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The effect of fetal renal artery Doppler ultrasound on neonatal outcomes in fetuses with ureteropelvic junction type obstruction

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ABSTRACT

Objective: Fetal urinary tract dilatation (UTD) is one of the common fetal problems with remarkable difficulties in diagnosis and management in the antenatal and postnatal periods. This study aimed to determine the value of Doppler ultrasound assessment of the renal arteries in fetuses with ureteropelvic junction type hydronephrosis (UPJO) for the prediction of neonatal outcomes of infants.

Materials and Methods: Fetal renal artery Doppler values were evaluated in pregnant women between 28-32 weeks. Measurements were taken for Doppler values and the fetal obstruction and were classified through the utilization of UTD classification. Based on postnatal ultrasound, these infants were grouped by UTD classification.

Results: There was a statistically significant difference between the left renal artery Systolic/Diastolic (S/D) Ratio and bilateral renal artery Peak Systolic Velocity (PSV) values of the control and patient groups, ($p<0.05$). PSV values were higher in the patient group. The difference between the pulsality index, resistive index, and right renal artery S/D values of the control and patient groups was not statistically significant ($p>0.05$).

Conclusion: Fetal renal artery Doppler is not effective in predicting the degree of hydronephrosis and renal damage in postnatal follow-up of fetuses with a diagnosis of UPJO.

Keywords: Renal artery, Fetal pyelectasis, Hydronephrosis, Doppler ultrasound

1. INTRODUCTION

Urinary obstructions are a common prenatal diagnosis, and its findings vary from clinically insignificant conditions to in-utero fetal death. Clinically significant urinary tract obstructions occur in 1 in 500 live births and are associated with elevated morbidity and mortality [1]. These abnormalities may be stratified to obstruct the upper and lower urinary tract. Common causes of obstruction of the upper urinary tract include ureteropelvic junction type obstruction (UPJO), obstruction of the ureterovesical junction, duplication of the collection system, polycystic dysplastic kidney, ureterocele/ectopic ureter as well as pelvic tumor. Of these causes, UPJO and associated hydronephrosis are the most common clinical conditions [1].

The characteristic of the upper urinary tract obstruction is the dilatation of the collector system and potential kidney damage [2]. Renal pelvic dilatation is most commonly seen in fetal renal abnormalities, and there is an estimated prevalence between 2 and 5.5% of all pregnancies [3]. The prognosis for each case depends on the underlying cause and severity of the obstruction and whether there are other findings. In fetal diseases where renal function is affected, the amount of amniotic fluid measured by ultrasound can be used as an indicator of fetal kidney function regarding urine production [5].

A group of urologists, radiologists, and nephrologists proposed a classification of UTD used before and after birth. In a study comparing this classification system with the Society of Fetal Urology (SFU) classification system, it was shown that both methods have the same prognostic capacity to detect the resolution of prenatal hydronephrosis [6]. In a study comparing researchers using the UTD and SFU classification systems, it was found that using UTD was more difficult and had a lower rate of agreement [7]. The UTD classification system is stratified according to six ultrasound findings in total, according to whether it is in the antenatal, postnatal period or the week of gestation [2].

For the assessment of fetal hemodynamics, Doppler ultrasonography is a suitable non-invasive modality when there is a need to obtain additional information about fetal health in

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many pregnant women. Renal artery Doppler parameters can potentially be a good indicator of fetal kidney function [7-10]. Although, with ultrasound follow-up, the course of UTD can be monitored, counseling families about the long-term outcome of these anomalies requires additional information; and for this purpose, assessment of fetal hemodynamics with Doppler ultrasonography of the renal arteries may provide additional data about the condition [12]. In a renal artery Doppler study conducted on fetuses with congenital renal tract anomalies, the Pulsality Index (PI) was found to be significantly higher than mild hydronephrosis, especially in cases with severe hydronephrosis [13]. There are not enough studies in the literature that determine the extent to which Doppler ultrasonography can be useful in diagnosing and monitoring fetal upper urinary system obstructions and evaluating their postnatal outcome. This study aimed to determine the value of Doppler ultrasound assessment of the renal arteries in fetuses with UPJO for the prediction of long-term outcomes of infants.

