Clinical Aspects and White Blood Cell Count in Children with Urinary Tract Infection

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ABSTRACT The purpose of this study was to evaluate the clinical aspects and to count white blood cells in attempt to find simple parameters to predict urinary tract infection (UTI) prospectivecaly. Twenty four children with pyuria were studied, the history of clinical symptoms of urinary tract infection and blood leucocyte count were obtained. Local symptoms was the commonest symptom found in this study (87.5%), followed by fever (75.0%). If urine culture was taken as the gold standard, the predictive value of positive local symptoms with pyuria to urinary tract infection was 76.19%, sensitivity 88.88% and specificity 16.66%. The predictive value of history of fever with pyuria ti urinary tract infection was 76.47%, sensitivity 72.22% and specificity 33.33%. The predictive value of leucocytosis with pyuria to urinary tract infection was 76.47%, sensitivity 72.22% and specivicity 33.33%. Meaning that the local symptoms, fever or leucocytosis with pyuria were not a good tool for the diagnosis of urinary tract infection, but probably useful as a screening procedure to distinguish the posibility of urinary treat infection. **(Paediatr Indones 1999; 39:38-46)**

Introduction

The term urinary tract infection (UTI) denotes infection within the urinary tract and encompasses both renal parenchymal infection and infection of the urinary bladder.[1] Rapid diagnostic and treatment are essential in order to preserve renal function and prevent permanent damage. Unfortunately, in most cases symptoms of UTI vary significantly with the patients age and the location of the infection within the urinary

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tract.[2-4] Preschool and school-age children with symptomatic UTI generally have "classic" sign/symptoms localized to the urinary tract including dysuria, urgency, and increased frequency of urination. Dysuria, however, can also be seen as a manifestation of conditions other than UTI, such as vaginitis, urethritis, or pinworm infection.[5,6] The presence of flank pain, fever, chills, and costovertebral tenderness suggests that the patient has upper urinary tract involvement or acute pyelonephritis.[2]

Laboratory investigations of children with UTI may vary from one center to another. The first and one of the simplest to be undertaken in child with suspected UTI is to perform urinalysis, especially the examination of urinary sediment. Pyuria or excretion of an increased number of white blood cells is considered to be presumptive UTI.[2,7] Urine culture is critical to confirm the diagnosis, but this procedure need few days to obtained the result.[8] Recognition of clinical symptoms and simple laboratories may be useful, during the result of urine culture was not accepted. The purpose of this study is to evaluate the clinical aspects and to count white blood cells in attempt to find simple parameters to predict UTI.

Methods

All patients with pyuria were admitted to Subdivision of Nephrology, Department of Child Health-Medical School, University of Udayana/Denpasar General Hospital during the period of June 1996-July 1997 were eligible for enrollment in this prospective study. All patients had urinalysis result at time of admission. Specimens for urinalysis were obtained by clean-voided procedure. The history of all symptoms were taken from parents. All patients underwent routine blood examination (especially leukocyte count), urine culture procedure and some radiological examination such as plain photo of abdomen. Intravenous pyelography (IVP) or advance radiological examinations were done in selective case.

Data of gender, age, rash and all of patient's complaint including physical findings and laboratories result were collected by using a form which had been prepared. Clinical symptoms of UTI were noted, including fever (body temperature of 38.5o or more), local symptoms, include suprasymphiser/abdominal pain, dysuria, frequency, hematuria, GI tract symptoms, include vomiting, diarrhea, constipation, poor feeding, and CNS symptoms include irritability, headache.

Blood samples for leukocyte measurement were obtained from antecubital venous puncture. Leukocytosis: if observed white blood cells more than 10,000/dL on routine blood examination. Culture of urine was done as soon as possible before antibiotic therapy. Urine specimens for culture were obtained by suprapubic aspiration and sent in special media to General Hospital Laboratory. Positive of urine culture is defined when:[9] Gram-negative bacilli: any number of colony count; Gram-positive cocci greater than a few thousand. Pyuria: defined as increasing white blood cells in urine more

than 10 cells per high power field visualized by light microscope in a centrifuged urinary sediment.[2,7] UTI was defined if a positive urine culture is found.

