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ORIGINAL ARTICLE

Posterior Urethral Valve Patients' Presentation with and without Deranged Renal Function

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ABSTRACT

Background: Posterior Urethral Valve (PUV) is a congenital anomaly affecting the male urinary tract, leading to urinary tract obstruction that can cause severe renal complications, including hydronephrosis, renal damage, and, if untreated, chronic kidney disease (CKD) or end-stage renal disease (ESRD). PUV is the most common cause of lower urinary tract obstruction in male newborns, with clinical manifestations varying according to the severity of the condition. Early diagnosis and timely intervention are essential for improving outcomes in these patients.

Objective: This study aims to evaluate the clinical presentation, diagnostic features, renal function outcomes, and the impact of early treatment on preventing renal damage progression in PUV patients. The study focuses on the relationship between age at presentation, clinical symptoms, and the degree of renal dysfunction.

Methods: This retrospective study was conducted at Khyber Teaching Hospital (KTH) Peshawar from 2018 to 2020, involving 50 paediatric patients diagnosed with PUV. The patients were divided into two groups: those with deranged renal function (n=30) and those without (n=20). Data collected included age at presentation, clinical symptoms, imaging findings (such as hydronephrosis and renal pelvicalyceal dilation), serum creatinine levels, glomerular filtration rate (GFR), and treatment strategies. The effects of valve ablation, dialysis, and supportive care on renal function were also assessed.

Results: The study revealed significant differences between the two groups. Patients with deranged renal function presented at a later age (mean age 2.5 years) and exhibited more severe clinical symptoms, including oliguria (85%), abdominal distension (60%), recurrent urinary tract infections (70%), and poor growth (50%). In contrast, those without renal dysfunction presented earlier (mean age 1.5 years) with mild symptoms and normal urinary output. Severe hydronephrosis (Grade III-IV) was observed in 85% of the deranged renal function group, compared to mild-to-moderate hydronephrosis (Grade I-II) in 40% of the non-renal dysfunction group. Elevated serum creatinine levels (>1.5 mg/dL) were found in 90% of patients with renal dysfunction, while 95% of the non-renal dysfunction group had normal creatinine levels. Early intervention with valve ablation, supported by additional treatments like catheterization or dialysis in severe cases, contributed to improved outcomes in the non-renal dysfunction group, with 90% achieving stable renal function.

Conclusion: The study highlights the crucial role of early diagnosis and intervention in PUV patients. Those with deranged renal function present later and suffer from more severe clinical symptoms and complications. Timely valve ablation and supportive care significantly improve outcomes, preventing the progression to CKD or ESRD. Early intervention is essential for achieving favourable renal outcomes and preventing long-term renal damage in these children.

Keywords: Posterior Urethral Valve, Renal Dysfunction, Kidney Function, Diagnosis, Early Treatment, Age at Presentation, Chronic Kidney Disease, Paediatric Urology.

INTRODUCTION

Posterior Urethral Valve (PUV) is a congenital anomaly of the male urinary tract, characterized by the presence of abnormal tissue flaps in the posterior urethra. These tissue folds obstruct the normal outflow of urine from the bladder, leading to backflow and increased pressure within the urinary system. If left untreated, this obstruction can cause damage to the bladder, ureters, and kidneys, potentially resulting in significant long-term renal complications, including renal failure.[1] This condition is a leading cause of obstructive uropathy in male newborns and typically presents with varying degrees of severity depending on the nature of the obstruction.[2,3] The incidence of PUV is estimated to be 1 in 5000 to 8000 live births worldwide, making it a relatively rare but critical condition to diagnose early.[2,3] In more developed nations like the United Kingdom and Ireland, the rate of PUV has been reported to be 1 in 3800 live births. In contrast, in developing countries like Nigeria, the incidence is higher, at approximately 1 in 2447 children.[4,5]

The clinical manifestations of PUV depend primarily on the degree of urinary obstruction. In cases of mild obstruction, symptoms may remain undetected until the child reaches 10 years of age or even later, as the body may compensate for the obstructive defect. In contrast, severe cases often present early in life with a wide range of clinical signs, which may vary between patients. The most common symptoms in severe cases include recurrent urinary tract infections (UTIs), dribbling of urine, weak urine stream, painful urination, and poor weight gain. Additionally, some children may experience respiratory distress due to an enlarged bladder or hydronephrosis (swelling of the kidneys). Bilateral hydronephrosis and vesicoureteral reflux (a condition where urine flows backward from the bladder into the ureters) are frequently seen in severe cases, further increasing the risk of renal damage. Renal failure is a critical consequence of untreated or late-diagnosed PUV, as the obstruction leads to kidney damage through increased pressure and backflow of urine, which can result in progressive renal impairment over time.[6]