2. PATIENTS and METHODS

The study protocol was reviewed by Istanbul University, Istanbul Faculty of Medicine, Clinical Research Ethics Committee with the file number 2015/785 and accepted at the meeting on 24.04.2015 with the number 08. Our study was created by examining the patients who applied to the Obstetrics Outpatient Clinic of Istanbul University Istanbul Medical Faculty Hospital between May 2015 and September 2015. The inclusion criteria were singleton pregnancy between 28 weeks and 32 weeks. Fetal renal artery Doppler ultrasound was performed on 125 healthy fetuses and 57 fetuses in the patient group. Ultrasound examination was performed only in the prenatal period in the control group and a total of 2 ultrasound examinations were performed (prenatal and postnatal) in the group with UPJO. All ultrasounds were performed by the same person and using the same device in our perinatology unit. The ultrasound examination was performed with the General Electrics Voluson 730 Expert brand Ultrasonography Device (General Electric Medical Systems , Istanbul, Turkey) and the 2.7 MHz transabdominal curvilinear probe. Fetus number, amniotic fluid volume, fetal heart activity, fetal presentation, placental structure/location, and fetal anatomy were evaluated. In addition to standard fetal biometric measurements, bilateral renal artery Doppler indices were taken, and kidney sizes, parenchymal thicknesses, and parenchymal echogenicity were also evaluated after these examinations. Patients with multiple pregnancies, diagnosed with preeclampsia, and with a medical record of diabetes mellitus were excluded. We also excluded subjects with extra-renal anomaly, chromosomal anomaly, and intrauterine growth retardation. Demographic and baseline clinical characteristics were collected as follows: maternal age, gravidity, parity, abortion, and history of previous pregnancy.

For sampling the renal arteries, the optimized image is the coronal plane of the fetal abdomen, which, like both kidneys, also allows viewing of the aorta in the longitudinal plane. During the ultrasound, the pregnant woman was placed in left lateral position was placed and the coronal axial abdominal appearance of the fetus was taken. Doppler measurement was performed at 1/3 proximal to the separation point of the renal artery from the aorta. The pulsed Doppler cursor was reduced to 0.5-1 mm in order to prevent contamination with proximal veins, and at least three clear waveforms were obtained.

The insonation angle was taken as small as possible and always below 30 degrees, and at least three clear waveforms were seen. Average values were used for analysis. Recordings were taken during fetal apnea periods. The Peak Systolic Velocity (PSV), PI, Systolic/Diastolic Ratio (V max), and Resistive Index (RI) values were measured in the fetal renal artery. Measurements of renal artery Doppler parameters were made by measuring renal blood flow on the affected side for fetuses in each classification in the patient group. Renal artery blood flow measurements of the healthy kidney were not calculated. To calculate bladder and kidney volume, the formula depth x width x length x 0.523 was used. Kidney volumes included the renal pelvis. A postnatal renal ultrasound was performed by the researchers and newborn examination was performed by pediatricians. Ultrasound, biochemical tests, urine analysis and in necessary cases, dimercaptosuccinic acid (DMSA) examination were performed for renal function evaluation. An antibiotic requirement in postnatal follow-ups was evaluated according to renal function and UTD classification grade.

