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Antenatal Detection of Urinary Tract Abnormalities by Ultrasonography

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Abstract

Background and Aims: Fetal urinary tract anomalies can be reliably detected antenatally by ultrasonography. The present study was done with objective to find out the incidence and pattern of fetal urinary tract abnormalities.

Methods: A prospective hospital based study included 5450 pregnant women. The ultrasonography was done after 20 weeks of gestation and the cases found to have urinary tract anomalies were followed till 4 weeks of postnatal life.

Results: The abnormalities were found in 20 fetuses (0.36%) involving 33 kidney units. The dilated renal system was found in 24 (72.7%), multicystic dysplastic kidneys in 6 (18.2%), polycystic kidney disease in 2 (6.1%) and renal agenesis in 1 (3.0%) kidney units. Five (25%) affected babies died and they had significantly lower mean birth weight, hemoglobin and higher blood urea and serum creatinine levels as compared to survivors. Renal anomalies resolved spontaneously in 6 (18.2 %) kidney units. The ureteropelvic junction / ureterovesical junction obstruction was the commonest abnormality followed by ureterovesical reflux at 4 weeks life. Antero-posterior renal pelvis diameter and renal size were significantly higher in cases in which anomalies persisted.

Conclusions: Thus, the babies with foetal urinary tract abnormalities require close follow up in post natal life regarding their persistence and renal function.

Keywords: Prenatal Ultrasonography, Urinary Tract Abnormality, Anteroposterior Renal Pelvis Diameter

Introduction

With the advent of ultrasonography, the detection of fetal urinary tract malformations has become possible. It is estimated that fetal urinary tract dilatation occurs in 0.59- 1% of pregnancies (1-2). Hydronephrosis is the most common anomaly (3) and in more than 50% of cases, it is transient and resolves spontaneously (4). If the abnormalities are not detected antenatally and subsequently managed, these cases may manifest as recurrent urinary tract infections, hypertension or end-stage renal disease (5). As per Indian Pediatric Nephrology Group recommendations (6), the foetal anteroposterior renal pelvis diameter of more than 10mm has clinical

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significance.

There is paucity of literature, and the exact incidence of fetal urinary tract anomalies is not available from this region our country (7-8). Therefore, the present study was undertaken to know the incidence and pattern of urinary tract abnormalities and its persistence in the postnatal life.

Materials and Methods

This prospective study was undertaken in the Departments of Pediatrics, Radiodiagnosis and Imaging and Obstetrics and Gynecology, Institute of Medical Sciences, Banaras Hindu University, Varanasi, India during the period of May, 2006 to August, 2008. An informed consent was taken from each study subject. The protocol of study was approved by Institute's Ethics Committee.

A detailed history and physical examination of all pregnant women were carried out. The inclusion criteria were pregnant women presenting after 20 weeks of gestation without any history of diabetes, hypertension, chronic renal disease and family history of renal malformations were enrolled for the study. The cases with inadequate data, no informed consent and incomplete follow up were excluded from the study. Obstetric ultrasound scanning was performed on 5450 pregnant women attending the out patients department and those admitted to Obstetrics and Gynecology department, using Toshiba Nemio-30 B-mode, real time, grey scale scanner and a 3.5Hz transducer by experienced sonologist. The prenatal ultrasound findings were noted in order to detect any fetal urinary tract anomalies as per recommendations of Indian Pediatric Nephrology Group (6). A criteria of anteroposterior renal pelvis diameter of >10mm was considered as dilated renal system for each gestational age. An amniotic fluid index (AFI) of <5cm was considered as oligohydramnios and >25cm as polyhydramnios, based on ultrasound findings.

The pregnant women were followed till delivery and postnatal evaluation of the babies having antenatal abnormalities were done. Postnatal ultrasound was done between 4–7 days of life for the persistence of antenatally diagnosed renal tract anomalies. Gestational age, mode of delivery, birth weight and resuscitation required were also noted. The hemoglobin, total and differential leucocyte counts, electrolytes, urea, creatinine and urine examination were done in babies with abnormality.

The survivors could be followed up till 4 weeks of postnatal life. Micturating cystourethrography (MCU) was done to look for etiology of dilated renal system, wherever indicated. The babies with posterior urethral valves were subjected to endoscopic fulguration. The cases of vesicoureteric reflux (VUR) were put on chemoprophylaxis to avoid urinary tract infections. The patients of ureteropelvic junction obstruction (UPJO) or ureterovesical obstruction were planned to follow with ultrasonography and renal scan to know their status and decide for surgical interventions later.

Statistics

Student's t-test was applied for the data following normal distribution and Mann- Whitney U test for the observations which were skewed.

