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Original Research Article

The fate of antenatal renal pelvis dilatation: a prospective postnatal cohort study

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ABSTRACT

Background: To assess the outcome of fetal hydronephrosis, based on antenatal sonography and to find the best cutoff APD of renal pelvis which lead to surgical outcome.
Methods: All patients diagnosed with isolated fetal renal pelvic dilatation (RPD) were prospectively followed between January 2016 and December 2018. RPD was classified according to SFU grading into four grades and by APD classification to 3 groups. Group I (5-9.9 mm), group II (10-14.9 mm) and group III (≥15 mm).
Results: Among a total of 57 patients, group I had 32 renal units, none required surgery; group II had 19 renal units, 5 (7.04%) required surgery; group III had 20 units, 11 (15.49%) required surgery. The difference in outcome between the groups was statistically significant (p=0.001). The causes of fetal hydronephrosis was transitional in 33.33%, pelvi ureteric junction obstruction in 33.33%, vesico ureteral reflux in 29.82%, and 3.5 % had posterior urethral valves. Of the 38 infants with RPD, urinary tract infection was seen in 36.84%. Thirty-four patients had MCUG of whom 29.82% had VUR. In 38 patients DTPA was performed with following results: 10.53% had partial obstruction and 14.04% showed complete obstruction.
Conclusions: Fetal hydronephrosis less than 5mm runs a benign course. In APD greater than 15 mm and bilateral disease thorough postnatal evaluation and regular follow-up is necessitated for timely intervention. The best cutoff point of anteroposterior renal pelvis diameter that led to surgery was 15 mm, with sensitivity 91% and specificity 73.5%.

Keywords: Antenatal hydronephrosis, Postnatal follow-up, Pelviureteric junction obstruction, Ultrasonography, Urinary tract infection, Vesico ureteral reflux

INTRODUCTION

The detection of renal abnormalities during antenatal ultrasonography was first reported by Garrett et al, in 1970.[1] With the advent of antenatal sonography, detection of fetal hydronephrosisis more frequent in recent times. Antenatal hydronephrosis is affects 1% to 5% of all pregnancies and is one of the most commonly detected anomalies.[2] This timely recognition aims to help in improving postnatal results and assist in preserving the renal function. If not detected by antenatal ultrasonography and subsequently managed, many of these anomalies would manifest later in life with complications. Antenatal identification of urinary tract dilatation does not necessarily indicate an obstruction, nor give any functional suggestion of an affected kidney. In some cases, antenatal detected hydronephrosis will improve or resolve spontaneously postnatally. The clinician is challenged with an impasse to distinguish the hydronephrosis which will resolve naturally from those

who would need surgery so that appropriate surgical intervention can be done to prevent renal function deterioration. Outcomes of patients at the end of the range in ANH are quite easily predicted. In contrast, great variability is seen in patients with moderate grades of hydronephrosis.[3] Society for Fetal Urology grading system and the measurement of the anteroposterior diameter of the renal pelvis (APD) represents the two most common standardized systems for evaluating hydronephrosis.[4-6]

This prospective study was conducted to analyze the clinical results of infants with antenatal diagnosed hydronephrosis and to ascertain whether there is any correlation between the renal pelvic diameter (APD) and the urinary tract abnormalities detected.

METHODS

After obtaining approval by the ethics committee, all newborns referred to our unit with antenatal hydronephrosis were included in this study. All patients diagnosed with isolated fetal renal pelvic dilatation (RPD) were prospectively followed between January 2016 and December 2018. Newborns with hydronephrosis that were not diagnosed prenatally, infants having multicystic dysplastic kidney, polycystic kidneys, kidney agenesis, horseshoe kidney, duplex system, patients diagnosed with neurologic abnormalities involving the lower urinary tract were excluded from the study.

Patients were followed up from the third trimester of pregnancy to a variable period (9-36 months) after birth. The kidneys were assessed in the axial plane with the fetal spine in dorso-anterior or dorso-posterior position to measure the renal pelvis. The renal pelvis was measured as a vertical line at the maximal dilation of the pelvis. Antenatal hydronephrosis was defined based on the grading system of the Society for Fetal Urology and APD measuring system. Renal pelvis dilation greater than 4mm in less than 33 weeks or greater than 7mm in a gestational age more than 33 weeks is taken.

According to the measured APD and pelvi calyceal dilation on ultrasonography, hydronephrosis was divided into three groups. Group I with an APD less than 10mm, group II with an APD of 10mm to 15mm, and grade III with an APD greater than 15mm. According to SFU consensus definition grading was done in 4 grades.

