Original Article

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Paediatrics Section

Neonatal Outcome of Antenatally Diagnosed Hydronephrosis at a Tertiary Care Centre, Telangana, India: A Prospective Study

SNEHA LATHA GOPU[1], AYESHA BEGUM[2]

ABSTRACT

Introduction: Antenatal Hydronephrosis (ANH) is one of the most commonly detected congenital anomaly by antenatal sonogram. It requires periodic follow-up and in selected cases, early interventions are required in postnatal period.

Aim: To study the relationship between Anteroposterior Diameter (APD) of foetal renal pelvis and postnatal outcome of hydronephrosis in neonates and to study the relation between APD of foetal renal pelvis and structural abnormalities of kidney.

Materials and Methods: This prospective study included neonates whose antenatal scan showed hydronephrosis. The study was conducted during the period of November 2018 to November 2020, in Niloufer Hospital (Osmania Medical College), Hyderabad, Telangana, India. A total of 50 neonates were included. For all neonates postnatal monitoring with ultrasonography was done to detect structural anomalies and resolution of hydronephrosis. Micturating cystourethrogram was done in selected cases. The cases which needed surgery were treated accordingly. The Statistical Package for the Social Sciences (SPSS) version 24.0 was used for data analysis. Kruskal-Wallis Chi-square test was used to test the significance of difference between quantitative variables. The p-value less than 0.05 was taken as statistically significant.

Results: Among 50 neonates enrolled in the study, 27 (54%) had transient hydronephrosis and 23 (46%) had urogenital structural abnormalities. Twenty-two cases (44%) required micturating cystourethrogram. Antenatal APD of 9.5 mm predicted the development of significant postnatal uropathy with a sensitivity of 74% and specificity of 89%. Antenatal APD of 9.5 mm had 100% sensitivity and 67% specificity in predicting the need for surgical intervention. Only 3 (6%) cases needed surgical intervention in neonatal period and all cases were kept under follow-up.

Conclusion: All cases of ANH need postnatal evaluation and pertinent follow-up to detect significant uropathy for their proper management to prevent renal damage. Antenatal renal pelvic diameter has significant role in predicting the significant uropathy and surgical intervention.

Keywords: Anteroposterior diameter, Neonates, Renal pelvis, Significant uropathy

INTRODUCTION

The ANH is one of the common foetal anomalies, detected by antenatal ultrasound or targeted imaging for foetal anomalies. The prevalence of ANH ranges from 0.6-5.4% [1,2]. ANH is defined as dilatation of renal pelvis (pyelectasis) or dilatation of both foetal renal pelvis and calices (pelvicaliectasis) or hydronephrosis [3]. In 41-88% patients ANH resolves by birth or during infancy [4,5]. About 4.1-15.4% patients with urogenital structural anomalies require interventions [6,7]. As ANH is a marker of underlying urological structural anomalies, it becomes mandatory to follow the babies during postnatal and infantile period. Early follow-up to detect structural anomalies requiring surgical intervention and use of medical prophylaxis to prevent recurrent urinary tract infections reduces chronic kidney damage. The foetal renal pelvis APD is widely used in the diagnosis and grading of ANH. Hence, the present study was conducted to know the relation between APD of renal pelvis and postnatal outcome of hydronephrosis in neonates. The current study is intended to identify the need of surgical intervention in neonatal period in hydronephrosis. We need to know the cut-off values of renal pelvic APD in predicting significant uropathy and need of surgical intervention at our institute, so that we can avoid evaluating all children with renal pelvic dilation and we can use the health resources in selected individuals, thereby reducing expenditure related to unnecessary interventions. We also intended to find out the newborns who needed follow-up and early interventions to prevent morbidity related to renal damage.

MATERIALS AND METHODS

This prospective study was conducted at a tertiary care hospital for women and children (Niloufer Hospital, Osmania Medical College), Hyderabad, India, during November 2018 to November 2020 after obtaining the ethical clearance (Reg. No. 181010010210). Total 50 neonates were included in this study.

Inclusion criteria:

- Pregnant mothers whose antenatal scan Targeted Imaging for Foetal Anomalies (TIFFA) showed hydronephrosis in foetus (second trimester or in third trimester-both were included)
- Neonates in whom antenatal scan showed hydronephrosis.

