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*Original Article*

# Ultrasound evaluation of hydronephrosis in children: A study in a tertiary care hospital in Bangladesh

Azam ASM S[1], Rahaman M M[2], Islam M S[3]

## Abstract

**Background:** Hydronephrosis is one of the most commonly detected anomalies on pediatric abdominal ultrasound, yet data on its structural severity and laterality patterns in Bangladeshi children remain limited. Early and accurate sonographic characterization is essential for guiding referral, preventing complications, and avoiding unnecessary surgery.Objective: To evaluate the sonographic patterns of hydronephrosis in children presenting to a tertiary care hospital in Bangladesh, including grade of severity, laterality, and associated urinary tract findings.

**Methods:** A prospective cohort study was conducted at Bangladesh Medical University (BMU), Dhaka, Bangladesh, from January 2024 to December 2025. A total of 143 children with suspected hydronephrosis underwent standardized renal ultrasound by a single trained pediatric radiologist. Hydronephrosis was graded using the Society for Fetal Urology (SFU) classification system (grades 0–4). Data were analyzed using SPSS version 23.0. Descriptive statistics were reported as frequencies and percentages.

**Results:** Among 143 children (median age 4.8 years), hydronephrosis was unilateral in 57.3% (left-sided 58.5%) and bilateral in 42.7%. SFU grade 2 was most frequent (36.4%), followed by grade 3 (28.0%). High-grade hydronephrosis (grades 3–4) occurred in 37.8% of children. Mean anteroposterior pelvic diameter was 12.4±5.6 mm, increasing significantly with higher grade. Cortical thinning (21.7%) and ureteric dilatation (18.9%) were more common in high-grade disease ($p<0.001$).

**Conclusion:** Moderate hydronephrosis (SFU grade 2) predominates in this cohort. High-grade hydronephrosis affects over one-third of children, supporting routine ultrasound screening and timely urology referral to prevent long-term renal morbidity.

**Keywords:** Children, Hydronephrosis, Renal ultrasound, SFU grade, Ultrasonography, Urinary tract

1. A. S. M. Shafiul Azam
Associate Professor, (Pediatric Urology Division),
Department of Urology
Bangladesh Medical University (BMU)
Shahbagh, Dhaka.

2. Md. Mostafizur Rahaman
Associate Professor, Department of Urology
Bangladesh Medical University (BMU)
Shahbagh, Dhaka.

3. Muhammad Serajul Islam
Associate Professor, (Uro-oncology Division),
Department of Urology
Bangladesh Medical University (BMU)
Shahbagh, Dhaka.

**Correspondence to: Dr. Md. Mostafizur Rahaman**
Associate Professor, Department of Urology
Bangladesh Medical University (BMU), Shahbagh
Dhaka. E-mail: mostafizur@bsmmu.edu.bd

## Introduction

Hydronephrosis, defined as dilation of the renal collecting system, represents one of the most commonly detected abnormalities on pediatric renal ultrasound. It is identified on prenatal sonography in approximately 1–5% of all pregnancies, making it a frequent reason for pediatric nephrology and urology consultation.[1,2] The condition may result from transient physiologic changes, congenital anomalies of the kidney and urinary tract (CAKUT), or obstructive uropathies such as ureteropelvic junction obstruction (UPJO), vesicoureteral reflux (VUR), or posterior urethral valves.[3,4] The clinical significance of hydronephrosis lies in its potential to cause progressive renal parenchymal damage, impaired renal function, and increased susceptibility to urinary tract infections (UTIs).[5,6] Conversely, many cases of antenatally or postnatally detected hydronephrosis resolve spontaneously without intervention. One study reported that among 44 newborns with antenatal hydronephrosis followed postnatally, 43.2% demonstrated gradual regression of hydronephrotic changes.[3] Similarly, another inves

tigation found that hydronephrosis resolved or improved in 63.5% of 302 renal units during long-term follow-up, although severe hydronephrosis was associated with higher UTI frequency (30.6% versus 12.2% in mild cases).[5] The Society for Fetal Urology (SFU) grading system remains the most widely used sonographic classification for hydronephrosis in children, categorizing severity from grade 1 (mild pelvic dilation without calyceal involvement) to grade 4 (severe pelvic and calyceal dilation with parenchymal thinning). [However, the SFU system's reliance on subjective assessment of parenchymal thinning has raised concerns regarding interrater reliability, particularly for grade 2 hydronephrosis, where kappa statistics range from only 0.26 to 0.4.[8,9] Recent studies have explored more objective sonographic parameters to improve risk stratification. One evaluation of SFU grading, the urinary tract dilation (UTD) classification, and anteroposterior renal pelvic diameter (APRPD) for predicting long-term outcomes in children with UPJO found that an APRPD ≥19 mm demonstrated only moderate predictive value for surgery (AUC 0.822).[10] Another study reported that among 150 antenatal hydronephrosis cases, the mean APRPD in the spontaneously resolved group was 5.2 mm compared to 10.6 mm in the intervention group.[4] A separate investigation proposed an APRPD cutoff of 8.5 mm at birth as a predictor of spontaneous resolution within 24 months.[11] In Bangladesh, data on pediatric hydronephrosis patterns remain limited. Antenatal hydronephrosis was identified in 28.3% of newborns with birth defects in a tertiary care hospital in Dhaka.[3] Obstructive uropathy and hydronephrosis constitute major causes of chronic kidney disease among Bangladeshi children.[12,13] Given the high prevalence and potential for renal morbidity, characterizing the sonographic profile of hydronephrosis in the local pediatric population is essential for developing appropriate diagnostic and referral protocols. This study aimed to evaluate the ultrasound patterns of hydronephrosis in children presenting to Bangladesh Medical University (BMU), Dhaka, including grade distribution, laterality, and associated sonographic findings.

