



## **The Relationship of Complete Urinalysis with Urine Culture in Infants Presenting with a Preliminary Diagnosis of Urinary Tract Infection**

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### **Abstract**

In this study, relationship of complete urinalysis (CUA) with urinary culture growth rates in infants admitted with a preliminary diagnosis of urinary tract infection (UTI) was examined. The files of 101 infants admitted with a preliminary diagnosis of UTI were reviewed retrospectively. Units used for the preliminary diagnosis of UTI; at CUA; Leukocyte>5, Leukocyte Esterase(LE) positivity, Nitrite Positivity, LE + Nitrite positivity were compared with the growth rate in urine culture. CUA samples were taken with sterile bags. Urine cultures were taken with a catheter from those with significant findings in CUA. While the rate of growth in urine culture was 67.4% in those with Leukocytes>5 in CUA, the rate of growth was 57.1% when Leukocytes were<5. While the rate of growth in urine culture was 76.1% in those with LE(+), it was 12.5% in those with LE(-). While the rate of growth in urine culture was 94.4% in those with nitrite(+), it was 44.7% in those with nitrite(-). While the growth rate in urine culture was 73.3% in those with LE(+)+Nitrite(+), it was 21.1% in those with LE(-)+Nitrite(-). When the relationship of CUA, which is required for the preliminary diagnosis of UTI, with the growth rates in urine culture, it was found that the highest growth rate was in those with Nitrite(+), but false negativity was also high. It is thought that the detection of LE(+) with the lowest false-negative rate in the reproduction of the urine culture is more reliable in diagnosing UTI.

## 1. Introduction

Urinary tract infection (UTI) is the most common bacterial infection in infants and children. The frequency of referral to the pediatrician in children diagnosed with urinary tract infection ranges from 2.4 to 2.8% . While the incidence of childhood diseases requiring hospitalization is 51/100,000, this rate rises to 174/100,000 in infants (Davenport and Shortliffe, 2018)). In the diagnosis of urinary tract infection in infants and children, anamnesis and examination findings may not be helpful, so a urine sample is required for the diagnosis of UTI. Urine strips for urinalysis is useful. (Bonadio ve Maida, 2014) Complete urinalysis (CUA) includes parameters that may be useful in the diagnosis of urinary tract infection such as leukocyte, bacteria, leukocyte esterase, nitrite (Tarin, Shinghal and Dairiki Shortliffe, 2010). It has been reported that CUA sensitivity in the diagnosis of urinary tract infection in children is generally between 75% and 85% (Bachur and Harper, 2001; Newman and et al., 2002 ). Therefore, urine culture is accepted as the gold standard in the definitive diagnosis of urinary tract infection. However, false positivity may be observed in patients with normal CUA parameters but with growth in urine culture due to asymptomatic bacteriuria or contamination (Hoberman, Wald, Reynolds, Perchansky and Charron,1996; Roberts and et al., 1983). A minimum of 18 hours is required for the detection of bacterial growth, and doctors decide whether to start empirical antibiotic therapy based on

clinical experience and urinalysis results (Korbel, Howell and Spencer, 2017).

Since urinary tract infection can cause permanent kidney damage when diagnosed late, empirical treatment should be started in the early period. In this study, it was aimed to evaluate the relationship between CUA parameters, which can be measured in the early period, and growth rates in urine culture in patients with suspected urinary tract infection.

## 2. Materials and Methods

The data of the study were obtained by retrospectively scanning the files of 101 patients under the age of 2 who applied to the outpatient clinic, emergency service and hospitalized in pediatric services between 2012 and 2017 with a preliminary diagnosis of urinary tract infection. CUA parameters and their growth in urine culture were noted in the files of the patients. Among these parameters, the units frequently used for the preliminary diagnosis of urinary tract infection are; Leukocyte>5, Leukocyte Esterase positivity, Nitrite positivity, Leukocyte Esterase+Nitrite positivity were compared with the growth rate in urine culture. Before the urine sample collection for CUA , perineum was cleaned with sterile saline or local antiseptic solution using sterile gauze for genital cleaning and urine sample was taken with a sterile bag. urine samples; Collected in sterile plastic boxes with a volume of 50 ml. The collected urine samples were delivered to the laboratory without waiting. For the acceptance of urine samples to the laboratory; Care was taken to ensure the suitability of the sample

container and the completeness of patient information. Urine cultures were taken with a catheter from those with significant findings in CUA. Colony bacterial growth of 50,000 or more in the urine culture was considered significant.

The ethics committee of the study was obtained from the S.B. Istanbul Medeniyet University Göztepe Training and Research Hospital Clinical Research Ethics Committee on 28.02.2017 with the decision number 2017/0091. While evaluating the findings obtained in the study, SPSS (Statistical Package for Social Sciences) for Windows 10.0 program was used for statistical analysis. While evaluating the study data, in addition to descriptive statistical methods (mean, standard deviation, frequency), Chi-square test was used in multi-well and four-well design in the comparison of qualitative data. The results were evaluated at the 95% confidence interval, the significance level of  $p < 0.05$ .

