ORIGINAL ARTICLE

EVALUATION AND MANAGEMENT OF HYDRONEPHROSIS AT FIRST YEAR OF LIFE IN CENTRAL ANATOLIA

Orta Anadolu'da Yaşamın İlk Yılında Hidronefrozun Değerlendirilmesi ve Yönetimi

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Geliş tarihi/Received: 23.11.2024
Kabul tarihi/Accepted: 06.05.2025
DOI: 10.16919/bozoktip.1590157

Bozok Tıp Derg 2025;15(3):337-344
Bozok Med J 2025;15(3):337-344

ABSTRACT

Objective: The aim of this study was to evaluate the prognosis and outcomes of patients diagnosed with hydronephrosis in the first year of life and to monitor the patients in terms of growth, development and urinary tract infection follow them in terms of growth, development and urinary tract infection.

Material and Methods: The study group consists of the follow-up of 28 patients who were followed up with the diagnosis of Antenatal Hydronephrosis in the Pediatrics outpatient clinics of our University. The study group consists of 28 follow-up of patients diagnosed with Antenatal Hydronephrosis at the Pediatrics outpatient clinics of our University. The files of the cases included in the study were retrospectively scanned and demographic data, imaging methods, previous urinary tract infection, growth development and nutritional status of the patients were evaluated during the one-year follow-up. The retrospectively scanned case files included in the study contain the demographic data, imaging methods, history of previous urinary tract infections, growth development and nutritional status of the patients, evaluated through the one-year follow-up. Renal ultrasonography from the scans performed in the antenatal period were graded according to pelvic anteroposterior diameters.

Results: A total of 28 patients with hydronephrosis detected by ultrasonography during antenatal period were included in our study. The findings were as follows: Unilateral hydronephrosis in 14 (50%) of the patients in the first postanatal ultrasonography, bilateral hydronephrosis in 10 (35.7%) and 4 (14.3%) were seen as normal. In the first postnatal ultrasonography of the patients followed during the thesis study, 71.4% had mild hydronephrosis, 14.3% had severe hydronephrosis, and 14.3% were normal. In our study, it was determined that the growth and development of patients with hydronephrosis in the antenatal period and varying degrees of hydronephrosis in the postnatal period were backward according to the growth curve reference values, and this was seen as statistically significant ($p<0.05$).

Conclusion: Many causes of antenatal hydronephrosis etiology can regress spontaneously without the need for intervention, and it is considered appropriate to identify patients who need further examination and to follow up with less examination and prospective follow-up plan for other patients.

Keywords: *Hydronephrosis; Antenatal Hydronephrosis; Postnatal Follow-Up.*

ÖZET

Amaç: Bu çalışmanın amacı, hidronefroz tanısı alan hastaların yaşamının ilk yılında prognoz ve sonuçlarını değerlendirmekle birlikte büyüme, gelişme ve üriner sistem enfeksiyonu açısından takip etmektir.

Gereç ve Yöntemler: Çalışma grubunu Üniversitemiz Çocuk Sağlığı ve Hastalıkları polikliniklerinde Antenatal Hidronefroz tanısı ile takip edilen 28 hasta oluşturmaktadır. Çalışmaya dahil edilen olguların dosyaları retrospektif olarak tarandı ve bir yıllık takipte hastaların demografik verileri, görüntüleme yöntemleri, geçirilmiş üriner sistem enfeksiyonu, büyüme gelişimi ve beslenme durumları değerlendirildi. Antenatal dönemde yapılan renal ultrasonografi bulguları pelvik anteroposterior çaplarına göre derecelendirildi.

Bulgular: Antenatal dönemde ultrasonografi ile hidronefroz saptanan toplam 28 hasta çalışmamıza dahil edildi. Birinci postanatal ultrasonografi'de hastaların 14'ünde (%50) unilateral hidronefroz, 10'unda (%35,7) bilateral hidronefroz ve 4'ünde (%14,3) normal görüldü. Tez çalışması süresince takip edilen hastaların %71,4'ünde hafif hidronefroz, %14,3'ünde ağır hidronefroz ve %14,3'ünde normal saptandı. Hidronefroz tanısı alan hastaların tüm takiplerinde, hidronefrozun derecesi ile takip arasında hastaların büyüme ve gelişmesi üzerine olumsuz etki olmuş ve zıt bir ilişki gözlenmiştir. Bu sonuçlar istatistiksel olarak anlamlı bulundu ($p<0,05$).

