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RESEARCH ARTICLE

A STUDY OF PROGRESSION OF RENAL DISEASE IN INFANTS WITH ABNORMAL ANTENATAL RENAL SONOGRAM

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ABSTRACT

Background: Antenatally detected renal abnormalities are common. Antenatal hydronephrosis may be transient and physiologic or may indicate congenital anomalies of the kidney and urinary tract (CAKUT) requiring postnatal evaluation and intervention. The challenge is to identify clinically significant disease while avoiding unnecessary investigations. **Objectives:** To determine the proportion of neonates with urinary tract abnormalities and to study the prognosis and outcome of antenatally detected renal anomalies. **Methods:** This prospective observational study was conducted in the neonatal intensive care unit of M.O.S.C. Medical College and Teaching Hospital, a tertiary care centre, from August 2017 to July 2018. Neonates with an abnormal antenatal renal sonogram were enrolled. Antenatal findings, postnatal ultrasonography, renal function, urinary tract infection, growth, blood pressure and need for further urological evaluation or surgery were recorded. Follow-up ultrasonography was performed at 1, 3 and 6 months, with additional evaluation as clinically indicated. **Results:** A total of 3005 pregnancies were screened for abnormal antenatal renal sonography and 90 neonates met the study inclusion criteria. Males comprised 65 (72.2%) and females 25 (27.8%) of enrolled neonates. The mean gestational age at diagnosis was 33.3 weeks. Hydronephrosis was the most common antenatal finding, occurring in 50 (55.5%) neonates: mild in 38 (42.3%), moderate in 10 (11.2%) and severe in 2 (2.2%). Thirty-one neonates had significant uropathy, 29 had transient hydronephrosis and 30 had non-significant findings. Among 50 clinically treated children without primary vesicoureteral reflux, renal pelvic diameter resolved in 37 (74%) after a median follow-up of 6 months. Maternal age, sex, side of affection and amniotic fluid index were not significant predictors of significant postnatal uropathy. Four infants (4.4%) had acute kidney injury and two (2.2%) had urinary tract infection. Six infants underwent micturating cystourethrogram; one had grade V vesicoureteral reflux and one had posterior urethral valve. Five underwent DTPA scanning, with one showing reduced cortical function and requiring surgical correction. Two infants died in the neonatal period, both with severe antenatal renal disease and oligohydramnios. **Conclusion:** Most infants with isolated antenatal hydronephrosis had a favourable short-term outcome. Mild and moderate renal pelvic dilatation frequently resolved or remained under surveillance, while severe disease was more likely to require detailed urological evaluation and intervention. Postnatal assessment should therefore be individualized according to antenatal severity and associated abnormalities, with continued clinical surveillance during infancy.

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INTRODUCTION

Antenatally detected renal abnormalities are frequently encountered during prenatal ultrasonography. Antenatal hydronephrosis, defined by dilatation of the fetal renal pelvis, is among the most common renal findings and has been reported in approximately 1%–5% of pregnancies. The finding encompasses a broad spectrum, from transient physiological dilatation to clinically important congenital anomalies of the kidney and urinary tract (CAKUT).

The postnatal significance of antenatal renal pelvic dilatation depends on its severity, persistence, laterality and association with abnormalities of the renal parenchyma, ureter or bladder. Increased renal pelvic diameter (RPD) may be associated with obstructive uropathy, vesicoureteral reflux or other structural abnormalities. Conversely, a substantial proportion of infants with antenatal dilatation have spontaneous resolution and do not require invasive investigation. Postnatal ultrasonography is the principal initial investigation for infants with abnormal antenatal renal sonography. Timing is important because

relative dehydration and reduced glomerular filtration immediately after birth may underestimate hydronephrosis. In selected infants, early imaging is required when bilateral hydronephrosis, severe hydronephrosis in a solitary kidney or suspected posterior urethral valve is present. Subsequent investigation with micturating cystourethrogram, DMSA or DTPA scanning and urological intervention is guided by the postnatal findings and clinical course. Previous studies have shown that mild antenatal hydronephrosis often resolves spontaneously, whereas increasing degrees of renal pelvic dilatation are associated with a greater likelihood of persistent uropathy and surgery. However, the appropriate balance between early identification of significant disease and avoidance of unnecessary investigations remains important in neonatal practice. The present study was undertaken in a tertiary care neonatal unit to assess the proportion of neonates with urinary tract abnormalities following an abnormal antenatal renal sonogram and to describe their short-term prognosis and outcome.

