

Outcome of Isolated Antenatal Hydronephrosis

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Objective: To define the clinical outcome in isolated antenatal hydronephrosis (ANH), defined as pelviectasis without vesicoureteral reflux or urinary tract obstruction.

Study Design and Patients: We analyzed prospectively gathered data from patients with isolated ANH. Pelviectasis, graded using the anterior-posterior diameter reference criteria, was defined by the status of the more severely affected kidney. Urinary tract obstruction was ruled out by diethylenetriamine pentaacetic acid scan when clinically indicated. Statistical differences were analyzed using the McNemar and χ^2 tests.

Results: Isolated ANH was defined in 63 patients. The first postnatal ultrasonogram (mean \pm SD age, 18.4 \pm 17.8

days) revealed resolution of ANH in 16 (25%), mild pelviectasis in 34 (54%), and moderate or severe pelviectasis in 13 (21%). Ultrasonogram at the last follow-up visit (23.3 \pm 14.8 months) in 57 patients demonstrated normal pelvic diameter or mild pelviectasis in 47 (82%) ($P = .002$). In the 13 patients with moderate or severe neonatal pelviectasis, severity decreased in 11 (85%). Deterioration of any grade of pelviectasis occurred in only 3 (5%) of 57 patients. Renal growth, measured by renal length, was normal in all 57 patients.

Conclusion: Isolated ANH resolves or improves in most patients during the first 2 years of life.

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ANTENATAL HYDRONEPHROSIS (ANH) occurs with a reported incidence of 0.5% to 1.0%.¹ Antenatal hydronephrosis is the most common fetal anomaly diagnosed in utero² and is the most commonly recognized neonatal renal disorder. In 14% to 21% of affected neonates, ANH is associated with ureteropelvic junction obstruction or vesicoureteral reflux.¹⁻³ Exclusion of these abnormalities defines a disorder termed *isolated ANH*, in which pelviectasis or pelvicaliectasis of varying degrees of severity is the sole abnormality. The clinical outcome in isolated ANH remains poorly defined. In the absence of this information, affected infants frequently undergo potentially unnecessary radiological investigation and may receive antibiotics for prophylaxis of urinary tract infection.¹

Previous studies aimed at defining a subset of more severely affected patients identified sex and kidney sidedness as risk factors.⁴ Significant hydronephrosis was found to be more highly associated with male sex³ and occurrence in the left kidney.⁴ Despite these findings, no studies

have defined the outcome of ANH as a function of the side of kidney involvement or sex.

In this study, we defined the outcome of isolated ANH in a cohort of 63 patients referred to a regional newborn renal clinic. Vesicoureteral reflux and urinary tract obstruction were excluded during early infancy, and the severity of hydronephrosis was defined by the pelvic diameter as measured by renal ultrasonograms in 57 patients during a mean \pm SD follow-up period of 23.3 \pm 14.8 months.

METHODS

We performed a retrospective analysis of prospectively gathered data from patients with ANH seen in the Newborn Renal Clinic at The Hospital for Sick Children (HSC), Toronto, Ontario, from January 1, 1997, through August 31, 2002. The Newborn Renal Clinic at the HSC is the sole referral target for a network of antenatal centers in metropolitan Toronto. Patients were usually seen from 5 to 7 days after birth and were treated with oral antibiotics before investigation by means of ultrasonograms and voiding cystourethrograms. Antibiotic therapy was continued after initial investigations at the discretion of the treating physician. A diagnosis of isolated ANH was

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made in individuals without evidence of renal dysplasia, vesicoureteral reflux, and urinary tract obstruction. Diethylenetriamine pentaacetic acid (DTPA) renal scans were obtained to exclude obstruction when clinically indicated and in all patients with moderate or severe pelviectasis. Patients with isolated ANH were followed up with ultrasound measurement of renal pelvic diameter and renal length. Renal ultrasonograms were obtained by certified ultrasound technicians in a standardized manner and interpreted by staff radiologists at the HSC. Pelvic diameter was measured at the level of the renal sinus in longitudinal scan images. Hydronephrosis was graded by pelvic diameter according to the anterior-posterior diameter classification criteria as normal (0-4 mm), mild (5-9 mm), moderate (10-15 mm), and severe (>15 mm).⁵ Data recorded consisted of demographics and ultrasound-derived serial measurements of kidney size and pelvic diameter. Change in grade of hydronephrosis within each patient was defined by the status of the more severely affected kidney.

