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The Role of Urinary Tract Dilation Classification in Predicting Prognosis of Antenatal Hydronephrosis

Urinary Tract Dilation Sınıflamasının Antenatal Hidronefroz Prognozunu Tahmin Etmedeki Rolü

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ABSTRACT

Aim: Antenatal hydronephrosis (HN) may indicate a temporary benign condition, as well as a manifestation of congenital anomalies of the kidney and urinary system (CAKUT). Different scoring systems have been introduced to recognize CAKUT cases and to perform the necessary intervention in a timely manner. The aim of this study is to reevaluate the follow-up results of patients admitted to our hospital with antenatal HN according to the Urinary Tract Dilation (UTD) classification, and to determine the prognostic prediction of the classification in determining the presence of CAKUT and the need for surgery.

Materials and Methods: Patients admitted to Pediatric Nephrology and Urology outpatient clinics with the diagnosis of antenatal HN between February 2020-March 2021 included in the study. Patients were grouped according to the UTD classification. The frequency of congenital anomalies, need for surgical intervention, and renal functions in the UTD groups were detected.

Results: Of the 132 patients (93 male/39 female), 84 (64%) of the patients were evaluated as transient/physiological HN, 48 (36%) as CAKUT. Isolated pelvic dilatation (pelvis anteroposterior diameter <10 mm) was detected in 47 patients. These patients were not included in the UTD classification (P0). Four (9%) of the UTD-P0 patients were evaluated as CAKUT. The incidence of CAKUT was 13% in patients with UTD-P1, 55% in patients with UTD-P2 and 100% in patients with UTD-P3. The diagnosis of CAKUT, loss of kidney function, and the need for surgical intervention were more common in patients in the UTD-P3 group respectly.

Conclusion: Urinary Tract Dilation classification is helpful in predicting prognosis of the patient. However, the presence of CAKUT cases even in the group not included in the UTD classification (P0) reminds us that a single fetal ultrasound imaging can be misleading. According to the UTD Classification, children with any degree of antenatal HN are at risk for postnatal pathology compared to the normal population. Particularly moderate and severe antenatal HN has a significant risk of pathologic outcome. It is important to carry out comprehensive postnatal diagnosis management of these patients.

Keywords: Antenatal hydronephrosis; congenital anomalies of the kidney and urinary tract; hydronephrosis; urinary tract

ÖZ

Amaç: Antenatal hidronefroz (HN), böbrek ve üriner sistemin konjenital anomalilerinin (CAKUT) bir tezahürünün yanı sıra geçici bir durumu da gösterebilir. CAKUT vakalarını tanımak ve gerekli müdahaleyi zamanında yapabilmek için farklı skorlama sistemleri geliştirilmiştir. Bu çalışmanın amacı antenatal HN ile hastanemize başvuran hastaların takip sonuçlarını 'Üriner Trakt Dilatasyonu' (UTD) sınıflamasına göre yeniden değerlendirmek ve sınıflamanın prognostik öngörüsünü belirlemektir.

Gereç ve Yöntem: Şubat 2020-Mart 2021 tarihleri arasında Çocuk Nefroloji ve Üroloji polikliniklerine antenatal HN tanısı ile başvuran hastalar çalışmaya alındı. Hastalar UTD sınıflamasına göre gruplandırıldı. UTD gruplarındaki konjenital anomali sıklığı, cerrahi girişim ihtiyacı ve böbrek fonksiyonlarındaki farklılıklar belirlendi.

Bulgular: Çalışmaya dahil edilen 132 hastanın (93 erkek/39 kadın) 84'ü (%64) geçici/fizyolojik hidronefroz, 48'i (%36) CAKUT tanısı aldı. Kırk yedi hastada izole pelvik dilatasyonu (pelvis ön-arka çapı <10 mm) saptandı. Üriner Trakt Dilatasyonu sınıflamasına dahil edilmeyen (UTD-P0) bu hastaların dördü (%9) CAKUT tanısı aldı. CAKUT insidansı UTD-P1 grubunda %13, UTD-P2 grubunda %55

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ve UTD-P3 grubunda %100 idi. UTD-P3 grubunda CAKUT varlığı, böbrek fonksiyon kaybı ve cerrahi girişim gereksinimi daha sıktı.