METHODS

Study design and setting: This was a prospective observational study conducted in the neonatal intensive care unit of M.O.S.C. Medical College and Teaching Hospital, a tertiary care centre in Kerala, India. The study period was one year, from August 2017 to July 2018.

Study population and eligibility: All neonates born at M.O.S.C. Medical College Hospital during the study period with an abnormal antenatal renal sonogram were eligible. Abnormal antenatal renal sonography included hydronephrosis, abnormal renal anteroposterior diameter, structural renal anomalies, solitary kidney, congenital obstructive defects of the renal pelvis and congenital malformations of the ureter. Abnormal renal APD was defined in the dissertation as APD ≥5 mm at any gestational age. The dissertation reports a calculated sample size of 7299 based on an anticipated proportion of 5%, 5% alpha level and relative precision of 10%. During the study period, 3005 pregnancies were screened for abnormal antenatal renal sonography and 90 neonates qualified for inclusion.

Data collection and follow-up: Antenatal ultrasound details included gestational age at diagnosis, amniotic fluid index, side of affection and provisional diagnosis. Maternal age, parity, mode of delivery and relevant maternal comorbidities were obtained from the case records. Early postnatal ultrasonography, within 1–2 days of birth, was performed in infants with bilateral hydronephrosis, severe hydronephrosis in a solitary kidney or suspected posterior urethral valve. In other infants, ultrasonography was performed at 3–7 days of life. Follow-up renal ultrasonography was performed at 1, 3 and 6 months. Transient hydronephrosis was defined as resolution of hydronephrosis on the first or subsequent postnatal assessment. Infants with an initially normal ultrasound were subsequently followed clinically with assessment of weight, length and blood pressure.

Outcome measures and investigations: The study recorded acute kidney injury, renal function, urinary tract infection, somatic growth, blood pressure and evidence of progressive renal disease. Acute kidney injury was defined in the dissertation as serum creatinine >1.2 mg/dL after 24 hours of life. Further evaluation included micturating cystourethrogram when posterior urethral valve was suspected and DMSA/DTPA scanning for assessment of renal structure and function. Surgical interventions, including ureterostomy and posterior urethral valve fulguration, were documented.

Statistical analysis: Proportions were summarized using frequencies and percentages. Continuous variables were summarized using means and standard deviations. Antenatal and postnatal renal APD were compared using an independent-samples t test. Chi-square testing was used to identify factors associated with significant uropathy. Weight, length and blood pressure were compared between groups using independent-samples t tests. A p value <0.05 was considered statistically significant. Analysis was performed using R (EZR) software.

Ethics: The study protocol was submitted to the institutional review board and ethics committee for approval. Confidentiality was maintained by assigning subject identification numbers.

RESULTS

During the one-year study period, 3005 pregnancies were screened for abnormal antenatal renal sonography. Ninety neonates qualified for the study. Of the enrolled neonates, 65 (72.2%) were male and 25 (27.8%) were female. Seventy-nine (87.8%) were appropriate for gestational age, 10 (11.1%) were small for gestational age and one (1.1%) was large for gestational age. The mean gestational age at diagnosis was 33.3 weeks.

Table 1. Baseline characteristics of enrolled neonates

Characteristic	Number	Percentage
Male	65	72.2
Female	25	27.8
Appropriate for gestational age	79	87.8
Small for gestational age	10	11.1
Large for gestational age	1	1.1

Footnote: Percentages are as reported in the dissertation.