Exclusion criteria: Neonates who were prenatally diagnosed as having polycystic kidneys, dysplastic kidneys, hypoplastic kidneys were excluded.

Study Procedure

The ANH is diagnosed if the APD of foetal renal pelvis is more or equal to 4 mm in second trimester and more or equal to 7 mm in third trimester [4]. After obtaining the informed consent from parents, clinical history and relevant data (antenatal ultrasound reports done during second and third trimester, grading of ANH, specific aetiology reported by ultrasound were recorded, laterality, family history of urologic disease, oligohydramnios and other associated anomalies) were collected from the study group and the data was recorded on a master sheet. The ANH was classified as mild, moderate and

severe based on foetal renal pelvic diameter in second and third trimester. Mild was defined as APD 4-6 mm in second and 7-9 mm in third trimester. Moderate was defined as APD7-10 mm in second and 10-15 mm in third trimester. Severe was defined as APD more than 10 mm in second and more than 15 mm in third trimester [4]. The data was recorded in a master sheet. Postnatal evaluation including performing ultrasound of abdomen during first week of life and at one month of age and micturating cystourethrogram were done as per Indian Society of Paediatric Nephrology (ISPN) on management of ANH [8]. The cases which needed immediate surgery were referred to paediatric surgery department.

STATISTICAL ANALYSIS

Data was collected on a structured proforma and SPSS version 24.0 was used for data analysis. The descriptive statistics like range, frequencies, percentages, means and standard deviations were calculated for all the variables. Kruskal-Wallis chi-square test was used to test the differences between quantitative variables. The p-value less than 0.05 was taken as statistically significant. The sensitivity, specificity, positive predictive value and negative predictive value were also calculated.

RESULTS

Total 50 neonates were enrolled in the study in which 35 (70%) were male and 15 (30%) were female neonates, showing male predominance. Out of 50 neonates, 30 (60%) had mild hydronephrosis, 15 (30%) had moderate hydronephrosis and 5 (10%) had severe hydronephrosis. [Table/Fig-1] shows gender and grading of hydronephrosis.

Gender	Number, n (%)	Mild	Moderate	Severe
Male	35 (70%)	19 (54%)	14 (40%)	2 (6%)
Female	15 (30%)	11 (73%)	1 (7%)	3 (20%)
Total	50 (100%)	30 (60%)	15 (30%)	5 (10%)

[Table/Fig-1]: Comparison of gender and grading of hydronephrosis.

On follow-up, 27 (54%) had transient hydronephrosis and 23 (46%) had significant uropathy, as shown in [Table/Fig-2]. Out of the 50 cases, 27 (54%) cases had transient hydronephrosis, 10 (20%) cases had Pelviueteric Junction Obstruction (PUJO), 7 (14%) cases had Vesicoureteric Reflux (VUR)s, 2 (4%) cases had Posterior Urethral Valves (PUV), 3 (6%) cases had extra renal pelvis, 1 (2%) case had VUR with double moiety kidney.

S. No.	Diagnosis	Number, n (%)	Male (n)	Female (n)	Grading of hydronephrosis n (%)		
					Mild	Moderate	Severe
1	Transient hydron-ephrosis	27 (54%)	19	8	24 (89%)	3 (11%)	0
2	Pelvic Ureteric Junction Obstruction (PUJO)	10 (20%)	7	3	4 (40%)	6 (60%)	0
3	Vesicoureteric Reflex (VUR)	7 (14%)	4	3	0	3 (43%)	4 (57%)
4	Posterior Urethral Valves (PUV)	2 (4%)	2	0	0	2 (100%)	0
5	Extrarenal pelvis	3 (6%)	2	1	2 (67%)	1 (33%)	0
6	VUR with double moiety kidney	1 (2%)	1	0	0	0	1 (100%)

[Table/Fig-2]: Urogenital structural anomalies detected by postnatal imaging.

Twenty percent cases with mild ANH, 80% cases with moderate ANH,100% cases with severe ANH had a significant uropathy.

Out of 27 transient hydronephrosis cases 14 (52%) resolved by 1st week of life and 13 cases (48%) resolved within 4th to 5th week of life. Eighty nine percent had mild ANH, and 11% had moderate ANH.