Prenatal diagnosis was confirmed by post-natal ultrasound. In the present study, renal pathologies were classified according to the UTD Classification System. The UTD Classification System is a retrospective grading system based on a review, consolidation, and a summary of the available literature [2]. It aims to bring together all the important abnormal urinary system findings including kidney, ureter, and bladder, to cover all types of urinary system problems and determine the risk level for the infant with hydronephrosis[14]. In the UTD classification system, patients are first divided into two main groups as antenatal (A) and postnatal (P), then as subgroups according to different ultrasound findings[2, 14]. Due to the difficulties of intrauterine ultrasonographic evaluation, there are three antenatal categories (normal, A1 [mild abnormality], and A2-3 [more severe findings]), although there are four postnatal categories (P0 [normal], P1 [mild], P2 [moderate], and P3 [severe]). The anterior-posterior renal pelvic diameter (APRPD) is used to characterize the severity of prenatal UTD. A1 UTD is described as an APRPD of 7 to <10 mm with or without central calyceal dilation, A2-3 UTD as an APRPD of >10 mm, peripheral calyceal dilation, renal parenchymal or bladder abnormalities (28–32 weeks). P1 UTD is defined as a normal urinary tract with APRPD 10 to <15 mm and/or central calyceal dilation. P2 UTD describes APRPD ≥ 15 mm or peripheral calyceal dilation. P3 UTD describes additional ureteral dilation, abnormal renal echogenicity, cysts or bladder abnormalities regardless of APRPD measurement [2].

Statistical Analysis

In the present study, all statistical analyses of the data obtained from 125 healthy fetuses and 57 patient fetuses were performed

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with the SPSS 23 Statistical Package for the Social Sciences, version 23 (SPSS 23). The frequency distributions and column percentages are given for categorical variables. The Chi-Square Independence Tests were used to determine whether there was a statistically significant relationship between the degree of fetal renal pyelactasia and categorical variables. The Fisher's Exact Test was used when more than 20% of the cells had an expected frequency value of less than 5 in the crosstabs for categorical variables. Also, column ratios were compared in all crosstabs created for categorical variables. Where the column ratios did not differ statistically at the 95% Confidence Interval, they were marked with the same superscript. The assumption of normality was checked with the Shapiro-Wilk Test for all quantitative variables according to the degree of fetal renal pyelactasia. The Kruskal Wallis H Test, which is one of the non-parametric statistical methods, was used to test the significance of the difference between the means of quantitative variables according to the degree of renal pyelactasia of the fetus because the assumption of normality was not provided. In case of statistically significant differences between the group means as a result of the Kruskal Wallis H Test, the group averages were compared by using the Mann-Whitney U-Test, which is one of the non-parametric tests. No statistically significant differences were detected between the means of the groups marked with the same superscript at the 95% Confidence Interval. All statistical analyses were performed at a 95% Confidence Interval. $p<0.05$ was considered significant [15].

3. RESULTS

Table I shows the clinical and ultrasonographic characteristics of the study population with numbers and percentages. The medians and interquartile ranges are given for the maternal age, gravidity, parity, miscarriage, gestational age, and estimated fetal weight according to the degree of fetal renal pyelectasis. The frequency distributions and column percentages are also presented for the gender, presentation, placental location, and amniotic fluid status for the controls, the A1 mild and the A2-3 severe pyelectasis groups. The rates of the male gender are significantly higher in the A1 mild and A2-3 severe pyelectasis groups compared to the controls ($p<0.05$). The rate of oligo – and an-hydramnios are significantly higher in the A2-3 severe pyelectasis group compared to the other groups ($p<0.05$).