Sonuç: Üriner Trakt Dilatasyonu sınıflaması hastaların prognozunu tahmin etmede yardımcıdır. Ancak UTD sınıflamasına (P0) dahil olmayan grupta bile CAKUT olgularının varlığı bize tek bir fetal ultrason görüntülemenin yanıltıcı olabileceğini hatırlatmaktadır. UTD sınıflamasına göre, herhangi bir derecede antenatal HN'si olan çocuklar, normal popülasyona kıyasla postnatal patoloji riski altındadır. Özellikle orta ve şiddetli antenatal HN, önemli bir patolojik sonuç riskine sahiptir. Bu hastaların kapsamlı doğum sonrası tanı yönetimini yürütmek önemlidir.

Anahtar Kelimeler: Antenatal hidronefroz; böbrek ve üriner sistemin konjenital anomalileri; hidronefroz; urinary tract dilation

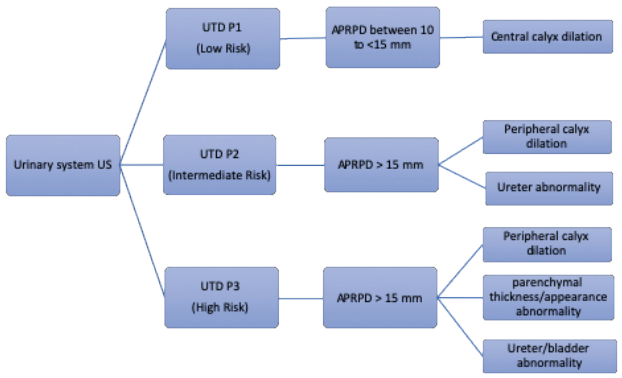
Introduction

Antenatal hydronephrosis (HN), enlargement of the renal pelvis, is one of the most common birth defects detected on fetal ultrasound (US) with a frequency of 1-5% (1-3). It may indicate a temporary benign condition, as well as a manifestation of congenital anomalies of the kidney and urinary system (CAKUT). Different scoring systems have been introduced in order to protect transient, nonspecific HN cases from unnecessary further investigations and to recognize CAKUT cases and to perform the necessary intervention in a timely manner. In 2014, a multidisciplinary group proposed a new urinary tract dilation (UTD) classification system. This new classification is based on features in US findings related to renal pelvic dilatation, calyx dilatation, renal parenchyma thickness/appearance, and bladder/ureteral abnormalities. According to this classification, patients were grouped as mild (P1), intermediate (P2) and high risk (P3) (4). There are publications reporting that the UTD classification shows good predictive accuracy for surgical intervention (5,6). The aim of this study is to reevaluate the follow-up results of patients admitted to our hospital with antenatal HN according to the UTD classification, and to determine the prognostic prediction of the classification.

Materials and Methods

This study was approved by local Ethic Committee of Adana City Training and Research Hospital (30.12.2021-1711). This study is a retrospective cohort study conducted between February 2020 and March 2021 with patients admitted to Adana City Training and Research Hospital Pediatric Nephrology and Urology outpatient clinics with a diagnosis of antenatal HN. The electronic medical records of the patients who were followed up at least one year were reviewed retrospectively. Demographic characteristics, medical history, laboratory, and imaging results, HN recovery times, final diagnosis, recurrent urinary tract infections, and surgical interventions were recorded. Patients who had a follow-up of less than one year and who could not attend regular outpatient clinic follow-up at three-month intervals were excluded from the study. Urinary system US findings of the patients after the 48th hour of life was re-evaluated, and the patients were grouped according to the UTD classification. According to the classification, those with anteroposterior renal pelvis diameter (APRPD) between 10 to <15 mm and central calyx dilatation were evaluated as UTD P1 (low risk); those with APRPD >15 mm and peripheral calyx dilatation or ureter abnormality were evaluated as UTD P2 (intermediate risk); those with APRPD >15 mm and peripheral calyx dilatation and parenchymal thinning/abnormal appearance, ureter/bladder abnormality were grouped as UTD P3 (high risk). The UTD classification scheme is shown in Figure 1.

Figure 1:Urinary Track Dilation (UTD) classification



US: Ultrasound, UTD: urinary track dilation, APRPD: anteroposterior renal pelvis diameter

The patients differentiated kidney functions and scarring were evaluated with Tc 99m dimercaptosuccinic acid (DMSA) scan. Presence of more than 10% decrease in differentiated kidney functions in scintigraphic evaluation was considered as loss of function. Posterior urethral valve was diagnosed by cystoscopy, vesicoureteral reflux (VUR) was diagnosed by voiding cystourethrography, ureteropelvic obstruction (UPJO) and ureterovesical junction obstruction (UVJO) were diagnosed by Tc-99m MAG3 (mercaptoacetyltriglycine). Fetal ultrasound imaging was used for other congenital anomalies.

