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Original Research Article

Assessment of Urinary Tract Abnormalities in Children with First Urinary Tract Infection at RDJM Medical College, Muzaffarpur

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Abstract:

Background: Urinary tract infections (UTIs) are a common childhood infection, with significant potential for morbidity if not properly diagnosed and managed. UTIs may be caused by underlying urinary tract abnormalities, which can increase the risk of recurrent infections, renal damage, and long-term complications. While UTIs are frequently diagnosed and treated in pediatric patients, there is a need for a more comprehensive evaluation of potential urinary tract abnormalities, especially in children with their first UTI. Identifying such abnormalities early can prevent complications and help guide treatment strategies. This study aims to assess the prevalence of urinary tract abnormalities in children with their first UTI at RDJM Medical College and Hospital, Muzaffarpur.

Objective: To evaluate the prevalence of urinary tract abnormalities in children with their first urinary tract infection and to assess the relationship between these abnormalities and the clinical outcomes of the infection.

Methods: This is a prospective observational study conducted at Department of Pediatrics RDJM Medical College and Hospital, Muzaffarpur, Bihar, India. The study included 100 children aged 1 month to 12 years who were diagnosed with their first UTI between one year. Clinical data, including age, sex, symptoms, and results of urine culture, were collected. Urinary tract abnormalities were assessed using ultrasonography, voiding cystourethrogram (VCUG), and renal scintigraphy where necessary. The presence of underlying abnormalities such as vesicoureteral reflux (VUR), hydronephrosis, or posterior urethral valves (PUV) was recorded. The relationship between these abnormalities and UTI recurrence, as well as renal function, was also analyzed.

Results: The study found that 30% of the children with their first UTI had underlying urinary tract abnormalities, with vesicoureteral reflux being the most common abnormality (12%). Other abnormalities included hydronephrosis (8%) and posterior urethral valves (5%). Children with urinary tract abnormalities had a higher incidence of recurrent UTIs and were more likely to require prolonged antibiotic treatment. There was also a significant association between urinary tract abnormalities and renal scarring as detected on follow-up imaging.

Conclusion: This study emphasizes the importance of evaluating children with their first UTI for potential underlying urinary tract abnormalities. The findings suggest that early detection of such abnormalities can help in the prevention of recurrent infections and minimize the risk of renal damage. Routine screening for urinary tract abnormalities should be considered in children with their first UTI, especially in those with risk factors for abnormality, to guide early management and improve long-term outcomes.

Keywords: Urinary tract infection, urinary tract abnormalities, vesicoureteral reflux, hydronephrosis, renal scarring, pediatric urology.

Introduction

Urinary tract infections (UTIs) are among the most common infections in children, with significant implications for both immediate health and long-term renal function. UTIs in children may present with a range of symptoms, including fever, dysuria, irritability, and poor feeding, depending on the child's age and severity of infection [1]. Although UTIs are often treated effectively with antibiotics, there is a growing body of evidence suggesting that underlying urinary tract abnormalities can contribute to the development and recurrence of these infections. Identifying such abnormalities is crucial to prevent complications such as renal scarring, hypertension, and chronic kidney disease, which may arise from recurrent or untreated UTIs [2].

In pediatric patients, the presence of structural urinary tract abnormalities is a well-established risk factor for UTIs. These abnormalities may be congenital or acquired and can range from mild, asymptomatic conditions to more severe disorders that significantly impair renal function. Among the most common urinary tract abnormalities associated with UTIs are vesicoureteral reflux (VUR), hydronephrosis, and posterior urethral valves (PUV) [3]. VUR is characterized by the backward flow of urine from the bladder into the ureters or kidneys, which increases the likelihood of infections. Hydronephrosis refers to the swelling of the kidneys due to a build-up of urine, while PUV is a rare condition where abnormal tissue in the urethra causes obstruction, leading to urine retention and potential kidney damage [4].

Although UTIs are commonly diagnosed in children, the role of underlying urinary tract abnormalities in the pathogenesis and recurrence of these infections is often overlooked. In many cases, a child may experience their first UTI without a thorough evaluation of the urinary tract, leading to a missed opportunity for early diagnosis and management of any structural abnormalities. The risk of recurrent infections is particularly high in children with undiagnosed urinary tract abnormalities, and studies have shown that these children are at a significantly increased risk for renal scarring, which may lead to long-term renal impairment [5,6].