No patients had been treated with antibiotic before admission. Antibiotic therapy was given after suprapubic aspiration was done. All patients were treated with cotrimoxazole before the bacterial result had been received. After urine culture results had been received, treatment was adjusted to the sensitivity result. The treatment was considered successful if the pyuria did not exist in three consecutive days after treatment. In patients with delay healing, progressive evaluation is performed to find out anatomic or functional abnormalities.

All data were plotted in table and chi square analysis is used compare the variables. A comparison was made between the clinical symptoms, white blood cells count and positive urine culture using sensitivity, specificity and predictive value.

Results

During a period of 13 months, 24 patients with clinical symptoms of UTI and pyuria were eligible for enrollment in this study. The mean age of the patients was 35.6 months (range: 5 months and 12 years old) and 17 (71%) were girls and 7 (29%) were boys making the sex ratio of 2.4:1.

Table 1. Distribution of patient's age in relation to gender

Age group (months)	Boy	Girl	Total
<24	2	7	9 (38%)
24-60	3	9	12 (50%)
>60	2	1	3 (12%)
Total	7 (29%)	17 (71%)	24 (100%)

As seen in Table 1 it seems that children between 24 and 60 months were the most affected. Table 2 showed that 29% of this children had a poor weight gain and more girls were affected than boys.

All of 24 patients have some symptoms refer to the UTI, however the symptoms vary among patients. The most common symptom in this study was local symptoms close to urinary tract complaints (88% of all cases), followed by fever (75%), CNS complaints (29%) and gastrointestinal complaints (25%) (showed in Table 3).

Distribution of clinical symptoms based on age showed in Tables 4 and 5.

Table 2. Nutritional status in relation to gender

	Undernourished	Well-nourished	Total
Boys	1	6	7
Girls	6	11	17
Total	7 (29%)	17 (71%)	24

df=1, x^2=2.09, p >0.05

Table 3. Clinical and laboratory of pyuric patients

Symptoms	n	%
Local symptoms	21	88
Fever	18	75
CNS symptoms	7	29
GI tract symptoms	6	25
Leukocytosis	17	71
Positive urine culture	18	75

Table 4. Frequency of fever based on age of patients

Age group (months)	n	%
<24	8	44
24-60	9	50
>60	1	6
Total	18	100

Fever was found in younger than older children (Table 4). In contrast to local symptoms that was found in older children (Table 5). If urine culture was taken as the gold standard, 16 out of 18 children with pyuria and positive urine culture had positive local symptoms made the sensitivity 89% and 1 out of 6 children with pyuria and negative urine culture had negative local symptoms made the specificity 17%. Positive predictive value of local symptoms to positive urine culture was 76%.

Table 5. Frequency of local symptoms based on age of patients

Age	n	%
<24 months	7	33
24-60 months	11	52
>60 months	3	14
Total	21	100

Table 6. Predictive value of local symptoms to positive urine culture

Local symptoms	culture (+)	culture (-)	Total
Positive	16	5	21
Negative	2	1	3
Total	18 (75%)	6 (25%)	24 (100%)

Sensitivity = 16/18 x100% = 89%
Specificity = 1/6x100% = 17%
Positive predictive value: 16/21x100% = 76%

Table 7. Predictive value of fever to positive urine culture

Fever	culture (+)	culture (-)	Total
Positive	13	4	17
Negative	5	2	7
Total	18 (75%)	6 (25%)	24 (100%)

Sensitivity = 13/18x100% = 72%
Specificity = 2/6x100% = 33%
Positive predictive value = 13/17x100% = 76%.

Thirteen out of 18 children with pyuria and positive urine culture had fever, making the sensitivity of 72%, and 2 out of 6 children with pyuria and negative urine

culture did not show fever, so that the specificity was 33%. Positive predictive value of fever to positive urine culture was 76%.

Table 8. Predictive value of leukocytosis to positive urine culture

Leukocytosis	Culture (+)	Culture (-)	Total
Positive	13	4	17
Negative	5	2	7
Total	18	6	24

Sensitivity = 13/18x100%=72%
Specificity = 2/6x100%=33%
Positive predictive value = 13/17x100%=76%

Laboratory examinations showed, leukocytosis was found in 17 cases (71%). Thirteen out of 18 children with pyuria with positive urine culture had leukocytosis in peripheral blood, made the sensitivity was 72% and 4 out of 6 children with pyuria with negative urine culture did not showed leukocytosis, made the specificity 17%. Positive predictive value of leukocytosis to positive urine culture was 76%.