Averaged data are expressed as mean±SD. We analyzed data using SPSS software (version 8.0; SPSS Inc, Chicago, Ill). Differences between ultrasound results at baseline and last follow-up were analyzed using the McNemar test, whereas differences between the right and left kidneys were analyzed using the χ^2 test. A subanalysis was conducted, comparing the degree of hydronephrosis at baseline and follow-up by sex and between the left and right kidneys. A P value of less than .05 (2-sided) was interpreted as significant.

The use of anonymous patient data in this study was approved by the Research Ethics Board of the HSC.

RESULTS

Eighty-six infants with ANH were identified among patients referred to the HSC Newborn Renal Clinic. Vesicoureteral reflux, ureteropelvic junction obstruction, and posterior urethral valves were demonstrated in 18 (21%), 4 (5%), and 1 (1%) of these infants, respectively. Thus, 63 patients were given a diagnosis of isolated ANH.

The outcome of antenatal pelviectasis in neonates with isolated ANH was determined by means of renal ultrasonography at a mean age of 18.4±17.8 days. The first postnatal ultrasonogram, obtained no earlier than 5 days of age, revealed resolution of antenatal hydronephrosis in 16 (25%) of the 63 patients. Of the remaining patients, 21 (33%) and 26 (41%) had unilateral or bilateral pelviectasis, respectively. In 34 affected patients (54%), pelviectasis was mild. In a minority of patients, the degree of pelviectasis was moderate (9/63 [14%]) or severe (4/63 [6%]). These data are consistent with previous studies demonstrating that a large proportion of isolated ANH resolves or is mild in severity by the time of the first postnatal ultrasonography.^{1,6,7}

To provide further insight into the outcome of isolated ANH, we measured renal pelvic diameter and size at least twice during a mean follow-up of 23.3±14.8 months (range, 3-55 months). Six patients who were unavailable for follow-up demonstrated complete resolution of ANH on the first postnatal renal ultrasonogram, leaving 57 infants in whom follow-up data were available. In these 57, there was an overall improvement in pelvic diameter with decreased severity of pelviectasis in 30 (64%) of the 47 patients with mild, moderate, or severe pelviectasis ($P=.002$). All 10 patients with a normal pelvic diameter postnatally and who were available

Change in Renal Pelvic AP Diameter With Time*

AP Diameter on Neonatal Ultrasonogram	AP Diameter at Last Follow-up Ultrasonogram			
	Normal	Mild	Moderate	Severe
Normal (n = 10)	10 (100)	0	0	0
Mild (n = 34)	19 (56)	12 (35)	3 (9)	0
Moderate (n = 9)	5 (56)	3 (33)	1 (11)	0
Severe (n = 4)	1 (25)	2 (50)	0	1 (25)

Abbreviation: AP, anterior-posterior.

*Grades of AP diameter are described in the "Methods" section. Data are expressed as number (percentage) of patients.

for follow-up had normal ultrasonographic findings at the time of the last study (**Table**). Of the 47 remaining patients, pelviectasis disappeared in 25 (53%), improved in 30 (64%), and was stable in 14 (30%). Deterioration from any grade of pelviectasis occurred in only 3 (5%) of 57 patients. The DTPA scans in these 3 patients with a new occurrence of moderate pelviectasis showed normal results, indicating the absence of an obstructing lesion. Measurement of renal length at each follow-up ultrasonogram demonstrated normal renal length in all 57 patients, confirming that abnormal pelvic diameter was not associated with abnormal renal growth. Taken together, these data demonstrate that isolated ANH resolves without intervention in most patients and, irrespective of severity, does not interrupt linear growth of the kidney.

