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Original Research Article

Study to Evaluate the Incidence of Urinary Tract Infection (UTI) in Febrile Children under age of 5 years and to Assess the Reliability of Microscopic Urine Analysis in UTI Diagnosis

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Abstract

Background: In order to determine the prevalence of urinary tract infections in children who are febrile and to evaluate the reliability of microscopic urine analysis in the diagnosis of urinary tract infections, this study was conducted. The study emphasises the importance of strongly suspecting UTI in febrile children in order to avoid complications in the future because it is frequently missed in children. The purpose of the study was to ascertain the prevalence of urinary tract infection in febrile children under the age of five and to evaluate the reliability of microscopic urine analysis in the diagnosis of UTI.

Methods: From July 2022 to December 2022, a prospective study was conducted in the department of Pediatrics at Sri Krishna Medical College and Hospital, Muzaffarpur, Bihar. From the enrolled febrile patients, urine was taken and sent for regular microscopic analysis, culture, and sensitivity testing.

Results: In this study, 120 febrile children were included, and of those, 6 had positive urine cultures, indicating a 5% prevalence of UTIs. For significant pyuria (>5 pus cells/HPF), chi-square analysis was performed, and a sensitivity of 100% and an accuracy rate of 95.8% were calculated.

Conclusion: Children who present with a febrile illness frequently have UTI, which should be highly suspected. The gold standard for identifying UTI is urine culture. Urine microscopic analysis is a powerful method that aids in UTI diagnosis.

Keywords: Urinary Tract Infection, Microscopic Urine Analysis.

Introduction

Urinary tract infections (UTIs) commonly occur in children of all ages. UTIs are most common in children under age 1 yr; the prevalence in febrile infants is 7%. During

the first yr of life, the male: female ratio is 2.8: 5.4. Beyond 1-2 yr, there is a female preponderance, with a male: female ratio of 1: 10. UTIs are much more common in uncircumcised males, especially in the first yr of life, where the rate is 20% in febrile uncircumcised males under age 1 yr. In females, the first UTI usually occurs by the age of 5 yr. UTIs have been considered a risk factor for the development of renal insufficiency or end-stage renal disease in children. [1]

UTI is a common bacterial infection that causes illness in babies and children. It may be difficult to recognise UTI in children because the presenting symptoms and signs are nonspecific, particularly in babies and children younger than 3 years. Collecting urine and interpreting results is not easy in this age group, so it may not always be possible to unequivocally confirm the diagnosis. [2]

UTI is common, with a reported prevalence range of 4.1% to 7.5%. It is one of the most prevalent bacterial illnesses in infants and young children with fever. [3-6] It ranks third among pediatric age groups, after respiratory and gastrointestinal diseases, and affects 4 to 10% of febrile children admitted to hospitals. [7] Since it is recognised as a sign of renal parenchymal involvement, fever has long been seen as a finding of clinical significance in children with UTI (Pyelonephritis).[8] Infants and young children rarely get urological symptoms. Only after the age of five do children typically show with the classic triad of abdominal pain, vomiting, and fever along with chills, rigors, or suprapubic pain.

Particularly in infants and young children whose symptoms are hazy and don't draw attention to the urinary system, urinary tract infections are frequently overlooked. The acute and chronic problems of undiagnosed UTI in children, which are not frequently encountered in adults, make it more concerning than in adults. The majority of these infections in the first 2 years of life are "occult" and most infections remain undiagnosed if tests are not routinely performed to detect them. Otherwise, unexplained renal scarring has been cited as one of most common cause of end-stage renal disease (ESRD) and is an established risk factor for subsequent hypertension. In addition, vesico-ureteric reflux (VUR) is more common and more severe in this age range than it is in older children, with the most severe type only occurring in infants. Concern should be expressed over the high rate of undiagnosed and untreated UTI in young children.