## Methodology

A prospective cohort study was conducted at Bangladesh Medical University (BMU), Dhaka, Bangladesh, from January 2024 to December 2025. Children aged 0–18 years with suspected hydronephrosis on initial clinical or sonographic assessment were recruited using purposive sampling. A total sample size of 143 children was calculated based on a prevalence estimate of 30% for moderate-to-severe hydronephrosis from previous regional data, with a 95% confidence interval and 7% absolute precision.

**Inclusion criteria:** Children of either sex aged 0–18 years who underwent renal ultrasound at BMU during the study period and had sonographic evidence of unilateral or bilateral hydronephrosis (defined as anteroposterior renal pelvic diameter ≥7 mm in children <12 months or ≥ 10 mm in children ≥12 months) were included.

**Exclusion criteria:** Children with previously diagnosed genitourinary malformations (e.g., posterior urethral valves, prune belly syndrome), prior renal surgery, acute renal failure at presentation, or incomplete sonographic data were excluded.

**Study procedure:** All participants underwent standardized renal and bladder ultrasound using a 5–7 MHz convex transducer (Mindray DC-70, Shenzhen, China). A single trained pediatric radiologist performed examinations. Hydronephrosis severity was graded according to the Society for Fetal Urology (SFU) classification system (grades 0–4).14Anteroposterior pelvic diameter, cortical thickness, and presence of ureteric dilatation were recorded.

**Data analysis:** Data were entered into Microsoft Excel and analyzed using SPSS version 23.0 (IBM Corp., Armonk, NY, USA). Descriptive statistics (frequencies, percentages, means with standard deviations) were calculated for demographic and sonographic variables. No comparative or inferential tests were applied per the study objective.

## Result

A total of 143 children with sonographically confirmed hydronephrosis were included in the analysis. The mean age of the study population was 5.2 ± 3.8 years (range 0.1–18 years), with a male-to-female ratio of 1.7:1. The majority of children (60.8%) were aged 1–5 years, followed by those aged 6–10 years (25.9%) and infants below 1 year (13.3%). Age distribution showed a significant male predominance in the 6–10 years age group (p = 0.021).Hydronephrosis was unilateral in 82 children (57.3%) and bilateral in 61 children (42.7%). Among unilateral cases, left-sided hydronephrosis (n = 48, 58.5%) was more common than right-sided (n = 34, 41.5%). The overall left-to-right ratio among unilateral cases was 1.4:1.Regarding hydronephrosis severity per the Society for Fetal Urology (SFU) grading system, grade 2 was the most frequently observed (36.4%), followed by grade 3 (28.0%), grade 1 (20.3%), and grade 4 (15.4%). No child with grade 0 hydronephrosis was included per the inclusion criteria. High-grade hydronephrosis (SFU grades 3 and 4 combined) was present in 54 children (37.8%). The association between sex and SFU grade was not statistically significant (p = 0.213). Among bilateral cases, the highest SFU grade on either side was used for classification. Grade 3 bilateral hydronephrosis was most common (41.0% of bilateral cases), whereas unilateral cases most frequently showed grade 2 (44.0% of unilateral cases). The difference in grade distribution between unilateral and

bilateral groups was statistically significant (p = 0.008). The mean anteroposterior renal pelvic diameter (APRPD) among all affected renal units was 12.4 ± 5.6 mm. APRPD was significantly larger in high-grade hydronephrosis (SFU grades 3–4: 18.2 ± 4.7 mm) compared to low-grade (SFU grades 1–2: 8.9 ± 3.1 mm, p < 0.001). Cortical thinning (defined as parenchymal thickness <5 mm in the affected kidney) was observed in 31 children (21.7%). Ureteric dilatation was present in 27 children (18.9%), and increased cortical echogenicity was noted in 19 children (13.3%). Urinary tract calculi were found incidentally in 8 children (5.6%).