Sonuç: Antenatal hidronefroz etiyolojisinin birçok nedeni girişime gerek kalmadan kendiliğinden gerileyebilmekte olup, ileri tetkik gereken hastaların belirlenmesi, diğer hastalar için daha az tetkik ve prospektif takip planı ile takip edilmesinin uygun olduğu düşünülmektedir.

Anahtar Kelimeler: *Hidronefroz; Antenatal Hidronefroz; Postnatal Takip*

INTRODUCTION

Hydronephrosis (HN) is the most commonly detected abnormality in the antenatal period and is defined as the enlargement of the hereditary system and renal pelvis. The incidence of antenatal hydronephrosis ranges between 1% and 5% (1). Most of the antenatal hydronephrosis is caused by transient hydronephrosis. Antenatal hydronephrosis is mostly caused by transient hydronephrosis. With the frequent use of ultrasonography (US) as a maternal and fetal imaging method during pregnancy, the frequency of prenatal diagnosis has increased (2). Abnormalities such as vesiculoureteral reflux (VUR), ureteropelvic (UP) junction stenosis, ureteral obstruction, ureterocele, megaureter, urethral atresia, posterior urethral valve (PUV) can be counted among the symptoms for the diagnosis of antenatal hydronephrosis (3). In cases where regular follow-up of babies diagnosed in the prenatal period cannot be performed, there is a risk of recurrent urinary tract infections, damage to renal parenchyma, impaired kidney function, end-stage renal failure, growth and growth retardation (4). Hydronephrosis is referred to as "enlargement of the renal collecting system or enlargement of the renal pelvis" (5). If the enlargements detected in the prenatal period are antenatal hydronephrosis, and if the enlargements includes the ureters outside the renal collecting system, this anatomical definition is called hydroureteronephrosis (6). There is no consensus on the optimal grading criteria for the diagnosis of fetal hydronephrosis. In general, the likelihood of having a significant kidney anomaly is associated with the severity of the hydronephrosis. Our approach to infants with fetal hydronephrosis is to allow confirmation of postnatal persistent hydronephrosis based on the following predictive factors (Figure 1), (Figure 2), (Figure 3). Renal pelvic diameter (RPD) is a measure of renal collecting system expansion and does not reflect the extent of parenchymal changes such as hydronephrosis and increased echogenicity, thinning, or calliectasia. There is no consensus on threshold RPD, which describes clinically significant fetal hydronephrosis that requires postpartum follow-up and has a high probability of renal pathology (7).

Society of Fetal Urology's (SFU) criteria for the diagnosis and grading of fetal hydronephrosis have been developed based on the degree and location of pelvic dilatation, the number of calyxes seen, the presence and severity of parenchymal atrophy. The SFU grading system focuses on the degree of hydronephrosis in the kidney without directly assessing the condition of the ureter and bladder (8). In the Urinary System Dilation (UTD) Classification System, A multidisciplinary panel of radiologists, nephrologists and urologists has proposed a classification system that applies to UTD that occurs before or after birth (9). The new guideline developed by the National Institute for Health and Clinical Excellence (NICE) urinary tract infection in children does not recommend imaging in children older than 6 months unless they have recurrent or atypical UTIs, and renal ultrasonography (US) is recommended within 6 weeks after the first urinary tract infection (UTI) in infants younger than 6 months (10). Studies show that the higher the degree of hydronephrosis in the prenatal period, the higher the probability of encountering obstructive pathologies in the postpartum period (11). Similarly, in the postpartum evaluation, if the anterior posterior diameter of the pelvis renalis is less than 15 mm and calyx dilatation is not observed, the probability of obstruction is very low (12).