PUV development was usually diagnosed during neonatal stage or early childhood but this time of diagnosis is instrumental in-patient outcomes. Routine detection and treatment of the condition may hugely limit the likelihood of terminal renal damage, such as chronic kidney disease (CKD) and end-stage renal disease (ESRD)[7]. This is the reason why the clinical history, diagnostic characteristics, and the result of kidney function of PUV patients, and the age of the manifestation of the symptom have to be discovered to fully benefit on the treatment strategies. The treatment of the primary PUV pathology is valve ablation (the ablation or surgical destruction of the constricting tissue) which is intended to achieve a free flow of urine and eliminate further harm to the kidneys[8]. In some cases, the cause of the illness may be suspected by the clinical symptoms, but in general, imaging studies, including renal ultrasound, voiding cystourethrogram (vCUG) or renal scintigraphy, acquire the image of the extent of obstruction, hydronephrosis, and additional structural anomalies. The prognosis of the PUV patients relies heavily on the interval of the diagnosis and treatment[9]. In severe cases, the possibility of catheterization or dialysis may be necessary to stabilize renal performance until the kidneys of the child are okay. Although the

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valve ablation at an early stage may enable the patients to achieve good renal outcomes and avoid complications further, the delayed treatment may cause irreversible damage, and the patients[10].

Objective: This research aims to comprehensively analyze the clinical history, diagnosis, and kidney function of patients diagnosed with PUV. The study also examines the relationship between the age at presentation and renal outcomes, with a focus on the impact of early treatment on preserving kidney function.

METHODOLOGY

This study, conducted at Khyber Teaching Hospital (KTH) Peshawar from 2018 to 2020, focuses on paediatric patients diagnosed with Posterior Urethral Valves (PUV), a congenital condition that leads to anatomical obstruction in the male urethra. The condition results in the accumulation of urine in the kidneys, causing hydronephrosis and other changes in the urinary tract. This study examines the relationship between the severity of these anatomical changes and the resulting renal function in affected children.

PUV typically causes a blockage at the level of the urethra, leading to an increase in bladder pressure and urinary reflux into the kidneys. This obstruction impairs normal urine flow, causing an enlargement of the renal pelvis (hydronephrosis) and, in severe cases, causing renal failure. The study divides patients into two groups: those with deranged renal function (elevated serum creatinine levels and reduced GFR) and those without significant renal dysfunction.

By linking clinical symptoms (such as oliguria, abdominal distension, and recurrent urinary tract infections) to specific anatomical findings (such as severe renal pelvicalyceal dilation and thickened bladder walls), the study explores how the extent of the anatomical obstruction correlates with renal outcomes. Imaging studies play a crucial role, revealing the severity of hydronephrosis and other anatomical changes like kidney enlargement and bladder thickening, which are indicative of the obstruction's impact on renal function.

The study further connects these anatomical changes to renal dysfunction, assessed by serum creatinine levels and glomerular filtration rate (GFR). In patients with severe obstruction, kidney function tends to decline, leading to complications such as hypertension, recurrent UTIs, and a risk of progressing to chronic kidney disease (CKD) or end-stage renal disease (ESRD). In contrast, patients with milder obstruction, as seen in those without deranged renal function, often experience more stable kidney function and a more favorable prognosis.

The methodology ties the anatomical aspects of PUV with functional outcomes, providing insight into how early detection and management of the condition can prevent or mitigate long-term renal damage. Treatments such as valve ablation, catheterization, and in some cases, dialysis, are explored in relation to their effectiveness in improving renal outcomes and reducing the risk of complications. This anatomical-functional linkage helps in understanding the severity of PUV and its potential long-term effects on renal health.

