

Comparative Evaluation of Laboratory Tests In The Diagnosis of Urinary Tract Infection In Adults

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Abstract- Urinary tract infection (UTI) is one of the most common bacterial infections seen in adult patients. There are various laboratory tests available for diagnosis of UTI. A Single test is not diagnostic, hence the combination of tests are used to diagnose UTI. Out 100 samples, Wet mount showed significant no. pus cells (>1pus cells/HPF) in 43(43%) and in Gram staining showed significant pus cells (>5 Pus cells / HPF) 79(79%), equivalent as significant growth (10^5 cfu /ml). Culture by Dip slide, 47 (47%) urine samples showed significant bacteriuria (more than 200 col- 10^5 CFU/ml) with showed Sensitivity- 45.30%, Specificity-100%, Positive predictive value-100% and Negative predictive value- 23%. Gram staining showed more Sensitivity (94.20%)and Specificity(71%) than Wet mount microscopy. Standard loop technique showed more Sensitivity(100%) and Specificity (100%).

and in the elder females(20%) were higher in number as compared to male(10%).⁽³⁾

- The common symptoms of UTI are frequency of micturition, burning micturition and urgency with pain and associated discomfort, fever with chills and rigors.
- "Significant bacteriuria" was intended by Kass to provide a means of differentiating between contamination in the voided specimen and true urinary infection. It was based on the reasonable assumption that the common pathogens of the urinary tract multiply in the urine and, therefore, when bacteria are deposited in the urine, they tend to multiply to very large numbers, usually exceeding 10^6 colonies per milliliter. The distinction between bacteriuria and contamination is "based on an analysis of the distribution of bacterial counts in nonbacteriuric and bacteriuric populations, so that, as Kass himself makes clear, there is no specific bacterial number for use in the detection of bacteriuria, but, rather, a degree of probability that a given colony count signifies either bacteriuria or contamination in a voided specimen. Thus, the concept of "significant bacteriuria" at the level of 100,000 colonies/ml is very useful in diagnosis of UTI
- Symptomatic UTI- The common symptoms include urgency, frequency of micturition, abdominal discomfort or pain. In upper UTI (pyelitis or pyelonephritis) patient present with fever and flank pain. In lower urinary tract infection (cystitis) frequent and painful urination of small amounts of turbid urine (dysuria) and suprapubic heaviness or pain are the usually clinical manifestation.^{[25][26][27]}

I. INTRODUCTION

Human race since ancient time has been interaction with microbes. Often the interaction leads to disease, disability or death due to the involvement of an organ or a system of the host. Both males and females are equally affected in UTI. Urinary tract infection is the most common infectious disease seen in humans. In 2013, 150 million cases per annum are encountered in medical practice in India.⁽⁴⁾ All portion of the urinary tract may be affected. The most commonly, infection of urethra (Urethritis), bladder (cystitis), Ureters (Ureteritis) and the renal pelvis of kidneys (pyelonephritis).

Urinary tract infection can be classified as –

- Upper UTI - Involves the kidney or ureter
Example- Acute pyelonephritis, Acute pyelitis
- Lower UTI - Involves infection from the urinary bladder downwards

Example –Urethritis, Cystitis, Prostatitis

The prevalence varies with the age and sex of the patient. In neonates and infants UTI is more common in boys , by the time children attend the school girls are prone to UTI

There are various tests available for the diagnosis of UTI are:

- Screening tests- Wet mount & Gram staining
- Culture method- Standard loop technique & dip slide
- Rapid test- Nitrite test, Leukocyte esterase test, Triphenyltetrazolium chloride (TTC) test, Griess nitrite test, Dip stick test

- It is found that there is no single diagnostic test available and each test has got merits and demerits and hence diagnosis should be based on combination of different test.

Wet mount microscopy – Wet microscopic examination of spun, clean-catch, midstream urine sediment. Pyuria is diagnosed by the presence of three to five white blood cells per high-power field, and hematuria is diagnosed by the presence of three to five red blood cells per high-power field.