Postnatal evaluation included ultra-sonogram, micturating cysto urethrogram (MCUG), and nuclear renogram. The first postnatal USG was performed on days 3-4. Ultrasonography was performed within 24-48 h of birth in neonates with suspected posterior urethral valve, oligohydramnios or severe bilateral hydronephrosis. Patients underwent nuclear renogram (99m Tc-DTPA) after the first month. Differential renal function 45% to 55% is normal and below 35% were taken impaired. MCUG was done within 3 months of life and immediately in the patient with bladder thickening. VUR was classified into five grades using the classification proposed by the International Reflux Study Committee.

At monthly follow-up visits urine cultures were acquired. Urinary tract infection was expressed as the occurrence of more than 100,000 cfu/ml in urine collected by a bag or from a midstream sample, with fever (≥ 38.0°C) and or with urinary symptoms. In the postnatal follow up renal APD > 10mm, SFU grade 3-4 and proven UTI received antibiotic prophylaxis. A chemoprophylaxis was not started to patients without VUR and those with RPD <10 mm.

Indications for surgery were posterior urethral valves immediately, non-response conservative therapy, worsening in renal function, progressive dilation in patients with bilateral hydronephrosis, and recurrent pyelonephritis.

Statistical analysis

The outcome, spontaneous resolution vs. surgical intervention, were compared between groups. All data were analyzed by SPSS software. Descriptive statistics were used to summarize data. Frequencies and proportions were calculated. The chi-square test was used to test for the significance of severity of hydronephrosis and need for postnatal surgery. A value of <0.05 was taken as significant. Using Cox proportional hazards analysis, we determined the association of ANH grading with surgical outcomes. Hazard ratios were calculated for APD, SFU, to estimate the risk for surgery on the basis of deteriorating grades of ANH disease. We computed the positive likelihood ratios with 95% confidence intervals to estimate the probability of surgical intervention using the baseline ultrasound by the APD and SFU system.

RESULTS

Among a total of 57 patients in the study group; 41 were (71.93%) males and 16 (28.07%) were females. The male to female ratio was found at 2.5:1. The follow-up duration ranged from 9 months to 3 years. Forty-four (77.19%) had unilateral and 13 (22.81%) infants had bilateral ANH.

Group I had 32 (45.07%), group II had 19 (26.76%) and group III had 20 (28.17%) renal units on antenatal USG scan. The patient distribution according to the SFU grading; nineteen renal units was grade 1, twenty-one grade 2, eighteen grade 3 and thirteen was grade 4. The second ultrasonography performed at 1 month of age showed normalization in nineteen RPD and in 52 renal units showed persistent hydronephrosis.

Causes of antenatal hydronephrosis are shown in Table 2.

Table 1: Demographic characteristics.

Parameter	n	%
Total patients	57	
Male	41	71.93
Female	16	28.07
Side of Hydronephrosis		
Left	33	57.89
Right	10	17.54
Bilateral	14	24.56
Renal units	71	

MCUG was performed in 34 (59.65%) patients, VUR was detected in 17 (29.82%) of which 9 was unilateral and 8 bilateral, equal to 25 refluxing renal units. Distribution of VUR grades in different groups is shown in the Table 3.

Table 2: Causes of antenatal hydronephrosis.

Etiology		n	%
Transitional Hydronephrosis		19	33.33
PUJ Obstruction	Unilateral	14	24.56
	Bilateral	5	8.77
VUR	Unilateral	9	15.79
	Bilateral	8	14.04
PUV		2	3.51

Table 3: Distribution of VUR grades in grading system.

VUR	APD			SFU Grading			
	Group I	Group II	Group III	Grade 1	Grade 2	Grade 3	Grade 4
Grade 1	2				6		
Grade 2		6			5		
Grade 3		4	4			7	
Grade 4			3				4
Grade 5			6				3

Thirty-eight patients required to be evaluated by DTPA, 29 (50.88%) patients had normal pattern, 6 (10.53%) had partial obstruction and 8 (14.04%) had complete obstruction. UTI was observed in 21 (36.84%) patients. UTIs were more frequent in group III. Antibiotic prophylaxis was given to 32 (56.14%) patients. Fourteen (24.56%) patients with grade 3 and above had recurrent UTIs on antibiotic prophylaxis.

Table 4: Outcome according to APD grading system.

