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Original Article

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Frequency of posterior urethral valves in newborns with hydronephrosis in nicu and early outcomes: A tertiary center experience

Abstract

Aim: To assess the frequency of posterior urethral valves (PUV) in male infants diagnosed with hydronephrosis in the neonatal intensive care unit (NICU) and the early outcomes.
Materials and Methods: The study included male patients who had been diagnosed with hydronephrosis in the antenatal or postnatal period in our NICU between 2017 and 2020. We investigated antenatal hydronephrosis detection statuses, birth histories, ultrasonographic findings, and the lowest creatinine values detected during the NICU treatment of PUV-diagnosed patients.
Results: A total of 73 infants had hydronephrosis and 20.5% of the patients (n=15) had PUV, and 26.6% (n=4) of the PUV patients had below 5 mm renal pelvic diameters. These patients were diagnosed with clinical suspicion (interrupted urination, decreased diuresis, or globe vesicle). In PUV-diagnosed patients, dysplastic kidneys and increased renal echogenicity are associated with poor outcomes (death or dialysis need).
Conclusion: Hydronephrosis finding in ultrasonography may not be sufficient, so complete clinical evaluation is needed in newborns not to miss PUV cases.

Keywords: Posterior urethral valve, puv, newborn, hydronephrosis

INTRODUCTION

Hydronephrosis is a term that defines dilatation of the renal pelvicalyceal system (1). Ultrasonography is the first step among imaging options to diagnose hydronephrosis in the neonatal period. However, it is essential to confirm hydronephrosis that is diagnosed antenatally and to determine the degree of dilatation and obstruction (2,3). As second trimester ultrasonographic fetal screening became routine in follow-ups, the number of patients that have been suspected of having hydronephrosis in the antenatal period has increased (4). Indeed, in periodic ultrasonographic follow-ups, fetal hydronephrosis is seen in 1–4.5% of pregnancies (1,5).

Hydronephrosis in newborns is not always secondary to obstruction in the urinary system, but some newborns with hydronephrosis may have structural or functional abnormalities in their urinary flow (2). The posterior urethral valve (PUV) describes the leaflets extending from the distal prostatic urethra to the external urinary sphincter (6). PUV is a common cause of bladder outlet obstruction with an incidence of 16 per 100.000 live male births and can cause tubular damage and decrease the number of nephrons (7). Chronic renal failure and progressive kidney damage can be seen even in the neonatal period, although renal functions parallel the number of nephrons (4). Early diagnosis can reduce impairment in kidney functions (8).

PUV is the most common cause of chronic renal disease in males over the long term, with 17% of the patients progressing to end-stage renal disease (9). If the patients progress to chronic kidney

disease, it is important to minimize new or ongoing damage to the kidney to improve long-term kidney survival and slow the progression to end-stage renal disease (10).

The frequency of PUV hydronephrosis among male babies who are diagnosed with hydronephrosis in neonatal intensive care units (NICU) is unknown. However, early detection of PUV is vital in preserving kidney functions, and in this study, we wanted to present PUV cases that were detected in the newborn period, the early outcomes of these cases, and the possible prognostic factors in the neonatal period.

MATERIALS AND METHODS

Marmara University Faculty of Medicine permission was obtained from the ethics committee with file number 09.2022.843 for the study. The study was carried out in accordance with the Declaration of Helsinki.

We included all male patients who had antenatal or postnatal hydronephrosis diagnosis that was found in ultrasonographic imaging performed for any reason in our hospital's NICU between January 2017 and December 2021 to assess the incidence in this retrospective study. We built a study group with PUV-diagnosed patients and recorded the birth week, birth weight, mode of delivery, antenatal hydronephrosis history, serum creatinine levels, urinary ultrasonography findings, and the need for urinary diversion before surgery for each patient. We defined the "poor outcome" by death or hemodialysis need in this study. The renal pelvis diameter of the more severely affected side was used for statistics.

