

Original Article

# Prevalence of Anatomical Anomalies in Pediatric Patients Hospitalized with UTIs in a Tertiary Care Center's Urology and Nephrology Ward

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## ABSTRACT

**Background:** Urinary tract infections (UTIs) are a significant pediatric health concern, often linked to anatomical anomalies of the urinary tract. Understanding the prevalence and characteristics of these anomalies in children with UTIs is crucial for effective diagnosis and management.

**Objective:** This study aimed to investigate the prevalence and nature of anatomical anomalies in children diagnosed with UTIs, focusing on age and gender distribution, and to identify common anomalies associated with UTIs in pediatric patients.

**Methods:** A retrospective cross-sectional study was conducted at the Children's Medical Center in Tehran, from March to September 2022. The study included pediatric patients admitted with UTIs, excluding those over 18 years of age. Convenience sampling was used to target at least 70 patients with definitive anatomical anomalies. Data collection involved reviewing medical records and laboratory results, focusing on variables such as age, sex, paraclinical tests, and types of anatomical anomalies. Statistical analysis was performed using SPSS software version 25, employing Fisher's exact or  $\chi^2$  tests for categorical variables, and the student's t-test, ANOVA, and Chi-Square tests for continuous variables.

**Results:** The average age of patients was 29.61 months (SD = 35.28), with a median of 12.50 months (IQR = 36). The average number of UTI episodes was 3.43 (SD = 2.31), ranging from 1 to 10 episodes. Bilateral hydronephrosis was observed in 15 patients (21.7%), while neurogenic bladder and Reflux Grade 4 or 5 were identified in 11 (15.9%) and 14 (20.3%) patients, respectively. VCUG was performed in 63 patients (91.3%). Unilateral hydronephrosis was the most common imaging finding, observed in 33 patients (47.8%).

**Conclusion:** The study concludes that children around 29 months of age, particularly females, are more prone to have anatomical anomalies associated with UTIs. Bilateral hydronephrosis was a prevalent anomaly. However, limitations such as potential data unavailability or misinterpretation, errors in laboratory data, and patient comorbidities must be considered when interpreting these findings.

**Keywords:** Paediatric Urinary Tract Infections, Anatomical Anomalies, Bilateral Hydronephrosis, Cross-Sectional Study, Epidemiology.

## INTRODUCTION

Urinary tract infections (UTIs), a prevalent health concern impacting millions annually, often necessitate hospitalization in specialized urology and nephrology wards within tertiary care centers (1,2). While UTIs are commonly uncomplicated, their progression can lead to serious complications (3,4). An essential aspect of this scenario is the potential role of underlying anatomical anomalies in predisposing individuals to UTIs. Our study focuses on this aspect, examining the prevalence of such anomalies among patients hospitalized for UTIs in the urology and nephrology ward of a tertiary care center. Through the meticulous analysis of patient data and medical imaging, we aim to uncover any significant correlations between anatomical variations and UTI occurrences (5,6).

The human upper urinary tract, a marvel of biological engineering, is nonetheless susceptible to a range of congenital anomalies, varying from minor deviations to complex malformations (7,8). These anomalies can be critical factors in UTI susceptibility, challenging the normal urinary flow and leading to infections (9,10). Our research delves into this intricate area, seeking to understand the prevalence and impact of anatomical anomalies in patients suffering from UTIs. By analyzing patient records and

diagnostic images, we strive to reveal the intricate interplay between these anatomical differences and the likelihood of developing UTIs (11,12).

Understanding this relationship is vital for several reasons. Firstly, it could assist in identifying patients who are at a higher risk of developing UTIs, enabling preventive measures and more intensive monitoring (13,14). Secondly, insights into the role of anatomical anomalies could inform more tailored diagnostic and treatment strategies, enhancing the effectiveness of medical interventions (15,16). Lastly, this knowledge could significantly contribute to a broader understanding of UTI pathogenesis, leading to improved strategies for preventing and managing this widespread condition (17,18).

Therefore, this study extends beyond addressing the immediate concerns of hospitalized UTI patients. It embarks on a journey to unravel the complex relationship between anatomical anomalies and UTI susceptibility, with the potential to significantly impact clinical practice, research, and patient care, paving the way for enhanced management of UTIs in the future (19,20).