MATERIALS AND METHODS

The study group consists of the follow-up of 28 patients who were followed up with the diagnosis of Antenatal Hydronephrosis in the Pediatrics outpatient clinics of Yozgat Bozok University Research Hospital between November 2019 and November 2020. All procedures performed in studies involving human participants were in accordance with the ethical standards of the institutional and/or national research committee and with the 1964 Helsinki Declaration and its later amendments or comparable ethical standards. The ethics committee approval of the study was carried out in accordance with the rules with the approval of the ethics committee dated 27.11.2019 from Yozgat Bozok University Clinical Research Ethics Committee (Decision number: 2019-10-235).

The files of the cases included in the study were retrospectively scanned and demographic data (gender, birth height, body weight and head circumference), imaging methods, previous urinary tract infection, growth development, and nutritional status of the

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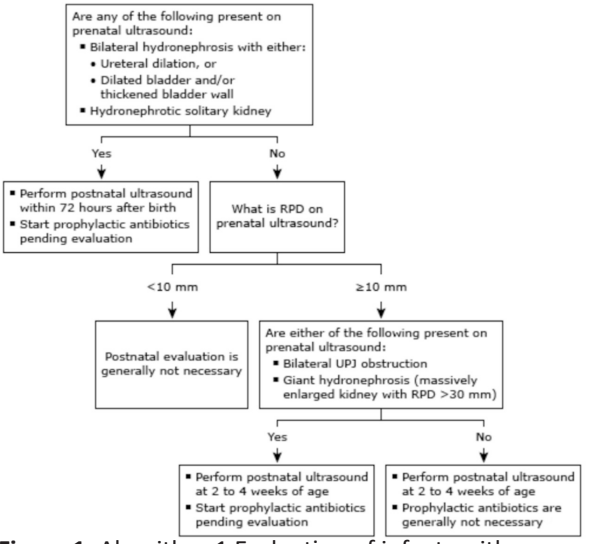

Figure 1. Algorithm-1 Evaluation of infants with prenatally diagnosed hydronephrosis: Determining timing of postnatal ultrasound and need for prophylactic antibiotics (8).

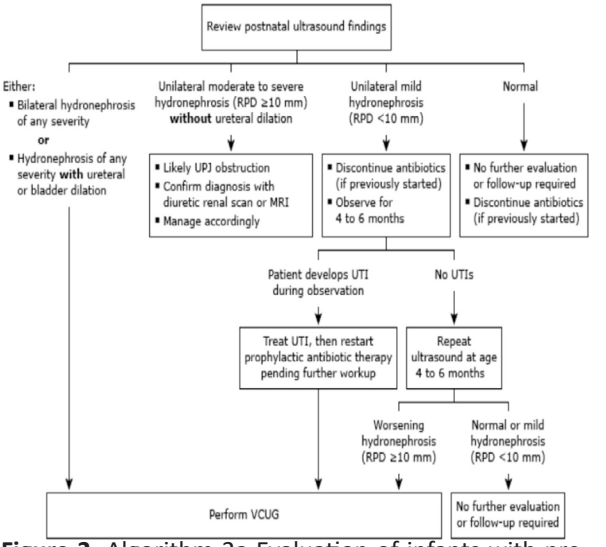

Figure 2. Algorithm-2a Evaluation of infants with prenatally diagnosed hydronephrosis: Subsequent evaluation and management based on postnatal ultrasound findings (8).