Table 1. *Clinical and ultrasonographic characteristics of the study population*

Quantitative Caracteristics[III]	Controls (n=125)	A1 Mild pyelectasis (n=21)	A2-3 Severe pyelectasis (n=36)	p-value[T]
Age (y), median (IQR)	28 (25-33.5)[a]	29 (25-34)[a]	28 (25-33.8)[a]	0.996
Gravidity, median (IQR)	2 (1-3)[a]	2 (1-3)[a]	2 (1.3-3)[a]	0.315
Parity, median (IQR)	1 (0-1)[a]	0 (0-1)[a]	1 (0-1.8)[a]	0.450
Miscarriage, median (IQR)	0 (0-1)[a]	0 (0-0)[a]	0 (0-1)[a]	0.594
Gestational age (w), median (IQR)	31 (30-32)[a]	29 (29-31)[a]	31 (30-32)[a]	0.089
Estimated fetal weight (g), median (IQR)	1906 (1665-2181.5)[a]	1872 (1130-1929.5)[a]	1786.5 (1208.3-2657.3)[a]	0.060
Qualitative Characteristics[T]				p-value
Gender (n, %)				
Female	62 (49.6%)[a]	6 (28.6%)[b]	8 (22.2%)[b]	0.006*
Male	63 (50.4%)[a]	15 (71.4%)[b]	28 (77.8%)[b]	
‡Presentation (n, %)				
Vertex	84 (67.2%)[a]	16 (76.2%)[a]	31 (86.1%)[a]	0.221
Breech	35 (28%)[a]	5 (23.8%)[a]	5 (13.9%)[a]	
Transverse	6 (4.8%)[a]	0[a]	0[a]	
‡Placental location (n, %)				
Anterior	57 (45.6%)[a]	8 (38.1%)[a]	25 (69.4%)[b]	
Posterior	57 (45.6%)[a]	11 (52.4%)[a]	11 (30.6%)[a]	0.093
Right lateral	10 (8%)[a]	2 (9.5%)[a]	0[a]	
Left lateral	1 (0.8%)[a]	0[a]	0[a]	
‡Amniotic fluid status (n, %)				
Normal	125 (100%)[a]	20 (95.2%)[b]	32 (88.9%)[b]	
Oligo – and Anhydramnios	0[a]	0[a]	2 (5.6%)[b]	0.003*
Polyhydramnios	0[a]	1 (4.8%)[b]	2 (5.6%)[b]	

[T] P-value was determined by the Kruskal Wallis H test.

† P-value was determined by the Chi-square test.

[‡] More than 20% of the cells have expected counts less than 5, therefore p-value was calculated by Fisher's Exact test through the Exact Tests option in SPSS.

** p<0.05.*

[T] When the column proportions do not differ significantly from each other at the 0.05 significance level, the proportions are marked with the same superscript letter (p>0.05).

[a,b] When there was no significant difference between the study groups, the variables are marked with the same letter (p<0.05).

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Table II. *Findings of urinary ultrasonography and Doppler ultrasonography in the study population*

Quantitative Characteristics[III]	Controls (n=125)	A1 Mild pyelectasis (n=21)	A2-3 Severe pyelectasis (n=36)	p-value[Ŧ]
Right kidney volume (mm^3), median (IQR)	3681.9(1652.2-7358.6)[a]	5672.5(2381-8305.2)[a]	12878.4(7699.1-22990.3)[b]	<0.001*
Left kidney volume (mm^3), median (IQR)	3987.9(1893.3-6536.1)[a]	6160.9(3540.4-9544.8)[b]	10052.1(5836.7-15604.8)[c]	<0.001*
Right renal pelvis diameter (mm), median (IQR)	3(2-4)[a]	4.8(4.2-5.8)[b]	10(4-15.8)[c]	<0.005*
Left renal pelvis diameter (mm), median (IQR)	3(2.6-3.3)[a]	6(5-8)[b]	10.5(7.7-14.8)[c]	<0.001*
Bladder volume (mm3), median (IQR)	3200.8(932-7257.7)[a]	4184(1518.3-13890.9)[b]	7102.9(3263.5-12417.7)[b]	0.001*
Bladder wall thickness (mm), median (IQR)	1.3(1-1.5)[a]	1.4(1.2-1.5)[a]	1.5(1.3-1.8)[b]	0.001*
Right renal PI, median (IQR)	2(1.7-2.2)[a]	1.9(1.8-2.1)[a]	2.1(1.8-2.3)[a]	0.101
Left renal PI, median (IQR)	2(1.7-2.2)[a]	2.1(1.9-2.3)[a]	2.1(1.8-2.2)[a]	0.285
Right renal RI, median (IQR)	0.9(0.9-1)[a]	0.9(0.9-1)[a]	0.9(0.9-1)[a]	0.148
Left renal RI, median (IQR)	0.9(0.9—1)[a]	1(0.9-1)[a]	0.9(0.9-1)[a]	0.526
Right renal S/D, median (IQR)	18(8-37)[a]	20(8.5-37.5)[a]	15(8-29)[a]	0.678
Left renal S/D, median (IQR)	16(8-30.5)[a]	27(11.5-42.5)[b]	15(6-29.8)[a]	0.049*
Right renal PSV, median (IQR)	40(32-50)[a]	40(26-54.5)[a]	50(34.3-59.5)[b]	0.035*
Left renal PSV, median (IQR)	40(30-48)[a]	47(38.5-57.5)[b]	48(37-59.3)[b]	0.002*
Qualitative Characteristics[T]				p-value[†]
[‡]Urinary tract malformation (n, %)				
No	125 (100%)[a]	0[b]	0[b]	<0.001*
Bilateral pyelectasis		15 (71.4%)[b]	4 (11.1%)[c]	
Unilateral pyelectasis		6 (28.6%)[b]	1 (2.8%)[a]	
Bilateral hydronephrosis		0[a]	14 (38.9%)[b]	
Unilateral hydronephrosis		0[a]	17 (47.2%)[b]	
[‡]Calyceal dilatation (n, %)				
No	125 (100%)[a]	14 (66.7%)[b]	6 (16.7%)[c]	<0.001*
Unilateral		6 (28.6%)[b]	19 (52.8%)[b]	
Bilateral		1 (4.8%)[a]	11 (30.6%)[a]	

