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Clinical Outcomes of 141 Cases of Isolated Antenatal Hydronephrosis; An Observational Study

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Introduction. Hydronephrosis, a condition that is mostly congenital, is considered as the most common type of pediatric urinary tract disorder. The aim of this study was the evaluation of the prognosis and outcomes of hydronephrosis in cases of congenital hydronephrosis.

Methods. In a cross-sectional study, run in a tertiary clinic of pediatric nephrology, from 2015 to 2020, patients with fetal hydronephrosis were selected. Ultrasonography, urinalysis and kidney function tests were ordered for all patients and in the presence of hydronephrosis, repeated ultrasonography, voiding cystourethrography and dimercaptosuccinic acid scan were performed. In cases with evidence of obstruction, a diethylenetriamine pentaacetic acid scan and relative surgical procedures were performed.

Results. Among 141 cases, mean age was 8 ± 1.4 years and 80.9% were male. Partial or complete obstruction in the right and left kidney was found in 16.3 and 24.8% of patients, respectively. The degree of hydronephrosis was mild in 46.1%, moderate in 39%, and severe in 9.2% of the patients. At the last follow-up period, hydronephrosis recovered in 46% of the patients, while 54% experienced persistence or exacerbation of the disease. Meanwhile, 7.1% of patients showed neurogenic bladder, 19.1% urinary tract infection and 22.7% urinary stones.

Conclusion. Our study revealed that fetal hydronephrosis ends in complete recovery following birth in 46% of the cases. However, in cases experiencing persistent or exacerbating hydronephrosis, optimized treatment and/or surgical intervention are required.

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INTRODUCTION

Hydronephrosis is one of the most prevalent prenatal ultrasonographic findings that occur in 1% of infants.[1] Fetal hydronephrosis is detected in more than 80% of cases after the gestational age of 30 weeks.[2] When detecting hydronephrosis, the dilatation rate of the ureter is calculated by measuring the anterior-posterior diameter of the pelvis in the horizontal aspect of the kidney, which depends on the gestational age.[3] Although there is a controversy about the anomalous threshold of this diameter, most studies suggest the anterior-posterior diameter (APD) of more than 6 mm at the end of pregnancy is indicative of fetal hydronephrosis and requires postnatal examination.[4] Nearly all sources and studies have identified ureteropelvic junction obstruction (UPJO), as the most common cause of hydronephrosis

in these patients.[1] Unilateral UPJO as the most common cause of hydronephrosis is followed by vesicoureteral reflux (VUR), ureterovesical junction obstruction (UVJO), and more rare cases such as duplicate, polycystic and multicystic kidneys.[5,6] One of the main concerns of families having children with hydronephrosis is knowing about the future of this condition. Studies have shown that children with prenatal hydronephrosis may be at risk for postnatal anomalies, but further studies are required to determine the appropriate treatment option for these children.[7] There are many studies investigating the causes of fetal hydronephrosis onset and development, but its prognostic implications have been less investigated. Certainly, it should also be emphasized that the prognosis of fetal hydronephrosis is completely dependent on the underlying etiology of the disease.[1] In one study on 178 neonates with fetal hydronephrosis, the area under the curve for APD to predict the need for surgery was 0.925 units, with an APD cutoff of 15 mm.[8] The present study was conducted to determine the outcomes of fetal hydronephrosis.