Results

The mean gestational age, at which ultrasonography done, was 29.9 weeks. The anteroposterior renal pelvis diameter of fetuses showed that 20 (0.36%) had values more than 10 mm. The observations of 20 cases with urinary tract abnormalities are mentioned in Table 1. The mean gestation and birth weight were 35.4 weeks (28-38 weeks) and 2365.5 g (800-3860 g), respectively. The mean birth weight of live born babies with anomalies (2531g) was significantly higher in comparison to still borns (875.0) ($p<0.001$).Of 20 foetuses, 9(45%) were preterm and 11(55%) had term gestation. Majority of cases were males (85%). Oligohydramnios was present in 15 (75%) pregnant women, 1 (5%) had

Table1. Profile of 20 cases with abnormalities

Renal malformations detected antenatally	Gestation (weeks)	Birth weight (g)	Sex	Amniotic fluid index	Associated anomalies
Lt agenesis, Rt. MCDK	28	800	M	Oligohydramnios	Hydrops fetalis
Rt. MCDK	29	950	F	Normal	Occipital meningoencephalocele
Bil. MCDK	30	1000	F	Oligohydramnios	-
Bil. MCDK	32	1200	M	Oligohydramnios	-
Bil. HN	35	2350	M	Oligohydramnios	-
Lt. HN	35	2760	M	Oligohydramnios	-
Lt. PCKD	36	2200	M	Oligohydramnios	-
Bil. HN	36	2400	M	Oligohydramnios	-
Bil. HN	36	2650	M	Oligohydramnios	-
Bil. HN	37	2000	M	Polyhydramnios	Hydrops fetalis
Bil. HN	37	2700	M	Oligohydramnios	-
Rt. HN	37	2700	F	Normal	-
Bil. HU	37	2760	M	Oligohydramnios	-
Lt. PCKD	37	3000	M	Normal	-
Bil. HN	37	3100	M	Oligohydramnios	-
Bil. HU	38	2500	M	Oligohydramnios	-
Lt. HN	38	2680	M	Normal	-
Bil. HN	38	2850	M	Oligohydramnios	-
Bil. HN	38	2850	M	Oligohydramnios	-
Lt. HN	38	3860	M	Oligohydramnios	-

Bil. **HN**, Bilateral hydronephrosis; **Rt**, Right; **Lt**, Left; **M**, Male; **F**, Female; **HU**, Hydro ureteronephrosis; **MCD**, Multicystic dysplastic kidney; **PCKD**, Polycystic kidney.

polyhyramnios and in remaining 4 (20%) amniotic fluid index was normal. In 20 fetuses, abnormalities were present in 33 kidney units. The dilated renal system was most common abnormality and found in 24 kidney units (72.7 %), multicystic dysplastic kidney in 6 (18.2%) and polycystic kidney disease in 2 (6.1%) kidney units. One case had left sided renal agenesis (3.0 %).

Mortality was noticed in 5 fetuses. The mean birth weight, and hemoglobin level were significantly lower and blood urea and serum creatinine levels were raised in non-survivors in comparison to survivors (Table 2). Among non-survivors, 2 of them were still borns (one was preterm with occipital meningo-encephalocele and other was preterm with hydrops foetalis, requiring medical termination of pregnancy) and the other 3 were live borns, who subsequently died due to sepsis.

The remaining 15 babies, who were followed up till 4 weeks of age, 5 of them showed improvement

Table 2. Basic parameters of survivors and non-survivors with urinary tract anomalies (Mean ± SD)

Parameters	Survivors (n=15)	Non-survivors (n=5)	p-value
Gestation (weeks)	31.13 ± 2.6	28.8±5.8	NS [a]
Birth weight (g)	2757.33 ± 387.7 (2692)	1190±474.9 (1220)	<0.001 [b]
Blood urea (mg/dl)	35.85 ± 11.4 (34)	70.5±10.8 (33)	<0.01 [b]
Serum creatinine (mg/dl)	0.69 ± 1.6	1.8±0.8	<0.001 [a]
Serum sodium (mEq/ l)	135.23 ± 3.2	131.25±7.4	NS [a]
Serum potassium (mEq/l)	3.79 ± 0.5	3.5±0.4	NS [a]
Hemoglobin (g/dl)	16.4 ± 0.8	13.75±0.4	<0.001 [a]
Total leukocyte count (/ mm^3)	8197 ± 2816.3	9275±1732.2	NS [a]
Antenatal APPD(mm)	Rt.-11.68 ± 6.3 (12.3)	12.2±2.3 (13.1)	NS [b]
	Lt.- 14.30 ± 5.7 (14.7)	12.4±1.8 (12.8)	
Postnatal APPD (mm)	Rt.-13.27 ± 6.8 (14.2)	Rt.-16.2±3.8 (15.9)	NS [b]
	Lt.-15.93 ± 8.1 (16.8)	Lt.-14.2±4.5 (13.8)	
Antenatal renal size (mm)	Rt Length: 49.6 ± 5.9 (48.7)	Rt Length: 70.6±16.2 (73.7)	NS [b]
	Breadth: 28.9 ± 10.4 (31.2)	Breadth: 40.5±12.0 (44.8)	
	Lt Length: 55.4 ± 6.3 (57.3)	Lt Length: 69.2±20.1 (71.4)	
	Breadth: 31.8 ± 12.9 (29.6)	Breadth: 36.3±6.3 (34.2)	
Postnatal renal size (mm)	Rt.Length: 53.6±16.8 (56.7)	Rt.Length: 60.2±32.2 (58.7)	NS [b]
	Breadth: 30.86±9.2 (27.5)	Breadth: 32.04±8.3 (33.8)	
	Lt.Length: 71.7±32.2 (73.4)	Lt. Length: 46.8±7.5 (47.9)	
	Breadth: 41.5±22.6 (43.3)	Breadth : 30.4±6.7 (28.2)	

APPD, anteroposterior pelvis diameter; **NS**, Not significant; Figures in parentheses indicate median values.
a: Student's- t; **b**: Mann-Whitney U test.

