

Original Research Article

Utility of urinary gram stain as a diagnostic method for urinary tract infection

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ABSTRACT

Background: Urinary tract infection (UTI) is one of the most common infections in humans. Timely diagnosis and treatment are necessary to reduce the complications from UTI. Urine culture is still the gold standard diagnostic test for UTI, however it is costly and time consuming. The present study was conducted to compare the utility of urinary gram stain, microscopy of centrifuged urine sample and urine culture for the diagnosis of UTI.

Methods: 100 urine samples were processed for gram stain, culture and microscopy. Urinary gram stain findings were correlated with microscopy and culture results. Using urine culture as gold standard, the sensitivity, specificity, accuracy, positive predictive value (PPV) and negative predictive value (NPV) of urinary gram stain were assessed for the diagnosis of UTI.

Results: The accuracy of urinary gram stain for detection of UTI was 97%.

Conclusions: Urinary gram stain is a reliable diagnostic test for early detection of UTI.

Keywords: Gram stain, Urinary tract infection

INTRODUCTION

Urinary tract infection (UTI) is a common health problem. Most of the times, clinical findings of UTI are subtle and non-specific and present with fever only. However, UTI can pose serious complications like septicemia, renal abscesses etc.

Hence, timely and accurate diagnosis of UTI is pertinent. Microscopic urinary sediment analysis, urine culture, dipstick analysis are the common methodologies used to detect UTI. Recently, even flow cytometry, renal or bladder ultrasound, cystourethrogram were also utilized for diagnosis of UTI.^{1,2} However, since decades urine culture has been the gold standard for detection of UTI.^{1,3,4}

Above cited techniques are time consuming and expensive. There are several studies in which urinary gram stain was utilized for UTI detection.³⁻⁶ In the present study, we evaluated the efficiency of urinary gram stain for detection of UTI using urine culture as gold standard.

METHODS

The midstream urine specimen was collected in sterilized tubes from male (55 cases) and female patients (45 cases) in the age group of 20-50years with clinical symptoms suggesting UTI. All the urine samples were processed by centrifugation at 3000rpm for 15minutes. Centrifuged samples were submitted for urine microscopy, urinary gram stain and urine culture. The patients receiving

antibiotic treatment were excluded from the study. Microscopy for bacteriuria and pyuria was performed on centrifuged urine samples. Pyuria was diagnosed if ≥ 5 WBCs per hpf (40x) noted on unstained microscopy. Bacteriuria was diagnosed if readings were noted on average hpf (40x). Urine samples were considered as gram stain positive if any organisms were present on the survey of 20 oil immersion fields.

The urine cultures were processed on Nutrient agar, Blood agar, MacConkey agar. Cultures were considered positive if the cultures yielded $\geq 10^5$ bacterial colonies.⁵ Urinary gram stain findings and microscopy findings were correlated with urine culture results. The urine culture results were considered as gold standard. The utility of urinary gram stain was evaluated for diagnostic accuracy by calculation of sensitivity, specificity,

accuracy, positive predictive value (PPV) and negative predictive value (NPV).

RESULTS

Amongst the 100 urine samples analyzed, 55% (55/100) were male patients and 45% (45/100) were female patients. Out of 100 urine specimen cultures, 95% reflected bacterial growth $\geq (10^5\text{CFU/ml})$ and were considered as culture positive. Out of 100 urine samples, 93% were positive for urinary gram stain and 90% were positive for urine microscopy for diagnosis of UTI.

When urine culture was used as gold standard, urine gram stain reflected sensitivity of 97.8%, specificity of 80%, accuracy of 97%, PPV of 98.9% and NPV of 66.6%. (Table 1).

Table 1: Comparison of performance urinary gram stain test with urine culture test.

Urinary gram stain results	Urine culture results			Sen.	Speci.	Accu.	PPV	NPV
	Pos.	Neg.	Total					
Positive	93	01	94	97.8%	80%	97%	98.9%	66.6%
Negative	02	04	06					
Total	95	05	100					

(Sen. = Sensitivity, Speci. = Specificity, Accu. = Accuracy, PPV= Positive Predictive Value, NPV= Negative Predictive Value, Pos.=Positive, Neg. = Negative)

Table 2: Comparison of performance urine microscopy test with urine culture test.

Urine microscopy results	Urine culture results			Sen.	Speci.	Accu.	PPV	NPV
	Pos.	Neg.	Total					
Positive	90	02	92	94.7%	60%	93%	97.8%	37.5%
Negative	05	03	08					
Total	95	05	100					

(Sen. = Sensitivity, Speci. = Specificity, Accu. = Accuracy, PPV= Positive Predictive Value, NPV= Negative Predictive Value, Pos.=Positive, Neg. = Negative)

Urine microscopy reflected sensitivity, specificity, accuracy, PPV and NPV of 94.7%, 60%, 93%, 97.8% and 37.5% respectively, using urine culture as gold standard. (Table 2).

DISCUSSION

Urinary tract infection is one of the most common clinical presentations encountered in medical practice. UTI is commonly seen in newborns, pre-pubertal girls and boys, elderly males and elderly females.⁷ UTI is an outcome of interaction between uropathogens and the host. Increased bacterial virulence over the host resistance leads to UTI.⁸ UTI presents from asymptomatic bacteriuria to severe complications like sepsis. In medical laboratories, urine microscopy and urine culture are commonly performed for diagnosis and follow up of UTI. The chemical screening with dipstick reagents also has been widely used to complement urine analysis. The traditional urine microscopy and urine

culture are labour intensive, time consuming and have wide variability.

In the present study, the centrifuged urine samples were utilized for urinary gram stain and urine culture tests. The centrifugation of urine tends to detect greater values for WBCs and bacteria. Thus, a wide range of concentration of cellular components is accurately detected by urine centrifugation method.⁹

The present study showed high percentage of UTI in males (55%) than females. The similar results were obtained by Tambyah and Maki et al, and Wennerstrom et al.^{10,11} Some counter studies like Walsh et al reported that UTI are more common in women than men.

The present study evaluates urinary gram stain as a screening test for detection of UTI using urine culture as gold standard. In the present study, when compared with urine culture as gold standard, out of 95 urine culture

positive cases, 93 cases were positive by urinary gram stain giving a sensitivity of 97.8%, specificity of 80%, accuracy of 97%, PPV of 98.9% and NPV of 66.6%. (Table 1).

At the same time, when urine microscopy was compared with urine culture, the accuracy turned out to be 93%. (Table 2) Thus, the present study observed that better results were obtained by urinary gram stain than urine microscopy for diagnosis of UTI. Similar findings were also observed by Lockhart GR et al, Arslan S et al, and Fernandez BJ et al.³⁻⁵

Regarding urine microscopy, even though reliability and accuracy are demonstrated there still will be disparity when same urine sample is reported by two pathologists, as discrepancies in urine microscopy reporting depend greatly upon inherent inaccuracies of the said method.¹² Similar findings were also reflected regarding urine microscopy in the present study.

CONCLUSION

The present study observes that the gram stain examination of urine is a significant and reliable tool in the diagnosis of urinary tract infection as there was a strong relationship between positive results of urinary gram stain with urine culture and urine microscopy results. In view of precision and cost effectiveness of urinary gram stain test over conventional tests like urine culture and urine microscopy, the urinary gram stain test should be included as routine screening test for diagnosing UTI in hospital set up.

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