Renal pelvis diameter (mm)	Outcome			
	Resolved	Required surgery	Under follow up	Total
Group I (<10)	30	Nil	2	32
Group II (10-15)	Nil	5	14	19
Group III (> 15)	Nil	11	9	20

Post-natal follow-up identified 32 mildly dilated renal pelvic units (APD 7-9 mm) of which 26 patients had insignificant dilation by 1 month and 6 had mild, stable, non-progressive dilation by 1-year follow-up. All of them (45.07%) resolved by the end of 2nd year and none required surgery. Out of 19 group II (APD 9-15mm), none resolved, but in 14, dilations slightly progressed and got stable in the follow up whereas in 4 there was progressive dilation and DTPA scan showed obstructive pattern requiring surgical intervention. Two patient was operated for posterior urethral valve.

Seventeen patients (29.82%) underwent surgery and 21 (36.84%) were followed up without requiring surgery. The median APD was 21mm, ranging from 5 mm to 45 mm. A positive correlation was found between APD and surgery rate ($P < 0.001$, $r = 0.64$) the best cutoff point for APD to differentiate the surgical cases was 15mm with sensitivity and specificity of 91% and 73.5%, respectively. The outcome according to APD grading systems and SFU grading system is shown in table 4 and 5.

Table 5: Outcome according to SFU grading system.

SFU grade	Outcome			
	Resolved	Required surgery	Under follow up	Total
Grade 1	19	Nil	Nil	19
Grade 2	5	Nil	16	21
Grade 3	Nil	6	12	18
Grade 4	Nil	11	2	13

DISCUSSION

Ultrasound screening during pregnancy has led to amplified identification of fetal hydronephrosis. The

prevalence of antenatal detected hydronephrosis ranges from 0.6-5.4%.[7,8] Antenatal diagnosis is important as it emphasizes the fetus at risk and facilitates parental counselling. The condition is bilateral in 17-54%.[9] The consequence of ANH depends on the primary etiology.[5] In 41-88% antenatal hydronephrosis resolves by birth or during infancy, though urological abnormalities necessitating intervention are associated with 4.1-15.4%.[10,11] In our series, we found twenty-two renal units (50.87%) resolved during infancy and urological abnormalities requiring intervention are identified in seventeen (28.07%). Male to female ratio 2.5:1 showed the dominance of the male in urinary tract abnormalities which is similar to the study by Bassanese et al.[12] Tombesi et al, reported 73% of renal units with APD <15 mm resolved after one year follow up, in this study, we found resolution in 70.17% of patients with APD <15 mm.[13] In the study of Abhishek et al. those classified as moderate hydronephrosis, 88% remained unchanged, and 12% worsened during the postnatal follow-up.[14] In our study 7.01% of infants progressed to severe dilatation. Moderate hydronephrosis is associated with variable outcomes postnatally, and the failure to predict results is frustrating to the clinicians.[3] The SFU grading system takes into consideration the calyceal dilation and renal parenchymal thickness which significantly improve the predictive probability of surgery. Our study demonstrated that moderate APD values in combination with diffuse caliectasis, grade 3 and 4 are associated with consequent surgical intervention. Consistent with our results, Grignon et al, in their study found 100% assessed kidney with moderate pelvis dilation and severe caliectasis underwent surgery postnatally in comparison to 62% with mild grade 1 and 2.[15] In the literature, data revealed 98% resolution of pelviectasis in SFU grade 1-2; in comparison, grades 3-4, APPD>15mm resolved in 51% of patients.[6] In this study, we found a resolution of pelviectasis in 87.17 % patients with grades 1-2 (95% [CI] 0.91-1.0; p =0.0008) and stabilization in 43.33% with grades 3-4 (95% CI 0.29-0.73; p <0.0001). Grades 1-2 pelviectasis was four times more likely to stabilize than grades 3-4 pelviectasis (OR 4.71; 95% CI 1.69-12.01; p =0.003). Many authors reported that renal pelvis diameter greater than 10 mm need careful postnatal follow-up and is strongly associated with surgery.[16,17] Mudrik-Zohar et al. using the ROC curve reported that APD > 14mm is the best cutoff point for surgery with sensitivity of 77% and specificity of 69%.[18] In the present study, the best APD leading to surgical treatment was 15mm with the sensitivity of 91% and specificity of 73.5%. A cut-off APD of 11 mm during the second trimester and 15 mm during the third trimesters was of suggestive value in selecting children at risk of postnatal surgery (OR 5.67; 95% CI 1.97-17.40), with relatively high sensitivity (OR 12.15; 95% CI4.75-29.37) and specificity (OR 6.71; 95% CI 4.65-15.91). In our study group, 17 (23.94 %) renal units required surgery, all had APD> 15mm and SFU grade 3 and 4. The difference in outcome between the groups was statistically significant (p = 0.002). These results are similar to those found in the literature.[10,19,20] VUR occurs in 10-20% of patients with antenatal hydronephrosis and is associated with substantial morbidity.[21] Lee et al, noted no significant difference in the incidence of VUR between mild, moderate, and severe hydronephrosis.[10] whereas others noted the increasing incidence of reflux with the degree of sonographic dilatation postnatally.[22] Study by Kortet al. reported that the frequency of the VUR is 4 times more in high-grade HN than in low-grade.[23] In addition, a normal postnatal USG does not rule out VUR.[24] Many authors recommend performing a MCUG to all children with ANH irrespective of the degree of postnatal dilatation in view of negligible risks related to MCUG in the neonatal period and the hazard associated with VUR and UTI even in mild ANH.[21,25] In our study, we found a lower frequency of VUR in infants with low-grade hydronephrosis and the consequences were minor. According to SFU grading in this study we found grade 2 had eleven VUR, grade 3,4 had fourteen VUR. Consequently, we recommend a MCUG to be performed in patients with unilateral or bilateral hydronephrosis with renal pelvic APD >10 mm, SFU grade 2, 3, 4 and with ureteric dilatation. MCUG be carried out early, within 24-72 h of life, in patients with suspected lower urinary tract obstruction. In other cases, the procedure was performed at 4-6 weeks of age.