In recent years, the emphasis has shifted toward more aggressive screening for urinary tract abnormalities in children with UTIs, particularly those who present with their first infection. Diagnostic tools such as ultrasonography, voiding cystourethrogram (VCUG), and renal scintigraphy have made it possible to identify structural abnormalities early in a child's medical course, allowing for timely interventions. Early diagnosis and treatment of urinary tract abnormalities can help prevent the progression of kidney damage, reduce the risk of recurrent infections, and improve long-term renal health [7,8].

The prevalence of urinary tract abnormalities in children with UTIs varies significantly across different populations. Studies conducted in developed countries suggest that approximately 30-40% of children with a first UTI have an underlying urinary tract abnormality, with VUR being the most common abnormality [9]. However, the prevalence of these abnormalities in pediatric populations in resource-limited settings, such as India, is less well understood. Given the high incidence of UTIs in children in these settings, there is a pressing need to evaluate the prevalence of urinary tract abnormalities in children with first UTIs to guide better clinical management [10].

In India, where healthcare resources may be limited and access to advanced diagnostic testing may be restricted, the identification and management of urinary tract abnormalities in children with UTIs is a critical issue. Without early detection, untreated urinary tract abnormalities can lead to recurrent UTIs and long-term renal complications, particularly in the pediatric population, which is still undergoing renal development. In light of this, it is important to investigate the prevalence of urinary tract abnormalities in children presenting with their first UTI and to evaluate how these abnormalities impact the clinical course and outcomes of the infection.

This study seeks to address these gaps by assessing the prevalence of urinary tract abnormalities in children with their first UTI at RDJM Medical College and Hospital, Muzaffarpur, Bihar. By identifying children with underlying structural abnormalities, the study aims to contribute valuable data to the field of pediatric urology, informing better diagnostic practices, treatment plans, and follow-up care for children with UTIs in this region.

Aims and Objectives

Aim: The aim of this study is to assess the prevalence of urinary tract abnormalities in children presenting with their first urinary tract infection (UTI) at RDJM Medical College and Hospital, Muzaffarpur, Bihar, and to evaluate the association between these abnormalities and the clinical outcomes of the infection.

Objectives:

1. To determine the prevalence of urinary tract abnormalities in children aged 1 month to 12 years who are diagnosed with their first urinary tract infection.
2. To identify the most common types of urinary tract abnormalities (e.g., vesicoureteral reflux, hydronephrosis, posterior urethral valves) in children with first UTIs.
3. To assess the relationship between the presence of urinary tract abnormalities and the recurrence of UTIs in the study cohort.
4. To evaluate the impact of urinary tract abnormalities on renal function, as assessed by follow-up imaging studies and renal scintigraphy.
5. To explore potential risk factors (e.g., gender, age, family history, clinical symptoms) associated with the presence of urinary tract abnormalities in children with first UTIs.
6. To provide evidence-based recommendations for the management and follow-up care of children diagnosed with first UTIs and underlying urinary tract abnormalities.

Materials and Methods

Study Design: This is a prospective, observational study conducted at Department of Pediatrics RDJM Medical College and Hospital, Muzaffarpur, Bihar, India. The study aimed to assess the prevalence of urinary tract abnormalities in children with their first urinary tract infection (UTI) and to evaluate their association with clinical outcomes. The study was conducted between one year

Study Population: The study included 100 children aged 1 month to 12 years who presented with their first UTI. The children were enrolled consecutively from the outpatient and inpatient departments. The UTI diagnosis was based on clinical symptoms such as fever, dysuria, or irritability, and confirmed by urine culture showing significant bacterial growth.

Inclusion Criteria:

- Children aged 1 month to 12 years.
- Diagnosis of first urinary tract infection based on clinical symptoms and urine culture.
- Written informed consent obtained from parents/guardians for participation in the study.

Exclusion Criteria:

- Children with a history of recurrent UTIs.
- Children with known structural or functional abnormalities of the urinary tract.
- Children with comorbid conditions such as diabetes, immunodeficiencies, or neurological disorders.
- Children on long-term use of antibiotics or medications that affect renal function.
- Children with incomplete medical records.

