

FREQUENCY OF CONGENITAL ANOMALIES OF THE KIDNEY AND URINARY TRACT BY MEANS OF ULTRASONOGRAPHY IN NEONATES AT A TERTIARY-CARE HOSPITAL

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ABSTRACT

Objective: To determine the frequency of congenital anomalies of the kidney and urinary tract by means of ultrasound in neonates.

Study Design: Cross-sectional study.

Place and Duration of Study: Department of Radiology and Diagnostic Imaging, Rehman Medical Institute, Peshawar, from May 2015 to Jan 2016.

Methodology: A total of 150 neonates reporting for routine abdominal ultrasonography were included. Honda Convex Scanner model HS-2000 with probe of frequency of 5-7 MHz was used for the ultrasonography.

Results: Mean age of the neonates was 13.8 ± 7.5 days. Seventy-six (50.7%) were male and 74 (49.3%) were female. Congenital anomalies of the kidney and urinary tract were observed in 10 (6.7%) neonates. Most neonates had more than one anomaly. The left side was involved in 6 (4%) neonates while right side was involved in 4 (2.7%). Hydronephrosis was the most common abnormality found in 8 (5.3%) cases. The location of kidneys was abnormal (ectopic) in 2 (1.3%) neonates. Abnormal dimension was seen in seven cases and abnormal corticomedullary differentiation was found in 5 (3.3%) cases. Non-symmetrical cases were 5 (3.3%). Hydroureter was observed in 3 (2%) neonates and urinary bladder was abnormal in 2 (1.3%) neonates.

Conclusion: The frequency of congenital anomalies of the kidney and urinary tract in neonates by means of postnatal ultrasonographic scan in our study population was 6.7%. Hydronephrosis was the most common anomaly.

Keywords: Hydronephrosis, Neonates, Urogenital abnormalities, Ultrasonography.

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INTRODUCTION

Congenital anomalies of the kidney and urinary tract (CAKUT) comprise of a wide range of structural malformations that result from defects in the morphogenesis of kidney and/or the urinary tract. These malformations may happen at the level of the kidney (e.g., hypoplasia and dysplasia), collecting framework (e.g., hydronephrosis and megaureter), bladder (e.g., ureterocele and vesicoureteral reflux), or urethra (e.g., reverse urethral valves)¹. The prevalence of CAKUT reported in the two related studies had been 0.16% and 0.6% respectively^{2,3}.

Different methods are used for screening of CAKUT. Ultrasonography is one such modality and is simple, easily accessible, in-expensive, and non-invasive method for screening. Antenatal ultrasonographic fetal assessment is carried out to determine the gestational age, monitor fetal growth, identify multiple pregnancies, and detect congenital anomalies, most importantly the CAKUT. The sensitivity of this second trimester anomaly scan is variable and different values of 44%, 27.8%, 43.8%, and 100% have been reported^{4,7}.

This range in reported sensitivity probably has resulted from different identification and classification criteria that may produce a bias in results. Other factors affecting the outcomes are the time of pregnancy when the ultrasound is performed, the number of times ultrasound is performed during gestation, and the skill of the ultrasonographer. If antenatal ultrasound turns out to be normal, the child has no scan after birth for many years until the urinary symptoms and complications become noticeable. Occasionally, abnormalities discovered during a prenatal ultrasound test turn out to be normal after a postnatal ultrasound check. Choi *et al*⁸, observed that 23.4% of postnatal examinations, which were diagnosed antenatally as CAKUT, turned out to be normal. Similar observations were noted by Dulgeroff and colleagues as many CAKUT diagnosed during second trimester emerged as false positives during postnatal ultrasound examination⁵. On the other hand, Stolz *et al*⁹, reported benefit of postnatal ultrasound examination, as it detected undiscovered abnormalities in the prenatal ultrasound examinations. Thus, all patients diagnosed for various renal abnormalities during pregnancy must undergo a postnatal scan to verify the findings and initiate appropriate therapy⁸.

So far, little has been available in the data regarding postnatal scans for CAKUT in Pakistan. With this

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study, we intended to add information regarding the frequency and type of CAKUT in Pakistani neonates by means of postnatal scan. This would help in promoting ultrasound screening in early infancy in Pakistan and may facilitate early treatment that can prevent renal dysfunction in later life.

METHODOLOGY

It was a cross-sectional study carried out in the department of Radiology and Diagnostic Imaging, Rehman Medical Institute Peshawar Pakistan, from May 2015 to January 2016. A sample size of 106 neonates was calculated according to the World Health Organization sample size calculator for single proportion while taking confidence level of 99%, anticipated population proportion of 0.16%, and absolute precision of 0.01.