Table 9. Bacteriological pattern of urine cultures

Organism	Total
E. coli	12 (67%)
Klebsiella Sp	3 (17%)
Staphylococcus	2 (11%)
Enterobacter Sp	1 (6%)
Total	18(100%)

Positive urine culture was found in 18 children (75%), with *E. coli* as a commonest organism (67%). The bacteriological pattern of urine culture was showed in Table 9. All patients underwent plain photo of abdomen. Twenty-three children had normal result, but one patient showed multiple stones in both Kidneys. In this patient, IVP was performed and final diagnosis was pyonephrosis.

Twenty-three out of 24 children (94%) healed completely, and one patient who

suffered from pyonephrosis underwent unilateral (left) nephrectomy. This patient showed recurrent pyuria and was nder close follow-up by the Department of Surgery.

Discussion

Urinary tract infection (UTI) is one of the commonest diseases in children. These bacterial urinary infections are potentially dangerous not only because they may present as life-threatening episodes with serious prognosis, but also because they may be the forerunners of severe renal disease of adulthood. So, early diagnosis and treatment are essential.[4]

In the beginning of the 20th century, there was a mortality of about 20% among neonates and infants with acute UTI. Although there is any declining in mortality due to advent of antibiotics, UTI is still the second commonest infection behind respiratory tract infections.[1,2] Of 7-year-old school entrants in Goteborg, Sweden, 7.8% of the girls and 1.6% of the boys had had symptomatic UTIs verified by urine culture.

In the neonatal period, UTI may present with such nonspecific symptoms as slow weight gain, temperature instability, feeding difficulties, irritability, vomiting, abdominal distention, and jaundice. Sepsis is a common accompaniment in neonates, and positive blood cultures with a congruence of urinary and blood bacteriologic isolates are seen in 30 percent of cases.[2-4]

Symptoms of UTI in infants less than 2 year of age but beyond the neonatal period are also somewhat nonspecific; they may consist of fever, irritability, a sickly appearance, refusal of food, vomiting and diarrhea. Jaundice and abdominal distention may also be seen. Local symptoms such as urgency, frequency and dysuria may be absent or not appreciated, although the parents or other caretaker may note malodorous urine.[2] The diagnosis is usually made because evaluation of the urine tract is part of the work-up of the infant with unexplained fever or failure to thrive.

Infection of the urinary tract in children vary in symptoms, may be asymptomatic or may present atypically with symptoms impossible to differentiate from the irregular voiding patterns associated with immaturity. Neonates and infants less than 2 year usually show atypical symptoms.[3] Neonates with systemic symptoms and significant bacteriuria often has bacteremia and resembles the infant with 'clinical sepsis'. In contrast to infant, children in preschool and school age usually show distinct symptoms like dysuria, urgency and increase in frequency.[6] Macroscopic hematuria is a common manifestation of UTI. Bergstrom (quoted from 2) reported that 26% of all children ranging from 1 to 16 years of age with UTI had macroscopic hematuria. There is a gradual shift from male to female predominance in the frequency of urinary tract infection during the first months of life.[3] A quantitative culture of a urine specimen is the only method to establish the diagnosis. Unfortunately, processing of urine culture takes at least 24 hours.

In this study, we tried to evaluate clinical and simple laboratory aspect in attempt to find some method for rapid diagnosis of UTI. The most common affected age group in this study 2-5 years (24-60 months), this age distribution was not understood. No statistically significant difference was observed among undernourished compare to well-nourished children in occurrence of pyuria. Theoretically, undernourished children more affected than well-nourished children caused by impairment of immunologic mechanism. But, in our study this phenomenon was not observed, might be caused by only a little amount of samples were used in our study.

Fever was found in 75% of cases as a second commonest symptom. It was higher than 66% reported by Lohr et al,[8] but lower than 84% reported by Winaya.[10] In our study, fever had sensitivity 72% and specificity 33% with predictive value 76% to positive urine culture. So do local symptom, had sensitivity 89% and specificity 17% with predictive value 76% to positive urine culture. Because positive urine culture reflect the diagnosis of UTI, both fever and local symptoms in children with pyuria in this study should not be used as a diagnostic tool, but probable useful as a screening procedure to distinguish possibility of UTI. Pyuria it self had known had high predictive value to predict UTI.[9,10] In other hand, pyuria could caused by other conditions such as severe dehydration, chemical injury to the urinary tract, urinary calculi etc.[3]

Leukocytosis in peripheral blood count was found in 71% of cases, it had sensitivity 72% and specificity 33% with predictive value 77% to positive urine culture. Similar to clinical aspects, leukocytosis in children with pyuria should not be used as a diagnostic tool for UTI, but as a screening procedure only. So, other methods should be used to determine UTI rapidly such as leukocyte esterase test alone, or with the nitrite test.[11,12] However these two tests not reliable for young baby (below 2 years of age).

