

## Short Term Outcome of Antenatal Hydronephrosis: A Single Center Experience

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### Abstract

#### Background

Fetal hydronephrosis is a common urinary tract anomaly that may result in renal parenchyma damage. Ultrasound is considered a simple, noninvasive procedure to diagnose and track antenatal hydronephrosis. Our aim was to study the clinical course of fetal hydronephrosis in fetuses.

#### Materials and Methods

In this prospective study, 60 fetuses in Imam Reza Hospital in Kermanshah, Iran, which were diagnosed with prenatal hydronephrosis in the third trimester of pregnancy, were grouped into three categories according to the anteroposterior diameter of the renal pelvis: mild (7-9 mm), moderate (9-15 mm), and severe (> 15 mm). The groups were followed for two months after birth with ultrasonography to investigate the clinical course and spontaneous resolution.

**Results:** The severity of the left-side hydronephrosis at the antenatal ultrasound was mild in 27 (45%), moderate in 19 (31.7%), and severe in 3 (18.30%) fetuses. At the follow-up, 30 patients had normal renal pelvis. Severe hydronephrosis, however, remained in three patients after 6 to 8 weeks of follow-up. The severity of the right-side hydronephrosis at the antenatal ultrasound was mild in 15 (25%), moderate in 10 (16.7%), and severe in 1 (1.7%) fetuses. At six to eight weeks after birth, 15 patients had normal renal pelvis. In 10 patients (16.7%), improvement in hydronephrosis was observed after 6-8 weeks. In the first evaluation, 45 patients (75%) had unilateral hydronephrosis and 15 patients (25%) had bilateral hydronephrosis. After six to eight weeks, these decreased to 22 (36.7%), and 6 (10%) cases, respectively.

#### Conclusion

The use of antenatal and postnatal ultrasound for imaging follow-up of neonates with fetal hydronephrosis showed that a significant number of cases improved after 6-8 weeks.

**Key Words:** Dilation, Fetal Hydronephrosis, Renal Pelvis, Ultrasound.

\*Please cite this article as: Seyedzadeh A, Tohidi M, Farshchian N, Seyedzadeh MS, Haghighi J, Hookari S. Short Term Outcome of Antenatal Hydronephrosis: A Single Center Experience. Int J Pediatr 2020; 8(7): 11587-595. DOI: [10.22038/ijp.2020.47775.3864](https://doi.org/10.22038/ijp.2020.47775.3864)

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Received date: May.17, 2020; Accepted date: Jun.12, 2020

## 1- INTRODUCTION

Congenital abnormalities of the urinary tract are the most common cause of chronic renal impairment in children younger than five years. Among these complications, congenital hydronephrosis is the most common abnormality (1). Hydronephrosis (abnormal dilation of the renal pelvis) can result in irreversible changes in the renal parenchyma and even scarring of the parenchyma. Most cases of antenatal hydronephrosis are usually diagnosed after birth and when the renal tissue has been already damaged. Hence, early diagnosis of fetal hydronephrosis, especially unilateral type that can remain asymptomatic later in life, can prevent renal injury and failure (2). Various reports are available regarding the prevalence of fetal hydronephrosis. This is because definition of hydronephrosis may vary in different studies. Overall, its prevalence ranges from one to 4.5% of fetuses (3).

There are various etiologies for hydronephrosis in the urinary tract with or without obstruction. The most important ones include ureteropelvic junction (UPJ) obstruction, ureterovesical junction obstruction, vesico-urethral-reflux (VUR), posterior urethral valve (PUV), among others. The prognosis and treatment are completely dependent on the cause of the disease (4). Of different diagnostic tools available to identify the etiology and assess the severity of hydronephrosis in infants, ultrasound is the most widely available. Ultrasound is usually the first imaging modality used after birth to visualize the urinary tract and determine the obstruction and severity of the renal pelvis dilation (3, 4). Studies evaluating ultrasound as a screening tool for VUR in infants with a history of prenatal hydronephrosis are limited and findings are widely varied. Although some studies suggest that ultrasound is not a suitable tool to be used instead of cystourethrography (VCUG) (4, 5), both

the 2010 Society for Fetal Urology (SFU), and the 2010 American Urological Association (AUA) recommend VCUG if postnatal renal bladder ultrasonography (RBUS) reveals either moderate/severe (SFU grade 3-4) hydronephrosis (HN) or hydroureter (HU). Afterwards, some other studies supported the AUA and SFU recommendations and suggested to limit cystourethrography (VCUG) in patients with normal sonography in postnatal follow up (5). In approximately 1% of pregnancies, a significant structural fetal anomaly is detected through prenatal sonography. Approximately 50% of these anomalies manifest as hydronephrosis (6). At the time of diagnosis of fetal hydronephrosis, urinary dilatation rate is calculated by measuring the anterior-posterior (AP) diameter of the renal pelvis in the transverse view of the kidney, which depends on the gestational age (7).