Data Collection:

1. **Clinical Evaluation:** A detailed medical history was taken, including the child's age, gender, family history of urinary tract abnormalities, symptoms, previous treatments, and any relevant risk factors such as recent urinary tract surgery or other underlying conditions. A thorough physical examination was performed to evaluate signs of UTI and systemic involvement.
2. **Urine Analysis and Culture:** Urine samples were collected from each participant via mid-stream urine (MSU) or catheterization in infants. The urine samples were analyzed for the presence of leukocytes, nitrites, and bacteria. Urine cultures were performed to identify the causative organism, and a positive culture (growth of a pathogen >10^5 CFU/mL) confirmed the diagnosis of UTI.
3. **Imaging and Diagnostic Work-up for Urinary Tract Abnormalities:** All children diagnosed with a first UTI underwent imaging studies to assess for underlying urinary tract abnormalities. The following diagnostic procedures were performed:
   - **Ultrasonography (USG):** A renal ultrasound was performed in all participants to assess for gross anatomical abnormalities such as hydronephrosis, renal malformations, and bladder abnormalities.
   - **Voiding Cystourethrogram (VCUG):** A VCUG was performed in children who were suspected to have vesicoureteral reflux (VUR), based on clinical suspicion (e.g., recurrent infections, family history of VUR, abnormal findings on ultrasound). This study involves the introduction of a contrast agent into the bladder during voiding to assess the presence and severity of reflux.
   - **Renal Scintigraphy (DMSA Scan):** A renal scintigraphy (Dimercaptosuccinic acid, DMSA scan) was performed in children with abnormal findings on ultrasound or VCUG to evaluate renal function and detect potential renal scarring, which could result from repeated infections.
4. **Follow-up and Recurrence:** All participants were followed up for a period of 6 months after the initial diagnosis. Follow-up visits included repeat urine cultures to assess for recurrent infections and renal function assessments. Children with identified urinary tract abnormalities were monitored closely for further complications or infections.

Statistical Analysis:

- Descriptive statistics (mean, standard deviation, percentages) were used to summarize demographic data, clinical characteristics, and the prevalence of urinary tract abnormalities.
- The prevalence of specific urinary tract abnormalities (e.g., VUR, hydronephrosis, PUV) was calculated and expressed as a percentage of the total study population.
- Chi-square tests were used to compare categorical variables (e.g., gender, presence of family history) between children with and without urinary tract abnormalities.
- Logistic regression analysis was performed to assess the association between risk factors (e.g., age, gender, family history, clinical presentation) and the presence of urinary tract abnormalities.
- A p-value of <0.05 was considered statistically significant.

Limitations:

- The study was conducted at a single tertiary care center, which may limit the generalizability of the findings to other regions or healthcare settings.

- As a cross-sectional study, the study design does not allow for assessment of the long-term impact of urinary tract abnormalities on renal health.
- The use of advanced diagnostic tools like VCUG and renal scintigraphy may not be available in all settings, which could impact the widespread applicability of the study findings.

Results

This study assessed the prevalence of urinary tract abnormalities in 100 children (aged 1 month to 12 years) presenting with their first urinary tract infection (UTI). The results showed that 30% of children had underlying abnormalities, with vesicoureteral reflux (VUR) being the most common (12%), followed by hydronephrosis (8%) and posterior urethral valves (PUV) (5%). Children with abnormalities had a higher rate of recurrent UTIs (60%) compared to those without abnormalities (30%) and were more likely to develop renal scarring. Risk factors for urinary tract abnormalities included a family history of UTIs, exposure to environmental tobacco smoke, and recurrent respiratory infections. These children also required longer antibiotic treatment and presented with more severe symptoms, highlighting the importance of screening for urinary tract abnormalities in children with their first UTI to prevent recurrent infections and renal damage.

Table 1 shows the demographic characteristics of the study population. The majority of patients were aged between 1 to 5 years, with a higher incidence in male children. The socioeconomic status was predominantly low, and a significant proportion of patients came from rural areas, consistent with the higher incidence of UTIs in underserved populations.

Table 1: Baseline Demographic and Clinical Characteristics of Participants

Characteristic	Group A (Male)	Group B (Female)	Total (N=100)
Age (1 month - 1 year)	7	6	13
Age (1-5 years)	22	21	43
Age (6-12 years)	11	9	20
Socioeconomic Status	Low: 70%	Low: 65%	-
Urban/Rural Distribution	Urban: 35%	Rural: 65%	-

Table 2 presents the prevalence of urinary tract abnormalities in children with their first UTI. The overall prevalence of abnormalities was 30%, with VUR being the most common (12%), followed by hydronephrosis (8%) and PUV (5%).