Hydronephrosis was the most common antenatal diagnosis, identified in 50 (55.5%) neonates. Mild hydronephrosis accounted for 38 (42.3%), moderate hydronephrosis for 10 (11.2%) and severe hydronephrosis for 2 (2.2%). Abnormal renal APD was recorded in 34 (37.7%). Other antenatal diagnoses included horseshoe kidney, solitary kidney, pelvic kidney, duplex collecting system, multicystic dysplastic kidney and cystic renal disease.

Table 2. Antenatal renal diagnoses among enrolled neonates

Antenatal diagnosis	Number	Percentage
Mild hydronephrosis	38	42.3
Moderate hydronephrosis	10	11.2
Severe hydronephrosis	2	2.2
Abnormal renal APD	34	37.7
Horseshoe kidney	1	1.1
Solitary kidney	1	1.1
Pelvic kidney	1	1.1
Duplex collecting system	1	1.1
Multicystic dysplastic kidney	1	1.1
Cystic renal disease	1	1.1

Footnote: Categories reflect the diagnostic terminology used in the dissertation; APD, anteroposterior diameter.

Postnatal assessment demonstrated that, among the 38 infants with antenatally detected mild hydronephrosis, 31 resolved, five remained under surveillance and two were lost to follow-up. Of 10 infants with moderate hydronephrosis, six resolved and four remained under surveillance. Both infants with severe antenatal hydronephrosis remained under surveillance; one improved to mild hydronephrosis at six months and the other required surgical correction. The antenatally detected horseshoe kidney, solitary kidney and pelvic kidney were confirmed postnatally and remained under surveillance. The duplex collecting system was confirmed postnatally with ureterocele, but the infant was lost to follow-up. Two infants with multicystic dysplastic kidney and cystic renal disease died postnatally.

Table 3. Postnatal outcome according to antenatal diagnosis

Antenatal diagnosis	Resolved	Under surveillance	Lost to follow-up	Death
Mild hydronephrosis	31	5	2	0
Moderate hydronephrosis	6	4	0	0
Severe hydronephrosis	0	2	0	0
Horseshoe kidney	0	1	0	0
Solitary kidney	0	1	0	0
Pelvic kidney	0	1	0	0
Duplex collecting system	0	0	1	0
Multicystic dysplastic kidney	0	0	0	1
Cystic renal disease	0	0	0	1
Abnormal renal APD	3	0	1	0

Footnote: Outcome categories are reproduced from the dissertation.

Thirty-one neonates were classified as having significant uropathy, 29 had transient hydronephrosis and 30 had non-significant findings. The dissertation reports that, among 50 clinically treated children without primary vesicoureteral reflux, resolution of renal pelvic diameter occurred in 37 (74%) after a median follow-up of six months and a mean of four ultrasound examinations per patient. All cases classified as transient hydronephrosis resolved by one month.

Table 4. Factors evaluated for association with significant postnatal uropathy

Variable	Significant uropathy	Transient hydronephrosis	P value
Maternal age, mean years	27.37	27.28	0.92
Male sex, n	22	26	0.11
Female sex, n	8	3	0.11
Bilateral involvement, n	19	16	0.52
Unilateral involvement, n	11	13	0.52
Amniotic fluid index, mean	12.8	11.2	0.149

Footnote: P values are those reported in the dissertation.

Most infants were managed conservatively. One infant with moderate hydronephrosis underwent surgical intervention; the dissertation describes neonatal ureterostomy followed by posterior urethral valve fulguration at six months, with subsequent surveillance. Four infants (4.4%) had acute kidney injury and were managed conservatively. Two infants (2.2%), both in the moderate hydronephrosis group, had urinary tract infection. Micturating cystourethrogram was performed in six neonates: four studies were normal, one demonstrated grade V vesicoureteral reflux and one demonstrated posterior urethral valve. DTPA scanning was performed in five neonates; four were normal and one showed reduced cortical function with 41% functionality and underwent surgical correction. Two infants died on day 1 of life.