Table 3. Comparative data of babies who improved and had persistent urinary tract abnormalities at 4 weeks follow up (Mean ± SD)

Parameters	Improvement (n=5)	Persistent abnormalities (n=10)	p-value
APPD (mm)	Rt 6.9±2.8 (5.7) Lt 7.46±2.5 (8.3)	Rt 15.4±6.4 (16.4) Lt 17.8±8.3 (18.3)	<0.05 [b]
Renal size (mm)	Rt Length 39.34±7.3 (37.3) Breadth 20.1±2.86 (21.8) Lt Length 38.5±8.2 (40.2) Breadth 18.7±2.8 (18.9)	Rt. Length 60.2±15.2 (62.8) Breadth 34.5±14.1 (36.6) Lt Length 68.5±37.7 (72.4) Breadth 40.0±25.9 (43.2)	<0.05 [b]
Blood urea (mg/dl)	27.2±5.1	42.7±10.4	<0.01 [a]
Serum creatinine (mg/dl)	0.4±0.1	0.79±0.2	<0.01 [a]

APPD, anteroposterior pelvis diameter; Figures in parentheses indicate median values.
a: Student's- t; **b**: Mann- Whitney U test

while 10 had persistent abnormalities. The anteroposterior renal pelvis diameter, renal size, blood urea, and serum creatinine levels were significantly higher in the babies with persistent abnormalities in comparison to those, who improved (Table 3).

Of the 33 kidney units involved, 9 were lost due to death and medical termination of pregnancy. The spontaneous resolution occurred in 6 kidney units. The etiological pattern of postnatally persistent abnormalities in 18 kidney units at 4 weeks follow up showed that ureteropelvic or ureterovesical junction obstruction was the commonest abnormality and present in 7 (38.8 %) followed by vesicoureteric reflux (VUR) in 6 (33.3 %), posterior urethral valves in 4 (22.2 %) and polycystic kidney disease in 1 (5.5 %) infants.

Discussion

The incidence foetal of urinary tract abnormalities was found to be 0.36 % in the present study. Previously, Sanghavi et al (7) reported a relatively lower incidence (0.2 %) from another region of the country. Livera et al (8) found the incidence of abnormalities detected by screening antenatally was 0.65%. In 95% of cases, kidneys can be identified on ultrasonography by 22 weeks gestation. The mean gestation at which ultrasonography was done in our study was 29.9 weeks. However, during a screening programme for fetal malformations in Sweden, only 9% of renal abnormalities were detected by 17 weeks gestation and 91% by 33 weeks (9). This is because the ultrasound performed at higher gestational age is likely to detect more renal anomalies because of better visualization of fetal urinary tract.

Of the 20 babies with fetal urinary tract malformations, male-female ratio was 9:1. Similarly a male preponderance has been reported earlier also (10-11). Oligohydramnios was found in 75 % of mothers with fetal urinary tract anomaly. A relatively

lower incidence has been reported by Sanghavi et al (7). It is a well known fact that babies with renal malformations have decreased urine formation in-utero leading to associated oligohydramnios in these mothers.

Fifty percent of fetuses had bilateral hydronephrosis in our study compared to 37 %, as reported by Livera et al (8). As such renal agenesis and hypoplasia are not a common abnormality and it was present in only 1 case. It appears that birth weight, anemia and azotemia were the major determinants in survival of these babies. Most of the non-survivors were preterm and complications of prematurity itself might have contributed to deaths. At 4 weeks follow up, spontaneous resolution occurred in 33 % patients in our study. However, Aksu et al (12) found spontaneous resolution in 24 % cases. In contrast, Sanghavi et al (7) reported lower percentage of resolution (8 %) in their patients.

The ureteropelvic or ureterovesical junction obstruction was the commonest abnormality (38.8%) followed by VUR (33.3 %), which are in accordance to the observations of Aksu et al (12). In contrast, Ahmadzadeh et al (11) found VUR in 40.2% and ureteropelvic junction obstruction in 32.8% of their cases. The antenatal fetal urinary tract malformations can be reliably detected by ultrasonography. Fetuses with dilated renal system require assessment in postnatal life for its persistence and specific treatment (13).

Conclusions

Thus, the fetuses with urinary tract abnormalities require follow up in postnatal life so that future management can be planned accordingly in order to avoid deterioration in renal function and development of end stage renal disease in later life.

Conflict of Interest

None declared.

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