MATERIALS AND METHODS

In this observational study, conducted from 2015 to 2020, in our tertiary care hospital, patients with a diagnosis of fetal hydronephrosis were selected. The study was part of the regular patients' survey; however, informed consent was obtained from parents before including the cases in the study. All patients referred to the kidney and urinary tract clinic with the diagnosis of fetal hydronephrosis were enrolled. Patients with systemic or syndromic disorders, multiple fetal anomalies, kidney failure and incomplete follow-up, were excluded. Demographic data and the findings in physical examination including weight, height and blood pressure were recorded. Also, we evaluated urinalysis, serum creatinine and glomerular filtration rate (GFR). The degree of hydronephrosis of all patients was evaluated by ultrasonographic examination at the first visit to the clinic. In the second trimester of the prenatal period, a renal pelvis APD between 4 to 7 mm was considered mild, 7 to 10 mm moderate and more than 10 mm severe hydronephrosis. An ultrasonographic exam was performed 3 times on each patient including after the fifth day of birth and the second and third months of birth. In the absence of a change or reduction in the degree of unilateral hydronephrosis, ultrasound was repeated one month after the primary exam to follow the disease. In cases of exacerbation of hydronephrosis, further evaluations such as voiding cystourethrography (VCUG) and dimercaptosuccinic acid (DMSA) scan were performed. If there was evidence of obstruction, a diethylenetriamine pentaacetic acid (DTPA) scan was performed and after all, an appropriate surgical intervention was implemented, if necessary. Data for all patients were recorded and analyzed by IBM SPSS software, version 23 (IBM statistics, Armonk, USA).

RESULTS

Of 141 patients diagnosed with hydronephrosis, with a mean age of 8 ± 1.4 years (1 month to 9 years), 114 (80.9%) were male and 27 (19.1%) were female. Details of the physiological variables of patients are presented in Table 1.

According to the ultrasonographic findings and the cumulative data obtained from other diagnostic tests including VCUG, mild, moderate, and severe hydronephrosis was diagnosed in 65 (46.1%), 55 (39%) and 13 (9.2%) of the patients, respectively. In 30 patients (21.3%), VUR was reported. The frequency of different degrees and severity of VUR in each kidney is pointed out in Table 2. DTPA scans indicated the presence of partial and complete obstruction in the right kidney of 13 (9.2%) and 10 (7.1%) patients and in the left kidney of 22 (15.6%) and 13 (9.2%) patients. The results of the DMSA scan focusing on renal function showed a decreased function in 7 right kidneys (5%) and 10 left kidneys (7.1%). The neurogenic bladder was detected in 10 patients (7.1%), urinary tract infection in 27 patients (19.1%) and urinary stones in 32 patients (22.7%).

Regarding patients' outcomes, the study

Table 1. Demographic Data of the Study Group

Parameter	Mean ± SD	Minimum	Maximum
Weight, kg	8.3 ± 6.4	2.1	63
Height, cm	67.5 ± 17.1	48	130
Systolic BP, mmHg	75.1 ± 10.8	60	160
Creatinine, mg/dL	0.37 ± 0.2	0.2	2.2
GFR, mL/min	84.7 ± 21	10	131
Hemoglobin, g/dL	12.2 ± 1.6	9.3	18.1

Abbreviations: Systolic BP, systolic blood pressure; GFR, glomerular filtration rate

Table 2. Frequency and Severity of Hydronephrosis in Right and Left Kidney

Hydronephrosis	Frequency in Right Kidney (%)			Frequency in Left Kidney (%)		
	First Time	Second Time	Third Time	First Time	Second Time	Third Time
Not Present	72 (51.1)	78 (55.3)	91 (64.5)	33 (23.4)	38 (27)	61 (43.3)
Mild	37 (26.2)	35 (24.8)	29 (20.6)	63(44.7)	59 (41.8)	46 (32.6)
Moderate	24 (17)	19 (13.5)	12 (8.5)	39 (27.7)	34 (24.1)	25 (17.7)
Severe	8 (5.7)	9 (6.4)	9 (6.4)	6 (4.3)	10 (7.1)	9 (6.4)

Table 3. Characteristic and Clinical Data of Recovered and Not Recovered Patients