Statistical analyses

All statistical analyses analyzed by SPSS version 21 software package. Continuous data were defined according to mean± standard deviation under parametric conditions and median (min-max) under nonparametric conditions. Categorical variables were defined by number and percentage. Chi-square analysis was used for categorical variables. P values less than 0.05 were considered to be statistically significant.

Results

Of the 132 patients included in the study, 93 were male and 39 were female. The mean postnatal US imaging time is 11±5 day. Left-sided HN was found in 59 patients (44.7%), right-sided HN in 28 patients (21.2%), and bilateral HN in 45 (34%) patients. During the follow-up period, 84 (64%) of the patients were evaluated as transient/physiological HN, 48 patients (36%) as CAKUT.

Of the 84 transient/physiological HN patients, 61 were evaluated as transient HN and 23 as physiological HN. Among 61 patients with transient HN, HN improved in 30% in the first 3 months, 18% in 3-6 months, 40% in 6-12 months, and 12% in >12 months. Diagnostic distribution of CAKUT were, VUR in 19 patients, UPJO in 16 patients, UVJO in five patients, PUV in three patients, megaureter in two patients, double collecting system in one patient, multicystic dysplastic kidney in one patient, ureterocele in one patient, respectively. Diagnostic distribution of patients with antenatal HN is shown in Table 1.

Table 1: Diagnostic distribution of patients with antenatal hydronephrosis

Diagnosis	n= 132 (%)
Transient/physiological hydronephrosis	**84 (63.6)**
- Transient hydronephrosis	61 (46.2)
- Physiological hydronephrosis	23 (17.4)
CAKUT	**48 (36.4)**
Vesicoureteral reflux	19 (14.4)
Ureteropelvic junction obstruction	16 (12.1)
Ureterovesical junction obstruction	5 (3.8)
Posterior urethral valve	3 (2.3)
Megaureter	2 (1.5)
Double collecting system	1 (0.8)
Multicystic dysplastic kidney	1 (0.8)
Ureterocele	1 (0.8)

CAKUT:Congenital anomalies of the kidney and urinary system

Anteroposterior renal pelvis diameter was <10 mm and isolated pelvic dilatation was detected in 47 of the patients on admission These patients without calyceal dilatation were not included in the UTD classification (P0). Four (9%) of the UTD-P0 patients were evaluated as CAKUT. Of the patients included in the UTD classification, 37% were grouped as UTD-P1, 37% as UTD-P2, and 27% as UTD-P3. According to the UTD classification, the UTD P1, P2, and P3 groups were similar in terms of gender, family history of consanguineous marriage, and frequency of recurrent urinary tract infections. The incidence of CAKUT was 13% in patients with UTD-P1, 55% in patients with UTD-P2 and 100% in patients with UTD-P3. Gender, consanguineous marriage, and history of recurrent urinary tract infection were similar in UTD P1, P2, P3 groups. None of the patients classified as UTD-P3 had recovery of HN, and the highest recovery rate was in the UTD-P1 group. The diagnosis of CAKUT, loss of kidney function, and the need for surgical intervention were more common in patients in the UTD-P3 group, respectively, and this frequency was statistically significant ($p<0.001$, $p<0.001$, $p<0.001$).

The diagnosis of CAKUT, loss of kidney function and the need for surgical intervention were more common in the UTD-P3 group. There was a significant difference between the three groups in these respects, with the UTD-P3 group having a higher rate of the aforementioned conditions than the P2 group, and the UTD-P2 group than the UTD-P1 group. The clinical features of the patients according to the UTD classification are shown in Table 2.

Table II: The clinical features of the patients according to the UTD

	UTD P1 n=31 (%)	UTD P2 n=31 (%)	UTD P3 n=23 (%)	p*
Male gender	23 (74.2%)	23 (74.2%)	19 (82.6%)	0.712
Consanguinity	3 (9.7%)	2 (6.5%)	6 (26.1%)	0.103
Recurrent urinary tract infection	1 (3.3%)	1 (3.3%)	4 (18.2%)	0.100
Recovery of hydronephrosis	21 (67.7%)	9 (29.0%)	0 (0%)	**<0.001**
CAKUT diagnosis (yes)	4 (12.9%)	17 (54.8%)	23 (100.0%)	**<0.001**
Loss of kidney function	1 (4.3%)	3 (12.5%)	12 (54.5%)	**<0.001**
Surgical intervention	1 (3.2%%)	7 (22.6%)	16 (69.6%%)	**<0.001**