### 3. Results

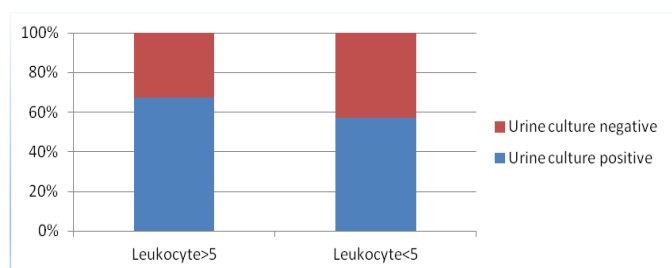
101 patients between the ages of 2 months and 2 years who were admitted to the outpatient clinic, emergency department and hospitalized between 2012 and 2017, and diagnosed with a urinary tract infection without a known major disease or genitourinary system anomaly were discussed.

In the complete urinalysis of our patients, a growth rate of 67.4 % was observed in the urine cultures of those with  $L > 5$  above. On the other hand, it was found 57.1% in the urine cultures of patients with  $L < 5$ . Leukocyte Esterase (LE)(+) (+, ++, +++ values were considered significant for LE) in the CUA sample taken from our patients was found to be

79.2%. 76.1% growth was found in the urine cultures (with probe) taken under sterile conditions from our patients with LE(+), and it was found to be statistically significant. In the urine cultures taken from our patients with nitrite (+) under sterile conditions, a growth rate of 94.4% was found, and it was found to be statistically significant.

There was significant growth in urine cultures in 57 of 101 patients who applied to us. The cutoff value of microorganisms grown in urine cultures of a single microorganism  $> 50,000$  cfu and above was considered significant. E.coli reproduced in 31 of the 57 cultures examined and was found to be the first among the factors with a rate of 54.3%. Then, the most common microorganism agents detected are Klebsiella and Proteus, respectively.

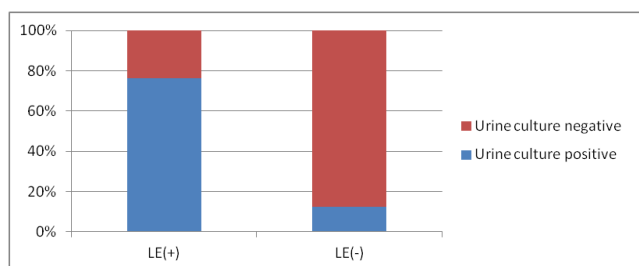
In the complete urinalysis of our patients, a growth rate of 67.4 % was observed in the urine cultures of those with  $L > 5$  above. On the other hand, it was found 57.1% in urine cultures of patients with  $L < 5$  (Figure 1).



**Figure 1:** Comparison of leukocyte and urine culture.

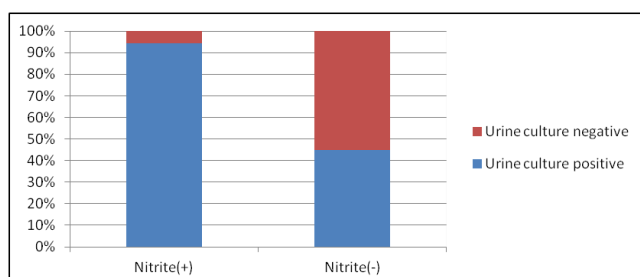
Leukocyte Esterase (LE)(+) (+, ++, +++ values were considered significant for LE) in the CUA sample taken from our patients was found to be 79.2%. 76.1% of the urine cultures taken from our patients with LE(+) under sterile conditions (with a probe)

were found to reproduce, which is statistically significant, however, there was also a growth in 12.5% of the patients with LE(-) (Figure 2).



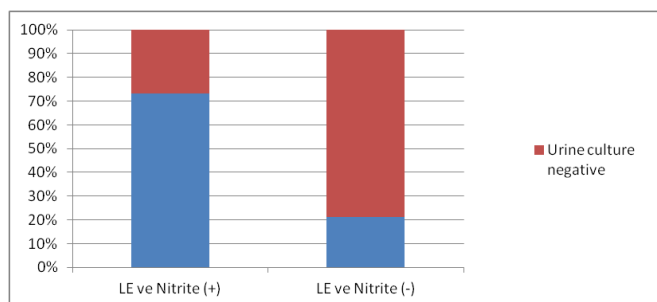
**Figure 2:** Comparison of leukocyte esterase and urine culture.

In the urine cultures taken from our patients with nitrite(+) under sterile conditions, 94.4% of a growth was detected, which is statistically significant, however, a growth was observed in 44.6% of the patients with nitrite(-) (Figure 3).