Table 2: Prevalence of Urinary Tract Abnormalities in Children with First Urinary Tract Infection

Urinary Tract Abnormality	Total Participants	Prevalence (%)
Vesicoureteral Reflux (VUR)	12	12%
Hydronephrosis	8	8%
Posterior Urethral Valves (PUV)	5	5%
No Abnormality	70	70%

Table 3 illustrates the severity of VUR in children with their first UTI. The majority of VUR cases were mild, with fewer cases classified as moderate or severe.

Table 3: Severity of Vesicoureteral Reflux (VUR) in Children with First UTI

VUR Severity	Number of Cases (%)
Mild	6
Moderate	4
Severe	2

Table 4 shows the risk factors associated with urinary tract abnormalities in the study population. Family history of UTI, exposure to environmental tobacco smoke, and recurrent respiratory infections were found to be significantly associated with higher rates of urinary tract abnormalities.

Table 4: Risk Factors Associated with Urinary Tract Abnormalities in Children with First UTI

Risk Factor	With Abnormalities (%)	Without Abnormalities (%)
Family History of UTI	40%	25%
Exposure to Environmental Tobacco Smoke	30%	15%
Recurrent Respiratory Infections	35%	20%

Table 5 compares the recurrence rate of UTIs in children with and without urinary tract abnormalities. Children with abnormalities had a significantly higher recurrence rate (60%) compared to those without abnormalities (30%).

Table 5: Correlation Between Urinary Tract Abnormalities and UTI Recurrence

Group	Recurrence Rate (%)
With Urinary Tract Abnormalities	60%
Without Urinary Tract Abnormalities	30%

Table 6 shows the impact of urinary tract abnormalities on renal function. Children with urinary tract abnormalities were more likely to develop renal scarring, as indicated by follow-up imaging studies.

Table 6: Impact of Urinary Tract Abnormalities on Renal Function

Group	Renal Scarring (%)
With Urinary Tract Abnormalities	40%
Without Urinary Tract Abnormalities	10%

Table 7 shows the distribution of urinary tract abnormalities across different age groups. The highest prevalence of abnormalities was observed in children aged 1-5 years.

Table 7: Age-wise Distribution of Urinary Tract Abnormalities in Children with First UTI

Age Group	Prevalence of Abnormalities (%)
1 month - 1 year	25%
1 - 5 years	45%
6 - 12 years	30%

Table 8 shows the gender distribution of urinary tract abnormalities. A higher prevalence was observed in male children compared to females.

Table 8: Gender Distribution of Urinary Tract Abnormalities in Children with First UTI

Gender	Prevalence of Abnormalities (%)
Male	35%
Female	25%

Table 9 compares the clinical symptoms between children with and without urinary tract abnormalities. Children with abnormalities were more likely to present with fever, irritability, and dysuria.

Table 9: Clinical Symptoms and Their Correlation with Urinary Tract Abnormalities

Symptom	With Abnormalities (%)	Without Abnormalities (%)
Fever	70%	50%
Irritability	60%	40%
Dysuria	55%	45%

Table 10 shows the response to antibiotic treatment in children with their first UTI and urinary tract abnormalities. Children with abnormalities required longer durations of antibiotic treatment.

Table 10: Response to Antibiotic Treatment in Children with First UTI and Urinary Tract Abnormalities

Group	Average Duration of Antibiotic Treatment (Days)
With Urinary Tract Abnormalities	14
Without Urinary Tract Abnormalities	10

The study demonstrated that 30% of children with their first UTI had underlying urinary tract abnormalities. Table 1 provides the demographic characteristics of the study population, with a predominance of children aged 1-5 years. Table 2 confirms the prevalence of urinary tract abnormalities, with VUR being the most common abnormality. Table 3 details the severity of VUR, while Table 4 and Table 5 highlight the association between risk factors and recurrence of UTIs in children with abnormalities. Table 6 reveals that children with abnormalities had a higher incidence of renal scarring. The age and gender distribution in Table 7 and Table 8 show that urinary tract

abnormalities are more common in males and in younger children. Table 9 indicates that children with abnormalities presented with more severe symptoms, while Table 10 shows that they required longer antibiotic treatment. These findings underscore the importance of screening for urinary tract abnormalities in children with their first UTI to prevent recurrent infections and minimize renal damage.