Patients who have antenatal oligohydramnios, hydronephrosis, or urinary anomaly history were all undergone postnatal ultrasonographic evaluation. NICU staff also assessed PUV in patients with clinical signs like urinary retention, difficulties in placing a urinary catheter, or interrupted urination but without antenatal hydronephrosis history. The definitive diagnosis was made and surgeries were performing voiding cystourethrography and cystoscopy.

Statistical Analysis

Data were presented as mean±standard deviation and median (interquartile range), depending on the distribution pattern. We used the Chi-square test to compare two independent groups with categorical variables, and Spearman's rho test for correlation analyses. A p-value of <0.05 was considered significant. The open-source statistical package program JAMOVI 2.2.5 was used for statistical calculations.

RESULTS

Hydronephrosis (both antenatal and postnatal period) incidence was %2.7 in all male infants treated among NICU patients in 5 years period. Also, PUV incidence was %0.5 in this period. PUV incidence was 20.5% (n=15) in all hydronephrotic patients, and 58.8% in antenatal hydronephrosis diagnosed patients, on the other hand, 66.7% of PUV patients had hydronephrosis diagnosis in the antenatal period (Figure 1) (Table 1).

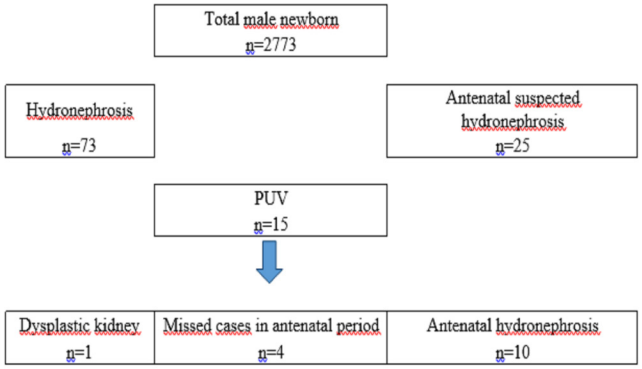

Figure 1. PUV and hydronephrosis diagnosed newborns

Table 1. Descriptive characteristics of PUV diagnosed patients (n=15)

Birth week	38.0 (36.6-40.0) weeks
Birth weight	2937±738 grams
Delivery type	66.7% (n=10) Cesarean section 33.3% (n=5) Normal spontaneous delivery
Renal pelvis diameter	7.75 (5.15-12) mm
Parenchyma echogenicity	Grade 0: 41.7% (n=5) Grade 1:16.7% (n=2) Grade 2:16.7% (n=2) Grade 3: 25% (n=3)
Bladder wall trabeculation or increased thickness	86.7% (n=13)
Antenatal hydronephrosis	66.7% (n=10)

Data are presented as mean±standard deviation, median (interquartile range), and % (n)

Four patients without antenatal hydronephrosis or urinary anomaly history were diagnosed due to clinical suspicions such as interrupted urination, difficulties placing the urinary catheter, decreased urination, and urinary retention.

We could not reach the antenatal history of 9 PUV patients as they were born in other centers. Two patients had oligohydramnios, and two patients had anhydramnios in antenatal history. One patient referred to our clinic due to renal failure in the late neonatal period was diagnosed with PUV as an underlying disease. Two patients died due to anhydramnios, pulmonary hypoplasia, and its consequences within two days. None of the other patients needed dialysis.

The patients were relieved with a urinary catheter, but one of them needed a vesicostomy. One patient declined surgery. All the rest 11 patients underwent endoscopic primary valve resection and were discharged healthy. The median PUV resection time was 15 (8.5-27) days. Poor outcomes (death and dialysis therapy need) occurred in 3 patients.

As we assess factors associated with poor outcomes, parenchymal echogenicity and dysplastic kidney image in ultrasonography were statistically significantly correlated with poor outcomes in PUV patients.

In Chi-square test dysplastic kidney (p=0.009, X2:6.87), and parenchymal echogenicity (p=0.012, X2:11) statistically, u significantly increased poor outcome probability. The correlation results are given in Table 2.