	Recovered (n = 37)	Not Recovered (n = 104)	*P*
Age,† mo	50 ± 1.22	90 ± 1.43	> .05
Sex,‡			
Male	27 (73)	87 (84)	> .05
Female	10 (27)	17 (16)	
Weight,† kg	6.78 ± 4.05	8.85 ± 6.95	> .05
Height,† cm	62.48 ± 16.20	69.29 ± 17.18	< .05
SBP†	70.81 ± 6.06	76.65 ± 11.65	< .05
Cr,† mg/dL	.31 ± .10	.39 ± .21	< .05
GFR,† mL/min	89.16 ± 19.16	83.04 ± 21.52	> .05
Hemoglobin,† g/dl	12.55 ± 1.87	12.05 ± 1.51	> .05
First Ultrasound†			
Right Side Renal Size	50.78 ± 6.84	54.86 ± 11.03	< .05
Left Side Renal Size	50.97 ± 6.99	55.48 ± 10.58	< .05
Second Ultrasound†			
Right Side Renal Size	55.70 ± 6.19	60.21 ± 12.36	< .05
Left Side Renal Size	55.75 ± 7.60	60.54 ± 12.43	< .05
Third Ultrasound†			
Right Side Renal Size	59.81 ± 7.98	64.98 ± 13.74	< .05
Left Side Renal Size	60.21 ± 8.51	65.14 ± 14.02	< .05
Neurogenic Bladder‡	1 (3)	9 (9)	> .05
Vesicoureteral Reflux‡			
Right Side	8 (22)	22 (21)	> .05
Left Side	7 (19)	23 (22)	> .05
UTI‡	8 (22)	19 (18)	> .05
Stone in Kidney or Bladder‡	8 (22)	19 (18)	> .05
DTPA Scan Right Side‡			
Normal	36 (97)	82 (78)	< .05
Partial Obstruction	1 (3)	12 (12)	
Complete Obstruction	0	10 (10)	
DTPA Scan Left Side‡			
Normal	37 (100)	69 (66)	< .001
Partial Obstruction	0	22 (21)	
Complete Obstruction	0	13 (13)	
DMSA Scan Right Side‡			
Normal Renal Function	37 (100)	97 (93)	> .05
Decreased Renal Function	0	7 (7)	
DMSA Scan Left Side‡			
Normal Renal Function	36 (97)	95 (91)	> .05
Decreased Renal Function	1 (3)	9 (9)	

†Mean ± SD
‡n (%)
Abbreviations: SBR, systolic blood pressure; Cr, creatinine; GFR, glomerular filtration rate; UTI, urinary tract infection

revealed sustained or exacerbated hydronephrosis in 34 patients (24.1%). Complete elimination or recovery was noted in 65 patients (46.1%) with medical treatment and 42 patients (29.8%) who underwent surgical intervention. Ultrasonographic study of the right kidney showed a progressive increase in kidney size, in 128 patients (90.8%) between the first and the third ultrasound. No kidney size change was noted in 5 patients (3.5%) and 8 (5.7%) revealed a decrease in size. The same study on the left kidney revealed an increase in kidney size in 120 patients (85.1%), while 8 (5.7%) remained unchanged, and 13 (9.2%) had a decrease in size. The characteristic and clinical data of recovered and not recovered patients are compared in Table 3.

All clinical and paraclinical variables with *P* value < .05; including height, systolic blood pressure, serum creatinine, DTPA scan result, and the first, second and third ultrasound results were entered into the logistic regression model to identify the variables that can predict the prognosis of antenatal hydronephrosis (Table 4). Systolic blood pressure, serum creatinine and the findings of the first ultrasound were able to predict the prognosis of antenatal hydronephrosis. Based on the findings shown in Table 3, high serum creatinine level was a robust risk factor for the persistence or exacerbation of the disease in patients with antenatal hydronephrosis (B = 5.51). High systolic blood pressure (B = 0.10) and increased renal size (B = 0.05) in the first ultrasound were the other risk factors for non-recovery in these patients.

