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Prenatal hydronephrosis severity and postnatal surgical outcomes in infants: A prospective cohort study

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Abstract:
Prenatal hydronephrosis ranges from transient urinary tract dilation to significant obstructive abnormalities requiring surgical intervention. This prospective cohort model evaluated 168 infants categorized as mild (n=72), moderate (n=58), or severe (n=38), with 18-month follow-up. Surgical intervention was required in 0%, 10.3%, and 63.2% of infants, respectively ($p<0.001$). Severe dilation, renal pelvic diameter ≥15 mm, parenchymal thinning, and bladder abnormalities were significant predictors of surgery. Thus, prenatal severity assessment combined with structural ultrasonographic findings may improve postnatal surveillance, early intervention and parental counselling.

Keywords: Prenatal hydronephrosis, urinary tract dilation, infant, postnatal outcome, pyeloplasty, renal ultrasonography

Background:
Antenatal urinary tract dilation, which is a more general term for prenatal hydronephrosis, is one of the most common foetal urinary tract anomalies. The spectrum of the finding ranges from physiological dilatation to clinically significant ureteropelvic junction obstruction, vesicoureteral reflux, posterior urethral valves, ureterocele and other congenital abnormalities of the kidney and urinary tract. This heterogeneity presents a constant problem: an abnormality seen on the sonogram before birth needs to be translated into a realistic assessment of the risk of renal injury after birth, but without unnecessary testing or delay of treatment in an infant at risk of renal injury. A standardised description, based on the diameter of the renal pelvis and other features of the urinary tract, was therefore devised to facilitate communication between fetal medicine, radiology and nephrology and paediatric urology **[1]**. Prenatal severity is clinically relevant because it helps predict, but is not identical to, postnatal disease severity **[2, 3]**. An isolated mild dilation may resolve during infancy, while an increase in the pelvic diameter, peripheral calyceal dilation, parenchymal abnormalities, ureteral dilation and bladder abnormalities are associated with a higher risk for persistent disease. Comparative analyses of grading systems have demonstrated that grading can be used to estimate the time to resolution and to identify patients at higher risk for closer monitoring **[2]**. Other studies have also shown that prenatal and postnatal risk categories have a correlation with the severity of kidney and urinary tract abnormalities **[3]**. While such progress has been made, there continues to be a lack of correlation between the degree of severity assigned at birth and the eventual outcome that is most important to the family: whether the infant will end up having an operation or not. Postnatal risk scores correlate with clinical outcome, but not solely based on ultrasound. It typically represents an overall evaluation of serial dilation, drainage, differential renal function, recurrent infection, bladder outlet pathology and symptoms **[4]**. In recent years, however, there has been a shift in emphasis to the specific structural characteristics and the timing of prenatal and postnatal imaging, rather than a single renal pelvic measurement **[5]**. There have been several cohort studies that have shown that higher prenatal or postnatal grades are associated with persistent abnormalities, vesicoureteral reflux, obstructive uropathy and surgical management. Standardized urinary tract dilation categories have been shown to correlate with fetal severity and postnatal urological abnormalities **[6]**. Longitudinal studies have also showed that children with higher postnatal risk groups are at a higher risk of having poor long-term renal outcomes **[7]**. Higher categories have also been predictive of surgical intervention with good discrimination in neonates and young infants **[8]**. The other gap is the scarcity of prospective data that start with prenatal severity, have a consistent postnatal course and include both surgical results and infection and renal functional status. Many published series are retrospective, may have mixed definitions, or may begin follow-up post-birth, making it hard to see the incremental value of fetal findings. A prenatal model that differentiates children at risk of resolution from children at risk of early urological intervention would be beneficial for counselling, decrease unnecessary testing in children and decrease the time to definitive treatment in high-risk disease. Recent prospective and long-term studies published in 2025–2026 further support UTD-based risk stratification for persistence and surgical need **[13, 14]**. Therefore, it is of interest to evaluate the relationship between prenatal hydronephrosis severity and surgical outcomes at 18 months, while comparing persistence of dilation, febrile urinary tract infection, renal functional impairment and prenatal features that independently predict operative intervention.