Roger published the first description of UTI in 1839, and a lot of clinical work and academic study have been done on this condition since then. Several researchers from India and other nations have determined that UTI is one of the most prevalent infections in kids. Because UTI may present in infants and young children with little symptoms other than fever and a higher risk of kidney injury than in older children, these children should be given special attention. [9-11]

The diagnosis of UTI requires a high degree of suspicion because it may reveal a youngster who has a severe VUR or an obstructive abnormality. Second, a delay in identification and treatment of the UTI may occur because these young patients with UTI may have a feverish illness and no localising symptoms. Finally, the initial UTI assault in infancy and early childhood typically marks the start of a continuing process with the possibility of recurrence. As the number of recurrences rises, so does the chance of kidney impairment. It is crucial to properly diagnose and treat UTI in children.

The current study goals were to ascertain the prevalence of urinary tract infections in

febrile children under the age of five and to evaluate the reliability of microscopic urine analysis in the diagnosis of UTI.

Material and Methods

From July 2022 to December 2022, this prospective hospital-based cross-sectional study was undertaken in the department of Pediatrics at Sri Krishna Medical College and Hospital, Muzaffarpur, Bihar. A total120 febrile children under 5-year age with axillary temperature >= 37.6^0C, either admitted to the pediatric department of Sri Krishna Medical College and Hospital, Muzaffarpur, Bihar, or who were outpatients there were included in this study.

Those children older than 5 years, received antibiotics within 48 h before admission or having congenital urogenital anomalies were excluded from study.

Information was gathered using a proforma that had been previously created and evaluated. For the purpose of including their children in the study, parents or legal guardians provided their informed consent. A systematic questionnaire for a urinary tract infection was used to interview guardians and children.

Age, sex, complete urine analysis and reports of urine cultures related data were collected.

Under aseptic conditions, urine samples from children younger than 2 year were obtained via transurethral bladder catheterization or suprapubic aspiration. Around 10 cc of urine were collected and sent for urine analysis, culture, and sensitivity testing in sterile bottle. To reduce periurethral flora contamination, a clean-catch mid-stream specimen was taken from children older than 2 year. By cleaning the genitalia with soap and water before collection, contamination was reduced. After allowing the child to pee, a midstream sample was taken and sent for urine analysis, culture, and sensitivity testing in sterile bottle.

Urinalysis was performed on the fresh urine samples that were collected by using the aforementioned approaches. After centrifuging the urine samples in accordance with industry standards, a microscope was used to check the urine for leukocyturia and hematuria. In the current investigation, significant pyuria was defined as more than 5 pus cells/HPF in a centrifuged urine sample.

Using a 0.01ml calibrated loop, urine collected in sterile containers was inoculated onto blood and Mac-Conkey agar plates. To acquire an accurate colony count, all plates were incubated for 24 hours in an aerobic environment at 35-37^0C. A colony count of more than10^5/ml organisms of a single species on urine culture was regarded as significant. Samples with negligible growth, growth involving two or more pathogens, or growth including non-pathogens were not regarded as culture-positive. In this investigation, the following definitions were used.

Presence of more than 5 pus cells /HPF in a centrifuged urine sample indicates pyuria. A positive urine culture was defined as growth of $>10^5$ colonies of a single urinary tract pathogen/ml of urine specimen.

All children diagnosed to have UTI underwent USG Abdomen, MCU scans as indicated by UTI management guidelines.

The data was analyzed by SPSS version 22 software along with below mentioned appropriate statistical tests at 5% level of significance. p value is calculated using Chi-Square Test given by the formula

$$\chi^2 = \Sigma(Oi - Ei)^2$$

$$Ei$$

Where *Oi* is Observed frequency and Ei is Expected frequency Significance was interpreted as:

$0.05<p<0.10$ Suggestive of significance

$0.01<p\leq0.05$ Moderately significant

p≤0.01 strongly significant.

Results

70 (58.33%) of the 120 patients that were included in the studywere males, and 50 (41.67%) were females.

