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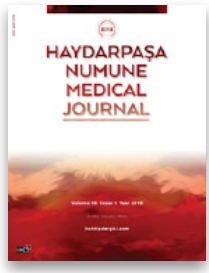

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ORIGINAL ARTICLE

Incidence of Congenital Urinary System Anomaly in Newborns with Urinary Tract Infection

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Abstract

Introduction: Childhood urinary tract infection (UTI) is one of the most important causes of renal failure in adult age. The presence of congenital urinary malformation should be investigated. In this study, by evaluating new-borns with UTI who were hospitalized in our clinic, we aimed to find clues that will help clinicians for choosing the right imaging methods.

Methods: This research includes 137 neonates who were hospitalized with the diagnosis of UTI or diagnosed as UTI after hospitalization in Zeynep Kamil Gynecologic and Pediatric Training and Research Hospital NICU-2 between January 2009-October 2012. All patients' demographic characteristics and urinary tract imaging were evaluated.

Results: Of the 137 neonates included in this study, 78.8% of them was male, and 21.2% of them was female. In 19% of the patients, abnormalities were detected with urinary tract ultrasonography. The most frequent abnormality was hydronephrosis and ectasia 13.9%. In 39 of the patients, three imaging technique was performed. Of the patients with abnormal urinary system ultrasound, 47.1% of them had pathologic voiding cystourethrography, and 58.8% of them had pathologic DMSA scintigraphy. Abnormal VCUG and DMSA rates were 9.1% in patients with normal urinary system ultrasonography.

Discussion and Conclusion: Urinary tract USG should be performed to each patient who was diagnosed as urinary tract infection in the newborn period because of this may be a signal of the urinary system abnormality. Choice of the advanced imaging modalities should be decided according to the patient's characteristics.

Keywords: Newborn; urinary tract infection; renal abnormality.

Urinary tract infection (UTI) occurs as a result of infection of the sterile urinary system [1]. UTI is more common in male infants in the first three months of life. The reason for this is that the incidence of congenital anomalies of the urinary system is higher in boys [2]. The incidence of UTI in term neonates in the newborn period is 0.1-1%, and various studies showed that this incidence rate increased up to 10% in low- birth weight infants and up to 25% in premature infants. The prevalence of UTI was reported to be 13.6-14% in febrile newborns and 5.3% in febrile infants [3, 4].

In timely diagnosed cases, the risk of renal damage due to infection can be reduced and serious complications, such as hypertension and progressive renal failure, which may develop in the long term may be prevented [5].

UTI may indicate an underlying urinary anomaly. Therefore, urinary system imaging is necessary. Imaging method should be selected according to age, sex, number of infections and localization [1, 6]. It has been proven by experimental and clinical data that even a single episode of pyelonephritis can cause scarring in the kidney. Therefore,

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the first UTI attack requires visualization of the urinary system [7]. Obstructive lesions are detected in 5-10% of children who experienced UTI for the first time and VUR is detected in 21-57% of them [8]. Urinary system stones, obstructive uropathies, vesicoureteral reflux and parenchymal injury can be detected by imaging methods.

Ultrasonography (USG) is the firstly preferred method because it is noninvasive and can detect much pathology in the kidney and bladder. Voiding cystourethrography (VCUG) is the most valuable method for the evaluation of vesicoureteral reflux (VUR) and is recommended to be administered 4-6 weeks after infection [9].

Nuclear renal scintigraphy provides information about the anatomy and functions of the kidneys. Common indications for scintigraphy include unilateral or bilateral hydronephrosis, UTIs with or without VUR, small kidneys, unilateral kidneys, and monitoring of various uropathies.

Radiopharmaceuticals marked with 99 Tcm are mainly used in urinary system scintigraphy [10].

In our study, urinary system USG results of all patients were evaluated. The incidence of urinary malformation was determined. DMSA scintigraphy and VCUG imaging were requested from the required cases and the results were evaluated. We aimed to find clues to help the clinician in the selection of imaging methods by examining the demographic information together with urinary system imaging results of the patients diagnosed as UTI in the newborn period.

Materials and Methods

A total of 137 newborn patients admitted to our hospital neonatal intensive care unit with the diagnosis of urinary tract infection between January 2009 and October 2012 were included in this study. Ethics Committee approval of the hospital was obtained for this study (Date: 05/25/2012). Patient files were examined and demographic information, presenting complaints, presence of antenatal hydronephrosis, pathogens grew, renal USG, VCUG and DMSA results were evaluated. Renal anteroposterior (AP) diameter of 10 mm and above was accepted as the presence of hydronephrosis. VCUG results were graded between 1, and 5. The frequency of urinary tract malformation was also determined.