[Ŧ]P-value was determined by the Kruskal Wallis test

†P-value was determined by the Chi-square test.

[‡]More than 20% of the cells have expected counts less than 5, therefore p-value was calculated by Fisher's Exact test through the Exact Tests option in SPSS

** p<0.05.*

[T]When the column proportions do not differ significantly from each other at the 0.05 significance level, the proportions are marked with the same superscript letter (p>0.05).

[III]When there is no significant difference at the 0.05 significance level between the groups, the group medians are marked with the same superscript letter (p>0.05)

PI: Pulsatility Index; RI: Resistive Index; S/D: Systolic/Diastolic Ratio; PSV: Peak Systolic Velocity; IQR: Interquartile range; (IQR)=(Q1 – Q3), Q1: First quartile, Q3: Third quartile

[a,b,c] When there was no significant difference between the study groups, the variables are marked with the same letter (p<0.05).

Table II presents the urinary ultrasonography and Doppler ultrasonographic findings of the controls, A1 mild and A2-3 severe pyelectasis groups. Dilatation is studied as bilateral and unilateral pyelectasis. In the unilateral pyelectasis group of the urinary tract malformation variable, 1 patient has the right and 6 patients have the left pelviectasis. While 1 of the patients with unilateral pelviectasis on the left side is in the A2-3 group, 5 of them are in the A1 group. A patient with unilateral pelviectasis on the right side is in the A1 group. In the unilateral hydronephrosis group, 7 patients had hydronephrosis on the right side and 10 patients on the left side. All those with unilateral hydronephrosis are in groups A2-3. Renal artery blood velocity waveforms were obtained from the control group (250 kidneys), A1 mild pyelectasis group (42 kidneys), and A2-3 severe pyelectasis group (72 kidneys). There is no statistically significant difference at a 0.05 significance level among the study groups regarding the right renal artery PI, the left renal artery PI, the right renal artery RI and the left renal artery RI (p>0.05). The S/D ratio of the left renal artery in the A1 mild pyelectasis group is significantly different from the control and A2-3 severe pyelectasis groups (p<0.05). There is no significant difference between healthy and mild pyelectasis kidneys regarding the right renal artery PSV values (p>0.05). However, the right renal artery PSV values in severe pyelectasis kidneys are significantly higher than those in healthy and mild pyelectasis kidneys (p<0.05). The left renal artery PSV values in mild and severe pyelectasiskidneys are significantly higher than those in the healthy kidneys (p<0.05).