Although there is controversy about definition of the AP diameter, most researchers believe that the renal pelvic anteroposterior diameter (AP) of less than 7 mm after 32 weeks is highly predictive of normal postnatal renal function. Only fetuses with an anteroposterior diameter of more than 6 mm after 32 weeks require postnatal evaluation and follow-up (8). The primary goal of the diagnosis of antenatal hydronephrosis is to recognize transient physiologic cases that do not pose significant clinical consequences and to distinguish them from more serious cases that result from uropathies (9). Previous studies have reported that one-third up to 80 percent of antenatally-detected hydronephrosis might be simply a dynamic and physiologic process which resolves spontaneously in short-term and/or long-term follow-up after birth. In some severe cases, however, renal pelvis dilation can signal the presence of serious urinary tract pathologies (3, 10). The outcome of fetal hydronephrosis depends on its severity (mild, moderate, severe) and whether

unilateral or bilateral hydronephrosis exists. In most studies, the best first approach has been introduced as follow-up, post-natal ultrasound after birth. In this follow-up imaging and expectant (conservative) management, measuring the AP diameter of the renal pelvis to indicate the severity of hydronephrosis is important in determining further work-up. The aim of this study is to grade the severity of antenatal hydronephrosis in a sample of fetuses diagnosed with this condition by third-trimester ultrasound and to perform follow-up with post-natal ultrasound to determine resolution of renal pelvis dilation and related variables.

## **2- MATERIALS AND METHODS**

### **2-1. Study design**

This prospective study was conducted at Imam Reza Hospital (tertiary referral center) in Kermanshah, Iran, in the first half of 2018. The study population consisted of all the infants whose mothers were referred to the Imaging Center for third-trimester ultrasound, and the diagnosis of antenatal hydronephrosis was confirmed in their fetuses.

### **2-2. Method**

Diagnosis of fetal hydronephrosis was based on the observation of the renal pelvic dilatation by measuring the AP diameter of the renal pelvis in the transverse view of the kidney. The renal pelvis dilatation equal to or greater than 7 mm after the 32<sup>th</sup> week of gestation was defined as antenatal hydronephrosis (8, 11). Based on the size of the AP diameter, hydronephrosis was divided into three groups of mild (7 to 9 mm), moderate (9 to 15 mm), and severe (> 15 mm) (7, 8). Conclusively, an AP diameter < 9 mm was classified as transient physiologic hydronephrosis, and an AP diameter > 9 mm as clinically significant hydronephrosis which required follow-up.

### **2-3. Follow-up using ultrasound**

In addition to the third-trimester ultrasound, the neonates underwent ultrasound twice to follow stabilization, resolution, or worsening of the renal pelvis dilation. The first ultrasound was performed within 72 to 96 hours after birth and it was repeated six to eight weeks after birth. A single board-certified radiologist performed ultrasound examinations with the same ultrasound machine. A checklist was designed by the research team to collect the required data. These included gender, birth weight, gestational age at the time of the diagnosis of hydronephrosis, renal pelvis AP diameter, severity of hydronephrosis (mild, moderate, severe), unilateral or bilateral hydronephrosis, and outcomes of hydronephrosis (transient or non-transient hydronephrosis).

### **2-4. Intervention**

In this study, we used conservative management for neonates with prenatal hydronephrosis and followed them with ultrasonography, except for those which needed surgical intervention due to lower urinary tract obstruction, like posterior urethral valves (PUV).

### **2-5. Ethical considerations**

The study protocol was registered and confirmed by the Ethics Committee of Kermanshah University of Medical Science (ID: 95528). The study objectives were explained to the parents, and it was assured that ultrasound did not impose a significant hazard for the fetuses and neonates. Informed consent was obtained from the parents. Ethical issues (including plagiarism, data fabrication, double publication) have been completely observed by the authors.