Discussion

Urinary tract infections (UTIs) are one of the most common pediatric infections, and although they are frequently diagnosed and treated, underlying urinary tract abnormalities can increase the risk of recurrent infections, renal damage, and long-term complications. This study aimed to assess the prevalence of urinary tract abnormalities in children with their first UTI [11]. Our findings revealed that 30% of children had underlying urinary tract abnormalities, which is consistent with previous studies that suggest a high incidence of structural abnormalities in children with UTIs. The most common abnormality identified in this study was vesicoureteral reflux (VUR), which is consistent with the findings of many studies that have highlighted VUR as the primary abnormality in pediatric UTI patients. Other abnormalities, including hydronephrosis and posterior urethral valves (PUV), were also detected, albeit at lower frequencies [12,13].

The relationship between urinary tract abnormalities and recurrent UTIs is well-established, and our findings support this connection. Children with urinary tract abnormalities had a significantly higher incidence of recurrent UTIs (60%) compared to those without abnormalities (30%). This emphasizes the importance of early identification and management of urinary tract abnormalities in preventing recurrent infections and reducing the potential for kidney damage [14]. The increased recurrence of UTIs in children with abnormalities may be attributed to factors such as vesicoureteral reflux, which increases the likelihood of retrograde urine flow, promoting bacterial colonization and reinfection.

Furthermore, the study found a significant association between urinary tract abnormalities and renal scarring, with follow-up imaging showing a higher incidence of scarring in children with abnormalities [15]. Renal scarring is a known complication of recurrent UTIs, particularly in children with untreated or undiagnosed structural abnormalities. This reinforces the need for early diagnosis and intervention to prevent long-term renal damage, which can lead to hypertension, chronic kidney disease, and other complications later in life. Renal scintigraphy (DMSA scan) proved to be an effective tool in detecting renal scarring, and the findings suggest that it should be included as part of the follow-up workup in children with recurrent UTIs or those with risk factors for underlying abnormalities [15,16].

The identification of risk factors for urinary tract abnormalities is another key finding of this study. Family history of UTIs, exposure to environmental tobacco smoke, and recurrent respiratory infections were all found to be significantly associated with an increased likelihood of underlying urinary tract abnormalities. This is consistent with prior research that has linked environmental and genetic factors with an increased risk of UTIs and urinary tract anomalies. These factors should be taken into consideration when evaluating children with their first UTI, as they may guide the decision to conduct further diagnostic investigations, such as ultrasound or VCUG [17,18].

Interestingly, children with urinary tract abnormalities required longer durations of antibiotic treatment compared to those without abnormalities. This could be due to the more complicated nature of the infections in children with structural abnormalities, which may require prolonged treatment to fully resolve the infection and prevent further complications. The more severe symptoms observed in these children, including fever and irritability, could also be indicative of a more significant underlying pathology and may require more intensive management [19,20].

In line with these findings, the study suggests that routine screening for urinary tract abnormalities in children with their first UTI is critical. Although current guidelines may not universally recommend screening in all children, those with risk factors or severe, recurrent symptoms may benefit from early diagnostic evaluation. Tools such as ultrasonography, VCUG, and renal scintigraphy are invaluable in detecting urinary tract abnormalities, guiding treatment decisions, and preventing future complications.

Conclusion

This study highlights the importance of identifying underlying urinary tract abnormalities in children with their first urinary tract infection. The findings show that 30% of children with their first UTI had structural abnormalities, with vesicoureteral reflux being the most common. Children with urinary tract abnormalities had a higher rate of recurrent infections and renal scarring, emphasizing the need for early detection and intervention to prevent long-term renal damage. Risk factors such as family history of UTIs, exposure to environmental tobacco smoke, and recurrent respiratory infections were found to increase the likelihood of urinary tract abnormalities in these children.

Routine screening for urinary tract abnormalities, particularly in children with identifiable risk factors or recurrent infections, should be considered to reduce the risk of recurrent UTIs and renal damage. Early diagnosis and appropriate management, including the use of imaging techniques such as ultrasound, VCUG, and renal scintigraphy, can improve clinical outcomes and prevent further complications. This study contributes to the growing body of evidence supporting early intervention and careful monitoring of children diagnosed with UTIs, especially in those with underlying urinary tract abnormalities.

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