0, Chicago, IL) software. Qualitative variables had described by frequency distribution, while quantitative variables were described by the mean and standard deviation. Chi-square test had applied for categorical data. The statistical significance was evaluated as appropriate probability level $p < 0.05$ for all tests.

RESULTS

[Table 1] showed the distribution of the posterior urethral valve respondents according to age category. It reveals that among all, more than half (53.4%) of the respondents age were in between 1 month to 1 year, just near 2/5th (39.7%) of them were more than one year old and only few (6.9%) of them were neonate. Mean (± SD) age of the respondents was 16.58 ± 20.41months and minimum age was 6 days (0.20 months) & maximum age was 7 (84 months) years.

Table 1: Distribution of the posterior urethral valve respondents according to age category (n = 58).

Age category of the posterior urethral valve respondents	Frequency	Percent
Less than 1 month	4	6.9
1 month to 1 Year	31	53.4
More than 1 year	23	39.7
Total	58	100.0

Table 2: Distribution of the respondents according to level of post operative long term renal function (on the basis of eGFR).

Level of post operative long term renal function of the respondents (on the basis of eGFR)	Frequency	Percent
Normal renal function (e GFR > 90 ml /min/1.73 m^2)	24	41.4
Moderately impaired renal function (e GFR 60 - 90 ml /min/1.73 m^2)	17	29.3
Poor renal function (eGFR < 60 ml /min/1.73 m2)	17	29.3
Total	58	100.0

[Table 2] showed the distribution of the respondents according to level of post operative long term renal function on the basis of eGFR. It reveals that just above 2/5th (41.4%) of the respondents had normal renal function after operation and equal proportion had moderate (29.3%) and poor (29.3%) renal functional status.

Table 3: Relation between age category and postoperative renal function status (On the basis of eGFR) of the posterior urethral valve respondents.

Age category of the respondents	Long term renal function status (On the basis of post operative eGFR)			Total	□2 (df)	p

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	Poor renal function	Moderately impaired renal function	Normal renal function			
Less than 1 month	0 (0.0%)	0 (0.0%)	4 (100.0%)	4 (100.0%)	6.91 (4)	>.05
1 month to 1 Year	10 (32.3%)	11 (35.5%)	10 (32.3%)	31 (100.0%)		
More than 1 year	7 (30.4%)	6 (26.1%)	10 (43.5%)	23 (100.0%)		
Total	17 (29.3%)	17 (29.3%)	24 (41.4%)	58 (100.0%)		

[Table 3] showed the relation between age category and postoperative renal function status (On the basis of eGFR) of the posterior urethral valve respondents. It reveals that all (100%) the respondents whose age less than one month had normal renal function. Among the respondents whose age between 1 month to 1 year, near 1/3rd (32.3 %) had poor renal function & just above 1/3rd (35.5 %) of them also had moderately impaired renal function. Again, out of 23 respondents who were more than 1 year old, only near 1/3rd respondent had poor renal function & just more than 1/4th of them had moderately impaired renal function. The relation between age category and postoperative renal function status (On the basis of postoperative eGFR) of the posterior urethral valve respondents were statistically not significant [p >0 .05].

Table 4: Relation between preoperative voiding cystourethrography (VCUG) findings and postoperative long term renal function status of the posterior urethral valve respondents (n =58).

Preoperative voiding cystourethrography (VCUG) findings	Postoperative long term renal function status			Total	χ^2 (df)	p
	Normal renal function (e GFR > 90 ml /min/1.73 m2)	Moderately impaired renal function (e GFR 60- 90 ml /min/1.73 m2)	Poor renal function (e GFR < 60 ml /min/1.73 m2)			
No VUR (n =24)	16 (66.7%)	6 (25.0%)	2 (8.3%)	24 (100.0%)		
Bilateral VUR (n =20)	2 (10.0%)	7 (35.0%)	11 (55.0%)	20(100.0%)	16.96 (4)	<.05
Unilateral VUR (n =14)	6 (42.9%)	4 (28.6%)	4 (28.6%)	14 (100.0%)		
Total	24 (41.4%)	17 (29.3%)	17 (29.3%)	58 (100.0%)		

[Table 4] showed the relation between preoperative voiding cystourethrography (VCUG) findings and postoperative long term renal function status of the posterior urethral valve respondents. It reveals that among the respondents before their operation who had no VUR, just more than 2/3rd (66.7%) of them had normal renal function,1/4th (25%) had moderately impaired renal function and less than 1/10th (8.3%) had poor renal function. Respondents who had bilateral VUR, among them more than half

(55.0%) had poor renal function; more than 1/3rd (35.0%) had moderately impaired renal function and 1/10th (10.0%) had normal renal function. Again, respondents who had unilateral VUR, among them just above 2/5th (42.9 %) had normal renal function and above 1/4th (28.6 %) of them had moderately impaired renal function as well as similar proportion (28.6%) also had poor renal function. The relation between preoperative voiding cystourethrography (VCUG) findings and postoperative long term renal function status of the posterior urethral valve respondents were statistically significant [p <0.05].

Table 5: Relation between changes of preoperative and postoperative renal function status (on the basis of preoperative S. creatinine) of the posterior urethral valve respondents.