Twenty-eight (56%) cases had unilateral, and 22 (44%) cases had bilateral hydronephrosis. Among 28 unilateral cases of hydronephrosis, 11 (39%) were right sided and 17 (61%) were left sided hydronephrosis. Out of 22 cases with bilateral hydronephrosis, 16 (73%) had structural abnormalities. The factors predicting risk of development of significant uropathy are depicted in [Table/Fig-3]. The gender did not show any statistical significance in predicting risk for development of significant postnatal uropathy (p-value=0.951). Side of hydronephrosis proved to be a factor in predicting risk of development of significant postnatal uropathy, which was statistically significant. (p-value is <0.001). Significant uropathy was statistically significant in patients with bilateral hydronephrosis. The significant uropathy increased with increasing severity of ANH (p-value is <0.001).

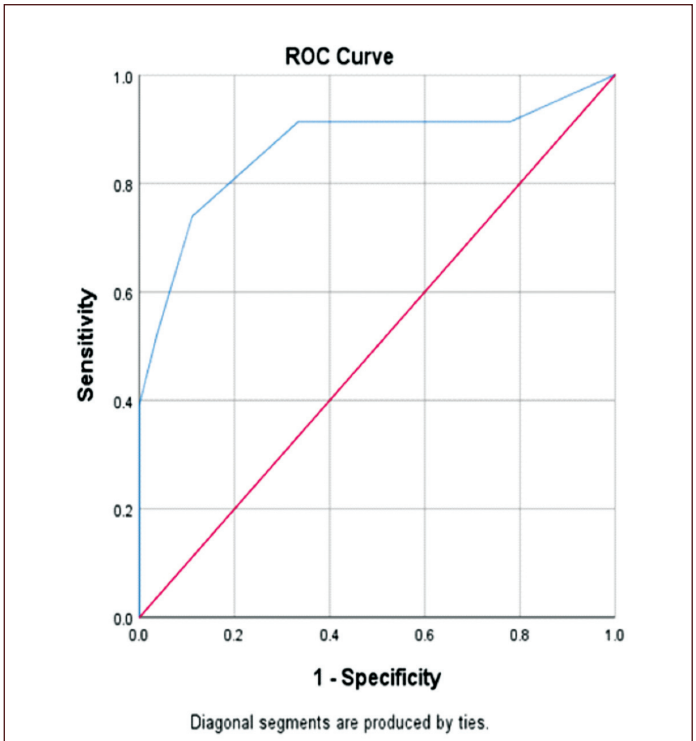
Variable	Groups	Significant uropathy	Transient hydronephrosis	Chi-square	p-value
Gender	Male	16	19	0.004	0.951
	Female	7	8		
Side	Unilateral hydronephrosis	7	21	11.298	<0.001
	Bilateral hydronephrosis	16	6		
Severity of hydron-ephrosis	Mild	6	24	21.014	<0.001
	Moderate	12	3		
	Severe	5	0		

[Table/Fig-3]: Factors predicting risk of development of significant uropathy.

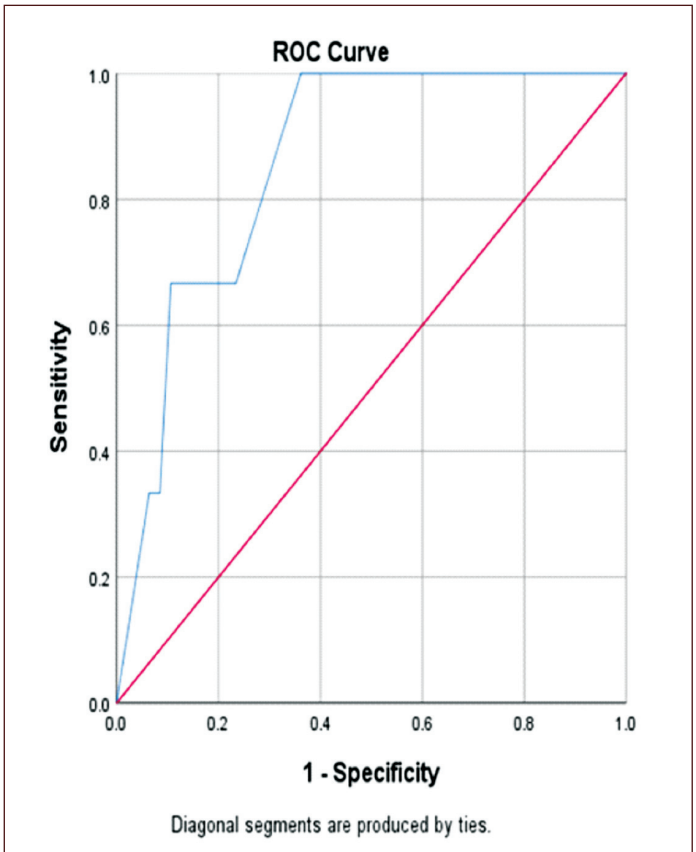
Mean antenatal APD in cases of transient hydronephrosis was 8.26±1.023 mm and those with significant uropathy were 11.39±2.824 mm. A statistically significant association was found between APD and development of significant uropathy (p-value is <0.0001) [Table/Fig-3]. The significant uropathy increases with increased APD diameter was shown in [Table/Fig-3].

