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ORIGINAL ARTICLE

Characteristics and Outcome of Babies with Antenatal Renal Pelvis Dilatation (RPD)

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ABSTRACT

Background: Antenatal renal pelvis dilatation (RPD) is the most common congenital renal anomaly detected on antenatal ultrasound. The present study was planned to determine the characteristics and outcome of neonates with antenatal renal pelvis dilatation.

Patients and Methods: A prospective, observational, non-interventional study was conducted in Fatima Memorial Hospital over a period of 12 months from April 2021 to March 2022. This study included 130 kidneys of 91 neonates >28 weeks of gestation with antenatally diagnosed isolated renal pelvis dilatation. Postnatal ultrasound was performed at 24-72 hours of life. Cases those resolved spontaneously were labelled as Physiological RPD (Transient RPD) , while all others were labelled as Pathological RPD (Persistent RPD).Descriptive statistics and tests of significance were calculated for all variables. Univariate analysis was performed to compare all possible risk factors for postnatal transient vs. persistent RPD of any grade. Correlation coefficients were calculated between risk factors with pathological RPD.

Results: Every 4th neonate of antenatally diagnosed RPD had persistent RPD ($p<0.05$). Only 5% of neonates showed a severe variety of persistent RPD. Statistically significant risk factors associated with pathological RPD were maternal anemia, oligohydramnios, diabetes mellitus, gestation age < 37 weeks, birth weight <3 kg, antibiotics administration, admission in intensive care unit, urinary tract infections, oliguria, high BUN and creatinine, posterior urethral valve, vesicoureteral reflux, neurogenic bladder and other urinary tract malformations ($P<0.05$). Persistent RPD had a strong positive direct correlation with the severity of antenatally diagnosed RPD, a moderate positive correlation of persistent RPD was seen with maternal anemia, oligohydramnios, high serum creatinine, PUV, and PUJ. Hence the study will help us in formulating management and follow up plan of our newborns with antenatal RPD.

Conclusion: About 71% of neonates with antenatally diagnosed RPD undergo spontaneous resolution. Severe antenatally diagnosed RPD persisted in neonatal life and persistent RPD has a strong correlation with the severity of renal pelvis dilatation.

Keywords: Ultrasonography, Renal Pelvis Dilatation (RPD), Antenatal, Postnatal, PUJ, Urinary tract malformation, neonatal kidney.

INTRODUCTION

Congenital anomalies affect about 1-6% of all pregnancies.[1] Genitourinary anomalies are the most common, accounting for 25-30% of all congenital anomalies.[2] Two to nine per 1000 newborns have a genitourinary anomaly; 50 to 87% have renal pelvis dilation.[3-4] According to the literature, both RPD and hydronephrosis are interchangeable terms.

Hydronephrosis affects males more commonly than females, with a prevalence of 2-3:1.[5-7] In addition, unilateral hydronephrosis is 2-4 times more prevalent than bilateral hydronephrosis.[2,5,7] It has been reported that the left kidney has a 2-3 times higher tendency to develop renal pelvis dilation.[2,7]

Prevalence of mild hydronephrosis varies from 20-90%.[2,7,10] The natural course of antenatally diagnosed hydronephrosis varies depending upon laterality and severity. Fifty to ninety percent of cases of mild hydronephrosis tend to resolve within the first two months of age.[6,8,10] Others are caused by severe structural issues such as pelvic-ureteric junction (PUJ) obstruction, posterior urethral valve (PUV) or vesicoureteral reflux (VUR).[6]

Although Mild renal pelvis dilatation is typically incidental and benign, it is a frequent and generic observation that can also be linked to structural and genetic problems. For example, it has been reported that 80% of cases of renal pelvis dilatation are isolated.[13] And some cases may be associated with chromosomal abnormalities such as trisomy.[12]

A complete imaging work-up includes ultrasonography, voiding cystourethrography (VCUG), renal scintigraphy, and magnetic resonance imaging.

With the advancement of health care services, now more fetuses are diagnosed with hydronephrosis in utero. However, to the author's optimal knowledge, data in our region is scarce regarding its incidence/prevalence, characteristics of such neonates, and outcome. Therefore, our study aims at determining the characteristics and outcomes of babies with antenatal renal pelvis dilation.