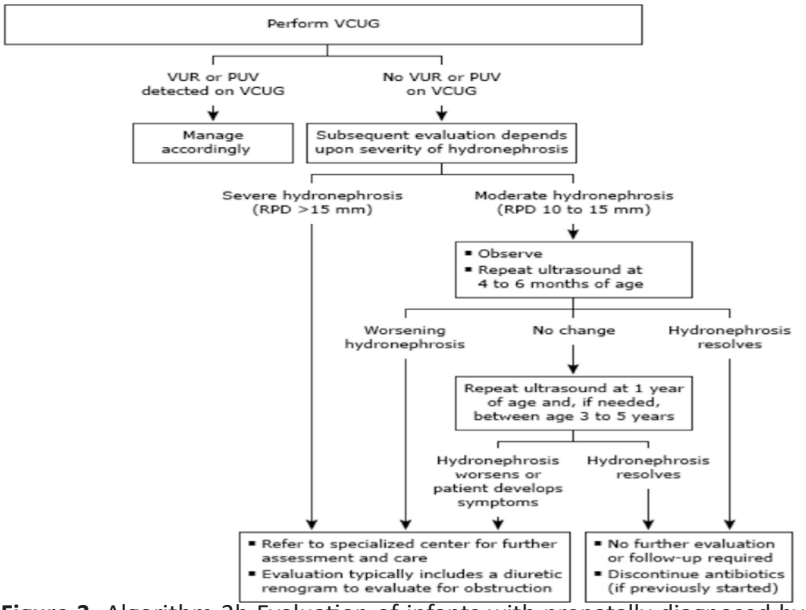

Figure 3. Algorithm-2b Evaluation of infants with prenatally diagnosed hydronephrosis: Subsequent evaluation and management based on postnatal ultrasound findings (8).

patients were evaluated during the one-year follow-up. The growth and development of the patients were evaluated using the growth and standard deviation parameters prepared for Turkish children. Newborns of mothers who did not have a healthy pregnancy process and who did not attend the prenatal follow-up, patients who did not visit the pediatric clinic within 12 months after delivery, patients with metabolic diseases, malabsorption syndromes and other diseases that may have relevance to growth retardation, and finally oncology/hematology patients were excluded from the study. Renal US findings performed in the antenatal

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period were graded according to pelvic AP diameters. Imaging studies were performed considering the condition of the patients and unnecessary examinations were avoided. Patients were periodically monitored with weight, height, clinical (blood pressure, UTI, etc.) and radiological examinations [ultrasonography (US), dimercaptosuccinic acid (DMSA), diethyylene triamine penta acetic acid (DTPA)] in accordance with the underlying renal pathologies. In the antenatal period, US results were evaluated and a follow-up plan was made according to the algorithms specified in our study. Each infant who met this inclusion criterion was referred to our clinics. Infants whose routine antenatal scans showed an antero-posterior diameter of pelvis (APPD) of 5 mm were observed in our department during this period. Hydronephrosis was classified into three groups according to antenatally sonographic measurement of renal pelvis diameter: Group I APPD 5–9 mm, Group II APPD 10–14 mm, Group III APPD ≥ 15 mm (Table 1). Both the increases and improvements in the degree of hydronephrosis were recorded. It was recorded whether there was an increase or improvement in the degree of hydronephrosis.

Statistical Analysis

All analyses were performed with the IBM SPSS 22.0 program (IBM Corp., Armonk, NY). Descriptive statistics; For continuous and discrete quantitative data, the mean ± standard deviation was expressed as median (minimum-maximum) for those with normal distribution, and as n (%) for qualitative data. The Kolmogorov-Smirnov test was used to evaluate whether the data were suitable for the normal distribution and the homogeneous variances were evaluated by the Levene's test. Correlation analysis was performed to determine the strength and direction of the relationship between the variables. A Spearman's 'rho' correlation coefficient was used to evaluate the data when the variables were continuous quantitative/discrete quantitative but did not show normal distribution or when there was ordinal qualitative data. In the correlation analysis, the 'rho' value was 0.01-0.29 as a low-level relationship, 0.30-0.70 as a moderate relationship, and 0.71-0.99 as a high-level relationship. A p-value below 0.05 was considered statistically significant for the results of all analyses.