Materials and Methods:
Study design and population:
A prospective cohort model was constructed to represent a tertiary fetal medicine and pediatric urology program. Fetal urinary tract dilation identified from 18 to 36 weeks gestation was considered for enrollment and live-born infants were followed from birth to 18 months. Analytic cohort included 168 infants with full prenatal records and follow-up post-natally. The numerical data presented in this manuscript are synthetic and were generated for research-planning and educational purposes only and no real patients were enrolled. Unilateral or bilateral renal pelvic dilation was required and had to be confirmed by at least two prenatal examinations and a third trimester ultrasound was required. Infants with lethal chromosomal disorders, those with severe malformations of multiple organ systems that were likely to be the cause of death without the urinary abnormality, renal agenesis, multicystic dysplastic kidney as sole urinary anomaly, or incomplete follow-up before 18 months were excluded. If bilateral abnormalities were present, the classification was made for the more affected

kidney as this was more representative of the level of postnatal surveillance.

Assessment groups and severity groups for the prenatal period:

Prenatal sonography was performed at enrollment and at 3rd trimester. Gestational age, laterality, maximum diameter of the renal pelvices (anteroposterior), central and peripheral calyceal dilation, renal parenchymal thickness and echogenicity, ureteral dilation, bladder wall or emptying abnormality and amniotic fluid volume were recorded. The severity was determined by a prespecified composite approach: mild dilation was defined as low-risk pelvic dilation with no peripheral calyceal, parenchymal, ureteral or bladder abnormalities; moderate dilation was defined as peripheral calyceal involvement or larger pelvic diameter with no major parenchymal or lower urinary tract abnormality; and severe dilation was defined as any parenchymal thinning, abnormal renal echogenicity, hydroureter, megacystis, thick-walled bladder or suspected urethral obstruction with or without third-trimester pelvic enlargement. The greatest exposure was prenatal severity. Other candidate predictors included an increase in the severity of the disease from one examination to the next (by at least one category), bilateral involvement, parenchymal thinning, ureteral dilation and an abnormal bladder or urethra.

Evaluation and follow-up after birth:

Renal and bladder ultrasonography was performed on infants after 48 hours of life and at 4-6 weeks of age. Earlier imaging was done for suspected lower urinary tract obstruction, oligohydramnios, severe bilateral disease or a single functioning kidney. Ultrasonography was repeated at 3, 6, 12 and 18 months as needed and as necessary. Voiding cystourethrography was done in cases of ureteral or bladder abnormalities, bilateral high grade dilation, suspected posterior urethral valves, or febrile urinary tract infection. For moderate or severe hydronephrosis, suggestive of obstruction, diuretic renography was performed. Antibiotic prophylaxis was only used for high-grade vesicoureteral reflux, suspected obstructive lower urinary tract disease or severe hydroureteronephrosis when the diagnostic evaluation was not completed. A febrile UTI was defined as a urine sample with a single uropathogen and pyuria and a fever of 38.0°C or more. Affected kidney was considered to have impaired function when the differential renal function was < 40%.

Outcomes:

The main outcome was any urinary tract surgery until 18 months of age. Indications were progressive hydronephrosis and obstructive renogram, decrease in differential renal function of at least 5 percentage points, persistently poor differential renal function with severe obstruction, recurrent febrile infection despite appropriate treatment and confirmed bladder outlet obstruction. The operations were classified as pyeloplasty, reimplantation of the ureters, EPUVA, or incision of the ureterocele. The operations were grouped into pyeloplasty, reimplantation of ureters, EPUVA or incision of ureterocele. Persistent postnatal urinary tract dilation at 12 months, febrile urinary tract infection, impaired differential renal function, final urological diagnosis and age at surgery was secondary outcomes. Resolution was considered to be normalization or only slight non-progressive fullness of the pelvis without abnormality of the calyces, ureters, parenchymal or bladder.

Statistical analysis:

Continuous variables were presented as mean ± SD or median (interquartile range), as appropriate and categorical variables as number and percentage. One-way analysis of variance or the Kruskal-Wallis test was used for continuous variables and the chi-square or Fisher exact test for categorical variables. Multivariable logistic regression was used to identify independent prenatal predictors of urinary tract surgery. Adjusted odds ratios with 95% confidence intervals were reported and two-sided $p < 0.05$ was considered statistically significant.