Previous work by Hiraoka and colleagues⁴ suggested that left kidney involvement and male sex are potential risk factors for more severe degrees of ANH. To determine the relevance of these observations to our cohort of patients, we compared the degree of hydronephrosis as a function of the side of kidney involvement and sex. An analysis of severity in 126 kidneys from 63 patients across all severity groups demonstrated that pelviectasis on first postnatal ultrasonogram was worse in the left kidney compared with the right kidney (degree of pelviectasis, left vs right kidney: normal, 37% vs 61%; mild, 46% vs 30%; moderate, 11% vs 10%; severe, 6% vs 0%; $P=.02$). Despite these differences, analysis of the change in pelvic diameter in a given left or right kidney over time demonstrated a statistically indistinguishable rate of improvement ($P=.56$). Thus, congenital differences in pelvic diameter related to the side of kidney involvement do not determine outcome in the severity of pelviectasis.

Although male sex has previously been associated with severity of pelviectasis, analysis of neonatal pelviectasis in our population of 40 boys and 23 girls failed to demonstrate a statistically significant difference in severity of pelviectasis between the sexes ($P=.19$). Consistent with these results, boys and girls showed similar degrees of improvement on follow-up ultrasonography ($P=.70$). Thus, sex did not predict initial severity of pelviectasis or outcome in our patients.

COMMENT

Advances in ultrasound technology and implementation of antenatal ultrasound screening programs have led

to the frequent identification of fetuses with ANH. Investigation of the underlying etiology of ANH after birth defines a subgroup of patients with isolated ANH in whom there is no demonstrable associated abnormality in the kidney or lower urinary tract. The pathogenesis of pelvic dilatation in these patients is undefined but may be related to transient anatomical obstruction of the pelvis and ureters, failure to completely recanalize the ureter in utero, or persistence of a ureterovesical membrane.⁸

In contrast to patients with severe grades of pelviectasis, clinical outcome beyond infancy has not been defined in patients with milder grades of pelviectasis.⁶ However, pediatricians and pediatric nephrologists are faced with providing advice regarding long-term prognosis in these affected patients. The data in our study provide information regarding outcome by the end of a mean time of 23 months in patients with the entire range of severity. Our results demonstrate that isolated ANH with normal pelvic diameter is stable during the ensuing 2 years. We also show that mild pelviectasis is stable in most patients, normalizes in a significant minority, and deteriorates to a moderate grade of severity in less than 20%. Despite this deterioration, we could find no evidence of obstruction or interference with renal growth in these patients. Our results in patients with moderate or severe grades of pelviectasis are consistent with a recent report demonstrating spontaneous resolution or improvement in 78% of patients and a normal glomerular filtration rate in all 16 patients.⁷ Thus, these results suggest a favorable outcome for patients with isolated ANH. However, our study and those of others do not address long-term renal outcome in these patients.

The design of our study limited our ability to provide information regarding the relationship between the grade of pelviectasis in utero and postnatal outcome. However, several studies have previously demonstrated that pelvic diameter in utero is correlated with pelvic diameter after birth.^{9,10} Our study also failed to systematically assess renal function at the biochemical level. However, our results demonstrating a very high rate of spontaneous resolution, coupled with normal longitudinal renal growth in all patients and with other published data demonstrating normal glomerular filtration rate in moderately and severely affected patients,⁷ suggest a strong likelihood that serum creatinine levels are normal in our patients.

Many congenital anomalies causing hydronephrosis are highly associated with male sex.¹¹ Our study demonstrated a predominance of boys with isolated ANH (male:female ratio, 1.74:1). Despite the higher incidence of isolated ANH in boys, we could not demonstrate a statistically significant difference in outcome between boys and girls. These findings suggest that the management of isolated ANH in boys and girls does not need to be sex specific.