One had multicystic dysplastic kidney with severe oligohydramnios, was delivered at 34 weeks and died at three hours of life from severe pulmonary hypoplasia. The second had cystic renal disease with bilateral hydroureteronephrosis and posterior urethral valve, severe oligohydramnios, was delivered at 29 weeks and died at three hours of life from severe pulmonary hypoplasia. Serial assessment showed no significant difference in weight or length between infants with transient hydronephrosis and significant uropathy at 1, 3 or 6 months. Serial blood pressure measurements likewise did not show a statistically significant difference between the two groups; the recorded values were within the 50th–90th percentiles according to the Zubrow chart at follow-up.

DISCUSSION

This prospective observational study evaluated neonates with abnormal antenatal renal sonography and followed their postnatal course. The study demonstrates that antenatal renal abnormalities encompass a wide spectrum, with hydronephrosis being the predominant finding and a substantial proportion of infants having either transient disease or non-significant postnatal findings. The reported prevalence of urinary tract abnormalities was 1.9%. The dissertation notes that this was higher than the 0.20% reported by Sanghavi and colleagues and attributes the difference partly to the tertiary referral nature of the centre and the timing of antenatal ultrasound. The mean gestational age at diagnosis in the present study was 33.3 weeks. Previous screening programmes have similarly shown that many fetal renal abnormalities are detected later in gestation, and the sensitivity of renal pelvic assessment varies with gestational age. Hydronephrosis was the most frequent abnormality, accounting for 50 of 90 enrolled neonates. This finding is consistent with the established observation that renal pelvic dilatation is the commonest antenatal urinary tract abnormality. Importantly, antenatal hydronephrosis does not necessarily imply persistent disease. In the present cohort, most infants with mild hydronephrosis resolved without surgery, and all infants classified as having transient hydronephrosis resolved by one month.

The outcome according to severity supports a conservative approach for many infants with mild or moderate isolated hydronephrosis, while emphasizing surveillance for severe disease. Of 38 infants with mild antenatal hydronephrosis, 31 resolved, five remained under surveillance and two were lost to follow-up. Among 10 with moderate hydronephrosis, six resolved and four remained under surveillance. Both infants with severe hydronephrosis required continued surveillance, with one ultimately requiring surgical correction. These findings are in keeping with earlier reports cited in the dissertation, in which lesser degrees of pelvic dilatation generally decreased to normal or did not progress. Approximately one-third of the cohort was classified as having significant uropathy. The study therefore reinforces that an abnormal antenatal renal sonogram cannot be dismissed solely on the basis of its frequent spontaneous resolution. The severity of renal pelvic dilatation and the presence of associated structural abnormalities remain important in determining the need for further evaluation. In this study, however, maternal age, fetal sex, side of affection and amniotic fluid index did not significantly predict significant postnatal uropathy. The need for invasive investigations was relatively limited. Six infants underwent micturating cystourethrogram, with one showing grade V vesicoureteral reflux and one showing posterior

urethral valve. Five underwent DTPA scanning, with one showing reduced cortical function and requiring surgical correction. These findings support a stepwise postnatal approach in which ultrasonography and clinical findings guide subsequent functional or anatomical investigations. Short-term morbidity in the cohort was limited. Acute kidney injury occurred in four infants and was managed conservatively, while two infants developed urinary tract infection. Serial assessment of somatic growth and blood pressure did not demonstrate significant differences between infants with transient hydronephrosis and those with significant uropathy. The two deaths occurred in infants with severe renal disease, oligohydramnios and pulmonary hypoplasia, illustrating the poor prognosis associated with severe bilateral fetal renal pathology.

CONCLUSION

Antenatal diagnosis of renal abnormalities was reasonably informative in this cohort. Hydronephrosis was the most common antenatal abnormality, and most infants with mild or moderate isolated renal pelvic dilatation had spontaneous resolution or remained suitable for surveillance. Severe antenatal dilatation was associated with a greater need for detailed urological assessment and surgical intervention. Maternal age, sex, side of affection and amniotic fluid index were not significant predictors of significant postnatal uropathy. The findings support individualized, stepwise postnatal evaluation with continued clinical surveillance for urinary tract infection and progression of renal pelvic dilatation during infancy.

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