Table III shows the postnatal findings of the study population. There is no significant difference among the A1 mild pyelectasis, and A2-3 severe pyelectasis groups concerning the gestational age and birth weight (p>0.05). There is a significant association between the degree of fetal renal pyelectasis and the mode of delivery, neonatal intensive care unit (NICU) admission, urinary tract dilation (UTD) assessed by the postnatal US on day 2, other fetal malformations, postnatal karyotyping, UTD grade after birth, postnatal treatment, renal function, prophylactic antibiotic (p<0.05). The rate of vaginal deliveries for the A2-3 severe pyelectasis group is significantly higher than those for the A1 mild pyelectasis groups (p<0.05). This statistically significant increase in the cesarean section rate in the A1 mild pyelectasis group was due to the individual and fetal characteristics of the patients (other than fetal anomaly)—for example, previous cesarean section, fetal malpresentation, labor dystocia, abnormal or indeterminate (formerly, nonreassuring) fetal heart rate tracing, failed induction (labor induction), arrest of labor, cephalopelvic disproportion, etc. Additionally, since our study was conducted in a university hospital, the average cesarean section rate in our hospital is around 70%. The rate of neonatal death in the A2-3 severe pyelectasis group is significantly higher than in those of the control and A1 mild pyelectasis groups (p<0.05). The rate of impaired renal function in the A2-3 severe pyelectatis group is significantly higher than in those of the control and the A1 mild pyelectasis groups (p<0.05). Considering the postnatal outcomes of the other 10 fetuses with A1 mild pyelectasis (UTD A1 group) in the prenatal period; there were mild pyelectasis (UTDP1) (15%) in 3 cases, moderate pyelectasis (UTD P2) in 6 cases (30%) and severe pyelectasis (UTDP3) in 1 case (5%). As for the UTD A2-3 group, the postnatal UTD grade of 3 fetuses was observed as normal. In fact, the rate of UTDP0 cases in the UTD A2-3 group is significantly lower than in those of the control and UTD A1 groups. According to the postnatal outcomes of the other 32 fetuses with A2-3 severe pyelectasis (UTD A2-3 group) in the prenatal period; there was mild pyelectasis (UTDP1) (17.1%) in 6 cases, moderate pyelectasis (UTD P2) in 23 cases (65.7%) and severe pyelectasis (UTDP3) in 3 cases (8.6%). The rate of UTDP2 cases in the UTD A2-3 group is significantly higher than in those of the control and UTD A1 groups. The rate of both UTDP1 and UTDP3 cases does not differ significantly from UTD A1 and UTD A2-3 groups.

As a result, the mean of left renal S/D in the A1 mild pyelectasis group is significantly higher than the mean of the control and A2-3 severe pyelectasis groups. The mean of the right renal PSV in the A2-3 severe pyelectasis group is higher than in those of the control and A1 mild pyelectasis groups. There is no significant difference between the A1 mild and the A2-3 severe pyelectasis groups regarding the mean of the left renal PSV. Loss of renal function was observed in 4 infants (1 in the UTD A1 group, and 3 in the UTD A2-3 group). Impaired renal function was observed only in 5 infants in the UTD A2-3 group. There were 2 (5.7%) neonatal deaths in the UTD A2-3 group and pregnancy termination was performed in one patient in each group.