Gram stained film of the centrifuged deposit of urine specimen in microscopic examination yielded more useful information compare to the examination of wet film of untreated urine.⁽²⁾

Dip-slide is a small plastic tray carrying layer of an appropriate agar medium on one side Opposite side may carry different media.

Calibrated standard loop culture is the gold standard method. It gives the 100% positive result.⁽¹⁾

Both the clinical diagnosis and laboratory tests are useful to diagnose UTI. Which provides the specific bacteriological profile and the antimicrobial susceptibility patterns of pathogens isolated.⁽⁴⁾

II. OBJECTIVE

To evaluate the laboratory tests in the diagnosis of UTI in adult patients.

III. METHODOLOGY

A Cross-sectional study of one year duration (Jan-Dec 2015) was conducted on adult patients attending the Gynecology, Surgery and Medicine Out patient and In patient Department of KLE'S DR. Prabhakar Kore's Charitable Hospital, Belgaum with their informed consent formed the study group. Ethical clearance was sought from Institutional Ethical Committee. 100 Mid stream urine sample was collected in sterile universal container and urine sample was transported within 1hour of collection to the Department of Microbiology, JNMC, KLE University, Belagavi. The samples were subjected to Wet mount and Grams staining for pus cells and bacterial count and cultured on MacConkey and Cystine lactose electrolyte deficient agar.

IV. RESULTS

Out 100 samples, Wet mount showed significant no. pus cells(>1pus cells/HPF) in 43(43%) samples and in Gram staining 79(79%) sample showed significant pus cells (>5 Pus cells / HPF) equivalent as significant growth (10^5 cfu/ml). Dip slide culture 47 (47%) samples showed significant bacteriuria (more than 200 col- 10^5 CFU/ml). Gram staining showed more Sensitivity(94.20%)and Specificity(71%) than Wet mount microscopy. Standard loop technique showed more Sensitivity(100%) and Specificity (100%) than Dip slide culture. Out of 100 sample 86 samples showed significant growth. Out of 86 sample 47 female and 39 male showed significant growth in urinary tract infection. Maximum no of patients were seen in the age group of 18-30 years with 47 cases. Total 86 isolates, the predominant organisms were: *Escherichia coli*- 46 (53.49%), followed by *Enterococcus species* -14 (16.28%), *Klebsiella pneumoniae* -13(15.12%), *Pseudomonas aeruginosa*, *Citrobacter freundii* & *Citrobacter koseri* – 2(2.33%) each, *Klebsiella oxytoca* and *Protes vulgaris* -3(3.49) each, *Serratia marscencs*- 1(1%).

V. DISCUSSION

Urinary tract infection is the most common infectious disease seen in humans. The prevalence varies with the age and sex of the patient. The common symptoms of UTI are burning micturition and urgency with pain, abdominal discomfort. Urinary tract infections are important complications of diabetes, renal disease, renal transplantation and structural neurological abnormalities that interfere with urine flow.

In our study total no 100 cases, Wet mount 43(43%) were positive for significant pyuria showed growth on culture and 43(43%) were negative for significant pyuria showed growth on culture.

Adem M et al (2001) showed out of 300 sample in Wet mount 30 were positive for pus cells and showed significant growth and 30 were negative for pyuria but showed significant growth.⁽³⁾

In Gram staining out of 100 cases 79(79%) were positive for significant pyuria showed growth on culture and 7(7%) were negative for significant pyuria showed growth on culture.

Adem M et al (2001) showed out of 300 sample in Gram staining 55 were positive for significant growth and 5 were negative for significant growth.⁽³⁾*Shobha K.L et al (2014)*

Gram's stain showed 59 positive for pyuria but only 57 of the same samples had significant bacteriuria in culture⁽²¹⁾

In our study Out of 100 samples in Wet mount 43(43%) sample showed > 1 Pus cells / HPF equivalent as significant growth (10^5 organism /ml) and in Gram staining 79(79%) sample showed > 5 Pus cells / HPF equivalent as significant growth (10^5 organism /ml).