Table 2. Correlation with poor outcome related factors

	Spearman's rho	p
Birth week	-0.076	0.797
Birth weight	-0.092	0.753
Parenchyma echogenicity	0.804	0.003
Operation time	-0.129	0.705
Renal pelvis diameter	-0.225	0.705
Birth type	0.189	0.519
Antenatal hydronephrosis	-0.067	0.821
Dysplastic kidney	0.701	0.005

Spearman's rank correlation test was used to analyze the relationship between factors and poor outcomes

In patients who were diagnosed with PUV, the diameter of the renal pelvis was measured as a minimum of 4.5 mm and a maximum of 30 mm. The renal pelvic diameters were less than or equal to 5 mm in 26.6% (n=4) of the patients.

The median creatinine level in the first 7-10 days was 0.75 (0.54-1.21) mg/dL and the mean "lowest creatinine detected during hospitalization" was 0.269 +/-0.157 mg/dL. A total of 8 patients had lower than 0.4 mg/dL creatinine levels. The serum creatinine levels were below 0.85 mg/dL in the remaining 3 patients out of a total of 11 patients.

DISCUSSION

In the literature antenatal hydronephrosis incidence is reported in 1.6% of all pregnancies (both gender) (11), and PUV incidence is reported up to 1/3800 in all populations (12). Although antenatal ultrasonography is essential in detecting hydronephrosis and urinary system obstructions, it may miss some PUV cases. A study reported the sensitivity of prenatal ultrasonography as 94% and the specificity as 43% (13). Two studies suggested that only 1/3 to half of PUVs could be detected in prenatal ultrasonography (12,14). Although antenatal screening has a vital role in diagnosing PUV, it can not detect or suspect all PUV cases. In NICU patients, we found 2.7% of hydronephrosis and 0.5% of PUV prevalence in male infants and fetuses in our study. In our study, we diagnosed PUV in 58.8% of the patients with antenatal hydronephrosis. Antenatal hydronephrosis was also present in 66.7% of the patients with PUV.

Severe fetal hydronephrosis is usually associated with significant postnatal uropathy and often requires surgery (15,16). A total of four PUV patients who have clinical symptoms such as interrupted urination, difficulties placing urinary catheter because of probably narrow urethra, decreased urination, and urinary retention had been diagnosed in the neonatal period with insisted imaging tests upon clinician's suspicion. We know antenatal ultrasonography imaging is essential in PUV diagnosis yet is not enough in atypical cases. A demonstrative voiding cystourethrography of non-antenatal hydronephrosis-diagnosed newborns, who were investigated further after having difficulties placing the urinary catheter, is presented in Figure 2.