PATIENTS AND METHODS

This prospective, observational, non-interventional study was conducted after ethical approval from IRB. This study spans 12 months, from April 2021 to March 2022, in the Neonatology department, Fatima Memorial Hospital, Lahore.

Initially, 123 mother-fetus pairs were enrolled but 32 were excluded (2nd trimester RPD resolved by 3rd trimester, diagnosis in other health facility, preterm < 28 weeks of gestation, < 2 scans from hospital, malformations and syndromes or parental refusal to participate in study).

However, finally, only those mother neonatal pairs who were our booked patients enrolled, and at least two serial scans were performed by our professional radiologist and maternal-fetal medicine expert. Ultrasonographic findings of the fatal and neonatal PA diameter were collected using the ultrasonographic machine Valouson S6 (GE company). This study finally included 130 kidneys of 91 neonates with antenatally diagnosed isolated hydronephrosis, having no other malformations. In addition, all neonates were of gestational age > 28 weeks of both genders. Finally, 91 neonates for the final analysis were enrolled after seeking consent from guardians/ parents.

Post-natally neonates were managed following institutional guidelines. In addition, ultrasonography KUB was performed after 24-72 hours of life to monitor the early outcome of RPD and classified according to table 1. This outcome includes physiological RPD (Transient RPD), labeled for spontaneously resolving within 24 - 72 hours, while all others were labeled pathological RPD (Persistent RPD).

All maternal and neonatal characteristics were documented on specially designed proforma. Maternal characteristics include

anemia, age, oligohydramnios, chronic hypertension, diabetes mellitus, and gestation age. At the same time, neonatal factors include gender, birth weight, APGAR score (Appearance, Pulse, Grimace, Activity and Respiration) at 1 and 5 minutes, antibiotics administration, admission to intensive care unit, urinary tract infections, oliguria, high BUN and creatinine, and urinary tract malformations (posterior urethral valve, vesico-ureteric reflux, neurogenic bladder, and others).

Data were entered and analyzed in SPSS 21V. Descriptive statistics and tests of significance were calculated for all variables. All continuous normally distributed variables were described as mean ± SD, while not normally distributed were described as median and IQR. For categorical variables, chi-square or Fischer exact were applied. The level of significance was considered when the p-value was <0.05.

A transient vs. pathological RPD was compared with all maternal and neonatal characteristics. Correlation coefficients were calculated between risk factors with pathological RPD. It is reported as follows:

Pathological Renal Pelvis Dilatation (RPD)

Correlation Coefficient Value	Relationship
(±) 0.00 – 0.19	very weak
(±) 0.20 – 0.39	weak
(±) 0.40 – 0.59	moderate
(±) 0.60 – 0.79	strong
(±) 0.80 – 1.0	very strong

RESULTS

Data analysis of 91 maternal-neonatal pairs shows that the mean maternal age was 27.6±4.5 years. The mean APGAR score at one and 5 minutes was 7.42 ± 0.56 and 8.63 ± 0.70, respectively. There were 83 (63.84%) males and 47 (36.15%) females.

Table 1: Renal Pelvis Dilatation (RPD)