SPSS (Statistical Package for Social Sciences) for Windows 15.0 was used for statistical analysis. In addition to descriptive statistical methods (frequency), chi-square test and Fisher's exact chi-square test were used to compare qualitative data. Statistical significance was evaluated at $p<0.05$.

Results

This study was performed on 137 newborn patients between January 2009 and October 2012. The distribution of demographic information of the patients is shown in Table 1.

The results of the imaging methods performed in the patients are shown in Table 2.

USG of all of the neonates (100%) diagnosed with antenatal hydronephrosis revealed some pathologic findings. There was no statistically significant relationship between the presence of antenatal diagnosis and abnormal DMSA scintigraphy and VCUG results. However, it was remarkable that the pathology detection rate was high in DMSA and VCUG imaging of neonates diagnosed with antenatal hydronephrosis.

Abnormal USG was detected in 13.8% of the girls and 20.4% of the boys without any statistically significant difference between genders. The probability of renal USG being normal (44.1%) in patients presenting with prolonged jaundice was statistically significantly higher than the possibility of USG being pathological (15.4%) ($p<0.01$). There was

Table 1. Demographic characteristics

	n	%
Gender		
Female	29	21.2
Male	108	78.8
Age (days)		
0-3	12	8.8
4-7	17	12.4
8-28	108	78.8
Type of delivery		
NSD	70	51.1
Cesarean	67	48.9
Birth weight		
<2500	27	19.7
≥2500	110	80.3
Gestational age		
Term	90	65.7
Preterm	47	34.3
Diagnosis of antenatal hydronephrosis		
Yes	5	3.6
Additional disease in mother		
Yes	12	8.8
Maternal history of UTI		
Yes	41	29.9
Family history of kidney disease		
Yes	3	2.2

no correlation between renal USG pathology in patients presenting with fever, inability to be breastfed, vomiting, restlessness, lethargy and dehydration.

There was no significant increase in the frequency of urinary malformation in patients with CRP elevation, abnormal renal function test results or leukocytosis. We found that the causative agent in urine culture being E.coli or non-E.coli did not increase the rate of anomaly detection in renal USG. Evaluation of VCUG and DMSA findings according to USG results is shown in Table 3.

Great majority of (90.9%) the cases with normal USG results had also normal DMSA scintigraphy and VCUG results, and in only 9.1% of the cases with normal USG results DMSA scintigraphy and VCUG revealed urinary tract abnormalities. We detected urinary tract pathologies in DMSA scintigraphy and VCUG in 58.8%, and 47.1% of the cases with abnormal USG results, respectively.

Table 2. Evaluation of US, DMSA and VCUG results

	n	%
US		
Normal	111	81,0
Ectasia+Hydronephrosis	19	13.9
Diffuse increase in blader wall thickness	2	1.5
Renal stone	3	2.2
Ectopic kidney	1	0.7
Solitary kidney	1	0.7
DMSA (n=39)		
Normal	27	69.2
Scar	12	30.8
Voiding (n=40)		
Normal	30	75.0
Grade 1	6	15.0
Grade 2	2	5.0
PMR	2	5.0

Table 3. Evaluation of USG Sonuçlarına Göre VCUG and DMSA Findings according to US results

	USG	
	n (%) Normal	n (%) Pathologic
VCUG		
Normal	20 (90.9)	9 (52.9)
Pathologic	2 (9.1)	8 (47.1)
DMSA		
Normal	20 (90.9)	7 (41.2)
Pathologic	2 (9.1)	10 (58.8)

Discussion

Diagnosis and treatment of UTI during infancy is important because it may cause renal damage and hypertension in advanced age by leading to kidney damage. The choice of advanced imaging methods to be applied for neonatal UTI cases is decided according to the characteristics of the patient. As a general point of view, USG imaging of the urinary system is performed after the first UTI episode, and VCUG and DMSA are planned in suspect cases. Studies reported that urinary system USG is the first imaging method that should be performed in patients with UTI during the neonatal period [11]. Bıyıklı et al. [12], applied urinary system USG to all sick newborns and found anomalies in 23% of them. In our study, all of our patients were evaluated for urinary system malformations using urinary USG. The urinary anomaly detection rate was 19%. The most common anomaly was hydronephrosis and ectasia at a rate of 13.9%. The rate of congenital malformation in girls and boys was similar. Patients with prolonged jaundice had a low risk of urinary tract pathology. Afroz et al. [13] found a urinary anomaly in the postnatal period in 17.7% of the patients with antenatal USG pathology. In our study, renal USG pathology was found in all newborns with antenatal ultrasonographic findings, which led us to believe that antenatal diagnosis requires close follow-up. In our clinic, the urinary system USG is performed to detect urinary malformations in all newborns diagnosed with UTI.

