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Are All Small Particles Parameters in the iQ200 Auto Particle Recognition Software Have Any Benefit on Reduce the Urine Culture Number?

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Abstract

Objective: It was aimed to compare the Iris iQ200 auto particle recognition software (APRS) results with bacteriological urine culture results, and also investigate whether the different evaluation criteria are useful or not in bacteriuria identification in the present study. **Methods:** The based to iQ200 auto particle recognition software, test results were grouped into three as based to different criteria. The evaluation criteria of groups as follows: group A; WBCs ≥6/µL, leukocyte esterase, the presence of few or more bacteria or yeast, nitrite and an all small particle (ASP) count of ≥10,000, group B; WBCs ≥6/µL, leukocyte esterase, the presence of few or more bacteria or yeast and nitrite, and group C (WBCs ≥6/µL, leukocyte esterase and presence of few or more bacteria or yeast. The sensitivity, specificity, positive predictive value (PPV) and negative predictive value (NPV) were calculated for each group. **Results:** The diagnostic specifications of groups A, B, and C, respectively, were found as follows; sensitivity was 95.6%, 80.6%, and 87.1%, the specificity was 51.9%, 58.7%, and 37.8%, PPV was 36.6%, 52.7%, and 37%, and also NPV was 97.6%, 84.4%, and 87.5%, respectively. It was also found fair agreement between iQ200 Workstation and culture results in groups A ($P<0.001$, $\varkappa=0.278$), and B ($P<0.001$, $\varkappa=0.353$), and also slight agreement in group C ($P<0.05$, $\varkappa=0.179$). **Conclusion:** Our study showed that agreement was highest in the analysis group which including ASP parameter. Addition of ASP to test combination apparently increased the diagnostic value of auto particle recognition software.

Keywords: IQ200 analyzer, sensitivity, specificity, urinary culture

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Introduction

The urinary tracts are widespread source for life-threatening infections such as sepsis or septic shock.[1] The diagnosis and treatment of urinary tract infection (UTI) require the collaboration of clinicians and laboratory specialists. Chemical testing of urine samples (reagent strip method) and identification and counting of particles is performed routinely to identify and monitor diseases of the kidney and urinary tract.[2]

The significant bacteriuria is characterized with presence of 10^5 Colony Forming Unit (CFU)/mL from urine culture. However, up to approximately 80% of bacteriologic culture results are negative in patients with UTI.[3,4,5] In an outpatient setting, urine culture is not always applicable and the physician has to rely on urinalysis for presumptive diagnosis of UTI.[6]

The combination of the automated image-based urinalysis system, iQ200 (Iris Diagnostics, Chatsworth, CA), and a chemistry dipstick analyzer (Arkray Aution Max AX-4280, Arkray, Edina, MN, USA) is referred to as the iQ200 Workstation. Images are stored and can be viewed on the Workstation screen, thereby eliminating the need for manual microscopy in most cases.[7] The Auto Particle Recognition (APR) software to categorize structures putatively identifiable as bacteria (consistent with bacteria and <3 micron) and all other detectable particles <3 micron (bacteria, crystals, and other formed elements). It was reported that as the detection of "all small particles" (ASP), which has been added to improve the sensitivity of the assay, is considered in conjunction with relevant urine chemistry and microscopy results.[8]

The aim of this study was to compare the Iris iQ200 auto particle recognition software results with bacteriological urine culture results, and also investigate whether the different evaluation criteria are useful or not in bacteriuria identification.

Material and Methods

Three hundred and eight urine specimens, 110 samples were from male and 198 from female patients, submitted consecutively that had urinalysis and urine culture were examined in the present study ordered on the same day to the biochemistry and microbiology laboratories with complaints of UTIs. No limitation regarding gender was imposed for the samples.

Patients who had been using antibiotics for any reason, who had structural urinary anomalies, who were being treated as inpatients, who had urinary catheter, and those who were pregnant, were excluded from the study.