Parameter	NO RPD n (%)	RPD n(%)	p-value	
Maternal				
Maternal Age (years)	<26 26-30 >30	11 (78.6%) 68 (69.4%) 14 (77.8%)	3 (21.4%) 30 (30.6%) 4 (22.2%)	.635
Parity Of Mother	Primigravida Multiparous	16 (64.0%) 77 (73.3%)	9 (36.0%) 28 (26.7%)	.244
PIH	0 (0.0%)	2 (100.0%)	.079	
Anemia In Mothers	0 (0.0%)	19 (100.0%)	<0.01	
Oligohydramnios	0 (0.0%)	16 (100.0%)	<0.01	
GDM In Mothers	0 (0.0%)	3 (100.0%)	.022	
Neonatal				
Gender	Male Female	63 (75.9%) 30 (63.8%)	20 (24.1%) 17 (36.2%)	0.104
Gestational Age (weeks)	<32 32-36 37 and above	19 (61.3%) 57 (69.5%) 17 (100.0%)	12 (38.7%) 25 (30.5%) 0 (0.0%)	.014
Severity Of Pathology	No Mild Moderate Severe	93 (100.0%) 0 (0.0%) 0 (0.0%) 0 (0.0%)	0 (0.0%) 22 (100.0%) 9 (100.0%) 6 (100.0%)	<0.01
APGAR at 01 min ≥7	91 (71.1%)	37 (28.9%)	.510	
APGAR at 05 min ≥7	91 (71.1%)	37 (28.9%)	.510	
Birth Weight (Kg)	<2 2.1-2.5 2.6-3 >3	4 (15.4%) 6 (33.3%) 61 (100.0%) 93 (1.5%)	22 (84.6%) 12 (66.7%) 3 (12.0%) 0 (0.0%)	<0.01
Antibiotic Administration	0 (0.0%)	7 (100.0%)	<0.01	
Admitted In NICU	0 (0.0%)	4 (100.0%)	.006	
Urinary Tract Infection	0 (0.0%)	3 (100.0%)	.022	
Oliguria	0 (0.0%)	5 (100.0%)	.002	
Renal failure	0 (0.0%)	11 (100.0%)	<0.01	
Blood Urea Nitrogen	93 (75.0%)	31 (25.0%)	<0.01	
PUJ Obstruction	0 (0.0%)	15 (100.0%)	<0.01	
PUV	0 (0.0%)	9 (100.0%)	<0.01	
VUR	0 (0.0%)	6 (100.0%)	<0.01	
Neurogenic Bladder	0 (0.0%)	4 (100.0%)	.006	
Other Pathologies	0 (0.0%)	3 (100.0%)	.022	

Data analysis was performed on 130 kidneys. Unilateral RPD was observed in 52 (40.77%) cases and bilateral RPD in 78(59.23%). About 71% of neonates with antenatally diagnosed RPD showed complete resolution, hence labeled as transient RPD. Only 5% of neonates showed a severe variety of persistent RPD. Neonates with persistent RPD and pelvic-ureteric junction obstruction was shown in 15 (11.5%) and posterior and vesicourethral valve in 9(6.9%) and 6(4.6%), respectively.

Univariate analysis was performed to compare all possible risk factors for postnatal transient vs. persistent RPD of any grade (table 2). Statistically significant risk factors associated with pathological RPD were maternal anemia, oligohydramnios, diabetes mellitus, and gestation age < 37 weeks.

Similarly neonatal factors were birth weight <3kg, antibiotics administration, admission in intensive care unit, urinary tract infections, oliguria, high BUN and creatinine, posterior urethral valve, vesico-ureteric reflux, neurogenic bladder, and other urinary tract malformations.

Different systems have been proposed for the diagnosis and classification of RPD. Measurement of the anteroposterior diameter (APD) of the renal pelvis in the transverse plane is the most accepted system for diagnosing RPD. It can be further classified as mild, moderate, and severe, as mentioned in table 1.

The study showed a strong positive correlation between persistent RPD and the severity of antenatally diagnosed RPD severity. In addition, a moderate positive correlation of persistent RPD was seen with maternal anemia, oligohydramnios, high serum creatinine, PUV, and PUJ. However, birth weight has a strong negative correlation with persistent RPD, which means that low birth weight strongly correlates with pathological RPD. At the same time, other risk factors have a weak or very weak correlation with persistent RPD (TABLE 3).

Table 2: Renal Pelvis Dilatation (RPD) Classification

Grade	APD (mm)	
	Second trimester	Third trimester
Mild	5 – 7	7 - 9
Moderate	7 – 10	9 – 15
Severe	> 10	> 15

Table 3: Correlation of Persistent Renal Pelvis Dilatation (RPD) with Risk Factors

Risk Factors	Pearson	p-Value
Maternal		
Gestational diabetes mellitus In Mothers	-0.244	0.005
Admitted In intensive care unit (NICU)	0.282	0.001
Chronic Hypertension In Others	0.198	0.024
Anemia In Mothers	0.656	<0.01
Oligohydramnios	0.594	<0.01
Neonatal		
Birth Weight Group	-0.769	<0.01
Gestational Age	-0.228	0.009
Antibiotic Administration	0.378	<0.01
Urinary Tract Infection	-0.244	0.005
Severity Of pathology	0.869	<0.01
Oliguria	0.317	<0.01
Renal failure	0.482	<.01
Pelvic-Ureteric Junction Obstruction	0.573	<0.01
Posterior Urethral Valves	0.432	<0.01
Vesico-Ureteral Reflux	0.349	<0.01
Neurogenic Bladder	0.282	0.001
Other Pathologies	0.244	0.005

DISCUSSION

In this study, 91 neonates (130 isolated RPD) were admitted with the diagnosis of antenatal renal pelvis dilatation in the department of Neonatology, Fatima Memorial Hospital, Shadman, Lahore-Pakistan. Their postnatal follow-up ultrasounds were done at 24-72 hours of life.