Clepper et al. [14] found that Klebsiella spp. rather than E. coli has proven to be four times more likely to be diagnosed in patients with VUR. It has been reported that non-E.coli gram- negative agents are more common in patients with urinary system anomalies. Although performed in a small number of neonates, Hansson et al. [15] found that non-E. coli gram- negative bacteria were significantly more dominant in patients with VUR. Theodoros et al. [16] found that non-E.coli gram-negative pathogens were more common in neonates with VUR, and argued that this might be considered as a guiding factor in the request for VCUG.

Pauchard et al. [17] suggested that VCUG may be avoided in the presence of E.coli growth and normal USG in 0*-3 -month infants who have febrile UTIs. In our study, the findings showed that the pathogen grown in urine culture did not affect the rate of the renal anomaly. E.coli was the causative agent in 53.7% of the patients with urinary anomaly detected on renal ultrasound and in 60% of the patients with urinary anomaly demonstrated in VCUG. Based on these findings, we concluded that any direct correlation could not be established in the neonatal period and that

cases with E.coli growth could not be ruled out in terms of advanced imaging methods.

Sastre et al. [18] thought that although urinary system USG is insufficient to evaluate renal scarring, it can be used as a screening test at the first febrile episode of UTI in the neonatal period. They believed that normal USG imaging cannot rule out VUR. Again, Wallace et al. [19] concluded that low grades of VUR cannot be detected by USG in infants younger than two months. In our study, in 9.1% of the patients with normal, and in 47.1% of the cases with abnormal renal ultrasound findings, VCUG detected urinary pathologies. These findings have shown us that urinary system ultrasound is an effective way to guide us to VUR in neonates, but that abnormal urinary system ultrasound does not necessarily mean that it will always indicate the presence of VUR. We saw that USG was inadequate in detecting VUR in approximately 10% of the patients. According to the recommendations in the latest guidelines, in infants with a history of first febrile UTI, if US reveals the presence of pathologic findings, such as hydronephrosis, renal scar or obstructive uropathy on USG, these patients should undergo VCUG [20].

CRP positivity and pathological urinary system USG were evaluated in combination. Only one of the patients with abnormal VCUG had CRP positivity. This showed that the presence of congenital urinary malformation cannot be ruled out even when CRP is within normal levels in newborns. Leroy et al. [21] found that high procalcitonin value is a strong marker indicating the presence of VUR, and argued that low-risk patients could be identified and unnecessary VCUG shots could be prevented accordingly. In our study, procalcitonin value was not evaluated in our patients.

Goldman et al. [22] detected renal damage only in patients with VUR when they performed DMSA scintigraphy in infants. Moorthy et al. [23] carried out DMSA scintigraphy in patients who had UTI under one year of age and had normal USG and found renal scars in 3.7% of these patients. They detected VUR in half of the patients with renal scarring. It was emphasized that cortical defects seen in DMSA scintigraphies during the acute period were mostly due to acute pyelonephritis and late stage of the disease should be awaited to detect permanent scars. We applied DMSA imaging to our patients in the long term and detected pathology in 30.8% of them.

In our study, in only 9.1% of the patients with normal USG, DMSA and VCUG revealed urinary tract pathologies. DMSA and VCUG imaging of approximately half of the patients with pathologic USG findings detected pathologies, which led us to conclude that ultrasonographic imaging is a 90% effective method for detecting congenital urinary malformations in the neonatal period. Close follow-up and application of advanced imaging methods in consideration of the clinical condition of the patient are still valid. We believe that it is more appropriate to decide on advanced imaging method based on patient follow-up, cost-benefit ratio and ease of application of tests.

As a result, it is a disturbing fact that UTI experienced at an early age increases the rate of renal scarring. We suggest that renal ultrasound imaging should be performed for each neonatal UTI case, and in the presence of findings suggesting hydronephrosis, renal scar or VUR and if atypical/recurrent UTIs are detected and then advanced imaging methods should be requested. In addition, close follow-up of the patient will be appropriate.

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