Association between pyuria and uropathogen in suspected urinary tract infection

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Abstract

Background: Urinary tract infections (UTI) are one of the most common infectious diseases diagnosed in outpatients as well as in hospitalized patients, and can lead to significant mortality. Several rapid methods have been developed in diagnosing urinary tract infections such as microscopic examination, chemical tests, and automated systems. Thus, in this study we aimed at determining pyuria in suspected UTI patients and their association with uropathogen. **Materials and Methods:** A total of 379 clean catch mid-stream urine samples were collected in sterile containers. Manual microscopy is used to determine pyuria. All the urine samples inoculated on routine bacteriological media. **Results:** Out of 379 urine samples, 181 yielded significant bacterial growth. Patients belonged to age group 21-30 were more commonly had significant growth followed by 11-20 years age group. Escherichia coli was the most common organism isolated. Majority of urine specimens which showed plenty of pus cells per high power field yielded significant growth. Escherichia coli was most commonly associated with pyuria. **Conclusion:** As the number of pus cells in urine increases, the chance of yielding significant bacterial growth is also high. Overall, significant pyuria was observed among specimens yielded Gram negative bacilli than Gram positive cocci. Among Gram negative bacilli, Escherichia coli was most commonly accompanied with pyuria.

Key words: Pyuria, uropathogen, Escherichia coli

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Introduction

Urinary Tract Infections (UTIs) are one of the most common infectious diseases and nearly 10% of people will experience a UTI during their life time [1]. It remains a major public health problem in terms of morbidity and financial cost with an estimated 150 million cases per annum worldwide, costing global economy in excess of 6 billion dollars [2].

Although UTIs occur in both men and women, clinical studies suggest that the overall prevalence of UTI is higher in women. Uncomplicated UTIs in healthy women have an incidence of 50/1000/year. Approximately 20% of all UTIs occur in men [3]. UTI is mostly caused by gram negative aerobic bacilli found in GI tract. Organism included in this family are the E. coli, Klebsilla, Pseudomonas aeruginosa,

Enterobacter, Proteus and serratia species. Other common pathogens include Staphylococcus epidermidis, Staphylococcus saprophyticus and Enterococcus species which presumably result in UTI following colonization of the vagina or perianal skin. Less common organism such as Gardenella vaginalis, Mycoplasma species and Ureaplasma urealyticum may infect patients with intermittent or indwelling catheters [4].

UTIs are challenging, not only because of the large number of infections that occur each year, but also because the diagnosis of UTI is not always straightforward. Physicians must distinguish UTI from other diseases that have a similar clinical presentation, some UTIs are asymptomatic or present with atypical signs and symptoms [5]. Laboratory examination of urine specimens accounts for a large part of the workload in many laboratories. In fact, in many clinical

laboratories, urine cultures are the most common type of culture, accounting for 24% – 40% of submitted cultures; as many as 80% of these urine cultures are submitted from the outpatient setting [5].

Even though, urine culture is gold standard method in diagnosing UTI, it is time consuming, expensive and requires culture set up. Hence, clinicians rely on urine analysis which is simple and inexpensive.

Pyuria is the most useful analyte for diagnosis of infection and the clinician has a choice between multiple laboratory tests. The gold standard for the definition of pyuria is the leukocyte excretion rate.

A leukocyte excretion rate of > 400000 cells/h correlates well with symptoms of dysuria and frequency as well as the presence of bacteriuria.[6]

Hence, we aimed at determining the incidence of pyuria and its association with uropathogen.

Materials and Methods

This is a prospective observational study in which a total of 379 urine samples were collected from both inpatient and outpatient departments of Vinayaka Mission's Medical College and Hospital. 119 were from males and 260 were from females. All the received samples were processed in the department of microbiology. Clean catch mid-stream urine samples were collected in sterile containers.

Manual microscopy is used to determine pyuria. Centrifuging 10–20 ml urine for approximately 5 min, then resuspending the sediment in a drop up to 0.2 ml supernatant [7,8].

Then the preparation was examined under high power objective. Significant pyuria was defined by presence of ≥ 5 WBCS /hpf [9].

Urine samples were inoculated on blood agar and Mac Conkey agar plates by direct streaking with sterile calibrated platinum wire loops. Both plates were incubated overnight at 37^0C.

Diagnosis of bacteriuria was made by bacterial count. A bacterial colony count of 10^5/ml of urine was considered as an evidence of significant bacteriuria and established the diagnosis of UTI [10].

Exclusion criteria: Specimens yielded growth more than two organisms were considered as contaminants and excluded from the study.