Out of 130 neonates in the current study, boys were twice the number of girls. Pensi et al. also found that 291 (67.99%) were males, and 137 (32.01%) were females.[17] Nazemipour et al. and Elmaci et al. reported similar findings of male prevalence.[18,19] This male predominance corresponds with the international dominance of renal malformations in males.

Our study revealed that bilateral RPD was more common than unilateral RPD. Baltra, however, reported no difference in laterality (21). While Pan et al. reported a significantly higher per-

centage of unilateral RPD (77.19%) and a lower percentage of bilateral RPD (22.81%). These mirror image results could be related to sociodemographic factors and diagnostic criteria for RPD.[15]

The mean birth weight of neonates with persistent RPD was 2.8+-1.2 kg. Low birth weight was strongly associated with persistent renal pelvis dilatation. In a study on the clinical outcome of renal pelvis dilatation in very low birth weight infants by Jeon et al., they found that at 40 weeks PMA, renal pelvis dilation persisted in 14% of low-birth-weight infants with RPD.[26] This association could be explained by the fact that ongoing renal maturation in utero completes by 30-34 weeks of gestation. In addition, ex-utero life has risk factors, e.g., UTI, further compromising renal growth and development.

Among the maternal risk factors for RPD, oligohydramnios is moderately associated with persistent RPD. Furthermore, Shukla et al. also reported a significant correlation between oligohydramnios with persistent RPD.[14] Since most of the persistent RPD cases have severe renal pelvis dilatation and are associated with pathologies, compromising urine output, this decreased urine output could lead to oligohydramnios supporting our finding.

Maternal anemia was found in 19 (14.6%) cases, and we found a moderate association of maternal anemia with the persistence of RPD. In addition, different studies have reported the effects of suboptimal maternal nutrition on developing kidneys. Maternal anemia is always coupled with malnutrition, impacting fetal growth and maturation, affecting the in-utero environment and epigenetics.[27-28]

In our study, every third case of RPD went through self-resolution. Similarly, Elsheemy and Afroze reported similar results at 69.69% and 76.5%, respectively (16, 20). Sharma et al. reported that postnatal ultrasounds were normal in 41-88% of cases with antenatal RPD.[29] It is a matter of debate why this occurs; According to Constantinou, the renal pelvis smooth muscle is stimulated by a pacemaker to begin peristaltic contractions. From the renal calyces and pelvis, peristalsis moves in the direction of the bladder. Poor coordination of the peristaltic activity may result from any immaturity of the pacemaker in the renal pelvis. As a result, the renal pelvis cannot empty, which causes urine stasis. Moreover, retrograde peristalsis is possible due to the incardinated muscle cell excitation, which can propagate in any direction.[29] Elsheemy et al. reported that it might be connected to natural kinks and folds that form throughout embryological development and vanish with maturation.[16]

In our study, 31 (23.85%) neonates had moderate and 23 (17.7%) severe cases of renal pelvis dilatation. All neonates with severe renal pelvis dilation were strongly associated with persistent renal pelvis dilatation. Among other studies, Passoreti et al. also found that the severity of renal pelvis dilatation was correlated with an increased risk of persistent renal pelvis dilatation (OR 3 in the mild-moderate group to OR 90 in the severe group).[24] Similarly, in a meta-analysis by Lee et al., the risk of persistent renal pelvis dilatation was 11.9% for mild RPD, 45.1% for moderate RPD, and 88.3% for severe RPD.[25]

PUJ obstruction was the commonest pathology observed in 15 (11.5%) of our study population, followed by PUV 9 (6.9%) and VUR 6(4.6%). We found a moderate association of PUJ obstruction with the persistence of renal pelvis dilatation. Passoreti et al. and Lee et al. also reported an increased incidence of persistent renal pelvis dilation with UPJO.[24,25]

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