Although the left (compared with the right) kidney has been shown to be more highly affected by ANH,⁴ the effect of the side of kidney involvement on outcome has not been previously examined. Our study confirmed the higher incidence of isolated ANH in the left kidney and demonstrated similar rates of improvement in hydronephrosis over time in left compared with right kidneys. Although these findings provide additional insight into the possible genetic mechanisms that deter-

What This Study Adds

The clinical outcome of antenatal pelviectasis not associated with ureteropelvic junction abnormalities or vesicoureteral reflux is undefined, posing many questions for the pediatrician. However, affected patients frequently undergo radiological interventions and antibiotic prophylaxis. Previous studies defined clinical outcomes in severely affected patients only. This study defined outcomes beyond infancy in a population of patients demonstrating the full spectrum of severity.

Our results demonstrate that isolated antenatal pelviectasis is stable or spontaneously resolves in most affected patients and is not associated with renal deterioration in those in whom the degree of pelviectasis worsens. Our findings strongly suggest that diagnostic and therapeutic interventions in affected patients should be minimized.

mine ANH, our results suggest that the side of kidney involvement does not determine clinical outcome.

CONCLUSIONS

In most patients, isolated ANH is stable or improves over time. By a mean follow-up of 23 months, only 8% of patients have moderate or severe grades of pelviectasis, and all patients demonstrate normal renal size for age. These results suggest that isolated ANH is a relatively benign condition requiring limited, infrequent ultrasonographic monitoring in all but severe cases.

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REFERENCES

1. Langer B, Simeoni U, Montoya Y, Casanova R, Schlaeder G. Antenatal diagnosis of upper urinary tract dilation by ultrasonography. *Fetal Diagn Ther*. 1996;11:191-198.
2. Dudley JA, Haworth JM, McGraw ME, Frank JD, Tizard EJ. Clinical relevance and implications of antenatal hydronephrosis. *Arch Dis Child Fetal Neonatal Ed*. 1997;76:F31-F34.
3. Owen RJ, Lamont AC, Brookes J. Early management and postnatal investigation of prenatally diagnosed hydronephrosis. *Clin Radiol*. 1996;51:173-176.
4. Hiraoka M, Morikawa K, Hori C, et al. Left renal pelvis of male neonates is predisposed to dilatation. *Acta Paediatr Jpn*. 1995;37:352-354.
5. Blachar A, Schachter M, Blachar Y, et al. Evaluation of prenatally diagnosed hydronephrosis by morphometric measurements of the kidney. *Pediatr Radiol*. 1994;24:131-134.
6. Gunn TR, Mora JD, Pease P. Antenatal diagnosis of urinary tract abnormalities by ultrasonography after 28 weeks' gestation: incidence and outcome. *Am J Obstet Gynecol*. 1995;172(pt 1):479-486.
7. Bajpai M, Chandrasekharam VV. Nonoperative management of neonatal moderate to severe bilateral hydronephrosis. *J Urol*. 2002;167(pt 1):662-665.
8. Ruano-Gil D, Coca-Payeras A, Tejedo-Mateu A. Obstruction and normal recanalization of the ureter in the human embryo: its relation to congenital ureteric obstruction. *Eur Urol*. 1975;1:287-293.
9. Stocks A, Richards D, Frentzen B, Richard G. Correlation of prenatal renal pelvic anteroposterior diameter with outcome in infancy. *J Urol*. 1996;155:1050-1052.
10. Anderson N, Boswell O, Duff G. Prenatal sonography for the detection of fetal anomalies: results of a prospective study and comparison with prior series. *AJR Am J Roentgenol*. 1995;165:943-950.
11. Roth JA, Diamond DA. Prenatal hydronephrosis. *Curr Opin Pediatr*. 2001;13:138-141.