The most common organism in this study was *E. coli* (67%) of cases. Our finding similar to Winaya, and Yee[13] who found that *E. coli* as most common organism in their study (72% of cases). Predominance of *E. coli* mainly caused by, this organism had some characteristics that did not found in other organism. These characteristic like it had p-fimbriae, adhere to the uroepithelium, belong to select O and K serotype, produce hemolysin, resistant to the bactericidal action or normal human serum, etc.[2]

All of our patients underwent plain photo abdomen. Almost all, but one had normal result. In one case, because the plain photo abdomen showed abnormal result, the patient was advised to underwent IVP and MSU. The final diagnosis of this patient was pyonephrosis and sent to Surgery Department. Ideally, advance radiologic examination such as IVP, MSU or USG and CT-scan were performed to all patients to find out anatomical anomalies or functional disorders. But, in our study these advance radiologic examination only performed if there was any indication like delay improvement or in recurrent cases. Our cases showed improvement (healing) rate was excellent (94% complete healing), so addition radiologic examination were not performed for these patients.

We conclude that local symptoms, fever or leukocytosis with pyuria are not good tool sfor the diagnosis of UTI, but probably useful as a screening procedure to distinguish the possibility of UTI. Further studies are warranted by using large sample, with control of confounding variables to provide more valid and precise information about the role of clinical and simple laboratory parameters in early diagnosis of UTI.

References

1. Jodal U, Hansson S. Urinary tract infection. In: Holliday MA, Barratt TM, Avner ED; eds: Pediatric nephrology. Baltimore: Williams & Wilkins, 1994; 950-62.
2. Kher KK, Leichter HE. Urinary tract infection. In: Kher KK, Makker SP eds. Clinical pediatric nphrology. New York: McGraw-Hill, Inc, 1992; 277-312.
3. Hellerstein S. Clinical features of urinary tract infections. In: PostlethWaite RJ eds. Clinical paediatric nephrology. Bristol: Wright 1986; 361-71.
4. Margileth AM, Pedreira FA, Hirschman GH, Coleman TH. Urinary tract bacterial infections, office diagnosis and management. Pediatr Clin North Am 1976;23:721-34.
5. Heldrich FJ. UTI Diagnosis: Getting it right the first time. Contemporary Pediatrics 1995;12:110-133.
6. Rusdidjas, Ramayati R. Infeksi saluran kemih (ISK). In: Alatas H, Tambunan T, Trihono PP eds. Nefrologi Anak I. Jakarta: Ikatan Dokter Anak Indonesia, 1993;109-31.
7. Hoberman A, Wald ER, Reynolds EA, Penchansky L. Is the culture necessary to role out urinary tract infection in young febril children? pediatr infect dis j 1996;15:304-9.
8. lohr ja. use of routine urinalysis in making a presumptive diagnosis of urinary tract infection in children. Pediatr Infect Dis J 1991;10: 646-50.
9. Glass J. Diagnosis of urinary tract infection. In: Kher KK, Makker SP, eds. Clinical pediatric nephrology. New York: McGraw-Hill, 1992; 350-60.
10. Winaya IBA. Evaluasi epidemiologik infeksi saluran kemih pada anak (studi retrospektif selama lima tahun). Lab/UPF Ilmu Kesehatan Anak Fakultas Kedokteran UNAIR/RSUD Dr. Soetomo Surabaya (personal communication).
11. Lohr JA, Donowitz LG and Sadler III JE. Hospital-acquired urinary tract infection. Pediatrics 1989;83:193-199.
12. Shaw KN, Hexter D, McGowan KL, Schwartz JS. Clinical evaluation of a rapid screening test for urinary tract infections in children. J Pediatr 1991;118:733-6.
13. Yee SL, Davies DP. Urinary tract infection in childhood. A study of 137 cases. Hongkong J Pediatr 1988;1:17-24.