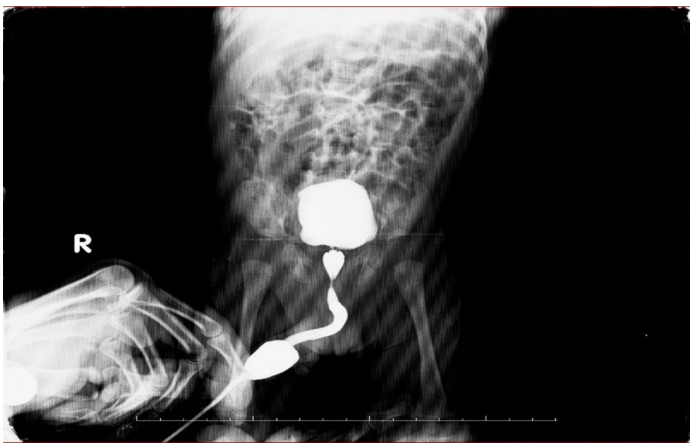

Figure 2. Voiding cysto-ureterogram of a non-hydronephrotic PUV

Early ultrasonography may mislead clinicians because postnatal first ultrasonographic imaging may be deceptively normal. A study observed that 21-28% of children who were found to have hydronephrosis during their prenatal follow-up had normal postnatal ultrasonographic imaging on their first screen. They found that 45% of children with this normal USG had abnormal USG results at follow-up (17). Studies reported that 5% of those requiring surgery for obstructive uropathies had normal USG results in the first week (18), and 15% of children with prenatal hydronephrosis developed progressive hydronephrosis after the first postnatal USG, which resulted in normal (19). The timing of postnatal ultrasonographic imaging is crucial because hydronephrosis severity may not be apparent until 48 hours after birth, partially due to dehydration (20,21). The first postnatal US should be delayed at least 48 hours after delivery, except for oligohydramnios, urethral obstruction, bilateral high-grade dilatation, and concerns about patient compliance with postnatal evaluation (22). We performed urinary system ultrasonographic imaging after the postnatal 48th hour in patients with no suspected urinary system obstruction. A total of 4 patients were diagnosed with PUV in after-48th-hour ultrasonography imaging.

Anteroposterior renal pelvic diameter usually is less than 3 mm in 99% of infants (23). Antero-posterior renal pelvis diameter threshold value of 4-5 mm is widely used in the third trimester

to select patients who require postnatal examination during pregnancy (24). However, there are also publications using a threshold value of 7-10 mm for the anterior-posterior renal pelvis diameter for urinary system dilatation, but there should be no pelvicalyceal enlargement in this dilatation but normal parenchyma and ureters/bladder appearances (23). In patients who were diagnosed with PUV, the median diameter of the pelvis were 7.75 mm and a minimum of 4.5 mm, and a maximum of 30 mm. The pelvic diameters were less than or equal to 5 mm in 26.6% (n=4) of the patients in the postnatal period. We believe clinicians should be alerted for PUV with even mild hydronephrosis in NICU babies.

It is reported that increased renal echogenicity is a future indicator for end-stage renal disease in later childhood follow-ups (25). Increased renal echogenicity is also an indicator of renal dysplasia in PUV patients (26). In another study conducted with 2-16 years children renal parenchymal echogenicity was reported as a risk factor for end-stage kidney disease (27). In our study group, increased renal parenchymal echogenicity was a risk factor for hemodialysis and death in the neonatal period.

Antenatal ultrasonographic findings in PUV include an overly distended bladder and thickened bladder wall (normal <2 mm, pathological>3 mm), bilateral or unilateral hydroureteronephrosis, oligohydramnios, and voiding dysfunction. Other findings include hyperechogenicity in the kidneys, renal dysplasia, renal cortical cyst, oligohydramnios, urinoma, or fetal ascites (8). In our study, 86.7% of the patients had bladder trabeculation and increased bladder wall thickness. One patient had a renal cortical cyst, and two patients had urinoma. These findings should be considered by clinicians and lead to further diagnostic tests for PUV.

Oligohydramnios may represent PUV in the antenatal period especially if it is associated with hydronephrosis (28). Further, oligohydramnios is reported as an independent factor for chronic kidney disease among congenital urinary anomalies (29). All patients diagnosed with posterior urethral valves (PUV) were under the follow-up of other medical centers during the antenatal period and following to delivery referred to our institution. Unfortunately, we were unable to access amniotic fluid data due to this referral process. It should be noted that two patients with PUV were born with anhydramnios at our hospital, which resulted in lung hypoplasia and subsequent mortality during the early postnatal period.

In surgical treatment, after relief with a urinary catheter, endoscopic primary valve ablation is performed in acute treatment when the baby is stable. Premature infants may not have a wide enough urethra for ureteral-cystoscopy, and these infants often require urinary diversion with cutaneous vesicostomy (4). Endoscopic primary valve resection was performed in all our patients, and we did not need a urinary diversion.

PUV carries a potentially high risk for urological and renal sequelae, which may develop into chronic kidney disease.