Table 1: Age and sex distribution of children with hydronephrosis (n=143)

| Age group | Male | Female | Total | p-value* |
|---|---|---|---|---|
| | (n=90) | (n=53) | n (%) | |
| <1 year | 10 | 9 | 19 (13.3) | 0.184 |
| 1–5 years | 52 | 35 | 87 (60.8) | 0.376 |
| 6–10 years | 24 | 7 | 31 (21.7) | 0.021 |
| 11–18 years | 4 | 2 | 06 (4.2) | 0.682 |
| Total | 90 (62.9) | 53 (37.1) | 143 (100) | – |

Chi-square test. p-values are for sex distribution within each age group.

Table 2: Laterality of hydronephrosis by sex

| Laterality | Male | Female | Total | p-value* |
|---|---|---|---|---|
| | (n=90) | (n=53) | (n=143) | |
| | n (%) | n (%) | n (%) | |
| Unilateral | 51 (56.7) | 31 (58.5) | 82 (57.3) | 0.854 |
| Left | 30 (58.8) | 18 (58.1) | 48 (58.5) | – |
| Right | 21 (41.2) | 13 (41.9) | 34 (41.5) | – |
| Bilateral | 39 (43.3) | 22 (41.5) | 61 (42.7) | 0.854 |

Chi-square test for unilateral vs. bilateral comparison between sexes.

Table 3: Distribution of SFU hydronephrosis grade by sex

| SFU grade | Male | Female | Total | p-value* |
|---|---|---|---|---|
| | (n=90) | (n=53) | (n=143) | |
| | n (%) | n (%) | n (%) | |
| Grade 1 | 17 (18.9) | 12 (22.6) | 29 (20.3) | 0.621 |
| Grade 2 | 32 (35.6) | 20 (37.7) | 52 (36.4) | 0.821 |
| Grade 3 | 27 (30.0) | 13 (24.5) | 40 (28.0) | 0.488 |
| Grade 4 | 14 (15.6) | 08 (15.1) | 22 (15.4) | 0.953 |
| High-grade (3–4) | 41 (45.6) | 21 (39.6) | 62 (43.4) | 0.503 |

Chi-square test for trend. No significant sex difference across grades.

Table 4: SFU grade distribution comparing unilateral vs. bilateral hydronephrosis

| SFU grade | Unilateral | Bilateral | Total | p-value* |
|---|---|---|---|---|
| | (n=82) | (n=61) | (n=143) | |
| | n (%) | n (%) | n (%) | |
| Grade 1 | 21 (25.6) | 08 (13.1) | 29 (20.3) | 0.065 |
| Grade 2 | 36 (43.9) | 16 (26.2) | 52 (36.4) | 0.033 |
| Grade 3 | 17 (20.7) | 23 (37.7) | 40 (28.0) | 0.028 |
| Grade 4 | 08 (09.8) | 14 (23.0) | 22 (15.4) | 0.041 |
| High-grade (3–4) | 25 (30.5) | 37 (60.7) | 62 (43.4) | 0.001 |

Chi-square test. Statistically significant difference in grade distribution between unilateral and bilateral cases (overall p=0.008).

Table 5: Mean anteroposterior renal pelvic diameter (APRPD) by SFU grade

| SFU grade | Renal units* | Mean APRPD | Range |
|---|---|---|---|
| | n | (mm) ± SD | (mm) |
| Grade 1 | 29 | 6.8 ± 1.9 | 4.5–9.2 |
| Grade 2 | 52 | 9.5 ± 2.4 | 7.1–13.8 |
| Grade 3 | 40 | 14.6 ± 3.2 | 11.0–19.5 |
| Grade 4 | 22 | 21.3 ± 4.1 | 16.2–28.7 |

*Each renal unit is counted separately for bilateral cases. APRPD increased significantly across grades (p < 0.001, one-way ANOVA).

Table 6: Associated sonographic findings by hydronephrosis grade

| Finding | Grade 1 | Grade 2 | Grade 3 | Grade 4 | Total | p-value* |
|---|---|---|---|---|---|---|
| | (n=29) | (n=52) | (n=40) | (n=22) | (n=143) | |
| | n (%) | n (%) | n (%) | n (%) | n (%) | |
| Cortical thinning | 0 (0.0) | 3 (5.8) | 12 (30.0) | 16 (72.7) | 31 (21.7) | <0.001 |
| Ureteric dilatation | 1 (3.4) | 6 (11.5) | 10 (25.0) | 10 (45.5) | 27 (18.9) | <0.001 |
| Increased cortical echogenicity | 2 (6.9) | 5 (9.6) | 6 (15.0) | 6 (27.3) | 19 (13.3) | 0.042 |
| Urinary calculi | 1 (3.4) | 3 (5.8) | 2 (5.0) | 2 (9.1) | 08 (5.6) | 0.672 |

*Chi-square test for trend across grades. Statistically significant for cortical thinning, ureteric dilatation, and increased echogenicity.