UTD: urinary tract dilatation, CAKUT: Congenital anomalies of the kidney and urinary system

*Chi-square analysis

Discussion

We concluded that the UTD classification could be a successful classification in predicting the presence of CAKUT, the need for surgical intervention, and the presence of kidney damage in patients presenting with a diagnosis of antenatal HN with this study. Antenatal HN remains a major clinical challenge in deciding which patient will benefit from treatment. Although HN is often considered a marker of CAKUT, in the vast majority of them no specific pathology can be detected (7). Oliviera et al. reported more than half of the ANH cases resolve by the end of the gestation or during the first year of life (8). In concordance with the literature vast majority of patients in our study were evaluated as transient/physiological HN.

However, it has been shown that the first normal imaging performed postnatally in children with antenatal HN may be misleading. Aksu et al. in their study, they observed that 45% of children with a normal postpartum USG, had abnormal USG at follow-up (9). In another study conducted with patients who needed surgery, it was reported that 5% of the patients had normal US imaging in the first week of pregnancy (10). In our study, CAKUT was detected with a frequency of 9% in the group not included in the UTD classification (UTD P0). For this reason, it should be known that a single postnatal US imaging can be misleading in children with antenatal HN and a second US should be performed.

The frequency of CAKUT in patients with antenatal HN was reported to be between 45-60% in different series (11). It is important for kidney survival to be able to predict

which patient has a CAKUT that requires further imaging and even surgical intervention, and which one has a nonspecific HN. For this purpose, the UTD classification was established by the consensus of pediatric urologists, pediatric nephrologists and radiologists. Differential diagnosis of CAKUT includes wide variety of abnormalities such as transient HN or severe lower urinary tract obstruction (11-13). To determine whether just the presence of any degree of HN seen in first postnatal US correlated with urological pathologies, 2022 patients from 31 studies were categorized based upon the absence (normal or normal-mild degree) or presence (mild or greater degree) of HN. Significant correlation detected between the degree of HN and urological pathology, primarily UPJO. Diagnosis of VUR did not correlate with the presence of HN on first postnatal US (11). The American Urological Association's clinical practice guidelines for screening neonates/infants with prenatal HN also reported the degree of HN as non-reliable indicator for the presence of VUR (14).

Braga et al. reported three year HN recovery rates as 90% for UTD-P1, 81% for UTD-P2, and 71% for UTD-P3 in their study, which excluded patients who underwent surgery and included patients with megaureter, VUR and non-obstructive partial UPJO. An inverse relationship between higher HN grades and lower resolution rates, regardless of etiology, has been observed in their study (15). In our study, no HN resolution was observed in any of the patients in the UTD-P3 group, supporting the argument that the probability of resolution decreases as the risk increases according to the UTD classification.

In a meta-analysis, the presence of CAKUT was defined as "Postnatal pathological outcome". They found the frequency of pathological outcome to be 11.9% in patients with moderate HN and 45.1% in patients with severe HN in prenatal US. They reported that the probability of 'pathological outcome' is higher in all groups, including mild HN, compared to the healthy population, and this risk is correlated with the degree of antenatal HN (1). In our study, the patients did not have prenatal US findings, the same classification was made with post-natal US, and similar results were obtained for conditions that would be considered a pathological outcome such as the presence of CAKUT, loss of kidney function, the need for surgical intervention.

Conclusion

As a result, UTD classification is helpful in detecting CAKUT, need for surgery, loss of kidney function and predicting prognosis of the patient apart from categorizing HN. We believe that the high frequency of CAKUT in patients included in the high-risk group in the UTD classification is secondary to the fact that the aforementioned classification includes all parameters of the urinary system that are valuable for diagnosis. However, the presence of CAKUT cases even in the group not included in the UTD classification (P0) reminds us that a single US imaging can be misleading, and the importance of repeated US and patient follow-up. According to the UTD Classification, children with any degree of antenatal HN are at risk for postnatal pathology compared to the normal population. Particularly moderate and severe antenatal HN has a significant risk of pathologic outcome. It is important to carry out comprehensive postnatal diagnosis management of these patients.

Limitations and Strength: One of the limitations of our study is that US examination could not be performed by the same radiologist due to its retrospective design. However, the high number of patients for a single center is one of the strengths of our study.

Statements and Declarations

The authors declare no conflict of interest.

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All authors declared that this manuscript has not been published before and is not currently being considered for publication elsewhere.

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