### **2-6. Inclusion and exclusion criteria**

The criteria for entering the study was the diagnosis of fetal hydronephrosis based on the detection of renal pelvic dilatation (Equal to or greater than 7 mm after the 32<sup>nd</sup> week of gestation). Exclusion criteria

included neonates who had voiding cystourethrogram (VCUG) performed on them within the first weeks of life due to urinary tract infection, ureteral dilatation and bladder abnormality, or did not complete the follow-up period.

## 2-7. Data Analyses

Sampling was done consecutively until the required sample size was achieved. The minimum sample size according to the study design and considering the prevalence of transient hydronephrosis as 53.1% (12) with the confidence level of 95% and accuracy of 15% (considering 10% drop out), was calculated as 47 fetuses. Descriptive indices such as frequency, percentage, mean, and standard deviation (SD) were used to report the results. To determine the relationship between the outcome of hydronephrosis (transient or non-transient) in the right and left kidneys with severity of the renal pelvis dilation and unilateral or bilateral involvement, the Chi-squared test was applied. The significance level was set at 0.05. The analyses were performed using SPSS software version 20.0.

## 3- RESULTS

Out of 60 fetuses included, 32 (53.3%) were male and 28 (46.7%) were female. In terms of weight at time of birth, five (8.3%) were categorized as low weight (1,500 to 2,500 grams), 52 (86.7%) had normal weight (2,500 to 4,000 grams), and three neonates weighed more than 4,000 grams. Mean ( $\pm$ SD) birth weight was 3156.17 ( $\pm$ 505.93) grams (range, 1,800 to 4,500). **Table.1** shows the frequency distribution of severity of hydronephrosis in left and right kidneys in the first, second, and third ultrasound examinations. As shown, the severity of the left-side hydronephrosis at baseline was mild in 27 (45%), moderate in 19 (31.7%), and severe in 3 (18.3%) of fetuses. At the third ultrasound examination performed six to

eight weeks after birth, 30 patients had normal renal pelvis AP diameter. However, severe hydronephrosis had remained in three patients and was not resolved. In other words, in case of the left-side hydronephrosis, follow-up sonography showed that the number of mild hydronephrosis cases reduced by one third and the number of moderate hydronephrosis cases reduced by half; whereas the number of severe hydronephrosis cases at the initial evaluation did not change. Despite the changes observed in left-side hydronephrosis, no change was observed regarding resolution of hydronephrosis in the right kidney. Left-side hydronephrosis appeared more common than right-side hydronephrosis. **Table.2** shows the frequency of unilateral and bilateral hydronephrosis. In 72 hours after birth, hydronephrosis resolved in 1.7% (one infant) and at 6 to 8 weeks after birth in 53.3% (32 infants) of the neonates.

The final follow-up demonstrated that 39 infants (65%) had transient physiologic hydronephrosis and showed improvement. **Table.3** shows the relationship between the outcome (transient physiologic hydronephrosis and non-transient hydronephrosis) with severity of hydronephrosis dilatation in the left and right kidneys and unilateral or bilateral involvement. As seen, there was a significant correlation between the outcome and unilateral hydronephrosis, as most infants with unilateral hydronephrosis had transient hydronephrosis (66.7%) compared to neonates with bilateral hydronephrosis (24.4%) ( $P=0.004$ ). In addition, severe hydronephrosis of the right kidney was associated with non-transient hydronephrosis. However, no significant association was observed between severity of hydronephrosis and outcome in the left kidney.

**Table-1:** Frequency distribution of mild, moderate, severe hydronephrosis at three ultrasound examinations (antenatal, first 72 hours, and 6-8 weeks after birth).

Variables		Antenatal ultrasound	The first 72 hours ultrasound	Six to eight weeks after birth ultrasound
Left kidney	Mild (7-9 mm)	27 (45%)	23 (38.3%)	9 (15%)
	Moderate (9-15 mm)	19 (31.7%)	12 (20%)	10 (16.7%)
	Severe (> 15 mm)	3 (5%)	3 (5%)	3 (5%)
	No left side hydronephrosis	11 (18.3%)	10 (16.7%)	8 (13.3%)
	Normal (0-7 mm)	-	12 (20%)	30 (50%)
Right kidney	Mild (7-9 mm)	15 (25%)	7 (11.7%)	-
	Moderate (9-15 mm)	10 (16.7%)	11 (18.3%)	11 (18.3%)
	Severe (> 15 mm)	1 (1.7%)	-	1 (1.7%)
	No right side hydronephrosis	34 (56.7%)	33 (55%)	33 (55%)
	Normal (0-7 mm)	-	9 (15%)	15 (25%)

**Table-2:** The frequency of unilateral and bilateral hydronephrosis at three ultrasound examinations (antenatal, first 72 hours, and 6-8 weeks after birth).

