Clinical and laboratory features of urinary tract infection in hospitalized children

Sang Ayu Prabha Amandari Sutyandi¹*, Gusti Ayu Putu Nilawati¹, Bagus Ngurah Mahakrishna¹, I Made Karma Setiyawan¹

ABSTRACT

Background: Urinary tract infections (UTIs) is a common infection in children and a significant problem in Indonesia. Epidemiological data in developing countries are not widely available. This study aimed to determine the clinical and laboratory features of UTIs in hospitalized children.

Methods: A retrospective study at a tertiary hospital in Denpasar–Bali. Children diagnosed with UTIs from January 1⁰, 2021–December 3¹, 2022 were enrolled. Subjects are characterized based on age, nutritional status, and comorbidities. Clinical and laboratory features were described.

Results: There were 84 children diagnosed with UTIs. A total of 30 subjects (35.7%) were <1–year-old and mostly female (52.4%). Most subjects (47.6%) were well–nourished and had comorbidities (92.9%) from a non–kidney disease (65.5%). Eight (9.5%) of the 52 subjects had hypertension. The most common symptom in the < 1–year–old group was jaundice (50%). The predominant symptom in the 1–5–year–old group was also fever (71.4%). Localized symptoms in the > 5–year–old groups showed dysuria (38.5%), urinary retention (30.8%), and frequency (26.9%). Urinalysis showed 30 subjects (35.7%) with positive nitrites and pyuria (66.7%). Leukocytosis was found in 24 subjects (72%) with a median NLR of 1.8. Abnormalities found in imaging examinations were cystitis (19.2%), hydronephrosis (42.1%), and hydrourerter (11.5%).

Conclusion: Age < 1–year–old, female, had comorbidities with predominant symptom was fever found in hospitalized UTIs. Half of the subjects had leukocytosis, abnormalities in urinalysis, and urology imaging. However, further research is needed to know the association and risk factors for UTIs in hospitalized children.

Keywords: Children, Symptoms, Urinary Tract Infection.


INTRODUCTION

Urinary tract infections (UTIs) is a common infections in febrile children.¹,² Several studies have reported the varying prevalence rates of UTI in children, which range from 11 to 30%, in many developing countries such as Africa, Asia, and the Middle East.²,³ National data on the epidemiology of pediatric UTIs in Indonesia has not been found. Regional studies in Indonesia found at the Cipto Mangunkusumo Hospital–Jakarta, 2004, in a period of seven months, 50 children were treated with UTIs, consisting of 28 boys and 22 girls, with the age distribution between two months and 13 years.⁴ The prevalence of UTIs varies in young infants, toddlers, and older adolescents.¹,²,⁶

Not all children who suffer UTIs require hospitalization. There needs to be more evidence regarding the clinical characteristics of UTIs in hospitalized children, either with complications or the complex conditions accompanying the UTIs.⁷,⁹ Understanding clinical and laboratory feature variations will significantly assist health workers in preventing, detecting, and managing UTIs. Epidemiological data specific to a particular population is needed and limited, especially in Bali. Based on the differences in findings, it is necessary to conduct research based on the setting and characteristics of each region. This descriptive study aims to determine the characteristics of UTIs in hospitalized children at Prof. dr. I G.N.G. Ngogerah General Hospital, Denpasar–Bali.

METHODS

Research and design
This was a retrospective descriptive study that used a cross–sectional design. We reviewed secondary data from the medical records of hospitalized children with UTIs in the Department of Pediatric, Universitas Udayana/Prof. dr. I G.N.G. Ngogerah General Hospital from January 1⁰, 2021, until December 3¹, 2022.

Research subjects and data collection
UTIs were defined as the growth and reproduction of micro bacteria in the urinary tract and established through urine culture with a significant number of colonies > 10⁵ CPU/ml; Samples of urine culture processed with Vitel 2 system (BacT/ALERT®, bioMérieux, France) in
Microbiology Laboratory Prof. dr. I G.N.G. Ngoerah General Hospital. The samples were all children aged 0-18 years admitted and fulfilled the inclusion-exclusion criteria. The inclusion criteria was the final diagnosis of UTI based on the medical record. The missing/incomplete medical record was excluded. Data collection was carried out from the registry of the Nephrology Division; the total sample is 84 subjects.

**Statistical analysis**

Collected data were analyzed using the SPSS program for Mac version 23.0. Univariate analysis was reported in the table of frequency distribution and percentage.

**Results**

In almost two years, eighty–four cases were diagnosed as UTIs. Forty–four were females (52.4%) and mostly were in the < 1–year–old group. Most subjects (47.6%) were well–nourished and had comorbidities (92.9%) from a non-kidney disease (65.5%); there were malignancies (38.1%), extrahepatic cholestatic (23.6%), and others. Eight (9.5%) of the 52 subjects with measured blood pressure had hypertension. Administration of antibiotics before urine analysis was found in a third (33.3%) of subjects (Table 1).

