

Association between Severity and Etiology of Antenatal Hydronephrosis in Neonates

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Abstract

Background and Aim: Antenatal hydronephrosis refers to the dilation of renal pelvis during fetal development. This condition is commonly diagnosed during intrauterine ultrasonography. According to available statistics, fetal anomalies are seen in about 0.5-2.5% of intrauterine ultrasound examinations. The most common anomaly is hydronephrosis. The severity of renal pelvic dilatation in the first sonography after birth may help to diagnose the underlying cause of antenatal hydronephrosis. On the other hand, knowledge of the etiology of hydronephrosis can help to understand the clinical course of the disease and to determine an appropriate therapeutic protocol for patients.

Methods: In this descriptive cross-sectional study, all infants with antenatal hydronephrosis referred to the pediatric nephrology clinic of Imam Khomeini Hospital, Ilam, Iran were evaluated. Considering a hydronephrosis frequency of 50%, confidence interval of 95%, and error rate of 13%, the sample size was calculated at 60 subjects.

Results: This study was performed in 61 neonates with antenatal hydronephrosis, including 43 (70.5%) males and 18 (29.5%) females. The frequency of hydronephrosis was significantly higher in boys than girls. Non-obstructive hydronephrosis was the most common underlying etiology in the patients. Most of the infants had a mild hydronephrosis. UPJO (ureteropelvic junction obstruction) was the most common cause of hydronephrosis. Furthermore, most of the patients had bilateral hydronephrosis.

Conclusion: Non-obstructive hydronephrosis accounted for about 50% of antenatal hydronephrosis cases in this study. The intensity of the pelvic dilatation was directly associated with obstructive hydronephrosis, which can be used as a diagnostic guide.

Keywords: Hydronephrosis; Etiology; Neonates; Severity.

Conflict of interest: The authors declare no conflict of interest.

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Introduction

Antenatal hydronephrosis refers to renal pelvic dilatation during fetal development. This condition is frequently detected in intrauterine ultrasonography (1). According to available statistics, fetal anomalies are seen in about 0.5-2.5% of intrauterine ultrasound examinations, with hydronephrosis being the most common (2). Management of fetal hydronephrosis varies based

on severity, neonate or infant's gender, and type of hydronephrosis (i.e. unilateral and bilateral); however, general procedures include imaging studies such as ultrasonography, voiding cystourethrography (VCUG), and functional renal scans during the first months of life (3, 4). These procedures also help to choose appropriate therapeutic interventions (i.e. surgical,

pharmaceutical, or no treatment) for these patients (5-8). The most common causes of unilateral hydronephrosis include ureteropelvic junction obstruction (UPJO), vesicoureteral reflux (VUR), and ureterovesical junction obstruction (UVJO). Proper identification and management of underlying causes of hydronephrosis and their complications resulting from either the disease itself or therapeutic interventions are the most important prognostic indicators in patients. Urinary tract infections (UTIs), growth retardation, renal insufficiency and failure, enuresis, and urination disorders are the most common complications of hydronephrosis (6-10).

There are many different viewpoints about the assessment and follow-up of neonates or infants with antenatal hydronephrosis after birth (11, 12). Meta-analysis studies have shown that children with pre-natal hydronephrosis may also be at risk of post-natal anomalies (13). In a study by Batug and colleagues in Turkey, the prevalence of urological abnormalities in neonates with hydronephrosis was 19.7% with bladder-ureter reflux being the most common condition (14).

Naseri and colleagues conducted a review study and found a prevalence of 4.5% for kidney stones in Asian children with urological disorders (15).

In a recent report, the prevalence of urologic disorders was significantly higher in boys than girls, and the most common etiologies of hydronephrosis included *UPJO* and *VUR* (16). Safaei-Asl and colleagues studied 64 children with kidney stones in Rasht, north of Iran and reported a prevalence of 14.3% for urological disorders including *UPJO* and *VUR* (17).

Rickwood and Reiner described four patients with pre-natal hydronephrosis in 1991 for the first time. Although no specific metabolic information was provided, the authors found that UTIs and Proteus were the major underlying causes in the three out of four patients (18). The incidence of antenatal hydronephrosis detected by ultrasound is 1 in 100-500 cases (19). In another report, the incidence of urinary-reproductive anomalies detected by ultrasonography was 9 in 1000 births. hydronephrosis comprised 50-70% of these anomalies (20).