Preoperative renal function of the respondents (on the basis of preoperative S. creatinine)	Postoperative renal function (On the basis of postoperative serum creatinine)		Total	χ^2 (df)	p
	Normal Renal function	Abnormal renal function			
Normal renal function (n =51)	50 (98.0%)	1 (2.0%)	51(100.0%)	8.87(2)	<.05
Abnormal Renal function (n = 7)	5 (71.4%)	2 (28.6%)	7 (100.0%)		
Total	55 (94.8%)	3 (5.2%)	58 (100.0%)		

[Table 5] showed the relation between changes of preoperative and postoperative renal function status of the posterior urethral valve respondents. It reveals that out 7 (100%) respondents who had preoperative abnormal renal function, more than 2/3rd (71.4%) of them had returned to normal renal function after operative procedure. Again, among the respondents who had normal renal function before operation of posterior urethral valve, only one respondent (2%) of them had abnormal renal function. The relation between changes of preoperative and postoperative renal function status of the posterior urethral valve respondents were statistically significant [p < 0.05].

DISCUSSION

Posterior urethral valve is the most common urinary anomaly that affects the renal and bladder function.[2] Though the mortality rate of these patients is decreased in recent decades but 25-60% patients may have renal failure in long term follow up.[2,10,11] Renal function deterioration depends on age at presentation, GFR, prenatal diagnosis, renal dysplasia, VUR, renal scarring, initial serum creatinine, nadir creatinine during 1st year of life, upper tract obstruction, bladder dysfunction, and urinary tract infection (UTI).[12] In this study we tried to evaluate the significance of different prognostic factors in children with PUV treated with primary valve ablation. The long-term renal outcome was evaluated in relation with age of presentation, presence of different types of VUR in initial VCUG, and changes of renal function according to initial and postoperative serum creatinine level.

Age at presentation has been suggested as a predictor of renal function in children with PUV.[13,14] However, the data on this issue are conflicting. Prenatal diagnosis was initially

thought to improve the outcome, but earlier studies failed to show that the long-term outcome in prenatally detected PUV cases is better than symptomatic cases detected postnatally.[3] Bhadoo et al,[12] stated that the renal function outcome was worse in patients presenting within 1 year of age compared with those presenting after 1 year of age. Their findings were similar to those reported by Parkhouse et al.[2] In this study, more than half (31/58, 53.4%) of the patients presented in between 1 month to 1year. just near 2/5th (39.7%) was more than 1year old and only few (6.9%) of them were neonate. In our study we found near one third (32.3%) of the respondents had poor renal function (eGFR <60ml/min/1.73m^2) whose ages between 1 month - 1 year which was a bit higher than patient above 1 year of age (32.3 % vs 30.4% respectively) at presentation. Again, none (0.0%) of the neonate had poor renal function and these age-related findings to long term renal function were statistically not significant (p >0.05). The role of VUR in patients with valves is controversial. In some studies documented that neither bilateral nor unilateral VUR was observed to affect the outcome.[3,14] On the other hand Tejani A et al,[16] reported that bilateral VUR, particularly persistent VUR, predicts the development of poor renal function (GFR < 60 ml/min/1.73m2) and ESRD eventually. We also observed that poor long-term outcome were associated with the presence of bilateral VUR. In our study more than half (55%) and more than 1/3rd (35%) patient with bilateral VUR had poor renal function and moderately impaired renal function respectively. On the other hand, renal outcome was found better in patients with unilateral VUR. We found similar proportion

(28.6% for each) of respondents with unilateral VUR had poor renal function and moderately impaired renal function. The relation between preoperative voiding cystourethrography (VCUG) findings and postoperative renal function status of the posterior urethral valve respondents were statistically significant [p <0.05]. Most VUR disappear once bladder is stabilized with anticholinergics. But the post treatment persistent upper tract dilatation should be considered for detrusor dysfunction by a complete urodynamic evaluation.[18]

Several investigators have emphasized the prognostic importance of initial serum creatinine levels in patients with PUVs.[3,19,20] Sarhan OM et al,[5] stated that initial serum creatinine was significantly higher in boys with a poor outcome than in those with a favorable outcome. They observed that when initial serum creatinine was below 1 mg/dl, the incidence of renal impairment was 22% while if it was above 1 mg/dl, the incidence increased to 63%. These results were similar to those previously noted by Connor and Burbige.[21] In the present study We also observed that the out of 58 only 7 (12.07%) patients had high serum creatinine value during admission. Among them serum creatinine values became normal among 5 (71.4%) patients after valve ablation. But 2 (28.6%) patients had retained their abnormal renal function in long term follow up. These changes were statistically significant (p<0.05).

The prevalence of chronic kidney disease (CKD) or End stage renal disease (ESRD) obviously depends on the length of the follow-up period. Renal function may not deteriorate until late adolescence during the growth spurt. Ylinen E et al described that the long-term renal outcome

was poor in 30% of the total of 46 boys after a mean follow-up period of 12.5 years.[14] In previous studies the frequency of patients developing poor renal function has varied from 22% to 68%.[3,10,11,15,16,17] In the present study we found 29.3% of our patients had poor renal outcome and similar proportion (29.3%) patients also had moderately impaired renal function within the mean follow up period of 19.33±12.38 months (ranges from 6 months to 4 years).

Our study has some limitations. It is a single center and short duration study. Some of our patients lost follow up during covid pandemic. We also excluded the patients from study those who underwent urinary diversion. For these reason the total no of patient included in the study is less. It is important that parents of the PUV patients must be aware that the PUV diagnosis means a long-term commitment to follow up and care of their children is essential for better management of posterior urethral valve patients.

CONCLUSIONS

Our research highlights the significance of age at presentation, despite its statistically negligible effect on long-term renal outcomes. However, among the children with PUV following valve ablation and with a long-term follow-up, beginning serum creatinine and the presence of various types of VUR on initial VCUG had a significant effect (p=0.05) on postoperative renal function on the basis of serum creatinine.

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