Samples were placed into sterile dishes and inoculated within 1 h for the culture. The calibration of IQ200 analyzer was performed at the beginning of the study. Before testing of urine samples each day, IQ Focus, IQ Negative, and IQ Positive control samples (Iris Diagnostics) were run according to the manufacturer's instructions. After inoculation, a 3 mL sample for the IQ200 urine analysis was obtained. No protective substances were added to the samples. Samples were studied within 1 h after being obtained. For the urine culture analysis, 10 µL of an uncentrifuged urine specimen was inoculated onto blood agar (Salubris, Turkey), and Eosin Methylene Blue (EMB) agar (Salubris, Turkey) and incubated under aerobic conditions at 37°C for 18-24 h. Growth results $<10^4$ CFU/mL were considered negative. In the case of growth of more than two microorganisms, it was reported as "mixed urethral flora," ignoring the total bacterial count. The identification of pathogenic microorganisms was performed by means of a VITEK II automatic bacteria identification device (Biomerieux, Marcy l'Etoile, France).

Specimens were tested for leukocyte esterase, nitrite, white blood cells (WBC), ASP, bacteria, and yeast with the iQ200 Workstation. iQ200 Workstation test results were grouped into 3 with respect to different parameter combinations used for analysis.

A total of 103 urine specimen were analyzed for combination of five parameters which are WBCs $\geq$6/µL, leukocyte esterase, the presence of few or more bacteria or yeast, nitrite and an ASP count of $\geq$10,000 in Group A. Totally 100 urine specimen analyzed for combination of four parameters (WBCs $\geq$6/µL, leukocyte esterase, the presence of few or more bacteria or yeast and nitrite) in Group B. In group C, 105 urine specimens analyzed for three parameters (WBCs $\geq$6/µL, leukocyte esterase and the presence of few or more bacteria or yeast. In these screening techniques, a positive result in any parameter constituted a positive screen.

Ethical Considerations

Before the study, the required ethics committee approval by Ordu University (2013/29) and written permission by the Ministry of Health and Ordu University Education and Research Hospital were obtained.

The aim of this study was explained to the patients during the data collection phase, and thus the "informed consent principle" was fulfilled.

Statistical Analysis

True positives (TP) and true negatives (TN) were determined by different "gold standards"—culture results, with false positives (FP) and false negatives (FN) attributed to findings from the iQ200. As statistical analysis for diagnostic evaluations, sensitivity (TP/[TP + FN]), specificity (TN/[TN + FP]), negative predictive value (NPV) (TN/[TN+FN]) and positive predictive value (PPV)(TP/[TP+FP]) were calculated. The agreements of results were calculated using of kappa analysis. Statistical analyses were carried out using SPSS 13.0 for Windows (SPSS Inc., Chicago, IL, USA).

Results

The number of culture positive samples was 90 (29.22%) and a single potential uropathogen was recovered from at any level ($\geq 10^3$ CFU/mL). Nineteen urine samples (6.16%) in which mixed flora had grown were regarded as contaminated, therefore contaminated urine samples were excluded from the present study.

The iQ200 Workstation reported that urine samples of 59 (57.28%) in group A, 55 (55.0%) in group d B, and 73 (69.0%) in group C as "urine culture necessary". Table 1 shows the diagnosis of infection based on culture. Sensitivities, specificities, PPV, NPV, and Kappa value for the automated urinalysis by comparison to culture results are shown in Table 2. As shown Table 2, the highest sensitivity and NPV (respectively, 95.6%, and 97.6%9) value found in group A. According to Kappa analysis, it was found fair agreement between IQ200 Workstation and culture results in group A ($P<0.001$, $\varkappa=0.278$), and also in group B ($P<0.001$, $\varkappa=0.353$). However, there was slight agreement between IQ200 Workstation and culture results in group C ($P<0.05$, $\varkappa=0.179$).