Table 4. Correlation of Variables and Prediction of Prognosis of Antenatal Hydronephrosis by Logistic Regression Model Analysis

	B	*P*	95% CI Lower to Upper
Height, cm	0.03	> .05	0.98 to 1.09
SBP	0.10	< .05	1.03 to 1.19
Cr	5.51	< .05	2.11 to 2.91
First Ultrasound			
Right Side Renal Size	0.05	< .05	1.0 to 1.10
Left Side Renal Size	0.05	< .05	1.0 to 1.10
Second Ultrasound			
Right Side Renal Size	0.03	> .05	0.99 to 1.08
Left Side Renal Size	0.03	> .05	0.99 to 1.07
Third Ultrasound			
Right Side Renal Size	0.03	> .05	0.99 to 1.07
Left Side Renal Size	0.02	> .05	0.98 to 1.06
DTPA Scan			
Right	2.02	.05	1.08 to 52.24
Left	19.48	> .05	0

DISCUSSION

This study was performed on 141 patients with hydronephrosis we found 10 cases of neurogenic bladder (7.1%), 27 cases of urinary tract infections (19.1%), and 32 cases of kidney stones (22.7%) in these patients. Additional diagnostic studies revealed decreased right kidney function in 7 and decreased left kidney function in 10 patients. Complete or partial obstruction was detected in 16.3% and 24.8% of patients in the right and left kidneys, respectively.

Most previous studies have revealed a male preponderance for fetal hydronephrosis.[9,10] This finding was also clearly evident in our study with 114 (80.9%) male cases among 141.

In a study by Samuelson *et al.*, the mean GFR was reported as 108 mL/min in 64 children with idiopathic unilateral hydronephrosis in a group with a mean age of 7.3 years.[11] In the present study, the mean GFR of the study population was 84.7 mL/min, which is considered near normal.

In a study by Ptrowski *et al.*, a 12-month follow-up period revealed an increase in the number of cases with first-degree hydronephrosis, whereas a reduction in the number of patients with second and third-degree hydronephrosis was noted. Additionally, after 3 years of follow-up, only grade 2 hydronephrosis was observed.[9] These findings are similar to our results indicating that 46% of the patients improved, while 54% experienced persistence or exacerbation of the disease, especially in moderate form, during follow-up.

Elder *et al.* have reported a higher prevalence of anomalies in the left kidney. [12] This finding is consistent with our study, which revealed that obstruction was more common in the left kidney.

A study by Ulman *et al.* indicated that 69% of patients with fetal hydronephrosis completely recovered during the 2.5-year follow-up period and 29.8% of patients required surgical intervention.[13] Follow-up studies by Van Dervoort *et al.* revealed improvement in 67% of patients and surgical intervention in 26%.[10] As compared to these 2 two studies, the higher rate of surgical intervention in the present study (29.8%) could be attributed to the non-exclusion of patients with urinary

reflux.

The most important long-term risk of vesicoureteral reflux is scar formation. This may eventually lead to hypertension, renal dysfunction and chronic kidney failure.[5,14,15] In the study by Riccabona *et al.* on 40 cases of hydronephrosis, 15% of patients showed high-grade urinary reflux.[16] A study by Wollenberg *et al.* also reported VUR and urinary tract infection in 64% of cases with severe hydronephrosis.[17] Meanwhile, the frequency of VUR in hydronephrosis patients in our study was 21.3%.

In the study by Sadeghi-Bojd *et al.*, 200 prenatal hydronephrosis patients underwent their first postnatal ultrasonography, 65% of whom had normal, 18% mild/moderate and 17% severe hydronephrosis. One-hundred and sixty-seven patients had performed VCUG, of whom 20.82% showed VUR. Of the 112 patients who performed a DTPA scan, 50 patients had an obstruction and 62 patients showed no obstructive finding. Totally, 54% of the patients recovered by conservative therapy, 12.5% by surgery and the remaining improved without any surgical intervention.[18]

Our study also revealed that kidney size increased in 90.8% of the patients on the right and 85.1% of the patients on the left side. This finding is not necessarily an indicator of the severity of hydronephrosis and may be due to the normal growth of the kidneys by increasing age. We also noticed a reduction in kidney size in 5.7% of patients in the right kidney and 9.2% of patients in the left kidney. This decrease in size could be due to a reduction in the severity of hydronephrosis over time.