Statistical method: Simple percentage method was used to analyse the data.

Results

A total of 379 urine samples were processed during the study period. 119 were from males and 260 were from females. 181 urine samples yielded significant bacterial growth. Patients belonged to age group 21-30(75.24%) were more commonly had significant growth followed by 11-20(48.15%) years age group [Table 1].

Table-1: Age wise distribution of positive and negative bacterial growth

S. No	Age	Culture positive	Culture negative	Total
1	1-10	32(41.56%)	45(58.44%)	77
2	11-20	26(48.15%)	28(51.85%)	54
3	21-30	79(75.24%)	26(24.76%)	105
4	31-40	22(25.58%)	64(74.42%)	86
5	41-50	9(45%)	11(55%)	20
6	51-60	7(31.82%)	15(68.18%)	22
7	>60	6(40%)	9(60%)	15

Escherichia coli 66(36.46%) was the most common organism isolated, followed by Klebsiella species 41(22.65%), Staphylococcus aureus 28(15.47%) and Pseudomonas aeruginosa 13 (7.18%) [Table 2].

Table-2: Bacteria isolated from urine specimens

S. No	Bacteria isolated	Number (%)
1	E.coli	66(36.46%)
2	Klebsiella species	41(22.65%)
3	Staphylococcus aureus	28(15.47%)
4	Pseudomonas aeruginosa	13(7.18%)
5	Enterococci	11(6.08%)
6	Proteus species	7(3.87%)
7	Enterobacter	7(3.87%)
8	CONS	5(2.76%)
9	NFGNB	3(1.66%)

CONS: Coagulase negative staphylococci, NFGNB: Non fermenting gram negative bacilli

One hundred and seventeen urine samples showed pus cells in the range of 1-5/HPF. Out of 117, only 21(17.95%) showed significant bacterial growth. 41 urine specimens showed plenty of pus cells out of which 36(87.80%) had significant growth [Table 3]

Table-3: Distribution of pyuria among culture positive specimens

S. No	No. of Pus cells/HPF	No. of Specimens	Culture Positive
1	1-5	117	21(17.95%)
2	6-10	99	48(48.48%)
3	11-15	63	38(60.32%)
4	16-20	59	38(64.41%)
5	Plenty	41	36(87.80%)

Table-4: Association between isolated bacteria and pus cells

Bacteria isolated	≤10pus cells/HPF	>10pus cells/HPF
E.coli	26(27.08%)	40(47.06%)
Klebsiella species	27(28.12%)	14(16.47%)
Staphylococcus aureus	15(15.62%)	13(15.29%)
Pseudomonas aeruginosa	8(8.33%)	5(5.88%)
Enterococci	8(8.33%)	3(3.53%)
Proteus species	6(6.25%)	1(1.18%)
Enterobacter	3(3.12%)	4(4.70%)
CONS	3(3.12%)	2(2.35%)
NFGNB	0(0%)	3(3.53%)
Total	96(53.04%)	85(46.96%)

Discussion

Manual microscopy is widely employed to determine pyuria. But the results are highly variable depending on the laboratory, technician and urine sample [7]. In the present study, majority of urine samples (n=117) collected and examined under high power objective showed pus cells in the range of 1-5. Only 21(17.95%) urine samples yielded significant bacterial growth. These results are similar with the study conducted by

Anushree et al, in which 240 out of 260 urine samples showed pus cells in the range of 1-5/HPF and only 4(1.6%) urine samples showed significant bacterial growth [11]. In this study, 262 samples showed significant pyuria (>5 pus cells/HPF). Out of 262 urine samples which had pus cells >5/HPF, 160(61.07%) samples showed significant bacterial growth. The study conducted by Kattel et al observed 53.9% urine samples

with significant bacterial growth and significant pyuria [12]. Other study which was conducted by Anjila Dongol et al, also found 84.09% (74/88) samples had significant pyuria with culture positive [13]. Significant bacterial growth was seen in 21(17.95%) urine samples which showed pus cells in the range of 1-5/HPF. Previous studies conducted by Ginsburg and Maskell found bacteriuria without pyuria with the rate of 15% and 44% respectively [14,15].

In a study conducted by Samia Khamees, 23% urine specimens showed bacteriuria without pyuria (or the presence of puss cells less than 5) [16]. Bacteriuria without significant pyuria often occur in cases of asymptomatic patients, patients with diabetes, enteric fever or bacterial endocarditis whereas significant pyuria with sterile bacterial culture occur in patients with prior antibiotic use, renal tuberculosis, corticosteroid administration, analgesic nephropathy, renal calculi or in the presence of bacteria that are not able to grow in the routine culture media [12].