**Figure 3:** Comparison of urine nitrite and urine culture.

CUA of 101 patients included in the study. There were 20 patients who were positive for nitrite (+) and leukocyte esterase (+) at the same time, and urine culture growth was found to be significant in approximately 73% of these patients. In the case of two parameters (-), the growth was found to be 21.1% (Figure 4).



**Figure 4:** Comparison of leukocyte esterase and urine nitrite with urine culture.

#### 4. Discussion and Conclusion

Leukocytes found in urine on microscopic examination are an important indicator of inflammation associated with UTI. However, it seems that there is no common definition for pyuria in the literature. In microscopic analysis of centrifuged urine, five leukocytes per area were reported as the threshold for pyuria. Pyuria may sometimes not be detected in early infection, in cases where the immune system is suppressed or insufficient (Okarska-Napierala, Wasilewska and Kucher, 2017) In a study evaluating urine analyzes in children with a preliminary diagnosis of urinary tract infection, sensitivity, specificity, positive predictive value and negative predictive value for leukocytes were found to be 64.3%, 95.0%, 76.4%, 91%, and 88,4 %, respectively. (Sezgin and Nar, 2017). In another study, sensitivity for leukocytes was reported as 90.3% , specificity as 65.5%, positive predictive value as 32.2% and negative predictive value as 97.4% (Zorbozan, Akarken and Zorbozan, 2017). In our study, sensitivity, specificity, positive predictive value, negative predictive value were found 88.5 %, 16.6%, 67.3%, 42%, respectively. The difference between the results shows that the leukocyte value in the urine taken in the bag may not be used as a

reliable parameter in the preliminary diagnosis of urinary tract infection.

The leukocyte esterase test is one of the parameters checked in the complete urinalysis and shows the level of esterase produced by leukocytes (Weiz, Seabrook and Lim, 2008).). In a study conducted on patients with growth in urine culture, the sensitivity of the leukocyte esterase parameter was 89.3%, the specificity was 18.2%, the positive predictive value was 55.5%, and the negative predictive value was 60.0%. In another study, leukocyte esterase sensitivity, specificity, positive predictive value, negative predictive value 41.6%, 90.0%, 41.6%, 90.0%, respectively. In our study, in accordance with the literature, the above-mentioned values were respectively; 93.3%, 42.8%, 73.3%, 78.9% (Üstündağ et al., 2013).

Nitrite test is another complete urinalysis parameter. In order to be looked at, morning urine or urine should be checked after waiting for 4 hours. Nitrite(-) status can be seen in agents other than the Enterobacteriaceae family. The presence of nitrite (-) does not mean that there is no urinary tract infection (Weiz et al., 2008).

In a study in which 183 urine analyzes were detected in urine culture, sensitivity, specificity, positive predictive value and negative predictive value for nitrite were respectively; 45.2%, 100%, 100%, 21.6% were detected. In another study, it was found to be 17.1%, 99.0%, 86.0%, and 3.5%, respectively. Our study is consistent with the literature, in order of nitrite sensitivity, specificity, positive predictive value and negative predictive value; 28.8%, 97.1%, 94.4%, 44.7% were found. The possible reason for

the low sensitivity in nitrite may be the inability to measure the nitrite test with morning urine or the inability to collect the urine in the bagged urine and/or bladder for 4 hours due to insufficient urine control in children. In the European urine analysis guideline, the sensitivity for nitrite is between 20-80% and the specificity is > 90% (Kouri et. al, 2000)

When the literature is examined, it is seen that there are very few studies evaluating positive leukocyte esterase, and nitrite positivity for the diagnosis of UTI simultaneously was observed to be lower. For the values specified in our study; sensitivity was 78% and specificity was 76%. The fact that the nitrite and LE parameters are positive simultaneously increase the sensitivity and specificity to a similar extent, and in cases where these two parameters are positive simultaneously, it can give more reliable information about the growth in the urine culture.

As a result, Leukocyte>5, one of the parameters of the complete urinalysis taken with a bag to diagnose urinary tract infection in infancy, cannot be considered reliable on its own. Although leukocyte esterase sensitivity is high, its specificity is low. The specificity of nitrite positivity is high, but the sensitivity is low in infancy babies since it may be difficult to collect bag urine and/or morning urine. In cases where nitrite and leukocyte esterase are positive at the same time, sensitivity and specificity are close to each other and can be accepted as the most reliable criterion.

### Statistical analysis

The SPSS (Statistical Package for Social Sciences) for Windows 10.0 program was used for statistical

analysis. The data were evaluated using descriptive statistical methods (mean, standard deviation, frequency). Chi-square test was used in multi-layered and four-layered design to compare qualitative data. The results were evaluated at the 95% confidence interval and the significance level of  $p < 0.05$

### Conflict of interest

There is no conflict of interest.

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