Discussion

The urinary tract infections are a group of infections in that the diagnosis is quite complex and semi-quantitative culture of a urine specimen is the gold standard for UTI diagnosis.[9,10]

However, the analysis takes at least 24 hours and screening urine samples with important bacteriuria from those without will anticipate negative results and reduce labor.[11,12]

The faster screening methods that could discard some of the culture-negative urine samples are needed to improve the efficiency of urine sample handling. In the present study, bacterial culture results were positive in 23%, 36% and 29.25% of samples in Groups A, B and C, respectively. However, IQ-200 workstation evaluation system reported as **"**urine culture necessary **"** in 57% and 55%, 69% of urine samples in groups of A, B and C respectively. We found statistically significant agreement between IQ200 Workstation and culture results in groups of A and B (Table 2). To similar to our results, a study was recently published by Stürenburg et al.[8] These investigators reported that use of cutoff values for leukocyte, bacterial, and ASP count significantly reduce the workload in the microbiology laboratory. Iris iQ200 system may alleviate the workload of laboratory by reducing microbiological urine analysis and urine culture requests On the other hand, Akin et al reported discordance results between IQ200 and bacterial cultures.[5] Parta et al have also reported that ASP did not increase to specificity, sensitivity, or NPV.[13] It was reported that low sensitivities for bacteria in comparison to bacterial cultures considered positive at $>10^4$ CFU/mL between routine microscopy and the iQ200 (without ASP) (60% and 58%, respectively).[14] Cappelletti et al reported that ASP and leukocytes are efficient tools for the screening of specimens collected from suspected UTI patients for rule out the need of bacterial culture for the definitive diagnosis of UTI.[15] Kellogg and co-workers suggested that a screening test for early detection of urine-culture positive patients must have 95% sensitivity and 95% NPV.[16] Five test combination used in Group A met this criteria with 95.6% sensitivity and 97.6% in the present study (Table 2).

There are various reports on the diagnostic performances that have been obtained using IQ200 Workstation. In various studies, significant correlations have been found between LE, nitrite results, and positive culture results. In particular, nitrite test alone has high specificity but low sensitivity, therefore its diagnostic value is limited.[17,18,19]

Similarly, Zaman et al. reported the sensitivities of LE and nitrite was very low in the presence of bacteria.[20]

On microscopic examinations performed with gram staining, higher diagnostic efficacy was determined with a positive predictive value (PPV) of 97.6% and a negative predictive value (NPV) of 98.7%.[21] However, LE may show a false negative result in specimens with an elevated specific gravity, protein or glucose.[6,22]

In conclusion, results of our study showed agreement between IQ200 Workstation and culture results were statistically significant in all groups. Therefore, we think that five parameters iQ workstation test that included ASP can be used as a useful test to reduce unnecessary urine cultures.

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TABLES

Table 1. Distribution of microorganisms isolated from urine cultures samples in all groups.

Microorganism	**Number**	**(%)**
Escherichia coli	55	61.11
Candida albicans	7	7.77
Staphylococcus aureus	6	6.66
Streptococcus spp	6	6.66
Enterococcus spp	4	4.44
Proteus mirabilis	3	3.33
Pseudomonas aeruginosa	3	3.33
Candida nonalbicans	2	2.22
Shigella spp	1	1.11
Gram negative bacil	1	1.11
Klebsiella pneumoniae	1	1.11
Proteus mirabilis	1	1.11

Table 2. Diagnostic performance of IQ200, leukocyte, leukocyte esterase, bacteria, nitrite, and all small particles (ASP) results in comparison with urine cultures.

Parameters	Sensitivity (%)	Specificity (%)	PPV (%)	NPV (%)	κ
Group A	95.6	51.9	36.6	97.6	0.278
leukocyte	91.3	60.8	40.4	96.0	
leukocyte esterase	73.9	62.0	36.2	89.1	
bacteria	30.4	97.5	77.8	82.8	
nitrite	34.8	98.7	88.9	83.9	
ASP	56.5	69.6	35.1	84.6	
Group B	80.6	58.7	52.7	84.1	0.353
leukocyte	72.2	56.3	48.1	78.3	
leukocyte esterase	66.7	62.5	50.0	76.9	
bacteria	5.6	95.3	40.0	64.2	
nitrite	11.1	93.8	50.0	65.2	
Group C	87.1	37.8	37	87.5	0.179
leukocyte	71.0	63.5	44.9	83.9	
leukocyte esterase	67.7	55.4	38.9	80.4	
bacteria	35.5	94.6	73.3	77.8	

PPV: Positive predictive value, NPV:Negative predictive value