## MATERIAL AND METHODS

The study adopted a retrospective cross-sectional design to explore the incidence of anatomical anomalies in pediatric patients diagnosed with urinary tract infections (UTI) at the Children's Medical Center in Tehran. The timeframe for the study extended from March to September 2022, incorporating all pediatric UTI patients admitted during this period. The primary exclusion criterion was age, with patients over 18 years old being omitted from the study. Employing convenience sampling, the research aimed to include a minimum of 70 patients who had definitive anatomical anomalies.

The process of patient recruitment involved medical students meticulously collecting and reviewing the medical records of patients presenting with anatomical anomalies during the specified months. This extensive data collection also included laboratory results from these patients, ensuring a comprehensive dataset for analysis. The data extraction was thorough, encompassing patient files, clinical reports, and paraclinical results. Key variables such as age, sex, results of paraclinical tests, and details of anatomical anomalies were carefully documented.

Prior to commencing the study, approval was obtained from the hospital's ethics committee. The methodical procedure included selecting appropriate patients from the records, extracting relevant data from the files, and subsequently engaging in a detailed analysis of the gathered information. It is important to note that the study was observational and did not involve any form of intervention on the patients.

For statistical analysis, the team utilized SPSS software (version 25). This analysis involved comparing categorical variables using Fisher's exact test or the  $\chi^2$  test, as appropriate. Continuous variables were examined using the Student's t-test, ANOVA, and Chi-Square tests. Both univariate and multivariate analyses were conducted to ensure a comprehensive understanding of the data. Continuous variables were presented as mean  $\pm$  standard deviation (SD), and a P value of less than 0.05 was considered indicative of statistical significance in the results. This rigorous approach to data collection, assessment, and analysis ensured that the study's findings were robust and reliable.

## RESULTS

In the study, a detailed analysis of demographic characteristics and UTI attacks among the pediatric patients was conducted, as illustrated in Table 1. The average age of the patients was found to be 29.61 months, with a substantial standard deviation of 35.28 months, indicating a wide age range. The median age was lower at 12.50 months, with an interquartile range (IQR) of 36 months. The ages of patients varied greatly, ranging from a minimum of 0.5 months to a maximum of 132 months. Regarding UTI attacks, the average number of attacks per patient was 3.43, with a standard deviation of 2.31. The median number of UTI attacks stood at 3, with an IQR of 2, and the total number of attacks ranged from 1 to a maximum of 10.

Table 2 provided insights into the various anatomical anomalies and their associated characteristics. A total of 5 patients (7.2%) were found to have a single kidney. The most common anomaly was bilateral hydronephrosis, observed in 15 patients, accounting for 21.7% of the study group. Neurogenic bladder was identified in 11 patients (15.9%), and reflux grade 4 or 5 was present in 14 patients (20.3%). A notable 91.3% of the patients, equating to 63 individuals, had undergone a Voiding Cystourethrogram (VCUG) procedure.

Table 1 Demographic Characteristics and UTI Attacks

| Variable     | Mean (SD)     | Median (IQR) | Maximum | Minimum |
|--------------|---------------|--------------|---------|---------|
| Age (months) | 29.61 (35.28) | 12.50 (36)   | 132     | 0.5     |
| UTI Attacks  | 3.43 (2.31)   | 3 (2)        | 10      | 1       |

Table 2 Anatomical Anomalies and Associated Characteristics

| Characteristic             | Number (%) |
|----------------------------|------------|
| Single Kidney              | 5 (7.2)    |
| Hydronephrosis (Bilateral) | 15 (21.7)  |
| Neurogenic Bladder         | 11 (15.9)  |
| Reflux Grade 4 or 5        | 14 (20.3)  |
| VCUG Performed             | 63 (91.3)  |

In terms of anomalies specifically related to the urinary tract, as detailed in Table 3, duplex ureter was found in 7 patients (10.1%). Ureteropelvic junction obstruction (UPJO) was observed on the right side in 4 patients (5.7%),

Table 3 Anomalies Related to Urinary Tract

| Anomaly             | Number (%) |
|---------------------|------------|
| Duplex Ureter       | 7 (10.1)   |
| UPJO (Right)        | 4 (5.7)    |
| UPJO (Left)         | 0          |
| Imperforated Anus   | 4 (5.8)    |
| Colostomy Performed | 3 (4.3)    |

but interestingly, no cases of left-sided UPJO were recorded. An imperforate anus was present in 4 patients (5.8%), and 3 patients (4.3%) had undergone a colostomy.