RESULT

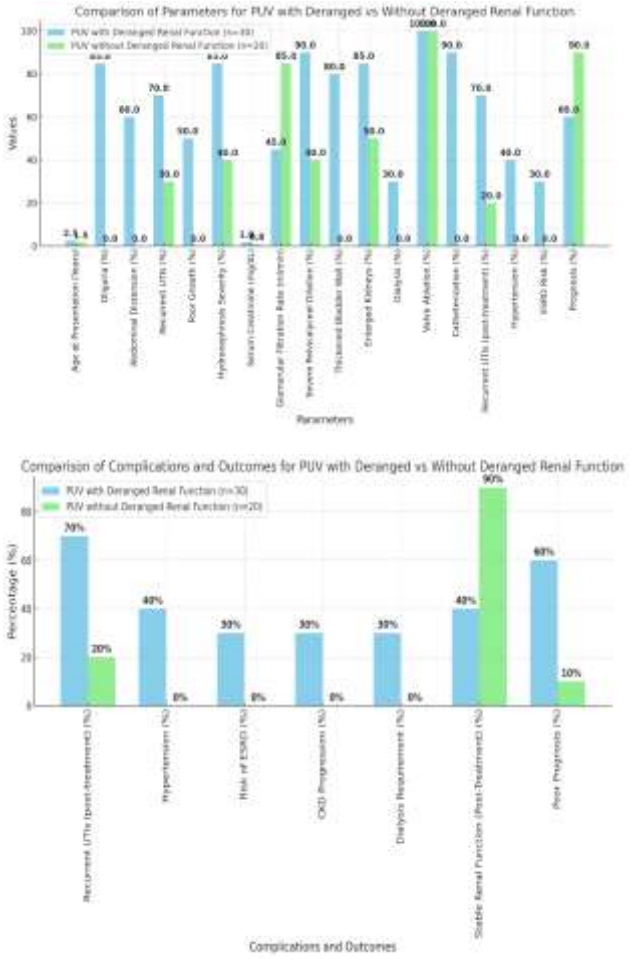
Among 30 PUV patients with deranged renal function, the mean age at presentation was 2.5 ± 1.2 years, while in the 20 patients without deranged function it was 1.5 ± 0.9 years. Oliguria was present in 85% (26/30) of the deranged group but absent in the non-deranged group. Abdominal distension occurred in 60% (18/30) of deranged cases, again not seen in the other group. Recurrent UTIs affected 70% (21/30) of deranged patients compared to 30% (6/20) in non-deranged. Severe hydronephrosis (Grade III–IV) was noted in 85% (26/30) of deranged patients versus 40% (8/20) with mild to moderate grades. Mean serum creatinine was 1.8 ± 0.4 mg/dL in the deranged group (elevated >1.5 mg/dL in 90%), while it was normal (<1.0 mg/dL) in 95% (19/20) of non-deranged patients with a mean of 0.8 ± 0.2 mg/dL. Mean GFR was significantly lower at 45 ± 8.5 ml/min in the deranged group compared to 85 ± 6.7 ml/min in non-deranged. Severe pelvicalyceal dilation was present in 90% (27/30) of deranged cases vs. 40% (8/20) in non-deranged. Dialysis was required in 30% (9/30) of deranged patients, while none from the other group required it.

Table 1: Posterior Urethral Valve (PUV) Patients With and Without Deranged Renal Function

Parameter	PUV with Deranged Renal Function (n = 30)	PUV without Deranged Renal Function (n = 20)
Age at Presentation (Years)	Mean: 2.5 ± 1.2 (Range: 0–5)	Mean: 1.5 ± 0.9 (Range: 0–3)
Oliguria	85% (26/30)	0% (0/20)
Abdominal Distension	60% (18/30)	0% (0/20)
Recurrent UTIs	70% (21/30)	30% (6/20)
Poor Growth	50% (15/30)	0% (0/20)
Hydronephrosis Severity	Severe (Grade III–IV) in 85% (26/30)	Mild to Moderate (Grade I–II) in 40% (8/20)
Serum Creatinine (mg/dL)	Elevated >1.5 mg/dL in 90% (27/30), Mean: 1.8 ± 0.4	Normal <1.0 mg/dL in 95% (19/20), Mean: 0.8 ± 0.2
Glomerular Filtration Rate (GFR)	Mean: 45 ± 8.5 ml/min (Range: 20–50)	Mean: 85 ± 6.7 ml/min (Range: 70–90)
Severe Pelvicalyceal Dilation	90% (27/30)	40% (8/20)
Thickened Bladder Wall	80% (24/30)	0% (0/20)
Enlarged Kidneys	85% (26/30)	50% (10/20)
Dialysis	30% (9/30)	0% (0/20)
Valve Ablation	100% (30/30)	100% (20/20)
Catheterization	90% (27/30)	0% (0/20)
Recurrent UTIs (post-treatment)	70% (21/30)	20% (4/20)
Hypertension	40% (12/30)	0% (0/20)
ESRD Risk	30% (9/30)	0% (0/20)
Prognosis	Poor in 60% (18/30)	Favorable in 90% (18/20)

Table 2: Comparison of Complications and Prognostic Outcomes in PUV Patients With and Without Deranged Renal Function