Table III. *Postnatal findings of the study population*

Quantitative Characteristics[III]	A1 Mild pyelectasis (n=21)	A2-3 Severe pyelectasis (n=36)	p-value[Ŧ]
Gestational age at birth (gw), median (IQR)	38(37-39)[a]	38(36.25-40)[a]	0.596
Birth weight (g), median (IQR)	3360(2785-3500)[a]	3200(2822-3500)[a]	0.785
Qualitative Characteristics[T]			p-value[†]
[‡]Mode of delivery (n, %)			
Vaginal	7 (33.3%)[a]	21 (58.3%)[b]	0. 009*
Cesarean	14 (66.7%)[a]	15 (41.7%)[b]	
[‡]NICU admission (n, %)[Ŧ]			
No	16 (80%)[b]	29 (82.9%)[b]	<0.001*
Yes	4 (20%)[b]	6 (17.1%)[b]	
[‡]UTD assessed by the postnatal US on day 2 (n, %)[Ŧ]			
Normal	8 (40%)[b]	6 (17.1%)[b]	<0.001*
Less than the first visit	4 (20%)[b]	9 (25.7%)[b]	
More than the first visit	3 (15%)[b]	10 (28.6%)[b]	
Same	5 (25%)[b]	10 (28.6%)[b]	
[‡]Other fetal malformations (n, %)			
Absent	21 (100%)[a]	29 (80.6%)[b]	<0.001*
VSD		3 (8.3%)[b]	
Short femur		1 (2.8%)[a]	
Hyperechogenic cardiac focus		2 (5.6%)[b]	
Cardiac or neurologic anomaly		1 (2.8%)[a]	
[‡]Postnatal karyotyping (n, %)			
Absent	16 (76.2%)[b]	31 (86.1%)[b]	<0.001*
Normal	5 (23.8%)[b]	4 (11.1%)[b]	
Abnormal	0[a]	1 (2.8%)[a]	
[‡]UTD grade after birth (n, %)[Ŧ]			
P0	10 (50%)[b]	3 (8.6%)[c]	<0.001*
P1	3 (15%)[b]	6 (17.1%)[b]	
P2	6 (30%)[b]	23 (65.7%)[c]	
P3	1 (5%)[b]	3 (8.6%)[b]	
[‡]Postnatal treatment (n, %)[Ŧ]			
No	18 (90%)[b]	26 (74.3%)[b]	<0.001*
Surgery	2 (10%)[b]	9 (25.7%)[b]	
[‡]Renal function (n, %)[Ш]			
Normal	19 (95%)[b]	25 (75.8%)[b]	<0.001*
Impaired	0[a]	5 (15.2%)[b]	
Loss of function	1 (5%)[b]	3 (9.1%)[b]	
[‡]Prophylactic antibiotic (n, %)[Ŧ]			
No	17 (85%)[b]	20 (57.1%)[b]	<0.001*
"Yes	3 (15%)[b]	15 (42.9%)[b]	
[‡]Termination (n, %)			
No	20 (95.2%)[b]	35 (97.2%)[b]	0.097
Yes	1 (4.8%)[b]	1 (2.8%)[b]	
[‡]Neonatal death (n, %)[Ŧ]			
No	20 (100%)[a]	33 (94.3%)[b]	0.051
Yes	0[a]	2 (5.7%)[b]	

[Ŧ]P-value was determined by the Mann-Whitney U test

†P-value was determined by the Chi-square test.

[‡]More than 20% of the cells have expected counts less than 5, therefore P-value was calculated by Fisher's Exact test through the Exact Tests option in SPSS.

** p<0.05.*

[T]When the column proportions do not differ significantly from each other at the 0.05 significance level, the proportions are marked with the same superscript letter (p>0.05).

[III]When there is no significant difference at the 0.05 significance level between the groups, the group medians are marked with the same superscript letter (p>0.05)

gw: gestational week; NICU: Neonatal Intensive Care Unit; UTD: Urinary Tract Dilation; US: Ultrasound; VSD: Ventricular Septal Defect; IQR: Interquartile range; (IQR)=(Q1 – Q3), Q1: First quartile, Q3: Third quartile

[a,b] When there was no significant difference between the study groups, the variables are marked with the same letter (p<0.05).