RESULTS

A total of 28 patients 32.1% female and 67.9% male with hydronephrosis detected by US in the antenatal period were included in our study. Unilateral hydronephrosis was observed in 50%, 35.7% had bilateral hydronephrosis and 14.3% of the patients were normal. Of the patients with unilateral hydronephrosis, 57.1% were right-sided and 42.9% were left-sided, 92.9% were at term (≥37th gestational week) and 7.1% were premature. Unilateral hydronephrosis was observed in 61.5% of patients who could be followed for one year, while hydronephrosis disappeared in 5 patients. 15.3% had mild hydronephrosis, 7.7% had moderate hydronephrosis, 38.5% had severe hydronephrosis, and 38.5% were normal. On the first postnatal US, 71.4% had mild hydronephrosis, 14.3% had severe hydronephrosis, and 14.3% had normal postnatal US. The 2nd follow-up was performed in all thesis patients: 39.2% had mild hydronephrosis, 25% had moderate hydronephrosis, 10.7% had severe hydronephrosis, and 25% were normal. One-year follow-up: 25% had UPBD and 12.5% had a double collector system. Patients followed for one year during the thesis study: 7.1% had UPBD, 7.1% had VUR, 3.6% had ureterocele, and 7.1% had a double collector system. Postnatal follow-up of our patients was performed for periods ranging between 48 hours and 7 days, between the 1st month and the 3rd month, and the subsequent follow-up was performed at trimonthly intervals and US findings were recorded.

In all follow-ups of patients with the diagnosis of

Table 1. Classification based on the measurement of the maximum antero-posterior (AP) diameter of the renal pelvis in defining the degree of antenatal hydronephrosis (7).

Antero-posterior (AP) diameter (mm)	Hydronephrosis degree
5-10 mm	Normal or Mild hydronephrosis
10-15 mm	Moderate degree hydronephrosis
>15 mm	Severe hydronephrosis

mm: millimeter

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hydronephrosis, there was a negative correlation between the degree of hydronephrosis and patient's growth and development, and also an opposite relationship was observed. These results were found to be statistically significant ($p<0.05$). A high correlation was observed in the opposite direction with the degree of hydronephrosis and the difference in total weight gain at the age of one year. As the severity of the disease increased, weight gain decreased. This was considered statistically significant at a high level ($r= 0.782$, $p=0.002$). In the first follow-up of patients with severe hydronephrosis (Grade 3) 50% were positive for UTI in urine culture. In subsequent follow-ups, it was observed that the frequency of UTI increased in proportion to the degree of hydronephrosis. The increase in UTI positivity with the increase in the degree of hydronephrosis was seen in a linear relationship and was interpreted as clinically significant.

VCUG was withdrawn in 9 of 28 patients (32.1%) due to the indications described and followed up with the diagnosis of antenatal hydronephrosis, and VUR was detected in 2 of these 9 patients (22.2%). Unilateral VUR was present in these 2 patients. Grade 2 VUR was detected in one of the 2 patients and grade 3 VUR was detected in the other. During follow-up, 5 of 28 patients (17.8%) underwent renal scintigraphy with Tc-99m mercaptoacetiltriglisin (MAG-3) with diuretics for advanced hydronephrosis. Of the 5 patients who underwent MAG-3, 1 (20%) had obstruction and 4 (80%) had non-obstructive dilatation (NOD). Antibiotic prophylaxis was given to 32.1% of the patients who made up our study. 88.8% of the patients had stage 3 hydronephrosis. VUR in 2 of patients receiving prophylaxis (grade 2-3); In 2 of them, UP junction stenosis was detected. The growth status of patients with antenatal hydronephrosis was evaluated. Growth, height, weight, head circumference percentile measurements according to age, 0-3 months, 0-6 months, 0-9 months, 0-12 months, 3-6 months, 6-9 months, 9-12 months weight differences were calculated and evaluated. The nutritional status of our patients with antenatal hydronephrosis was evaluated. It was determined that the growth and development of the patients with hydronephrosis in the antenatal period and with varying degrees of hydronephrosis in the postnatal period were backward according to the growth curve reference values, and this was seen as statistically significant. Of the patients who underwent surgery; UP junction stenosis, a double collecting system, ureterocele and double collecting system anomaly were seen. Surgical procedure was performed in 10.7% of patients with severe hydronephrosis according to renal AP pelvic diameter, and mild hydronephrosis was detected in 39.2% of the cases who did not undergo surgical procedure. Accordingly, severe hydronephrosis according to pelvic AP diameter was found to be statistically significantly higher in the surgical group than in the non-surgical group. The grades and growth status of the patients with hydronephrosis were evaluated by calculating the difference in weight from 0-3 months, 0-6 months, 0-9 months, 0-12 months with length, weight, head circumference percentile measurements according to age (Table 2).