CONCLUSION

In general, most cases of fetal hydronephrosis are idiopathic and recover after birth, with no further treatments required. In patients with persistent or exacerbated hydronephrosis, optimal treatment and/or surgical intervention is mandatory. This study revealed various clinical outcomes in patients with fetal hydronephrosis including, complete or partial obstruction of the left kidney, urinary stones, VUR, urinary tract infection, complete or partial obstruction of the right kidney and neurogenic bladder, in descending order of frequency. Follow-up ultrasonographic examination for cases of fetal hydronephrosis is suggested.

REFERENCES

1. Vazirian S, Mohammadjafari H, Mohammadjafari R. Postnatal management of prenatal hydronephrosis. Clin Exc . 2013;11:63-80.
2. Aksu N, Yavaşcan Ő, Kangın M, et.al. Postnatal management of infants with antenatally detected hydronephrosis. Pediatric Nephrology. 2005;209:1253-9.
3. Roth JA, Diamond DA. Prenatal hydronephrosis. Current opinion in pediatrics. 2001;132:138-41.
4. Odibo AO, Raab E, Elovitz M, et al. Prenatal mild pyelectasis: evaluating the thresholds of renal pelvic diameter associated with normal postnatal renal function. Journal of ultrasound in medicine. 2004;234:513-7.
5. Lee RS, Diamond DA. Perinatal urology. Pediatric nephrology. 6th ed; 2009; 95-107.
6. Ylinen E, Ala-Houhala M, Wikström S. Outcome of patients with antenatally detected pelviureteric junction obstruction. Pediatric Nephrology. 2004 Aug 1;198:880-7.
7. Coelho GM, Bouzada MC, Pereira AK, et al. Outcome of isolated antenatal hydronephrosis: a prospective cohort study. Pediatric Nephrology. 2007Oct1; 2210:1727-34.
8. Sharifian M, Esfandiar N, Mohkam M, et al. Diagnostic accuracy of renal pelvic dilatation in determining outcome of congenital hydronephrosis. Iran J Kidney Dis. 2014 Jan;81:26-30.
9. Petrovski M, Simeonov R, Todorovikj L, et al. Congenital hydronephrosis: disease or condition? Prilozi. 2014 Oct 1; 352:123-9.
10. Van Dervoort K, Lasky S, Sethna C, et al. Hydronephrosis in infants and children: natural history and risk factors for persistence in children followed by a medical service. Clinical medicine. Pediatrics. 2009 Jan; 3: CMPed-S3584.
11. Samuelson U, Granerus G, Bjures J, et al. Renal function in idiopathic hydronephrosis in children: follow-up after conservative and surgical treatment. Scandinavian journal of urology and nephrology. 1984 Jan 1; 182:135-41.
12. Elder JS. Urologic disorders in infants and children. In: Behrman RE, Kliegnman RM, Jenson HB, editors. Nelson textbook of pediatrics. 20th ed. USA: Saunders; 2016.
13. Ulman I, Jayanthi VR, Koff SA. The long-term followup of newborns with severe unilateral hydronephrosis initially treated nonoperatively. The Journal of urology. 2000 Sep 1; 1643:1101-5.
14. Mohammadjafari H, Mohammadjafari R. Postnatal management of prenatal hydronephrosis. Clinical excellence. 2013 Jan 15;11:63-80.
15. ElSheemy MS. Postnatal management of children with antenatal hydronephrosis. African Journal of Urology. 2020 Dec;26(1):1-4.
16. Riccabona M, Fritz GA, Schöllnast H, et al. Hydronephrotic kidney: pediatric three-dimensional US for relative renal size assessment—initial experience. Radiology. 2005 Jul; 2361:276-83.
17. Wollenberg A, Neuhaus TJ, Willi UV, et al. Outcome of fetal renal pelvic dilatation diagnosed during the third trimester. Ultrasound in Obstetrics and Gynecology: The Official Journal of the International Society of Ultrasound in Obstetrics and Gynecology. 2005 May; 255:483-8.

18. Sadeghi-Bojd S, Kajbafzadeh AM, Ansari-Moghadam A, Rashidi S. Postnatal evaluation and outcome of prenatal hydronephrosis. Iranian journal of pediatrics. 2016 Apr;26(2).

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