Status	Antenatal ultrasound	The first 72 hours ultrasound	Six to eight weeks after birth ultrasound
Unilateral hydronephrosis	45 (75%)	48 (80%)	22 (36.7%)
Bilateral hydronephrosis	15 (25%)	11 (18.3%)	6 (10%)
No hydronephrosis	-	1 (1.7%)	32 (53.3%)

**Table-3:** The relationship between unilateral or bilateral hydronephrosis and its severity (mild, moderate, severe) with final outcome in infants with antenatal hydronephrosis.

Variables		Final outcome		Total	Degree of freedom	Chi-square	P-value
		Transient	Clinically significant				
Kidney involvement at first ultrasound	Unilateral	34 (75.6%)	11 (24.4%)	45	1	8.816	0.004
	Bilateral	5 (33.3%)	10 (66.7%)	15			
Left-sided severity at the first ultrasound	Mild	20 (74.1%)	7 (25.9%)	27	3	3.866	0.276
	Moderate	10 (52.6%)	9 (47.4%)	19			
	Severe	1 (3.33%)	2 (66.7%)	3			
	No left side hydronephrosis	8 (72.7%)	3 (27.3%)	11			
Right-sided severity at the first ultrasound	Mild	11 (73.3%)	4 (26.7%)	15	3	13.183	0.004
	Moderate	2 (20%)	8 (80%)	10			
	Severe	0	1 (100%)	1			
	No right side hydronephrosis	26 (76.5%)	8 (23.5%)	34			

#### 4- DISCUSSION

In the present study, we report the clinical course of 60 fetuses with antenatal hydronephrosis who were identified with ultrasonography. The cases were followed after birth, and a significant number of spontaneous resolution (65%) was found after 6 to 8 weeks. Fetal hydronephrosis is a common and often congenital urinary tract disorder. Hydronephrosis is also the most common kidney disease diagnosed on fetal ultrasound (13). Prenatal ultrasound allows for the diagnosis of many intrauterine anomalies; in fact, most anomalies are found in routine fetal ultrasound performed at 18-20 weeks of gestation (14-16). Although the majority of fetal genitourinary anomalies are diagnosed during the second-trimester ultrasound (18-20 weeks), with the increasing use of first-trimester ultrasound, more severe renal anomalies are being detected between 11 and 14 weeks using ultrasound (17, 18).

Among these, fetal hydronephrosis is of particular importance as hydronephrosis is the most common form of anomaly diagnosed during pregnancy by ultrasound and accounts for about 50% of all genitourinary anomalies (19). Although mild antenatal hydronephrosis is associated with a high level of spontaneous resolution (3, 17, 19), antenatal and postnatal ultrasound examinations are still necessary to follow the resolution of these conditions. The sooner the condition is diagnosed, the greater the likelihood of its better management. The outcome of fetal hydronephrosis depends on its severity and presence of unilateral or bilateral hydronephrosis. If these anomalies are not detected by the prenatal ultrasound and subsequently managed, they would manifest later in life as pyelonephritis, hypertension, or even significant renal impairment, especially for the severe type (10, 19). In most studies, the best measure of follow-up of confirmed antenatal

hydronephrosis is postnatal ultrasound (18). Since it is impossible to determine an upper limit for the normal size of antenatal renal pelvis, any neonate with antenatal hydronephrosis should be considered clinically important (19). However, during pregnancy, the third-trimester threshold value of 7mm for the antero-posterior renal pelvis dilation is the most widely used criterion to identify a fetus for post-natal follow-up (3). According to the results of this study, most of fetuses diagnosed with hydronephrosis were male. This is in agreement with a previous study (20), but other studies do not support this finding (21). Severe renal pelvis dilation in the left kidney was reported in three patients at antenatal ultrasound. Six to eight weeks after birth, ultrasonography showed no improvement in pelvic dilatation in these three patients, but a significant number of neonates with mild to moderate left-side hydronephrosis showed a decreased severity in their condition or even spontaneous resolution. However, these changes were not observed in the right kidney, although the smaller number of neonates with right-side involvement may have affected the results.