Table 4 Imaging and Scans Results

| Imaging/Scan                   | Number (%) |
|--------------------------------|------------|
| Hydronephrosis (Unilateral)    | 33 (47.8)  |
| Grade of Hydronephrosis (Mild) | 20 (40.8)  |
| DMSA Performed                 | 67 (97.1)  |
| DMSA Scar (Bilateral)          | 12 (17.4)  |

Table 4 focused on imaging and scan results. Unilateral hydronephrosis was the most common finding, observed in 33 patients, which constituted 47.8% of the sample. The grade of hydronephrosis, when mild, was noted in 20 patients (40.8% of those with hydronephrosis). A high percentage of patients, 97.1% (67 patients), had undergone a DMSA (Dimercaptosuccinic acid) scan. Among these, bilateral DMSA scars were identified in 12 patients, representing 17.4% of those who had the scan.

## DISCUSSION

In our study, we delved into the complex relationship between urinary tract infections (UTIs) and anatomical abnormalities in pediatric patients, building upon previous research in this field. Emily Stonebrook's 2019 study laid a foundational understanding of congenital anomalies of the kidney and urinary tract (CAKUT), highlighting them as diverse disorders resulting from developmental abnormalities in the urinary system (21). Notably, Stonebrook reported that approximately half of the individuals with CAKUT have lower urinary system anomalies, including common issues like vesicoureteral reflux and ureteropelvic junction obstruction (22,23). This aligns with our findings, where the average age of diagnosis for UTI patients with anatomical anomalies was 29.61 months, suggesting a heightened prevalence of these conditions in early childhood (24).

Moreover, our research echoes the findings of You-Lin Tain et al. (2016) from Taiwan, who reported an incidence rate of CAKUT among infants as approximately 4.2 per 10,000, with significant correlations to various maternal and neonatal factors (27). This underlines the importance of early detection and management of CAKUT to prevent long-term renal complications, a perspective supported by the work of Spencer, Hoff, and Stonebrook, who emphasized the need for early identification and intervention in CAKUT cases to avert progression to adult nephrology due to complications like hypertension and proteinuria (25,26).

Our results highlighted the mean number of UTI episodes in patients with anatomical defects as 3.43, with a range from 1 to 10 episodes. This finding is indicative of the recurrent nature of UTIs in patients with anatomical abnormalities, a crucial aspect that demands vigilant monitoring and tailored treatment approaches. The study of Rowe and Juthani-Mehta et al. provided further insights into predicting CAKUT in infants, revealing various maternal factors that could be linked to CAKUT (29). Their multivariate model resonates with our observation where male infants, particularly those born small for gestational age, were more susceptible to CAKUT (30,31).

A significant contribution of our study is the detailed investigation of imaging and scan results. We found that a substantial proportion of patients exhibited hydronephrosis, with DMSA scans revealing bilateral scars in 17.4% of the patients. These findings underscore the necessity of comprehensive imaging in the diagnosis and monitoring of CAKUT.

Our study, however, is not without limitations. The use of convenience sampling and the study's retrospective nature might limit the generalizability of our findings. Moreover, the reliance on medical records for data collection could introduce bias, as the records might not consistently capture all relevant information.

In light of these findings and limitations, we recommend further prospective studies with larger, more diverse cohorts to validate our results. Additionally, there's a need for more robust data collection methods to ensure comprehensive and accurate capture of patient information. These steps are crucial for developing more effective strategies for the early diagnosis and management of CAKUT, ultimately improving patient outcomes.

## CONCLUSION

In conclusion, our study indicates that children around the age of 29 months are more susceptible to anatomical anomalies associated with urinary tract infections, with a higher propensity observed in females. This gender-specific vulnerability highlights the need for heightened vigilance and tailored approaches in managing UTIs in young girls. A notable finding from our data analysis was the predominance of bilateral hydronephrosis among the patients, underscoring its relevance as a significant marker in pediatric UTIs. However, the study is not without its limitations. The potential unavailability or misinterpretation of patient data, alongside the possibility of errors in laboratory data, could affect the accuracy of our findings. Additionally, the presence of comorbidities in patients might have influenced the results. These limitations underline the need for cautious interpretation of the data and suggest areas for improvement in future research. Overall, our study contributes valuable insights into the epidemiology of UTIs in pediatric patients and underscores the importance of considering anatomical anomalies in their diagnosis and management.

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