The lowest creatinine value measured in the postnatal first year (NADIR creatine) is the most critical data in prognosis (30). However, recurrent urinary tract infections are also associated with the risk of new renal scar formation and secondary nephron loss in children (31). However, in multivariate analysis, NADIR creatine is a more decisive prognostic risk factor for end-stage kidney disease than VUR and recurrent infections (32). In the first year of life, all patients with NADIR creatine>0.85mg/dL progress to chronic renal failure. Chronic renal failure is of 5.3% incidence at values <0.4mg/dL, and 28.3% in the intermediate values (10). During our study, it was not feasible to conduct a one-year follow-up on patients. However, the median serum creatinine level was recorded as 0.75 mg/dL between 7 to 10 days post-surgery, while the average "lowest creatinine level detected during hospitalization" was found to be 0.269 mg/dL. 8 patients had below 0.4 mg/dL creatinine and 3 patients' creatinine levels were below 0.85 mg/dL. This result suggests a good outcome for renal functions for infantile period diagnosed PUV patients.

The best solution that modern medicine can offer these children to improve their long-term health is a close nephrological-urological follow-up after birth to maintain peak bladder and kidney function, and of course, early-term diagnosis (6). Clinicians must detect atypical presentations of PUV to preserve kidney functions, even in non-hydronephrotic newborns.

Strengths and Weaknesses of the Study

This is a tertiary center study, and the number of the patient group is low. Thus, all the patients were undergone diagnosis and therapy with the same NICU staff in a third-stage referral NICU center.

CONCLUSION

A pelvis diameter threshold of 5 mm is not helpful in a quarter of PUV patients. Mild hydronephrosis may be a sign of PUV. Clinicians shall not miss atypical PUV presentations, like urinary retention, difficulties in placing a urinary catheter, or interrupted urination. Neonatal period diagnosed PUV cases are expected favorable kidney function outcomes. Dysplastic kidneys and increased renal echogenicity are related to poor outcomes.

Conflict of Interests
The authors declare that there is no conflict of interest in the study.

Financial Disclosure
The authors declare that they have received no financial support for the study.

Ethical Approval
This study was approved by the ethics committee of Marmara University Faculty of Medicine on May 06, 2022 with the decision number 09.2022.843.

REFERENCES

1. Ismaili K, Hall M, Piepsz A, et al. Insights into the pathogenesis and natural history of fetuses with renal pelvis dilatation. Eur Urol. 2005;48:207-14.

2. Epelman M, Victoria T, Meyers KE, et al. Postnatal imaging of neonates with prenatally diagnosed genitourinary abnormalities: a practical approach. Pediatr Radiol. 2012;42:124-41.

3. Ismaili K, Avni FE, Alexander M, et al. Routine voiding cystourethrography is of no value in neonates with unilateral multicystic dysplastic kidney. J Pediatr. 2005;146:759-63.

4. Becker A, Baum M. Obstructive uropathy. Early Hum Dev. 2006;82:15-22.

5. Dudley JA, Haworth JM, McGraw ME, et al. Clinical relevance and implications of antenatal hydronephrosis. Arch Dis Child Fetal Neonatal Ed. 1997;76:31-4.

6. Chiodini B, Ghassemi M, Khelif K, Ismaili K. Clinical outcome of children with antenatally diagnosed hydronephrosis. Front Pediatr. 2019;7:103.

7. Lloyd JC, Wiener JS, Gargollo PC, et al. Contemporary epidemiological trends in complex congenital genitourinary anomalies. J Urol. 2013;190:1590-5.

8. Sharma S, Joshi M, Gupta DK, et al. Consensus on the Management of posterior urethral valves from antenatal period to puberty. J Indian Assoc Pediatr Surg. 2019;24:4-14.

9. Hodges SJ, Patel B, McLorie G, Atala A. Posterior urethral valves. ScientificWorldJournal. 2009;9:1119-26.

10. Carlström M. Causal link between neonatal hydronephrosis and later development of hypertension. Clin Exp Pharmacol Physiol. 2010;37:14-23.

11. Kari JA, Habiballah S, Alsaedi SA, et al. Incidence and outcomes of antenatally detected congenital hydronephrosis. Ann Saudi Med. 2013;33:260-4.

12. Brownlee E, Wragg R, Robb A, et al. Current epidemiology and antenatal presentation of posterior urethral valves: outcome of baps cass national audit. J Pediatr Surg. 2019;54:318-21.