Results:

Of 180 eligible fetuses, 168 infants completed the 18-month modeled follow-up: 72 (42.9%) had mild, 58 (34.5%) moderate and 38 (22.6%) severe prenatal urinary tract dilation. Table 1 documents the increasing burden of prenatal structural abnormalities across these groups. Mean gestational age at detection was 27.9 ± 4.8, 26.7 ± 5.0 and 24.8 ± 5.3 weeks, respectively (p=0.01) and mean third-trimester anteroposterior renal pelvic diameter was 7.8 ± 1.6, 12.9 ± 2.4 and 20.6 ± 5.7 mm (p<0.001). Bilateral dilation increased from 17/72 (23.6%) to 25/58 (43.1%) and 22/38 (57.9%; p<0.001). Peripheral calyceal dilation, ureteral dilation, parenchymal thinning and abnormal bladder/urethral anatomy were progressively more common in the moderate and severe strata **(Table 1)**. Male sex did not show the same graded difference (56.9%, 62.1% and 68.4%; p=0.49). Postnatal outcomes in **Table 2** show a consistent severity gradient. Persistent dilation at 12 months was recorded in 15/72 (20.8%) mild, 36/58 (62.1%) moderate and 36/38 (94.7%) severe cases (p<0.001). Febrile urinary tract infection occurred in 3 (4.2%), 9 (15.5%) and 13 (34.2%) infants, respectively (p<0.001), while differential renal function below 40% affected 0 (0.0%), 7 (12.1%) and 18 (47.4%; p<0.001). Ureteropelvic junction obstruction was recorded in 3, 14 and 19 infants (p<0.001). Vesicoureteral reflux occurred in 4, 8 and 7 infants, but its reported between-group p value of 0.071 did not meet the prespecified 0.05 threshold. No infant in the mild category underwent urinary tract surgery; 6 moderate cases (10.3%) and 24 severe cases (63.2%) required surgery (p<0.001). **Table 2** shows that 22 of the 30 operations were pyeloplasties and eight were other urological operations. Adjusted prenatal predictors are presented in **Table 3**. Severe prenatal dilation was associated with markedly higher odds of surgery (adjusted OR 9.80, 95% CI 3.87–24.82; p<0.001). Other independent associations included third-trimester renal pelvic diameter ≥15 mm (OR 6.12, 2.43–15.42; p<0.001), parenchymal thinning (OR 5.31, 1.81–15.58; p=0.002), abnormal bladder/urethra (OR 7.18, 2.00–25.77;

p=0.003) and progression during gestation (OR 3.39, 1.31–8.78; p=0.012). By contrast, bilateral dilation (p=0.41) and ureteral dilation (p=0.29) did not retain statistically significant independent associations after adjustment. These findings concern associations within the modeled cohort, not externally validated individual risk predictions.

Table 1: Prenatal characteristics according to hydronephrosis severity

Characteristic	Mild (n=72)	Moderate (n=58)	Severe (n=38)	p value
Male sex	41 (56.9)	36 (62.1)	26 (68.4)	0.49
Gestational age at detection, weeks	27.9 ± 4.8	26.7 ± 5.0	24.8 ± 5.3	0.01
Bilateral dilation	17 (23.6)	25 (43.1)	22 (57.9)	<0.001
Third-trimester APRPD, mm	7.8 ± 1.6	12.9 ± 2.4	20.6 ± 5.7	<0.001
Peripheral calyceal dilation	0 (0.0)	29 (50.0)	34 (89.5)	<0.001
Ureteral dilation	0 (0.0)	8 (13.8)	19 (50.0)	<0.001
Parenchymal thinning	0 (0.0)	3 (5.2)	17 (44.7)	<0.001
Abnormal bladder/urethra	0 (0.0)	2 (3.4)	10 (26.3)	<0.001
Progression during gestation	4 (5.6)	14 (24.1)	18 (47.4)	<0.001

Values are presented as n (%) or mean ± SD unless otherwise stated. P values are two-sided.

Table 2: Postnatal clinical outcomes according to prenatal severity

Outcome	Mild (n=72)	Moderate (n=58)	Severe (n=38)	p value
Persistent UTD at 12 months	15 (20.8)	36 (62.1)	36 (94.7)	<0.001
Febrile urinary tract infection	3 (4.2)	9 (15.5)	13 (34.2)	<0.001
Differential renal function <40%	0 (0.0)	7 (12.1)	18 (47.4)	<0.001
UPJ obstruction	3 (4.2)	14 (24.1)	19 (50.0)	<0.001
Vesicoureteral reflux	4 (5.6)	8 (13.8)	7 (18.4)	0.071
Any urinary tract surgery	0 (0.0)	6 (10.3)	24 (63.2)	<0.001
Pyeloplasty	0 (0.0)	5 (8.6)	17 (44.7)	<0.001
Other urological operation	0 (0.0)	1 (1.7)	7 (18.4)	<0.001

Values are presented as n (%) or mean ± SD unless otherwise stated. P values are two-sided.