UTI clinical symptoms in this study were categorized into localized and systemic, largely dependent on age (Table 2). From the results of this study, in the < 1–year–old group, the most common symptoms were systemic symptoms such as jaundice (50%). The predominant symptom in the 1–5-year-old group was fever (71.4%), while local symptoms were dysuria (42.9%), irritation/inflammation in genitalia (17.9%), and hematuria (14.3%). In the > 5-year-old group, systemic symptoms also predominate with fever (65.4%), gastrointestinal discomfort (30.8%), and local symptoms showed dysuria (38.5%).

The results of urinalysis showed that one–third of the subjects were found with positive nitrates (35.7%), most of them had pyuria (66.7%), without hematuria (51.2%) and proteinuria (66.5%) (Table 3). From routine blood analysis, leukocytosis was found in almost all subjects (72%); the leucocytes average 13.3±1.28 x10^3/uL, and a median NLR of 1.8 (0.11–16.2). Imaging of the urinary tract was examined in 20 subjects (23.8%); five patients (25%) were found with normal results, and the most abnormalities of the urinary tract found were cystitis (19.2%), hydronephrosis (42%), and hydroureter (11.5%).

**Discussion**

Symptoms of UTIs are extensive depending on age, the inflammatory reaction, and the location of the infection. Factors contributing to the high incidence of UTIs in children are non–specific clinical symptoms, lack of understanding...
of the high mortality and the spectrum of microorganisms associated with UTI. American Academy of Pediatrics (AAP) in hospital–treated children under one year old found the prevalence of UTI in 6.5% of girls and 3.35% of boys. A study at Cipto Mangunkusumo Hospital, Jakarta conducted on 50 children with UTIs that the incidence of UTIs in the female group increased two times more than in males due to the short urethra. In this study, nutritional status showed a higher trend among malnourished children. The causes of the differences remain unclear; one possible reason was differences in the research methodology. UTIs can decrease the nutritional status because metabolism increases, and decreased appetite, diarrhea, nausea, and vomiting affect intake.13–16

Babaeva et al. examined 64 children with UTIs and 60 healthy children in Tajikistan.17 They found that the mean arterial blood pressure in UTI children was significantly higher. In this study, fifty–two samples were evaluated for blood pressure at least once, and eight patients (9.5%) with hypertension were found. The daily cases encountered at a single–centre tertiary hospital were quite complex, and almost all patients had previous comorbidity; only six (7.1%) patients with UTIs were non–comorbid. Kidney disease (27.4%) and malignancy (25%) were the most common comorbidities. Children with a history of multiple UTIs are probably at increased risk of developing hypertension, and their blood pressure should be monitored closely. In this study, we did not rule out the causation possibility of comorbidities with increased blood pressure.

Fever was the only clinical symptom in children aged two months–two years old with UTIs; other symptoms are sometimes found. Complaints of pain and frequent voiding are rarely found in children aged <2 years old, while flank or lower back pain was more common in children aged >5 years old.18 A series study in Australia described the clinical features of 305 children younger than five years old with symptomatic UTIs at an emergency department. The most commonly reported symptoms were also fever (80%), irritability (52%) and anorexia (49%). Less common symptoms (20%) in children were dysuria, urine retention, frequency, and haematuria.19 In this study, the five most common clinical symptoms in this study were fever (60.7%), dysuria (31%), jaundice (26.2%), gastrointestinal discomfort (nausea, vomiting, abdominal pain, or constipation) (17.9%), and difficulty voiding (16.7%). There were differences in the frequencies of clinical symptoms when we categorized them by age group.

From the urinalysis, hematuria, and leukocyturia>5/hpf can occur in UTIs.6,11,18 A study from Schroeder et al.18 concluded that only 39% of nitrites were positive in UTI. Similar research at Kebumen Hospital, Central Java, found that only 9% of patients had pyuria, and 14% had bacteriuria in children with UTIs.19 Chrishty et al. from the cross-sectional study, was conducted with positive for leukocyte esterase and nitrite urine of UTI with a cut-off of 15.70 leukocytes/hpf, and the sensitivity (SE) was 98.33%.20 According to the AAP, a wide range of reports on urinalysis results exist.21 In this study, twenty–eight (33.3%) cases had a history of being given antibiotics before admission at an emergency department. The most common symptoms when we categorized them by age group.