More studies are required to find appropriate treatments for neonates or infants with antenatal hydronephrosis. The severity of renal pelvic dilatation in the first sonography after birth may help to diagnose the underlying cause of antenatal

hydronephrosis. Therefore, evaluating the main causes of hydronephrosis can help to understand the disease clinical course and to determine the best therapeutic protocol for patients.

Methods

Study population

This descriptive cross-sectional study was conducted in all neonates or infants with antenatal hydronephrosis referred to the pediatric nephrology clinic of Imam Khomeini Hospital, Ilam, Iran. Informed consent was obtained from the parents.

Sample size calculation

Considering a prevalence of 50% for antenatal hydronephrosis, confidence interval of 95%, and error rate of 13%, the sample size was calculated at 60 subjects.

Data collection tool

A researcher made questionnaire was used to collect demographical data. Clinical data were gathered by imaging studies.

Study protocol

All infants who were diagnosed with hydronephrosis during the 34th-38th weeks gestation underwent ultrasonography 3-5 days after birth. If hydronephrosis was confirmed, necessary imaging studies (i.e. VCUG, IVP, DTPA, and DMSA) were conducted to determine the final diagnosis (urinary tract reflux or obstruction).

The collected data included the neonate's sex, severity of hydronephrosis (mild, moderate or severe defined as a pelvic anterior-posterior diameter of 5-10 mm, 10-15 mm, and >15 mm, respectively), amniotic fluid volume (i.e. oligohydramnios, normal, or polyhydramnios), and type of hydronephrosis (bilateral or unilateral).

According to the etiology, patients with a definite diagnosis of hydronephrosis were categorized into obstructive or non-obstructive. The severity of hydronephrosis was determined based on radiographic findings.

Data analysis

Descriptive variables are expressed as percentage and mean $\pm$ standard deviation using tables and graphs. Chi-square was used to evaluate the relationship between qualitative variables, and student t-test was used to compare the mean values of quantitative variables between study groups. Analysis of variance was applied to compare the mean values of quantitative variables among several

groups. The data were analyzed using the SPSS 20 software.

Results

This study was conducted in 61 neonates with antenatal hydronephrosis, including 43 female (70.5%) and 18 (29.5%) male subjects.

The mean age of the neonates was 9.11 ± 6.83 months. The frequency of hydronephrosis was higher in boys than girls. Most of the patients had non-obstructive hydronephrosis. As for severity, hydronephrosis was mild, secondary to UPJO, and bilateral in the majority of the cases (Table 1).

Table 1. Distribution of variables in neonates with antenatal hydronephrosis

Studied variables		Prevalence	Percentage
Hydronephrosis etiology	Obstructive	12	19.7
	Non-obstructive	49	80.3
Hydronephrosis cause	UPJO	28	45.9
	VUR	4	6.6
	UVJO	1	1.6
	PUV	1	1.6
Hydronephrosis severity	Mild	38	62.3
	Moderate	16	26.2
	Severe	7	11.5
Hydronephrosis location	Unilateral (right)	19	31.1
	Unilateral (left)	18	29.5
	Bilateral	24	39.3

There was a direct association between the severity of pelvic dilatation and the cause of neonatal hydronephrosis (i.e. obstructive or non-obstructive) with obstructive cases being more severe.

Hydronephrosis was also more severe in boys compared to girls (Table 2).

Table 2. Relationship between severity of hydronephrosis and study variables

Studied variables		Hydronephrosis severity			p-value
		Mild n (%)	Moderate n (%)	Severe n (%)	
Gender	Male	24 (55.8)	12 (27.9)	7 (16.3)	0.13
	Female	14 (77.8)	4 (22.2)	0 (0)	
Hydronephrosis location	Unilateral (right)	12 (63.2)	5 (26.3)	2 (10.5)	0.34
	Unilateral (left)	13 (72.2)	5 (27.8)	0 (0)	
	Bilateral	13 (54.2)	6 (25)	5 (20.8)	
Hydronephrosis etiology	Obstructive	3 (25)	3 (25)	6 (50)	<0.0001
	Non-obstructive	35 (71.4)	13 (26.5)	1 (2)	

Although no statistically significant relationship was found between gender and cause of

hydronephrosis, obstructive hydronephrosis was more common in boys compared to girls (Table 3).