On a urine culture, 95% of febrile patients (n=114) showed no discernible growth. The cultures from 5% (n=6) of the febrile patients were positive (50% for E. coli, 16.67% each for Acinetobacter, Serratia and Proteus, respectively). UTI cases are equally(3 each) distributed among male and female in our study. E.coli and Acinetobacter are more common in males while Serratia and Proteus are in females. (Table-1)

Table 1: Distribution of pathogens in urine culture

Gender	E. coli	Acinetobacter	Serratia	Proteus	No Growth
Male(n=70)	2	1	0	0	67
Female(n=50)	1	0	1	1	47

It was shown that 5% of febrile infants under the age of 5 had UTIs. It was discovered to be 4.8% in the first 12 months, 3.7% in the next 13 to 24, 5.9% in the next 25 to 36, 3.7% in the next 37 to 48, and 9.1% in the next 49 to 60 months (Table-2).

Table 2: Age and prevalence of UTI

Age Group (in months)	No. of Cases	Prevalence of UTI (%) age specific	Prevalence overall (%)
<=12(n=21)	1(16.67%)	4.8	0.83
13-24(n=27)	1(16.67%)	3.7	0.83
25-36(n=34)	2(33.33%)	5.9	1.67
37-48(n=27)	1(16.67%)	3.7	0.83
49-60(n=11)	1(16.67%)	9.1	0.83
Total(n=120)	Total-6(100%)		Total- 5%

11 (9.16%) of the 120 children tested positive for significant pyuria (>5 pus cells/HPF) in centrifuged urine samples, including 6 (54.5%) boys and 5 (45.5%) girls. Most (n=6; 54.5%) were under 2 year of age.2 children (18.2%) had more than 10 pus cells/HPF (table-3).

Table 3: Distribution of pus cells in urine

	Sex		
PUS Cells	Male	Female	Total
5-10	5(83.3%)	4(80%)	9(81.8%)
>10	1(16.7%)	1(20%)	2(18.2%)
Total	6(100%)	5(100%)	11(100%)
X^2=0.825, p=0.363notsignificant.			

Table 4: Chi Square Analysis (urine analysis urine culture)

Urine analysis	Urine culture		
	Positive	Negative	Total
Positive	6 (TP)	5 (FP)	11
Negative	0 (FN)	109(TN)	109
Total	6	114	120
X^2=62.58, p<0.01highlysignificant.			

Urine culture was used as the gold standard for the chi-square analysis of UTIs (table-4). Significant pyuria (> 5 pus cells/HPF) was analysed, and the following were computed using the formulas:

- Sensitivity=100%
- Specificity= 95.6%
- Positive predictive value=54.5%
- Negative predictive value=100%
- Percentage of false positive=4.3%
- Percentage of false negative=0%
- Accuracy rates=95.8%

Discussion

The prevalence of UTI in febrile children under the age of five was 5.0% in the current study, which is comparable to Quigley R [9] study where a prevalence of 7% was noted. Other studies like Ferrara P *et al* [11] and Kaushal RK *et al* [20] also showed prevalences between 4.1% and 7.5% and 8.4%, respectively. While Rabasa AI and Gofama MM21 reported a high incidence of 13.7%, two other studies (Bauchner *et al*. [13] and Schlager TA [14]) observed a similar low prevalence of 1.7%.