In the present study, the significant bacterial growth was found to be high (87.80%) in samples with plenty of pus cells per HPF which differs with the previous studies. Anjila Dongol et al and Dhakal et al observed that the presence of 5-10 pus cells per HPF could be a good marker of UTI [13,17]. The chance of getting significant bacterial growth was high when pus cells are more per HPF. This correlates well with the study conducted by Anushree et al [11].

The diagnostic accuracy and microscopic result analysis are influenced by specimen processing (centrifuged/ uncentrifuged and stained/unstained) the method of quantifying leucocytes (per microscopic high power field/ per cubic millimeter) and cutoff value to define pyuria [18]. Previous studies reported that examining uncentrifuged urine is easier and less time-consuming, hence it is suitable for the out-patient department and however, it is reassuring that no significant difference was found between the results of centrifuged and uncentrifuged specimens [19].

However, pyuria alone cannot be used for detecting bacterial pathogen in patients with significant bacteruria. In our study, pyuria was most commonly observed among females. In females, inflammation of the external surfaces of the urinary organs or contiguous infection, potentially resulting in pyuria and sometimes a UTI. This is similar to the study conducted by Hooker et al [20]. As per Hooker et al women had higher incidence of pyuria but the proportion with positive cultures was not different between women and men with pyuria. Macdermott stated that there was no association between degree of pyuria and a significant urine culture [21]. Further, Bachman et al concluded that pyuria on urine microscopy was poor in identifying asymptomatic bacteruria [22]. Wammanda et al found positive urine culture with significant bacteria in 24.3%, urine microscopy for significant leucocyturia had a sensitivity of 51.1% [23]. But, Shaw et al reported that urine WBC count was sensitive in detecting UTI [24].

In the present study Escherichia coli(36%) was the predominant pathogen. This is in accordance with previous studies [25]. Other study conducted by Kristiansen found 81.5% of UTI caused by E.coli. Second most common uropathogen was Klebsiella spp (22%) followed by Staphylococcus aureus(15%).[26] But in other studies, lower proportion of UTI was caused by Klebsiella spp (8.4%) [27,28].

In our study, When infections were analyzed by the organisms causing infection, Gram negative Bacilli were mostly accompanied with pyuria than gram positive cocci. However, among Gram negative bacilli, Klebsiella and Pseudomonas aeruginosa were less likely to elicit pyuria. This is in accordance with the study conducted by shaik et al [29].

Others studies also reported the frequent absence of pyuria in noncatheterized and catheterized patients with urinary tract infection caused by coagulase-negative staphylococci or yeast [30,31].

The reasons underlying these observations are not entirely clear. While CAUTI caused by staphylococci, enterococci, or yeasts occasionally leads to bloodstream infection, especially if urinary tract obstruction occurs [31]. The degree of urinary tract inflammation elicited by these organisms is clearly not as great as occurs with the gram-negative bacilli. Coagulase - negative staphylococci have been shown in animal models of infection to incite far less cytokine release than gram negative bacilli [32]. Few studies reported correlation between method of sample collection and significant bacterial growth [31]. Virtanen et al, found only 6% false positive in clean-voided specimens [33] and Houston found that 86% (75 out of 87) of 'non-infected' children gave negative results (less than 10,000 organisms/ml.) in mid-stream urine culture [34]. In

repeat cultures, using the same method of cleansing and collection, definite negative results were obtained in all those with significant growth. But in our study no repeat urine culture was performed due to lack of patient follow up especially samples received from outpatient departments. Even other study showed, approximately 50% patients no longer had pyuria on a repeat urinalysis [20]. In our study, majority of samples especially received from outpatient departments were not subjected to repeat urinalysis which remained as limitation of the study. No proper information was obtained from out patients regarding antimicrobial therapy received before submitting urine sample and remained as another limitation of the study.

Conclusion

Majority of urine samples received from suspected UTI patients showed no growth in spite of significant pyuria on routine bacteriological media. As the number of pus cells in urine increases, the chance of yielding significant bacterial growth is also high. Overall, significant pyuria was observed among specimens yielded Gram negative bacilli than Gram positive cocci. Among Gram negative bacilli, Escherichia coli was most commonly accompanied with pyuria.

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How to cite this article?

M.J. Haja Abdul Nazeer, Y. Kavitha. Association between pyuria and uropathogen in suspected urinary tract infection. Trop J Path Micro 2017;3(2):223-228.doi: 10.17511/jopm.2017.i2.26.
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