Receiver Operating Characteristic (ROC) curve predicted sensitivity and specificity of APD in diagnosis of significant uropathy. Area Under Curve (AUC) was 0.866 (95% CI,0.753,0.978) and p<0.0001. The statistical significance was found between APD (9.5 mm) and development of significant uropathy. A cut-off value of APD-9.5 mm predicted the development of significant uropathy postnatal with a sensitivity of 74% and specificity of 89% (with accuracy of 82%) and with positive predictive value of 85 and negative predictive value of 80 as shown in [Table/Fig-4].

ROC curve predicted statistically significant association between antenatal renal pelvic diameter and requirement of surgical intervention. Area under the curve was 0.858 (95% CI, 0.705,1.00); p-value was less than 0.05. The mean APD was 9.49 mm±2.431 SD in cases not requiring surgical intervention and mean APD was 13 mm±3 SD in cases requiring surgical intervention. A cut-off APD of 9.5 mm had 100% sensitivity and 67% specificity and with the positive predictive value of 81 and the negative predictive value of 100 in predicting the need for surgical intervention [Table/Fig-5].



[Table/Fig-4]: ROC curve predicting the development of significant uropathy by antenatal APD.



[Table/Fig-5]: ROC curve predicting of requirement of surgical intervention by antenatal APD.

DISCUSSION

With increasing use of antenatal ultrasound, urogenital abnormalities are recognised at an early age. Development of urogenital tract starts in first trimester. Antenatal ultrasound can pick up kidney and bladder images in first trimester [9]. The APD of renal pelvis is widely used to characterise severity of renal dilatation [10]. The APD of renal pelvis is the most studied system for assessing ANH in utero. APD of renal pelvis varies according to gestational age. Two gestational age groups were used to define ANH, the first was in second trimester (16 to 20 gestational weeks) and the second was in third trimester (28 to 32 weeks). The APD of renal pelvis 4 mm or more in second trimester and APD of renal pelvis 7 mm or more in third trimester were taken as cut-off values to diagnose ANH [11]. This definition was used to diagnose ANH.

A total of 54% neonates had transient hydronephrosis. Transient hydronephrosis was most common aetiology and was diagnosed in 41 to 88% neonates with ANH [4]. Mallik M and Watson AR, in their study, detected Transient hydronephrosis in 69.69% of all infants [12]. Passerotti CC et al., reported transient hydronephrosis in 52.2% of the infants with ANH [5]. The Transient hydronephrosis was due to immature and poorly coordinated peristalsis of the smooth muscle of the renal pelvis which leads to inadequate emptying and resultant urinary stasis within the renal pelvis [13]. The mild forms of transient hydronephrosis resolve by 18 months of age [12]. In the study, all newborns with transient hydronephrosis resolved by 4 to 5 weeks of age.

In this study, pelvic ureteric junction obstruction was second common aetiology, seen in 20% of cases. It is the most common cause of obstructive hydronephrosis in neonates, seen in 10 to 30% cases with ANH as per Nguyen HT et al., [4]. All cases were kept under follow-up and planned for diuretic renography.

This study found 14% cases with ANH had Vesicoureteric reflex. Vesicoureteric reflex was diagnosed in 10 to 20% cases with ANH in a study done by Nguyen HT et al., [4]. Grazioli S et al., reported 10% cases with ANH had VUR [14]. Micturating cystourethrogram was done in all cases to grade VUR. Patients were kept on antibiotic prophylaxis and advised for periodic follow-up. In view of difficulties of detecting UTI in infancy and risks of renal scarring, ISPN recommends that all infants with VUR should receive antibiotic prophylaxis [8].