Littlewood JM *et al*(1977) showed only 14 (36%)of the 38 urines that grew > 10^5 organisms/ml also contained more than 5 pus cells in each microscopical field, while in 8 (21 %) of the samples no pus cells were seen.⁽⁸⁾ Shobha K.L *et al* (2014) In Gram's stain Presence of pus cells (5 cells/ml of urine) were seen in 54 sample and 46 sample did not show any pus cells.⁽²¹⁾

Out of 100 samples in Dip slide culture 40 (40%) samples showed significant bacteriuria (more than 200 col- 10^5 organism/ml) and in Standard loop technique showed 86 (86%) significant bacteriuria(10^5 organism/ml)

Similar study done by Hadapad D *et al* (2015) out of 108 cases, 87 were culture positive, and all (100%) were positive by standard loop where as 11.50% were positive by dip slide culture method.⁽⁴⁾ Baum J *et al* The results of 73 dip inoculum urine cultures were compared with the results after routine plating and culture. There was complete agreement in 63 cases. The dip-slides gave 7 false positive results and 2 false negative results.⁽¹⁸⁾

In our study Wet mount microscopy showed Sensitivity -50% , Specificity- 100%. Positive predictive value- 100% and Negative predictive value- 24.3% when compared with Standard loop technique gold standard method. Similar study conducted by Adem M *et a* (2011) Wet mount microscopy had Sensitivity -50% ,Specificity- 77%, Positive predictive value- 43 % and Negative predictive value- 86% were compared with Standard loop technique gold standard method.⁽³⁾This study doesn't support the common practice in Ethiopia of diagnosing UTI on the basis of pyuria alone, since their study reveals that in using pyuria as the sole laboratory criterion for the diagnosis of UTI 25% of the cases may be missed. On the other hand, over 60% of cases clinically suspected to have UTI may be falsely diagnosed as such on the basis of pyuria .^(3,41)

In our study Gram staining showed Sensitivity-94.20%, Specificity-71%, Positive predictive value-95% and Negative predictive value- 66.66% when compared with Standard loop technique gold standard method.This study co relates with Adem M *et al* (2011) in Gram staining showed

Sensitivity-95% , Specificity –86%, Positive predictive value-66% and Negative predictive value- 99% .

In our study Dip slide showed Sensitivity- 45.30% , Specificity-100%, Positive predictive value-100% and Negative predictive value- 23% when compared with Standard loop technique gold standard method.

Rosenberg M *et al* (1992) showed Dipslide had Sensitivity- 97.3 , Specificity -99.6 , Positive predictive value -97.3& Negative predictive value- 99.6 . It is simple, convenient method should allow more extensive use of quantitative urine culture in the diagnosis and follow up of patients with urinary tract infections in office practice. It should not be considered a substitute for the more definitive pour plate method or for standard methods.

In present study, among the 100 samples collected, 86 (86%) showed significant bacteriuria .

Similar study done by-

Adem M *et al* (2011) Among the 300 samples collected, 60 (20%) had significant bacteriuria so the prevalence was 20%.⁽³⁾

Hassan A *et al* (2014) in Andhrapradesh; Out of the 800 urine suspected cases of urinary tract infection ,360 samples showed significant bacterial growth so the prevalence was 20%.⁽⁶⁾

In our study out of 57 female patients, 47 (54.65%) showed significant growth and out of 43 male, 39 (45.34%) showed significant growth.

The study conducted by Jabber *et al* (2016) Out of 37 females patients 30 showed significant growth and out of 23 male, 15 showed significant growth.⁽¹³⁾

High prevalence of UTI in females is due to-

1. Presence of short urethra^(6,13,25)
2. Sexual intercourse that cause introduction of bacteria to bladder.⁽¹³⁾
3. Its proximity to the warm , moist , vulvar and perianal areas that are colonize with enteric bacteria.^(3,26,29)

In our study total no of 100 cases were distributed between the age group of 18-90 years. Maximum no of patients were seen in the age group of 18-30 years with cases 47 (47%) followed by 46-60 years with cases 19(19%) and above 60 years with cases 16(16%).