The decision to place all children with ANH on prophylactic antibiotics is controversial. The ultimate goal is the prevention of febrile UTI and its attendant risk of renal damage. Many authors reported a lower frequency of UTI and higher spontaneous resolution rate in patients with low-grade HN as compared to patients with high grade.[26] Coelho et al. reported female gender and presence of uropathy as independent predictors of UTI in patients with AHN.[27] Consistent with the literature, in our study, the risk of UTI increased with increasing grade of hydronephrosis. Wollenberg et al. observed no urinary tract infection in children with mild dilatation in contrast, (23%) children with moderate hydronephrosis and (64%) with severe hydronephrosis had UTI.[14,28] Lee et al. found no UTI with severe RPD whereas children with moderate RPD presented with 81.8% UTI.[10] Coelho et al, demonstrated incidence of UTI in 39%, 18% and 11% at 36 months of age for severe, moderate, and mild RPD, respectively.[27] In our study, the incidence of UTI in cases with mild ANH was determined at 4.7%, while it was 31.75% in cases with moderate and severe ANH. According to SFU grading UTI as seen in 28.07% in grade 3- 4 while 7% was seen in grade 1 and 2.

Diuretic renograms are taken to decide if urinary tract obstruction is present in patients with persistent hydronephrosis in the absence of VUR, or if the RPD is >10 mm even in the presence of VUR. Measurement of individual renal functions with the finding of a diminishing pattern has been taken to determine the presence of obstruction. The conclusive value of individual renal capacity underneath which block is

viewed varied among different authors. Estimations of <30%, <35%, or <40% have been recommended.[29,30] Obstruction is generally considered absent if half the radionucleotide has cleared from the renal pelvis within 10–15 min. Critical obstruction is considered to be present if the t1/2is >20 min, with 15– 20 min viewed as uncertain.

The major strength of this study is that we collected a well-defined cohort of ANH patients who were carefully followed up in a single centre. None of the patients were lost from follow-up. We did perform prenatal grading and the timing of AH diagnosis was defined.

Our study has few limitation like small sample size, non uniform urine sample collection methods, we did not have baseline scintigraphic data about renal damage immediately after birth and therefore some reported scars may belong to congenital events. VCUG was performed in 77.1% of the patients and it is therefore possible that some patients with reflux were missed.

CONCLUSION

We conclude that the level of ANH can be utilized as a guide for deciding about diagnostic imaging and treatment. Our results strongly submit that fetal hydronephrosis less than 5mm, SFU grade 1-2 runs a benign course, needs minimal investigation and the likelihood of spontaneous resolution are high. In APD greater than 15 mm, SFU grades 3–4, bilateral disease, or bladder distension thorough postnatal evaluation and regular follow-up is necessitated to plan a timely intervention. We consider that MCUG is not obligatory in asymptomatic newborns with mild ANH. The best cutoff point of antero-posterior renal pelvis diameter that led to surgery was 15 mm, with sensitivity 91% and specificity 73.5%. Further multicentre, prospective, long-term follow-up studies with large number of patients are required to address the outcome of fetal hydronephrosis.

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