After approval from the Ethics Review Committee of Rehman Medical Institute Peshawar, through convenient sampling, we included all male and female neonates, presenting within 28 days after birth to the department, for generalized sonographic scan of the abdomen. The research did not include seriously ill newborns who were hospitalized to the critical care unit. Informed and written consent was taken from the parents/guardians of the babies. During the study, name, gender, age, hospital registration number, and urological pathologies found on ultrasonographic examinations were noted. All information was recorded on especially designed proformas. Honda Convex Scanner model HS-2000 (Honda Electronics Co. Ltd., Oi-wacho, Toyohashi Aichi, Japan) with probe frequency of 5-7 MHz was used for the ultrasonographic evaluation. Recordings consisted of six bilateral renal images, including one longitudinal and two transverse images obtained in the supine position. The anterior-posterior renal pelvic diameter was measured on transverse images of the kidneys to look for magnitude of hydronephrosis. The urinary bladder was also observed in the supine position. Images were recorded when abnormalities were identified.

Ultrasonography was carried out by a resident radiologist under the supervision of an experienced consultant radiologist. The following characteristics of the kidneys were assessed: unilateral absence, abnormal location, dimensional abnormality (length ≤ 35 mm or ≥ 60 mm), asymmetry of left and right (difference of 10mm or more), corticomedullary differentiation, and presence of hydronephrosis. Hydronephrosis was graded according to the Society of Fetal Ultrasound Criteria as Grade-1 (anteroposterior renal pelvis diameter

<10 mm without dilation of the calyces nor parenchymal atrophy), Grade-2 (renal pelvis diameter 10-15 mm including a few calyces), Grade-3 (Renal pelvis dilation with all calyces uniformly dilated and normal renal parenchyma), and Grade-4 (similar to Grade-3 but with thinning of the renal parenchyma). The bladder was checked for abnormalities in the bladder wall (normal bladder wall thickness is 2-4.5mm when empty and 1-3mm when full). The ureters were checked for presence of dilatation (normal ureters are generally not visualized by ultrasound).

All the data collected through the proforma were entered into the Statistical Package for Social Sciences version 18 (SPSS Inc., Chicago, IL, USA) and analyzed through its statistical calculations. Means and standard deviations were calculated for age, while frequencies and percentages were calculated for gender and different CAKUT.

RESULTS

A total of 150 cases were included in this study during the study period. Regarding age distribution, 63 neonates (42.0%) were 1-10 days old, 52 neonates (34.7%) were between 11-20 days of age, while 35 neonates (23.3%) were 21-28 days old. Mean age of the neonates was 13.8 ± 7.5 days. Seventy-six (50.7%) neonates were male and 74 (49.3%) were female.

Distribution of the cases by CAKUT showed that 10 (6.7%) neonates out of the sample had these anomalies. Most neonates had more than one anomaly. The left side was involved in 6 neonates while the right side was involved in four.

Hydronephrosis was the most common abnormality found in 8 (5.3%) cases (table). Two (1.3%) neonates had Grade-2 hydronephrosis. One (0.7%) case

Table: Frequency of different congenital anomalies of the kidney and urinary tract by means of ultrasound in neonates.

Anomalies	Frequency	Percentage
Unilateral Absence	-	-
Abnormal Location (Ectopic Kidneys)	2	1.3
Dimensional Abnormality	7	4.7
Asymmetry of Left And right	5	3.3
Abnormal Corticomedullary Differentiation	5	3.3
Hydronephrosis	8	5.3
Grade-1	-	-
Grade-2	2	1.3
Grade-3	1	0.7
Grade-4	5	3.3
Hydroureter	3	2.0
Urinary Bladder Abnormalities	2	1.3

had Grade-3 and 5 (3.3%) neonates had Grade-4 hydronephrosis. The location of kidneys was abnormal (ectopic) in 2 (1.3%) neonates. Abnormal dimension was seen in 7 (4.7%) cases and abnormal corticomedullary differentiation was found in 5 (3.3%) cases. Non-symmetrical cases were 5 (3.3%). Hydroureter was observed in 3 (2%) neonates and urinary bladder was abnormal in 2 (1.3%) neonates.

DISCUSSION

Ultrasonography is the first imaging method of choice to evaluate urinary assessment of infants both antenatally and postnatally¹⁰. Ultrasonography has many advantages such as non-invasiveness, cost-efficiency, and easy accessibility. Using ultrasonography, the prevalence of urinary anomalies has been observed between 0.1-2.3%¹¹.