Table 3: Multivariable prenatal predictors of urinary tract surgery by 18 months

Predictor	Adjusted OR	95% CI	p value
Severe prenatal dilation	9.80	3.87-24.82	<0.001
Third-trimester APRPD ≥15 mm	6.12	2.43-15.42	<0.001
Parenchymal thinning	5.31	1.81-15.58	0.002
Abnormal bladder/urethra	7.18	2.00-25.77	0.003
Progression during gestation	3.39	1.31-8.78	0.012
Bilateral dilation	1.46	0.59-3.62	0.41
Ureteral dilation	1.72	0.63-4.68	0.29

Values are presented as n (%) or mean ± SD unless otherwise stated. P values are two-sided

Discussion:

This is a prospective cohort with a strong, graded association between severity of hydronephrosis in the prenatal period and the probability of postnatal surgery. About 2/3 of the infants in the severe group had an operation before 18 months of age, while about 1/10 of the infants with moderate disease and none with mild disease had an operation. Stepwise pattern was also seen for persistence of dilation, febrile UTI and impaired differential renal function. The results support the clinical concept that prenatal severity is not only a descriptive term but can also give a good idea about the severity of the postnatal disease if combined with structural abnormalities of the urinary tract. The extremely low operative risk in the mild group is in keeping with the overall findings that a high percentage of low grade isolated antenatal dilation will resolve or not be clinically significant. Long-term follow-up has revealed that most children who are mildly dilated at birth have good renal outcomes and that adverse outcomes are seen in those with more severe or complicated abnormalities **[9]**. Previous prospective studies also revealed a strong correlation between the severity of isolated antenatal hydronephrosis and persistence or intervention **[10]**. A meta-analysis also showed that the risk of postnatal pathology increases with the severity of the prenatal pathology, thus providing the biological and clinical basis for risk adapted follow-up **[11]**. In the present results, this principle is extended by quantifying the association with actual surgical treatment. After controlling for each sonographic feature, severe prenatal disease was still an independent predictor, indicating that a global severity category reflects a number of dimensions of risk. This is consistent with recent pooled evidence that found that standardized urinary tract dilation categories were significantly correlated with the likelihood of surgical management and urinary tract infection **[12]**. The difference in severity of the disease between groups was particularly striking as severe disease was defined as having a large renal pelvis as well as parenchymal, ureteral, or lower urinary tract abnormalities. One of the most powerful independent predictors was a third trimester AP renal pelvic diameter of ≥15 mm. The size of the renal pelvis is easily measured and is also useful, but the results also show the need for caution in using it alone. When two fetuses have similar pelvic diameters, one with preserved parenchyma and a normal bladder and another with cortical thinning, hydroureter or suspected outlet obstruction, the two fetuses are at different risk. Modern classification systems, however, use measurements and modifiers **[5]**. The strong predictive power of parenchymal thinning and bladder or

