Original Article

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

Muhammad Sajid[1], Sibtain Raza[1], Asia Riaz[2], Areeshah Khan[2], Syeda Anza Imtiaz[2], Muhammad Amjad Hussain[1]*

[1]Tehran University Medical Sciences School of Medicine, Tehran-Iran.

[2]Quid-e-Azam Medical College, Bahawalpur.

Corresponding Author: Muhammad Amjad Hussain; Email: mkhang87@gmail.com

Conflict of Interest: None.

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 χ2 tests for categorical variables, and the student's ttest, 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

Pediatric UTI Anomalies in Tertiary Care
Sajid M., et al. (2023). 3(2): DOI: https://doi.org/10.61919/jhrr.v3i2.298

Journal of Health
and Rehabilitation
Research 2791-156X
JHRR

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 χ^2 test, as appropriate. Continuous variables were examined using the Student's t-test, ANOVA, and ChiSquare tests. Both univariate and multivariate analyses were conducted to ensure a comprehensive understanding of the data. Continuous variables were presented as mean ± 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.

REFERENCES

1.   Plaire JC, Pope JCt, Kropp BP, Adams MC, Keating MA, Rink RC, et al. Management of ectopic ureters: experience with the upper tract approach. The Journal of urology. 1997;158 (3 Pt 2):1245-7.
2.   Bilge I, Kayserili H, Emre S, Nayir A, Sirin A, Tukel T, et al. Frequency of renal malformations in Turner syndrome: analysis of 82 Turkish children. Pediatric nephrology (Berlin, Germany). 2000;14 (12):1111-4.

3. Clark CJ, Kennedy WA, 2nd, Shortliffe LD. Urinary tract infection in children: when to worry. The Urologic clinics of North America. 2010;37 (2):229-41.

4. Rowe TA, Juthani-Mehta M. Urinary tract infection in older adults. Aging health. 2013;9 (5).

5. Foxman B. Urinary tract infection syndromes: occurrence, recurrence, bacteriology, risk factors, and disease burden. Infectious disease clinics of North America. 2014;28 (1):1-13.

6. Tain YL, Luh H, Lin CY, Hsu CN. Incidence and Risks of Congenital Anomalies of Kidney and Urinary Tract in Newborns: A Population-Based Case-Control Study in Taiwan. Medicine. 2016;95 (5):e2659.

7. Gupta K, Grigoryan L, Trautner B. Urinary Tract Infection. Annals of internal medicine. 2017;167 (7):Itc49-itc64.

8. Kalinderi K, Delkos D, Kalinderis M, Athanasiadis A, Kalogiannidis I. Urinary tract infection during pregnancy: current concepts on a common multifaceted problem. Journal of obstetrics and gynaecology : the journal of the Institute of Obstetrics and Gynaecology. 2018;38 (4):448-53.

9. Waller TA, Pantin SAL, Yenior AL, Pujalte GGA. Urinary Tract Infection Antibiotic Resistance in the United States. Primary care. 2018;45 (3):455-66.

10. Byron JK. Urinary Tract Infection. The Veterinary clinics of North America Small animal practice. 2019;49 (2):211-21.

11. Poggiali IV, Simões ESAC, Vasconcelos MA, Dias CS, Gomes IR, Carvalho RA, et al. A clinical predictive model of renal injury in children with congenital solitary functioning kidney. Pediatric nephrology (Berlin, Germany). 2019;34 (3):465-74.

12. Stonebrook E, Hoff M, Spencer JD. Congenital Anomalies of the Kidney and Urinary Tract: A Clinical Review. Current treatment options in pediatrics. 2019;5 (3):223-35.

13. Daniel M, Szymanik-Grzelak H, Turczyn A, Pańczyk-Tomaszewska M. Lactobacillus rhamnosus PL1 and Lactobacillus plantarum PM1 versus placebo as a prophylaxis for recurrence urinary tract infections in children: a study protocol for a randomised controlled trial. BMC urology. 2020;20 (1):168.

14. Tahir M, Tehzeeb K, Javaid F, Khan UA, Ayyaz A, Usama M. EFFECTS OF ROUTINE PHYSICAL THERAPY WITH AND WITHOUT HIGH INTENSITY INTERVAL TRAINING ON BALANCE, QUALITY OF LIFE AND FUNCTION IN PARKINSON'S DISEASE PATIENTS. Journal of Population Therapeutics and Clinical Pharmacology. 2023;30 (19):483-90.

15. Neugent ML, Hulyalkar NV, Nguyen VH, Zimmern PE, De Nisco NJ. Advances in Understanding the Human Urinary Microbiome and Its Potential Role in Urinary Tract Infection. mBio. 2020;11 (2).