Table 2. Statistical evaluation of hydroneprosis grade,growth and development in the follow-up.

	Length (p)	Weight (p)	Head circumference (p)	0-3 Months Weight(g) difference	0-6 Months Weight(g) difference	0-9 Months Weight(g) difference	0-12 Months Weight(g) difference
1. Follow-up	rho=0.167	rho=0.025	rho=-0.004	rho=-0.331	rho=-0.192	rho=-0.303	rho=-0.408
HN Grade	p=0.395	p=0.898	p=0.983	p=0.085	p=0.357	p=0.237	p=0.167
2. Follow-up	rho=-0.024	rho=0.188	rho=0.157	rho=-0.495	rho=-0.516	rho=-0.579	rho=-0.727
HN Grade	p=0.904	p=0.338	p=0.426	p=0.007	p=0.008	p=0.015	p=0.005
3. Follow-up	rho=-0.055	rho=0.130	rho=0.149	rho=-0.529	rho=-0.530	rho=-0.606	rho=-0.679
HN Grade	p=0.795	p=0.537	p=0.478	p=0.007	p=0.006	p=0.010	p=0.011
4. Follow-up	rho=0.106	rho=0.434	rho=0.367	rho=-0.786	rho=-0.536	rho=-0.576	rho=-0.670
HN Grade	p=0.684	p=0.082	p=0.147	p=0.000	p=0.027	p=0.016	p=0.012
5. Follow-up	rho=0.120	rho=0.472	rho=0.345	rho=-0.726	rho=-0.475	rho=-0.484	rho=-0.782
HN Grade	p=0.696	p=0.104	p=0.249	p=0.005	p=0.101	p=0.094	p=0.002

Spearman Correlation Coefficients (p: percentile, HN: Hydronephrosis, g: grams)

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DISCUSSION

The diagnosis of hydronephrosis in the prenatal period has increased with the widespread use of US as a fetal and maternal imaging method. Hydronephrosis is the most common anomaly among fetal anomalies. The incidence of antenatal hydronephrosis varies between 1-5% (1, 2). If patients diagnosed in the prenatal period are not followed up regularly, there is a risk of developing recurrent urinary tract infections, growth-development retardation, damage to the renal parenchyma, impaired kidney function and end-stage renal failure. It is known that genitourinary system abnormalities are more common in men (13). Grazioli et al. evaluated a total of 121 patients with ANH and identified 84 boys (69.5%) and 37 girls (30.5%), which shows that congenital uropathies and ANH are more common in boys (14). In our study, males constituted 19 of 28 cases (67.8%). It was seen to be consistent with the literature. Ureteropelvic junction stenosis and vesicoureteral reflux are the most common abnormalities in patients with antenatal hydronephrosis (15).

The most common anomalies in our study were ureteropelvic junction stenosis and vesicoureteral reflux. Ureteropelvic junction obstruction (UPJO) was detected in 2 (7.1%) of the patients and VUR was detected in 2 (7.1%) patients. In the literature, antibiotic prophylaxis has generally not been applied to infants with low-grade fetal hydronephrosis and it has been shown that prophylactic antibiotic administration is unnecessary for moderate hydronephrosis (Table 1) (16). Based on algorithm 1, figure 1, 9 (32.1%) of the patients who constituted our study were given antibiotic prophylaxis. 88.8% of the patients had grade 3 hydronephrosis. VUR in 2 of the patients receiving prophylaxis (grade 2 and 3); In 2 of them, UP junction stenosis was detected.