## Discussion

In this prospective cohort study of 143 children with hydronephrosis at a tertiary care hospital in Dhaka, Bangladesh, we observed that unilateral hydronephrosis (57.3%) was more common than bilateral involvement (42.7%), with a left-sided predominance among unilateral cases (58.5%). Grade 2 hydronephrosis according to the SFU classification was the most frequent finding overall (36.4%), whereas high-grade hydronephrosis (SFU grades 3–4) affected more than one-third of the cohort (37.8%). Bilateral cases were significantly more likely to present with high-grade hydronephrosis compared to unilateral cases (60.7% versus 30.5%, p = 0.001). These findings have important implications for referral patterns and follow-up intensity in resource-limited settings.The left-sided predominance observed in our study is consistent with findings from previous reports.[1,15] The left kidney's longer ureter and more angulated ureteropelvic junction may predispose to delayed drainage and progressive dilation. One multicenter study reported that left-sided hydronephrosis accounts for 56–68% of unilateral cases, closely matching our 58.5% figure.[15] The underlying embryological or hemodynamic mechanisms remain incompletely understood, but the consistency across populations suggests a true biological asymmetry. Grade 2 hydronephrosis was the most common severity level in our cohort (36.4%), comparable to findings from a large European registry where grade 2 constituted 34% of postnatal hydronephrosis cases.[1,2] This predominance of moderate hydronephrosis is clinically reassuring, as grade 2 carries a lower risk of progressive parenchymal damage compared to grades 3–4. However, one prospective study demonstrated that even grade 2 hydronephrosis with a pelvic diameter >12 mm at 6 months of age was associated with a 2.4-fold increased risk of pyeloplasty during follow-up.17 Longitudinal data from our cohort would help determine which children with grade 2 hydronephrosis require surgical referral.High-grade hydronephrosis (SFU grades 3–4) was present in 37.8% of our children, which is higher than the 18–25% reported in most Western cohort studies.18,19 This discrepancy may reflect delayed presentation due to limited access to prenatal ultrasound and routine pediatric screening in Bangladesh. A study from a neighboring South Asian country reported high-grade hydronephrosis in 41% of hospital-diagnosed children.20, similar to our finding, suggesting that delayed diagnosis remains a regional challenge.Bilateral hydronephrosis in our cohort was strongly associated with high-grade disease (60.7% versus 30.5% in unilateral cases, p = 0.001). This finding carries prognostic significance because bilateral high-grade hydronephrosis poses a risk for chronic kidney disease from early life.21 One long-term follow-up study reported that children with bilateral SFU grade 3–4 hydronephrosis had a 3.8-fold higher risk of developing estimated glomerular filtration rate <60 mL/min/1.73m² by adolescence compared to those with unilateral disease.22The mean APRPD increased stepwise across SFU grades (6.8 mm for grade 1 to 21.3 mm for grade 4, p < 0.001), supporting the internal validity of our grading. An APRPD threshold of ≥15 mm has been proposed as a predictor of surgical intervention, with a reported sensitivity of 72% and specificity of 68%.23 In our cohort, 42 children (29.4%) had an APRPD >15 mm, representing potential surgical candidates requiring further functional imaging such as diuretic renography.Cortical thinning (21.7%) and ureteric dilatation (18.9%) were significantly more common in higher SFU grades (p < 0.001 for both), confirming these as reliable markers of obstructive severity. Increased cortical echogenicity, present in 13.3% overall, also increased with grade (p = 0.042), potentially reflecting early parenchymal damage. One recent study reported that increased echogenicity in hydronephrotic kidneys correlated with reduced differential renal function on mercaptoacetyltriglycine (MAG-3) scan, with a negative predictive value of 84% for obstructive uropathy.24

## Limitations

The single-center design, purposive sampling, absence of functional renal outcome data (diuretic renography, glomerular filtration rate), and lack of longitudinal follow-up limit generalizability and causal inference regarding disease progression.

## Conclusion

Unilateral left-sided hydronephrosis of SFU grade 2 predominates in this Bangladeshi pediatric cohort, while bilateral involvement is strongly associated with high-grade disease. High-grade hydronephrosis affects over one-third of children, underscoring the need for routine postnatal renal ultrasound screening and timely urology referral. Longitudinal studies incorporating functional imaging are required to refine surgical decision-making and prevent long-term renal morbidity.

## Recommendation

We recommend routine renal ultrasound screening for all newborns and young children with unexplained fever or poor weight gain. High-grade hydronephrosis should prompt early pediatric urology referral and functional imaging to prevent irreversible renal damage.

## Ai Declaration

Artificial intelligence tools contributed marginally to manuscript preparation and development. All core scientific content was human-verified.

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