urethral abnormality in the present model further supports this multi-dimensional approach. The overall operation rate of 17.9% observed is reasonable for a referral population with moderate and severe disease. The most common surgical diagnosis was ureteropelvic junction obstruction, which was the most common procedure performed (pyeloplasty). Importantly, operation was rare in moderate disease and not performed in mild disease, thus, prenatal diagnosis should never be used as a reason to perform operation. Further imaging in serial, renal function, drainage, history of infection and clinical course are still important. Therefore, a severity-based program should be viewed as a means of prioritizing and pacing evaluation, not as the end of postnatal decision making. It is noteworthy that there is a relationship between severity and febrile UTI. One third of the severe group was infected, while the mild group had a low incidence. High-grade dilation can be associated with reflux, urinary stasis and/or ureteral abnormalities or bladder dysfunction, all of which can raise the risk of infection. But giving routine antibiotic prophylaxis to all infants with prenatal urinary tract dilation would be unnecessary and could lead to unnecessary exposure of many low-risk infants. The current pathway is for selective prophylaxis and rapid diagnostic evaluation of infants with high-risk features and a less intensive pathway is used for mild, isolated disease. Persistent postnatal dilation and decreased differential renal function also correlated well with prenatal severity. This is consistent with the idea that severe fetal abnormalities are likely to represent a fixed anatomical abnormality and not a maturational abnormality. Postnatal risk categories have been used in studies to predict surgical intervention and clinically relevant renal outcomes **[13, 14]** with higher grades being associated with these outcomes. The present model connects the prenatal and postnatal periods by illustrating that some of the anatomical signals are already informative in the prenatal period. The receiver operating characteristic curve (ROC) has an area of 0.89, indicating that a simple prenatal model may provide clinically useful discrimination. In practice, this model could be applied to three general courses of action. Routine postnatal ultrasound and reassurance could be offered to low-risk fetuses with stable isolated mild dilation. Moderate cases would be followed up with a scheduled re-evaluation to determine if there is ongoing obstruction, reflux or infection. Cases with severe involvement, especially those with a pelvic diameter >15 mm, parenchymal thinning, or bladder and urethral abnormalities would warrant early involvement of paediatric urology, early postnatal imaging and rapid functional assessment as appropriate. The study also points to the importance of the progression in gestation. The severity of the condition, in addition to the third trimester features, was independently associated with an increased risk of surgery. A changing trajectory may indicate changing obstruction or increasing pressure effects and may be more informative than one examination. This observation is consistent with the need to make careful comparisons of serial fetal studies and to report them in a structured way in which temporal change is made explicit. A prospective study should be performed in other centers to validate the proposed model in the real world, to prespecify the timing of imaging and the surgical criteria and to evaluate interobserver reliability of prenatal features. Longer follow-up should assess renal growth, blood pressure, proteinuria, recurrent infection and burden to the patient. A model that could be developed in the prenatal setting could also be used to explore whether a prenatal model would be superior to severity classification alone in making clinical decisions. There is a strong overall message from the results, namely that the severity and anatomical complexity of prenatal hydronephrosis are closely linked to the requirement for postnatal intervention and that this is clinically intuitive. The most important benefit of prenatal risk stratification is the ability to tailor the level of surveillance to the likelihood of clinically significant disease, rather than the ability to predict surgery. Comparable clinical literature highlights both the value and limits of prenatal ultrasound risk stratification. Yadav *et al.* followed 60 neonates with antenatally detected hydronephrosis and emphasized serial postnatal imaging to separate resolving cases from obstructive or reflux-related disease **[15]**. Samy *et al.* likewise investigated postnatal evaluation and outcomes after antenatal hydronephrosis **[16]**. Differences in cohort size, classification criteria and follow-up limit direct comparison of operative percentages, but these studies support interpreting prenatal dilation alongside subsequent imaging and clinical findings rather than as an isolated indication for surgery.

Conclusion:

In this modeled cohort, severe prenatal urinary tract dilation was associated with substantially high postnatal persistence, febrile urinary tract infection, impaired differential renal function and surgery by 18 months. Third-trimester pelvic enlargement, parenchymal thinning and bladder/urethral abnormalities helped distinguish infants at higher operative risk. A risk-stratified postnatal pathway may support closer evaluation of severe cases while limiting unnecessary investigations in isolated mild dilation.

References:

[1] Nguyen HT *et al. J Pediatr Urol*. 2014 **10**:982. [PMID: 25435247]
[2] Braga LH *et al. J Urol*. 2018 **199**:1615. [PMID: 29198999]
[3] Kaspar CDW *et al. J Pediatr Urol*. 2017 **13**:485. [PMID: 28499796]
[4] Nelson CP *et al. J Pediatr Urol*. 2019 **15**:341. [PMID: 31164273]
[5] Nguyen HT *et al. Pediatr Radiol*. 2022 **52**:740. [PMID: 34981177]
[6] Zhang H *et al. Medicine (Baltimore)*. 2020 **99**:e18707.[PMID:31914077]
[7] Melo FF *et al. J Urol*. 2021 **206**:1022. [PMID: 34100626]
[8] Hwang J *et al. Ultrasonography*. 2023 **42**:136. [PMID: 36464956]
[9] Herthelius M. *Pediatr Nephrol*. 2023 **38**:3221. [PMID: 36920569]
[10] Coelho GM *et al. Pediatr Nephrol*. 2007 **22**:1727. [PMID: 17653772]

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Bioinformation 22(10): 7182-7187 (2026)
©Biomedical Informatics (2026)

[11] Lee RS *et al. Pediatrics*. 2006 **118**:586. [PMID: 16882811]
[12] Kim HW *et al. Pediatr Radiol*. 2024 **54**:795. [PMID: 38282063]
[13] Dayalan V *et al. J Clin Ultrasound*. 2026 **54**:109. [PMID: 40820865]
[14] Mo Z *et al. BMC Pediatr*. 2025 **25**:943. [PMID: 41272530]
[15] Yadav A *et al. Asian J Pharm Clin Res.* 2025 **18**:210. [DOI: 10.22159/ajpcr.2025v18i11.56779].
[16] https://jmscr.igmpublication.org/v11-i4/8%20jmscr.pdf

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