Bilateral hydronephrosis indicates an obstructive process at the bladder level or distal, such as ureterocele or PUV in a male infant, which may be associated with renal dysfunction and ongoing kidney damage. If postpartum ultrasonography shows persistent hydronephrosis, voiding cystourethrogram (VCUG) examination should be performed to identify cases of PUV or bilateral VUR. In countries where the follow-up rates of the patient are low in close follow-up, VCUG will be useful in case of suspicion of VUR in terms of preventing chronic diseases in the future. Our study supports previous research indicating that severe antenatal hydronephrosis is associated with increased risk of urinary tract infections and impaired growth. Therefore, early monitoring and intervention may be beneficial for these patients (4). As the severity of the disease increased, families provided supplementary food in full compliance with the recommendations, as shown in statistical analysis. The quality of supplementary food delivery has increased. In the follow-up of cases with antenatal hydronephrosis, it was observed that there was an improvement in nutritional status, growth and development as the finding of hydronephrosis regressed, and it was found to be statistically significant ($p<0.05$).

It was found that there was no statistically significant difference between patients with left and right hydronephrosis in terms of UTI, surgical requirements and spontaneous recovery rates. In our study, it was determined that infants with low-grade hydronephrosis had lower frequency of UTI and surgical requirements, and higher rates of spontaneous recovery, in line with other studies. Kıllı et al. found that the most effective US measurement in the decision of surgery was the renal pelvis AP diameter in the investigation of the markers that guide the treatment in AHNs. It was observed that every 1 mm increase in the measurement value with US increased the risk of the patient being operated on by 1.36 times (17). Lim et al. have been found that as the degree of hydronephrosis increases in postnatal US, the rate of surgical intervention required at the end of follow-up increases (18). In a retrospective study conducted by Chertin et al., it was found that the rate of surgical intervention was high in patients with advanced hydronephrosis (19). In our study, patients with a history of antenatal hydronephrosis who applied to our outpatient clinic had records of restlessness, vomiting and malnutrition. VCUG was withdrawn in 9 of 28 patients (32.1%) due to the indications followed and defined with the diagnosis of antenatal hydronephrosis, and VUR was detected in 2 of these 9 patients (22.2%). Voiding cystourethrography is the gold standard for the diagnosis of VUR in patients with antenatal hydronephrosis. There is an opinion that voiding cystourethrography should be performed at

the earliest 6 weeks after birth. It is known that the frequency of VUR increases when it is done in the early period. It is accepted that the VUR detected in this period is mostly transient (20). There are a limited number of detailed literature studies examining the growth-development and nutritional status of patients with antenatal hydronephrosis with UTI. In our study, the increase in UTI (+) with the increase in the degree of hydronephrosis was seen in a linear relationship and was interpreted as clinically significant. Our inclination to better analyse the relationship between growth redardation, development of urinary infection, and severity of hydronephrosis of patients. Regrettably, the sample size did not permit the use of regression-based analyses,which reqire a larger number of independent observations to ensure statistical validity. In our study, it was determined that the growth and development of patients with hydronephrosis in the antenatal period and varying degrees of hydronephrosis in the postnatal period were backward according to the growth curve reference values, and this was seen as statistically significant ($p<0.05$). However, in a study evaluating children with VUR, low weight and height measurements were determined in these patients at the time of diagnosis (21). It is known that urinary system anomalies directly contribute to the development of growth retardation or malnutrition in the fetal period (22).

CONCLUSION

In conclusion, the frequency of UTI in patients with advanced hydronephrosis may be higher than in patients with low-grade hydronephrosis, and the frequency of follow-up should be taken into account when planning. Prophylaxis should be started in patients with advanced hydronephrosis due to the high frequency of VUR detection. Despite of the extended advances in the understanding of the genetic basis, clinical period, and outcomes of congenital anomalies of the kidney and urinary tract (CAKUT), there are still many controversies regarding the clinical consequences, postnatal evaluation, and management of newborns with antenatal hydronephrosis (ANH). Mild ANH will often clear up spontaneously, though moderate to severe ANH is frequently associated with CAKUT. It has been determined that the continuation of hydronephrosis detected in the prenatal period in the postnatal period affects growth and development and nutritional status, and hydronephrosis that does not regress has a significant relationship with UTI, and the combination of these factors has a negative correlation on nutrition, growth and development.

Acknowledgment

The authors declare that there is no conflict of interest between the authors.

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