In the present study, posterior urethral valve (4%) required immediate surgical intervention by cystoscopy fulguration. One case of vesicoureteric reflux that had double moiety kidney with severe hydronephrosis underwent ureteric reimplantation. Three neonates with extra renal pelvis underwent follow-up without any intervention. About 6% cases with ANH underwent surgery in the neonatal period. Bouzada MCF et al., reported 11 ANH cases required surgical correction. Lower urinary tract obstructions should be treated surgically as early as possible to prevent recurrent urinary tract infection, renal scarring, cortical thinning and renal insufficiency [15].

In the present study, gender did not have any statistical significance in predicting the development of significant postnatal uropathy or postnatal surgical intervention. Similar findings were concluded by Cheng AM et al.,[16].

Out of 50 neonates, 30 (60%) had mild hydronephrosis, 15 (30%) had moderate hydronephrosis and 5 (10%) had severe hydronephrosis. In present study, 20% cases with mild ANH, 80% cases with moderate ANH, 100% cases with severe ANH had significant uropathy. Lee RS et al., reported that increasing APD during antenatal evaluation was associated with increasing in detection of significant uropathy and reported 11.9% mild, 45.1% moderate, 88.3% severe hydronephrosis had significant uropathy during postnatal evaluation [17].

Coelho GM et al., followed-up 192 cases and found the incidence of significant uropathy as 40.6%, which was comparable to our study

(46%) [18]. The frequency of surgical intervention was found to be 15% as opposed to 6% in our study. He reported a cut-off 15 mm had 89% sensitivity and 88% specificity in predicting the need for surgical interventions in his study, while the cut-off was 9.5 mm in the present study. This difference in cut-off APD in predicting need for surgery may be due to larger sample size. In a study by Bouzada MC et al., cut-off of 10 mm APD had best accuracy for identifying infants with a significant uropathy (sensitivity, 90.4%; specificity, 91%) which was comparable to the present study but cut-off of 15 mm was best indicator for need of surgical intervention (Sensitivity, 100%; specificity, 92.5%) [19]. In our study, a cut-off APD of 9.5 mm had 100% sensitivity and 67% specificity which was less compared to the above study. Ismaili K et al., reported that a cut-off 7 mm APD predicted 23% renal anomalies but 10 mm cut-off predicted 68% of abnormalities after birth [20]. Kim HJ et al., reported that cut-off APD of 5 mm during the second trimester, 8 mm during the early third trimester and 10 mm during the late third trimester had 100% sensitivity in predicting postnatal surgery [21]. Mallik M and Watson AR reported that increasing the cut-off to 10 mm in the third trimester will miss 25% of pelvic ureteric junction obstruction cases and 50% of VUR cases [12].

The present study also reported lower cut-off values of APD of renal pelvis were more sensitive in predicting significant uropathy and need for surgical intervention in patients with ANH.

Limitation(s)

Limitations of the study were small study population; sonography was done by different radiologists, so inter-observer variability needs to be considered. Also, follow-up was done for a shorter period. Further studies can be conducted in future with a larger sample size.

CONCLUSION(S)

Severity of hydronephrosis and bilateral hydronephrosis were associated with significant uropathy and need for surgical intervention. The antenatal APD was 9.5 mm, which indicated presence of significant uropathy and need to early surgical intervention. Early detection of ANH and close postnatal monitoring will decrease the morbidity caused by significant uropathy, as majority of neonates with ANH are entirely asymptomatic at birth.

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PARTICULARS OF CONTRIBUTORS:

1. Associate Professor, Department of Paediatrics, Osmania Medical College, Hyderabad, Telangana, India.
2. Associate Professor, Department of Paediatrics, Osmania Medical College, Hyderabad, Telangana, India.

NAME, ADDRESS, E-MAIL ID OF THE CORRESPONDING AUTHOR:
Sneha Latha Gopu,
10-4-771/7-1, Satyasree Arcade, Sriramnagar Colony, Masabtank,
Hyderabad, Telangana, India.
E-mail: snehanaren_1@yahoo.com

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