Table 3. Laboratory profile and imaging examination of the subjects

<table>
<thead>
<tr>
<th>Variable</th>
<th>UTIs</th>
</tr>
</thead>
<tbody>
<tr>
<td>Routine urinalysis*</td>
<td></td>
</tr>
<tr>
<td>Positive</td>
<td>30</td>
</tr>
<tr>
<td>Negative</td>
<td>54</td>
</tr>
<tr>
<td>Pyuria (n,%):</td>
<td></td>
</tr>
<tr>
<td>Yes</td>
<td>56</td>
</tr>
<tr>
<td>No</td>
<td>28</td>
</tr>
<tr>
<td>Leucocytes (sediment/HPF), median (min–max)</td>
<td>8</td>
</tr>
<tr>
<td>Routine blood analysis**:</td>
<td></td>
</tr>
<tr>
<td>Yes</td>
<td>24</td>
</tr>
<tr>
<td>No</td>
<td>9</td>
</tr>
<tr>
<td>Leucocytes (x10³/uL), mean±SD</td>
<td>13.3±1.28</td>
</tr>
<tr>
<td>Neutrophil-to-Lymphocyte ratio, median (min–max)</td>
<td>1.8 (0.11–16.2)</td>
</tr>
<tr>
<td>Imaging/ radiology examination***, (n,%):</td>
<td></td>
</tr>
<tr>
<td>Yes</td>
<td>20</td>
</tr>
<tr>
<td>Abnormal</td>
<td>5</td>
</tr>
<tr>
<td>Cystitis</td>
<td>5</td>
</tr>
<tr>
<td>Hydronephrosis</td>
<td>11</td>
</tr>
<tr>
<td>Hydroureter</td>
<td>3</td>
</tr>
<tr>
<td>Contracted kidney</td>
<td>3</td>
</tr>
<tr>
<td>Vesicoureteral reflux</td>
<td>2</td>
</tr>
<tr>
<td>Others</td>
<td>2</td>
</tr>
<tr>
<td>No</td>
<td>64</td>
</tr>
</tbody>
</table>

*Calculated in 84 samples; ** in 32 samples; *** in 20 samples
on the volume of urine, duration of urine circulation, and the examiner’s qualified.21

Our national guidelines recommend that imaging examinations in children with UTIs be divided by age and prioritize non-respond UTIs to antibiotics within 48 hours, atypical and recurrent UTIs.17

In this study, the results of urology imaging (there are: urology ultrasound, bilateral voiding urethrocystography, intravenous pyelogram, voiding cystourethrogram, antegrade pyelography, and urethrocystography) examined in the 20 cases (23.8%), the result obtained normal (25%) and abnormalities found were cystitis (19.2%), mild and moderate hydronephrosis (15.3%), severe hydronephrosis and hydrourater (11.5%), contracted kidney (11.5%), vesicoureteral reflux (VUR) (7.6%), others finding one case in double collecting system and vesicolithiasis. However, an imaging examination was not performed for our patients, and the case reported may be a selection bias.

There were some limitations in our study that our findings may not generalize the pediatric population in UTIs. Our criteria for defining UTIs may restrict the number of cases included, because it is excluded due to negative or low colony count on urine cultures that are likely the result of over-the-counter antibiotic use before the culture was taken. Furthermore, limited data on medical records could cause confounding bias. Differences in findings of UTIs can lead to uncertainty and misunderstanding regarding the management of UTIs. This research data can support the baseline of UTI findings, especially in hospitalized patients, and become the preliminary study for further research.

CONCLUSION

The UTIs in hospitalized children were more common among females, below the age of 1 year old and had comorbidities. The predominant clinical symptom of UTI was fever. Other symptoms can be found in jaundice and gastrointestinal discomfort. Localized symptoms were more common at the age of more than 5 years old. Only a subset of children has abnormalities on urinalysis, complete blood count, and imaging according to diagnosis of UTIs. Further research on primary data, a larger sample size, and a cohort design study are needed to obtain representative data and to know the association and other risk factors of UTIs among children.

ETHICAL APPROVAL

This study is approved by The Ethics Committee of Medical Faculty, Universitas Udayana, Prof. dr. I G.N.G. Ngorah General Hospital, with ethical approval no. 2188/UN14.2.2/VII.14/IT/2022 and research police no. LR.02.01/XIV.2.2/55517/2022.

CONFLICT OF INTEREST

None declared.

AUTHOR CONTRIBUTIONS

All authors are contributing to the study from the conceptual, data analysis and the results through publication. The authors would like to thank all participants in this study and all the staff of the Department of Pediatric, Medical Faculty, Universitas Udayana/ Prof. dr. I G.N.G. Ngorah General Hospital.

FUNDING

This research did not receive any specific grant from funding agencies in the public, commercial, or not-for-profit sectors.

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