R. Theresa *et al* (2013) UTI is frequent in young sexually active women with reported incidence rates ranging from 0.5 to 0.7 per year.⁽³⁸⁾ Beyene G *et al* (2011) showed that age categories of 19 to 39 years, 122 cases was associated with increased incidence of UTI.⁽¹¹⁾ Magnliano E *et al* (2012) showed that female to male ratio was highest in age group 15–29 years (F/M = 13:5).⁽³⁶⁾ Adem M *et al* (2001) showed consists of 172 females and 128 males where 75% of them were found with the age range of 15-49 years old of both sexes.⁽³⁾

These studies co relates the findings of the our study where the 19- 30 years age group shows the maximum rate of Urinary Tract Infection 47(47%).

In our study culture was positive with Significant colony count showed in 86 samples out of 100 samples. The predominant organisms were: *Escherichia coli*- 46 (53.49%), followed by *Enterococcus species* -14(16.28%), *Klebsiella pneumoniae* -13(15.12%), *Pseudomonas aeruginosa*, *Citrobacter freundii* & *Citrobacter koseri* – 2(2.33%) each , *Klebsiella oxytoca* and *Protes vulgaris* -3(3.49%) each, *Serratia marscencs*- 1(1%). Similar study done by Beyene G *et al*(2011) The most common organism was *Escherichia coli* which was isolated from 14 patients with percentage of 31.1% . *E.coli* was the most prevalent followed by *Proteus mirabilis* 22.2% (10), *Pseudomonas aeruginosa* 15.5% (7) , *Staphylococcus aureus* 11.1% (5) , *Klebsiella pneumonia* 13.3 % (4) , *Staph.saprophyticus* 4.4% (2) and *Serratia marcescenes* 2.2% (1).⁽¹¹⁾ Hadapad D *et al*(2015) showed *Escherichia coli* (47.91%), and Coagulase negative *Staphylococcus* (13.54%) were the commonest isolates.⁽⁴⁾ Ayazi P *et al* (2016) out of the cultures, 57 (76 percent) were Positive for *Escherichia coli*, 5(6.7 percent) For *Proteus mirabilis*, 5 (6.7 percent) For *Enterococci*, 4 (5.2 percent) For *Klebsiella pneumonia*, 3 (4 percent) for Coagulase negative *staphylococci* and 1 (1.4%) *Pseudomonas aeruginosa*.⁽¹⁴⁾

VI. CONCLUSION

Different laboratory tests are available to diagnose urinary tract infection. This study compared Wet mount microscopy, Gram staining, Dip slide & Standard loop technique. 79% samples which showed significant pyuria by Gram staining showed significant growth on culture.43% samples which showed significant pyuria by Wet mount showed significant growth on culture. Dip slide culture 47(47%) sample shows significant bacteriuria and in Standard loop technique showed 86 (86%) significant growth. *Escherichia coli* is the most predominant isolate in adult patient. In our study the antibiotic susceptibilty test was done for all Gram Negative bacilli was more effective for Nitrofurantoin.

Summary: Among those laboratory tests- Wet mount microscopy showed Sensitivity -50%, Specificity-100%, Positive predictive value- 100% and Negative predictive value- 24.3% when compared with Standard loop technique gold standard method.

Gram staining showed Sensitivity-94.20%, Specificity-71%, Positive predictive value-95% and Negative predictive value- 66.66% when compared with Standard loop technique gold standard method.

Dip slide showed Sensitivity- 45.30%, Specificity-100%, Positive predictive value-100% and Negative predictive value- 23% when compared with Standard loop technique gold standard method.

A Single test is not diagnostic, hence the combination of tests are used to diagnose UTI.