Six culture-positive cases were included in this investigation, and of those, 3(50%) grew E. coli, 1 each (16.6%) of Acinetobacter, Serratia and Proteus sp. E. coli was the most prevalent urinary pathogen, accounting for 66.6% of community-acquired UTI, according to Byran CS *et al* [22]. E. coli is the cause of 70% of recurrent infections and 90% of first symptomatic UTI, according to Bagga A *et al* [23]. In their research, Waisman Y *et al*. [24] reported that of the 35 cultures, 27 were positive for E. coli (76%) and 1 each for group B streptococcus (3%), Klebsiella (6%), Enterococcus (6%), Pseudomonas (6%), and Staphylococcus coagulase negative (3%). Enteric, gram-negative bacteria, particularly E. coli, are the most often isolated urine pathogens, according to Chris H *et al*. Others are Proteus species, Klebsiella, and Enterobacter. Escherichia coli 229 (85%), Klebsiella sp. 13 (5.1%), Proteus sp. 12 (4.7%), Pseudomonas aeruginosa, Enterococcus fecalis, and Morganella morgana (1% each) were the primary culprits in Zamir G *et al* [25] study on children with UTI. The most prevalent pathogen, according to Saadeh SA and Mattoo TK [26], was E. coli (60-92%); other species included Klebsiella, Proteus, Enterococcus, and Enterobacter sp. In Madhubalan T *et al*. [31] study, most common organism isolated in culture was *E coli*. (58%) followed by *Klebsiella* (32%), *Pseudomonas* (5%) and *Proteus* (5%).

11 (or 9.1%) of the 120 febrile children who matched the inclusion criteria had significant pyuria (>5 pus cells/HPF of centrifuged urine sample). Six patients of significant pyuria (54.5%) had detectable bacterial growth. Only 44.4% (4 out of 9) of children presenting >5 pus cells were culture positive, compared to 100% (2 out of 2)of children showing >10 pus cells. In Madhubalan T *et al*. [31] study, 89.4% of UTI cases (17 out of 19) had shown significant pyuria which was statistically significant. Sensitivity and specificity of urine analysis in the current study were 100% and 95.6%, respectively. PPV and NPV were 54.5% and 100%, respectively. False positive and negative percentages were 4.3% and 0%, respectively. 95.8% accuracy rate. The sensitivity and specificity were reported to be 82% and 92%, respectively, by Bachur R and Harper MB [27]. Almost identical to the current investigation, Waisman Y *et al* [28] showed sensitivity and specificity of 88.6% and 88.4%, respectively. Similar to our work, Waisman Y reported PPV and NPV of 75.6% and 95%, respectively. In contrast to our investigation, Zorc JJ *et al* [29] showed that urine analysis sensitivity and specificity were

67% and 79%, respectively. Sensitivity and specificity were reported to be 57–87% and 53–79%, respectively, by ShawKN *et al* [30].

In our study,1(16.67%) out of 6 UTI cases each in <=12mo, 13mo-24mo, 37mo-48mo, and 49mo-60mo age groups while 2(33.33%) out of 6 in 24mo-36mo age group was present. In Saheb SA study [32], 33.33%, 25.00%, 10.42%, 18.75% and 12.50% cases were in <1yr, 1-2yr, 2-3yr, 3-4yr, 4-5yr age group respectively.

In our study, out of 6 cases 3(50%) each were male and female respectively. Out of 11 significant pyuria case, 6(54.5%) were boys and 5(45.5%) were girls. Sensitivity, specificity, PPV, NPV and accuracy were 100%, 95.6%, 54.5%, 100% and 95.8% respectively. In Kaushik V *et al*. study [33], 7 out of 12(58.33%) UTI cases were male and 5(41.67%) were female. Out of 22 significant pyuria cases, 12(54.5%) were male and 10(45.5%) were female. Sensitivity, specificity, PPV, NPV and accuracy were 100%, 97.3%, 66.6%, 97.3% and 97.5% respectively.

Conclusion

The most reliable method for identifying UTIs is urine culture. When urine analysis revealed >10 pus cells/HPF as opposed to >5 pus cells/HPF, urine culture positive was higher. In comparison to the standard >5 pus cells/HPF, pyuria >10 pus cells/HPF was more specific (100%) and had a greater positive predictive value. A strong index of suspicion is required to identify UTI and avoid complications because many patients with other provisional diagnoses turned out to be UTI.

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