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4. DISCUSSION

In this study, we assessed the relationship between fetal renal arterial parameters with perinatal outcomes of pregnancies with fetal upper UTD. The PSV value of the right renal artery was higher in the fetuses with severe pyelectasis than in the healthy fetuses and fetuses with mild pyelectasis. The PSV value of the left renal artery was higher in the fetuses with mild and severe pyelectasis than in the healthy fetuses. In the first postnatal ultrasonography of the fetuses with mild pyelectasis, a decrease in renal pelvis diameter was found in most of the fetuses. In the first postpartum ultrasound findings of the fetuses with severe pyelectasis, we observed that the diameters of the renal pelvis increased or remained similar in most of them. We observed that fetuses with severe pyelectasis had a higher risk of kidney failure in the postnatal years compared to fetuses with mild pyelectasis.

One of the most common causes of renal pyelectasis in the antenatal period is ureteropelvic junction stenosis [14,16]. Approximately, half of the urinary tract anomalies in the neonatal period are ureteropelvic junction strictures. In general, unilateral and sporadic strictures can be seen due to abnormal collagen or fibrous bands that may occur at the ureteropelvic junction (90% of cases) [17]. Fetal ultrasound shows a renal pelvic dilation with or without renal calyx dilation, and the degree of dilation depends on the type and severity of the obstruction [14,16].

Wang et al., also reported that fetuses with bilateral hydronephrosis, increased renal pelvis anteroposterior diameter, or higher SFU grade required a longer spontaneous regression period [18]. In our study, we reached results that support the findings of this study. Another study conducted by Ismaili et al., investigated the presence of renal pelvis dilatation in fetuses. They found that minor degrees of renal pelvis dilatation occurred in 4.5% of the fetuses [19].

Bates and Irving emphasized in their study that when they performed renal artery Doppler examination on 29 patients with renal pelvis dilatation, the PI value could not confirm any anomaly in these fetuses. [20]. In the study in which postnatal follow-up of fetuses with hydronephrosis due to UPJO was performed, it was recommended to perform a color Doppler examination in fetuses with antepartum hydronephrosis, since obstruction due to crossing vessels was detected in 11 of 100 operated patients. [21] Benjamin et al. investigated the effect of gestational age on urological outcomes in fetuses with hydronephrosis and concluded that late preterm/early-term deliveries lead to worse postnatal outcomes in the short term [22]. In a study, it was shown that the degree of UTD in the antenatal period is associated with spontaneous regression in the postpartum period, the risk of developing uropathies, urinary tract infection, and surgery, but no relationship has been regarding renal dysfunction.[23]. We found similar results in this study.

The validation of the UTD Classification System was evaluated in the study of Zhang et al.[14]. When fetuses that had isolated hydronephrosis classified as UTD in the antenatal period were evaluated postnatally, postnatal normal ultrasonic urinary tract findings were detected in 24 infants with UTD A1. It was also found that postnatal hydronephrosis persisted in 10 cases with UTD A2-3, and the postnatal UTD classification of these 10 cases was reported as UTD P1 (6 cases), UTD P2 (2 cases), and UTD P3 (2 cases), respectively.

As a result, it was reported that the UTD Classification System is an effective system for both antenatal and postnatal periods in the validation evaluation. In the present study, similar results were found in the validation study, showing that postnatal prognosis may be worse, especially in fetuses with UTD A2-3 Classification.

Conclusion

Based on the data we obtained from our study, an increase in renal echogenicity, oligohydramnios and loss of corticomedullary differentiation are among the poor prognostic factors in terms of renal function in the postnatal period. Periodic follow-up of pregnant women with ultrasound and evaluation with the UTD classification system is significant for the management of the prenatal and postnatal periods. As a final comment, in this study, sample size estimation was not possible despite the retrospective nature of the study because there was not enough data in the literature.

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Compliance with Ethical Standards Ethical approval

Ethical approval: The study protocol was reviewed by Istanbul University, Istanbul Faculty of Medicine, Clinical Research Ethics Committee with the file number 2015/785 and accepted at the meeting on 24.04.2015 with the number 08.

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