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REFERENCES

- [1] Bale J, Matsen J .Evidence Against the Practicality and Cost-Effectiveness of a Gram-Positive Coccal Selective Plate for Routine Urine Cultures from University of Utah School of Medicine. journal of clinical microbiology.1981;617-619
- [2] Wilson M, Gaido L. Laboratory Diagnosis of Urinary Tract Infections in Adult Patients from University of Colorado. Clinical Infectious Diseases.2004; 38:1150–8
- [3] Adem M *et al*. Evaluation of Screening Methods for the Detection of Urinary Tract Infection from School of Medical Laboratory technology Jimma University Jimma University .*Ethiop J Health Sci* .2001;Vol. 11, NO.1.
- [4] Hadapad D, Solabannavar S . A comparative study of aerobic bacteriological profile of urinary tract infection in children by standard loop and dip slide semi-quantitative culture methods and their from S.N. Medical college ,Bagalkot ,India. International Journal Current Microbiology and Applied Sciences.2015:450-456
- [5] Rosenberg M, Berger A, Barki M, Goldberg S, Fink A, Miskin A. Initial Testing of a Novel Urine Culture Device from The Department of Human Microbiology from Maurice and Gabriela Goldschleger School of Dental Medicine, Sackler Faculty of Medicine, Tel-Aviv University, Tel-Aviv 69978, Ramat-Aviv, Tel-Aviv Sourasky Medical Center, Tel-Aviv and Kaplan Hospital. Journal of clinical microbiology. Oct. 1992: p. 2686-2691

- [6] Hassan A, Kumar N, Kishan R, Neetha. Laboratory diagnosis of urinary tract infection using diagnostics tests in adult patient from Mamta Medical College , Andhra Pradesh, India. *International Journal of Research in Medical Sciences*.2015; 2(2):415-421
- [7] Jeana F, Judy T, Miller M . Evaluation of a new, semi quantitative screening culture device for urine specimens. *J. Clin. Microbiology*.1995;33(5):1351-1353.
- [8] Littlewood JM, Jacobs SI, Ramsden CH. Comparison between microscopical examination of unstained deposits of urine and quantitative culture. *Archives of Disease in Childhood*. 1977;52: 894-896.
- [9] Ellner P, Papachristos T. Detection of Bacteriuria by Dip-slide from Columbia University College of Physicians and Surgeons, and the Diagnostic Microbiology Service; October 7, 1974:516-521.
- [10]McGeachie, J. and Kennedy, A. C. (). Simplified quantitative methods for bacteriuria and pyuria; *J. clin. Path*. 1963; 16 :p-32-38.
- [11]Beyene G, Tsegaye W. Bacterial uropathogens in urinary tract infection and antibiotic susceptibility pattern from jimma university. *Ethiop J Health Sci*. 2011; Vol. 21,No 2:141-146
- [12]Jackaman F , Darrell J, Shackman R. The Dip-slide in Urology from Royal Postgraduate Medical School. *British Medical Journal*. 1973; Vol 1: 207-208
- [13]Jabber A et al . Detection of bacterial pathogens causing urinary tract infection and study their susceptibility to antibiotics from Thi-Qar University. *European. Journal of Biology and Medical Science Research*. February 2016; Vol.4; No.1: p.37-43
- [14]Ayazi P, Daneshi M . Comparison of urine culture and urine dipstick analysis in diagnosis of urinary tract infection from Ghazvin University of Medical Sciences. *Acta Medica Iranica*; 2007; 45(6): p-501-504
- [15]Duerden B, Moyes . A Comparison of laboratory methods in the diagnosis from Edinburg University Medical School,Edinburg. *Journal.clinical. Pathology*. 1976; 29 : p-286-291
- [16]Shilpi T, Ahmed M, Huq S, Baul S, Khatun M. Isolation of bacteria causing urinary tract infections and their antibiotic susceptibility profile from Anwer Khan Modern Medical College Hospital. *AKMMC J*. 2013; 4(2): 23-27.
- [17]Leigh D, Williams J. Method for the detection of significant bacteriuria in large groups of patients form Edgware General Hospital. *J. clin. Path*. 1964;17: 498