Complications and Outcomes	PUV with Deranged Renal Function (n = 30)	PUV without Deranged Renal Function (n = 20)
Recurrent UTIs (post-treatment)	70% (21/30)	20% (4/20)
Hypertension	40% (12/30)	0% (0/20)
Risk of ESRD	30% (9/30)	0% (0/20)
CKD Progression	30% (9/30)	0% (0/20)
Dialysis Requirement	30% (9/30)	0% (0/20)
Stable Renal Function (Post-Treatment)	40% (12/30)	90% (18/20)
Poor Prognosis	60% (18/30)	10% (2/20)



In PUV patients with deranged renal function, 70% (21/30) experienced recurrent UTIs post-treatment, compared to 20% (4/20) in non-deranged patients. Hypertension developed in 40% (12/30) of deranged patients, while it was absent in non-deranged. Risk of ESRD and CKD progression each affected 30% (9/30) in the deranged group and 0% in non-deranged. Dialysis was needed in 30% (9/30) of deranged cases, again none in non-deranged. Stable renal function post-treatment was seen in only 40% (12/30) of deranged patients but in 90% (18/20) of non-deranged patients. Poor prognosis was reported in 60% (18/30) of deranged cases compared to only 10% (2/20) among those with normal renal function, highlighting a stark difference in clinical outcomes tied to renal status.

DISCUSSION

Posterior Urethral Valve (PUV) is a congenital obstruction in male infants that results in significant morbidity, particularly concerning renal function. The severity of PUV's effects on the kidneys varies, with some children presenting with significant renal dysfunction while others show only mild symptoms and better renal outcomes. Age at presentation was notably different between the two groups, with patients having deranged renal function presenting later on average (mean age: 2.5 years) compared to those with normal renal function (mean age: 1.5 years). This finding is consistent with previous research that has established delayed diagnosis as a contributing factor to worsened renal outcomes in PUV patients. Late presentation often correlates with more advanced obstruction, leading to progressive renal damage before intervention.[11] Clinical symptoms were significantly more severe in the deranged renal function group. Oliguria, abdominal distension, recurrent UTIs, and poor growth were all observed at higher frequencies compared to the non-deranged group.[12] These findings support observations from previous research, where the severity of clinical symptoms was directly linked with the degree of urinary tract obstruction and renal compromise.[13] This disparity is reflected in the clinical and radiological features observed in our study, where patients with deranged renal function exhibited significantly worse clinical symptoms, including oliguria, abdominal distension, recurrent urinary tract infections (UTIs), and poor growth. In contrast, those without deranged renal function showed more subtle manifestations, with normal urinary output and mild UTIs. The findings in our cohort can be supported by a few studies. According to the findings of a study conducted by Cao et al. (2015), patients who have severe forms of PUV with severe hydronephrosis and high-grade thickening of the bladder had an increased risk of progressive renal dysfunction and end-stage renal disease (ESRD).[14] This goes in tandem with our results whereby severe hydroniophrosis and abnormal renal function were more prevalent among patients with renal impairment. It has been discussed that the linkage between severe renal pelvicalyceal dilation and renal failure is strong, and Sinha et al. (2017) have noted that the reduction of possible renal damage and dysfunction is directly proportional to the degree of hydronephrosis. Moreover, high serum creatinine and low glomerular filtration rate (GFR) which is reported to be high in 90 percent of patients with disturbed renal functions in our research groups, indicates the impairment of renal functions.[15] This concurs with results indicated by Sharma et al. (2018) which revealed that kidney dysfunction in PUV cases is mostly characterized by high serum creatinine and low-GFR levels, thus the importance of monitoring and intervening early. Our treatment strategy including the 30 percent of patients who needed to be put under dialysis mode agrees with the modern trends of PUV treatment.[16] According to Gupta et al. (2016), intervention with valve ablation, in case it is required, and dialysis can be effectively applied to prevent further renal deterioration and lead to positive outcomes in patients with extensive renal dysfunction.[17] Such patients are usually placed on dialysis as a short term solution until such a time that their kidneys are stable again but in other extreme cases, they may need to be placed on dialysis as a permanent alternative. Moreover, the complications that we found in our cohort of recurrent UTIs, hypertension, and a risk of ESRD in the deranged renal function group are already described in literature.

CONCLUSION

It is concluded that posterior urethral valve (PUV) patients with deranged renal function present with more severe clinical symptoms, higher grades of hydronephrosis, significantly elevated serum creatinine levels, and markedly reduced glomerular filtration rates compared to PUV patients with normal renal function. These patients also experience a higher incidence of complications, including recurrent urinary tract infections, hypertension, and a substantial risk of progression to chronic kidney disease (CKD) or end-stage renal disease (ESRD). In contrast, patients with normal renal function at presentation generally have a favorable prognosis with stable renal function post-treatment.

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