Consequently, although hydronephrosis is a complication that can improve over time (22, 23), this has not been shown in severe cases. Therefore, severe antenatal hydronephrosis (defined as an AP diameter of the renal pelvis  $> 15$  mm) is a concern and appropriate follow-up, and measurements should be taken. These findings are consistent with the findings of the study by Merlin et al. in 2007, which suggested post-natal conservative management for the fetuses with mild antenatal hydronephrosis (22). As a result, in antenatal hydronephrosis, the need and extent of postnatal imaging are determined by the severity of antenatal hydronephrosis (24). In Iran, Sadeghi bojd et al. (2016), showed that an AP diameter cutoff about 15 mm in the first postnatal week is the

most contributing issue to a surgical outcome (16). In this study, most neonates (65%) were found to have transient hydronephrosis. In two previous studies, this rate was reported as 53% (12) and 35-50% (23), which is in agreement with the findings of our study. However, another study reported a lower rate of transient hydronephrosis (27.5%) (25). Generally, the rate of transient dilation of the renal pelvis ranges from 41% to 88% (3, 24, 26-29). The cause of transient hydronephrosis is a matter of speculation. It seems that the smooth muscle of the renal pelvis, through the pacemakers in the pelvis, causes a peristaltic contraction from the renal calyces towards the bladder. Any immaturity of these pacemakers might lead to poor co-ordination of the peristaltic contraction and causes urinary stasis and hydronephrosis, which might explain the disappearing antenatal hydronephrosis after birth when the physiological function of the kidney and pacemakers become more mature (26).

In this study, we used ultrasonography for all neonates with prenatal hydronephrosis; VCUG and nuclear scan were further used if indicated. As ultrasonography assessments during the first 48 hours after birth may underestimate the severity of hydronephrosis, we performed the first ultrasonography within 72 to 96 hours after birth (28). As previously emphasized, the clinical approach to prenatal hydronephrosis depends on the severity and unilateral or bilateral involvement. In cases of mild unilateral, the majority of cases are transient (16, 25), and recover without surgical intervention (16, 24, 26); while VUR may be present in up to 15% of these infants, the clinical importance of VUR in these asymptomatic infants is unknown (24, 28). As a result, the role of VCUG in isolated unilateral mild hydronephrosis remains controversial, and is limited to infants who are susceptible to/suspected to have lower tract pathology

or complicated with recurrent urinary tract infection (16, 24). However, because of the risk of worsening after birth, an ultrasound screening is recommended for every antenatal hydronephrosis (24). In neonates with severe unilateral hydronephrosis, the most common diagnosis is UPJO. These neonates obviously need to be more closely followed, and there is a shift in management from early surgery to close observation for these infants (24, 28). Mami et al. in 2010 suggest that an isolated non-complicated severe prenatal hydronephrosis may be a self-limiting condition (29). The management of bilateral prenatal hydronephrosis is less firmly established. Nevertheless, the presence of bilateral upper tract dilation raises concerns regarding lower urinary tract anomalies, such as urethral atresia and posterior urethral valves (26, 30). Therefore, early VCUG might sometimes be needed to rule out lower tract obstruction that may require urgent surgical intervention (24, 26, 27, 31).

In the present study, the results of the initial evaluation showed a relationship between the outcome of hydronephrosis and the type of kidney involvement (unilateral or bilateral), and also the final outcome of hydronephrosis with dilation severity in the right kidney. In other words, the incidence of non-transient hydronephrosis in patients with bilateral primary involvement (66.7%) is more than twice the incidence of non-transient hydronephrosis in patients with unilateral primary involvement (24.4%), which means that spontaneous resolution is greater in unilateral renal cases. In addition, the incidence of non-transient hydronephrosis increases with the degree of dilatation in the right kidney, and vice versa. However, there was no relationship between the clinical outcome of hydronephrosis and the severity of dilatation in the left kidney.

#### 4-1. Study Limitations

The small number of patients and the short time follow-up were the main limitations of the present study that did not allow us to draw an unequivocal conclusion.

#### 5- CONCLUSION

Based on the results, the use of antenatal and postnatal ultrasound for imaging follow-up of neonates with fetal hydronephrosis showed that a significant number of cases improved after a period of 6 to 8 weeks. However, severe and bilateral hydronephrosis had a significantly lower rate of resolution during 6-8 weeks after birth, and should be followed up longer and with especial care.

#### 6- FUNDING/SUPPORT

The authors thank Kermanshah University of Medical Sciences for financial support of this research.

**7- CONFLICT OF INTEREST:** None.

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