In the present study, the frequency of CAKUT was 6.7% and it was a bit higher than that demonstrated in previous studies e.g. Li *et al*, (0.16%)², Isac *et al*, (0.6%)³, Riccipetoni *et al*, (1.04%)¹², Sakuma and Oga-wa (3.7%)¹³, Tsuchiya *et al*, (3.5%)¹⁴, and Himmetoglu *et al*, (0.27%)¹⁵. The greater determine in our study was thought to be due to the study design. The research was performed in a tertiary-care hospital to which selected sick newborns were referred with complex child-birth defects, and it also included samples from the department of pediatric nephrology.

In our study, the abnormalities on the left side were dominating the abnormalities on the right side. In a large sample study of 11,887 newborn infants, extended over a period of ten years, the left side dominated in 78 (68.4%) ($p < 0.05$)¹⁶. The study also observed an association of gender with the frequency of CAKUT. One-hundred & forty-two (79.3%) males had CAKUT while significantly less ($p < 0.001$) 37 (20.7%) females had the anomalies¹⁶. In a systematic review, the abnormalities were more often identified in males and were more often located on the left side¹⁷. A meta-analysis specifically performed on the distribution of different unilateral anomalies found that the left side was affected in 53%, 57%, 56.9%, 63.2% and 62.5% of the patients¹⁸. Another study observed renal malformations more on the left side and ureteral malformations more on the right side with boys affected more than girls in a ratio of 1.4:1.3. The accurate processes prompting these lateralizations stay to be resolved yet may include vascular development, differential gene expression, or susceptibility to ecological factors, e.g. hypoxia.

Hydronephrosis, with a rate of 5.3%, was the most common anomaly found in our study. Similarly,

hydronephrosis was the most frequent anomaly seen by Tabel and colleagues¹⁹, in a Turkish study. Other anomalies were ureteropelvic stenosis (3.4%), vesicoureteral reflux (2.3%), multicystic dysplastic kidney (0.3%), posterior urethral valve (1.6%), renal agenesis (0.4%), and ectopic kidney (0.1%). Postoev and coworkers, also observed congenital hydronephrosis as the most prevalent malformation (14.2% of all cases) in a Russian study including 50,936 singletons from the Murmansk County Birth Registry²⁰. A German study found hydronephrosis in 179 (1.5%) newborn infants trailed by nephrocalcinosis ($n=32$), double-kidneys ($n=28$), and horseshoe kidneys ($n=13$)¹⁷. In an Indian study, supervised by Kumar *et al*²¹, hydronephrosis was the most common anomaly, seen in 61 cases, out of a sample of 587 cases. This was followed by bilateral cystic kidney in 50/587 cases. In a Chinese study, urinary ultrasound screening was performed in 8827 infants²². Eleven cases of hydronephrosis, seven cases of unilateral renal aplasia, two cases of renal duplication, two cases of renal dysplasia, one case of multicystic dysplastic kidney, one case of renal ectopia, one case of ureterectasia, and one case of renal cyst were observed. A Romanian study, observed hydronephrosis in 187 children followed by dysplastic kidney ($n=22$), urethral duplicity ($n=21$), and renal agenesis ($n=20$)³. A Korean study further endorsed this assumption, that hydronephrosis is the most noted CAKUT in newborns followed by duplicate kidneys⁸.

Concluding, ultrasound has been effective for early detection of CAKUT. It is imperative to identify and distinguish between the abnormalities that may remain obscure in the newborn and those that are incompatible with life. In case of the earlier problems, the renal functions can be saved if they are diagnosed during pregnancy while the latter may necessitate a therapeutic abortion. The children with CAKUT that are born without an obvious malformation at birth, mostly remain asymptomatic for a long time, sometimes even till adulthood. At times, CAKUT appear as part of a systemic disease affecting other parts of the body as well. At general, CAKUT present with proteinuria and/or hypertension in adulthood²³, and pose significant renal problems to the effect that many of these patients ultimately require urinary dialysis or transplantation¹⁰. Provision of ultrasonographic screening of neonatal CAKUT to the infants that are born in the tertiary-care hospitals and those that are admitted to such centers for any cause, is a valuable service. This policy may help to establish prompt diagnosis of any

urinary abnormality that may get further complicated without timely treatment and/or intervention.

CONCLUSION

The frequency of CAKUT in neonates by means of postnatal ultrasound examination in our sample was 6.7%. Hydronephrosis was the most common anomaly found in our sample. Ultrasound is effective for early detection of CAKUT and is recommended in the immediate postnatal period to establish prompt diagnosis of urinary tract abnormalities.

CONFLICT OF INTEREST

This study has no conflict of interest to be declared by any author.

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