16. Vachvanichsanong P, McNeil EB, Dissaneewate P. Extended-spectrum beta-lactamase Escherichia coli and Klebsiella pneumoniae urinary tract infections. Epidemiology and infection. 2020;149:e12.

17. Akhtar A, Ahmad Hassali MA, Zainal H, Ali I, Khan AH. A Cross-Sectional Assessment of Urinary Tract Infections Among Geriatric Patients: Prevalence, Medication Regimen Complexity, and Factors Associated With Treatment Outcomes. Frontiers in public health. 2021;9:657199.

18. Chenoweth CE. Urinary Tract Infections: 2021 Update. Infectious disease clinics of North America. 2021;35 (4):857-70.

19. Goldberg L, Borovitz Y, Sokolover N, Lebel A, Davidovits M. Long-term follow-up of premature infants with urinary tract infection. European journal of pediatrics. 2021;180 (9):3059-66.

20. Houat AP, Guimarães CTS, Takahashi MS, Rodi GP, Gasparetto TPD, Blasbalg R, et al. Congenital Anomalies of the Upper Urinary Tract: A Comprehensive Review. Radiographics : a review publication of the Radiological Society of North America, Inc. 2021;41 (2):462-86.

21. Khan MT, Shareef F, Farooq U, Tahir A. Impact of Facility Characteristics on Patient Safety, Patient Experience, and Service Availability for Procedures in Hospitals. Pakistan Journal of Rehabilitation. 2022;11 (1):136-44.

22. Brandström P, Hansson S. Urinary Tract Infection in Children. Pediatric clinics of North America. 2022;69 (6):1099-114.

23. Chang JW, Liu CS, Tsai HL. Vesicoureteral Reflux in Children with Urinary Tract Infections in the Inpatient Setting in Taiwan. Clinical epidemiology. 2022;14:299-307.

24. Tahir M, Tariq F, Saeed HW, Nauman M, Usman M, Ali S. Impact of Air Pollution on Respiratory Health of Traffic Wardens in Lahore: Air Pollution and Respiratory Health. The Healer Journal of Physiotherapy and Rehabilitation Sciences. 2023;3 (7):703-9.

25. Karwat MF. [Complicated urinary tract infection]. MMW Fortschritte der Medizin. 2022;164 (4):46-7.

26. Lu J, Liu X, Wei Y, Yu C, Zhao J, Wang L, et al. Clinical and Microbial Etiology Characteristics in Pediatric Urinary Tract Infection. Frontiers in pediatrics. 2022;10:844797.

27. Lu J, Wang L, Wei Y, Wu S, Wei G. Trends and risk factors of extended-spectrum beta-lactamase urinary tract infection in Chinese children: a nomogram is built and urologist should act in time. Translational Pediatrics. 2022;11 (6):859.

28. MURUGAN PP, IYYAN AB. Clinical Profile and Outcome Analysis among Patients with Urosepsis at a Tertiary Care Centre: A Retrospective Cohort Study. Journal of Clinical & Diagnostic Research. 2022;16 (7).

29. Tahir M, Maqsood M, Azhar N, Safdar Z, Amin U, Waheed TS. Association of Knee Pain in Long Standing and Sitting among University Teachers: Association of Knee Pain in University Teachers. The Healer Journal of Physiotherapy and Rehabilitation Sciences. 2023;3 (1):314-21.

30. Ehrlich S, Livni G, Zioni I, Barnea Melamed S, Pasternak Y. Prevalence of Enterococcal Urinary Tract Infections With Positive Nitrites in Urinalysis in Pediatric Patients With High-Risk for Enterococcal Infections. Clinical Pediatrics. 2023:00099228231179937.

31. Fésüs A, Matuz M, Papfalvi E, Hambalek H, Ruzsa R, Tánczos B, et al. Evaluation of the Diagnosis and Antibiotic Prescription Pattern in Patients Hospitalized with Urinary Tract Infections: Single-Center Study from a University-Affiliated Hospital. Antibiotics. 2023;12 (12):1689.

32. Asghar M, Safdar Z, Tahir M. Quality of life and functional Outcomes among Burn Patients: A Cross Sectional Survey. Journal of Health and Rehabilitation Research. 2023;3 (2):293-8.

33. Seraficka A, Stańczyk M, Tkaczyk M. Analysis of bacterial flora of urinary tract infection in hospitalized children with and without congenital urinary tract malformations. Pediatria Polska-Polish Journal of Paediatrics. 2023;98 (3):208-15.