Table 3. Relationship between the causes of antenatal hydronephrosis and gender

Variables		Hydronephrosis type		p-value
		Obstructive n (%)	Non-obstructive n (%)	
Gender	Male	9 (20.9)	34 (79.1)	0.7
	Female	3 (16.7)	15 (83.3)	

Discussion

Hydronephrosis is one of the most common neonatal kidney abnormalities that may progress to kidney failure and related complications if it remains undiagnosed or is inappropriately treated. The aim of this study was to investigate the relationship between the severity and etiology of antenatal hydronephrosis. In this study of 61 neonates with antenatal hydronephrosis, most of the patients were boys and had non-obstructive hydronephrosis, which was consistent with a study by Ruth et al. that described a male to female ratio of 3-4 to 1 (19).

In this study, most of the cases with obstructive hydronephrosis had UPJO (21%). On the other hand, VUR (9%) was the most common etiology of non-obstructive hydronephrosis. Similarly, Reddy and colleagues (21) described UPJO (44%) and VUR (12%) as the main underlying causes of hydronephrosis. However, the results of this study were inconsistent with the findings of Woodward and colleagues (22) who reported transient hydronephrosis (60%), UPJO (10%), and VUR (33%) as the main etiologies. Nevertheless, the proportion of the patients with UVJO (4%) was similar between the present study and the study conducted by Woodward and colleagues (22). Dai Jong and colleagues (23) found that the most frequent underlying causes were UPJO (65.6%), VUR (7%), and UVJO (4%). Nevertheless, the findings of the present study were different from the results of a study by Marcio and colleagues (24) that found UPJO (26.5%), VUR (20.6%), UVJO (14.7%), PUV (17.6%), and transient hydronephrosis (11.8%) were the main etiologies. Regarding the association between the type and severity of hydronephrosis, the majority of the cases with non-obstructive hydronephrosis had a mild disease. Among patients with severe hydronephrosis, UPJO was the most common underlying etiology. Overall, right unilateral, left unilateral and bilateral hydronephrosis was found in

31.1%, 29.5%, and 39.3% of the neonates, respectively. There was a direct correlation between the severity of pelvic dilatation and the type of hydronephrosis (i.e. obstructive or non-obstructive). Mild and moderate hydronephrosis was found in 77.8% and 22.2% of the female neonates while 55.8%, 24.9%, and 16.3% of the male neonates had mild, moderate, and severe hydronephrosis, respectively. Furthermore, hydronephrosis was more severe in boys than in girls although the difference was not statistically significant. In addition, the frequency of obstructive hydronephrosis was higher in boys compared to girls (20.9% vs. 16.7%). There was no statistically significant relationship between gender and the cause of hydronephrosis.

Mild, moderate, and severe pelvic dilatation was detected in 62.3%, 26.2% and 11.5% of the patients, respectively. This finding was not in line with a study by Dai jong and colleagues in which mild and severe pelvic dilation was found in 52.7% and 2.6% of the patients, respectively. The present study indicated a direct correlation between the severity of pelvic dilatation and the cause of neonatal hydronephrosis (i.e. obstructive or non-obstructive), which was consistent with a study conducted by Olkuk in which a pelvic anterior-posterior diameter of >19 mm predicted severe obstructive hydronephrosis requiring surgical intervention (25).

Conclusion

About half of the patients presented with non-obstructive hydronephrosis. The most common causes of hydronephrosis were *UPJO*, *transient* hydronephrosis, and *UVJO*. A significant association was observed between the severity of pelvic dilatation and obstructive hydronephrosis, which may be used as a diagnostic guide for early diagnosis and treatment of obstructive disease.

Recommendations

ultrasonography, as a simple and accessible diagnostic procedure, is recommended for early detection of reflux or other abnormalities of the urinary system. It is also suggested to follow up the patients with mild hydronephrosis by performing consecutive ultrasound examinations. In addition, functional scanning procedures are recommended in male patients with moderate hydronephrosis and both female and male patients with severe hydronephrosis.

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Conflict of Interest

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