13. Bernardes LS, Aksnes G, Saada J, et al. Keyhole sign: how specific is it for the diagnosis of posterior urethral valves?. Ultrasound Obstet Gynecol. 2009;34:419-23.

14. Thakkar D, Deshpande AV, Kennedy SE. Epidemiology and demography of recently diagnosed cases of posterior urethral valves. Pediatr Res. 2014;76:560-3.

15. Coplen DE, Austin PF, Yan Y, et al. The magnitude of fetal renal pelvic dilatation can identify obstructive postnatal hydronephrosis, and direct postnatal evaluation and management. J Urol. 2006;176:724-7.

16. Dias CS, Silva JM, Pereira AK, et al. Diagnostic accuracy of renal pelvic dilatation for detecting surgically managed ureteropelvic junction obstruction. J Urol. 2013;190:661-6.

17. Aksu N, Yavaşcan O, Kangin M, et al. Postnatal management of infants with antenatally detected hydronephrosis. Pediatr Nephrol. 2005;20:1253-9.

18. Signorelli M, Cerri V, Taddei F, et al. Prenatal diagnosis and management of mild fetal pyelectasis: implications for neonatal outcome and follow-up. Eur J Obstet Gynecol Reprod Biol. 2005;118:154-9.

19. Matsui F, Shimada K, Matsumoto F, Takano S. Late recurrence of symptomatic hydronephrosis in patients with prenatally detected hydronephrosis and spontaneous improvement. J Urol. 2008;180:322-5.

20. Dejter SW Jr, Gibbons MD. The fate of infant kidneys with fetal hydronephrosis but initially normal postnatal sonography. J Urol. 1989;142:661-8.

21. Laing FC, Burke VD, Wing VW, et al. Postpartum evaluation of fetal hydronephrosis: optimal timing for follow-up sonography. Radiology. 1984;152:423-4.

22. Wiener JS, O'Hara SM. Optimal timing of initial postnatal ultrasonography in newborns with prenatal hydronephrosis. J Urol. 2002;168:1826-9.

23. Nguyen HT, Benson CB, Bromley B, et al. Multidisciplinary consensus on the classification of prenatal and postnatal urinary tract dilation (utd classification system). J Pediatr Urol. 2014;10:982-98.

24. Leung VY, Chu WC, Metreweli C. Hydronephrosis index: a better physiological reference in antenatal ultrasound for assessment of fetal hydronephrosis. J Pediatr. 2009;154:116-20.

25. Odeh R, Noone D, Bowlin PR, et al. Predicting risk of chronic kidney disease in infants and young children at diagnosis of posterior urethral valves: initial ultrasound kidney characteristics and validation of parenchymal area as forecasters of renal reserve. J Urol. 2016;196:862-8.

26. Partin AW, Kavoussi LR, Peters CA, Dmochowski RR. campbell walsh wein handbook of urology - e-book. Elsevier Health Sciences. 2021.

27. Sarhan OM, El-Ghoneimi AA, Helmy TE, et al. Posterior urethral valves: multivariate analysis of factors affecting the final renal outcome. J Urol. 2011;185:2491-5.

28. Ezel Çelakil M, Ekinci Z, Bozkaya Yücel B, et al. Outcome of posterior urethral valve in 64 children: a single center's 22-year experience. Minerva Urol Nefrol. 2019;71:651-6.

29. Çetinkaya PG, Gülhan B, Düzova A, et al. Clinical characteristics of children with congenital anomalies of the kidney and urinary tract and predictive factors of chronic kidney disease. Turk J Pediatr. 2020;62:746-55.

30. Coleman R, King T, Nicoara CD, et al. Nadir creatinine in posterior urethral valves: How high is low enough?. J Pediatr Urol. 2015;11:356.e1-5.

31. Jodal U. The natural history of bacteriuria in childhood. Infect Dis Clin North Am. 1987;1:713-29.

32. Bilgutay AN, Roth DR, Gonzales ET Jr, et al. Posterior urethral valves: risk factors for progression to renal failure. J Pediatr Urol. 2016;12:179.e1-7.