

Diagnostic Accuracy of Urine Analysis (DR) in Suspicious Cases of Urinary Tract Infections by Taking Urine Culture as Gold Standard

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ABSTRACT

Background: Urinary tract infections (UTI) are one of common clinical condition encountered in various clinical settings. This the most common infection, typically diagnosed on the basis history and clinical examination endorsed by urine analysis and culture sensitivity. Timely diagnosis and treatment are crucial in management. For diagnosis of UTI, Urine culture is standard, as it provide detail information for urinary pathogens, but it has certain disadvantages e.g. urine culture is costly, takes longer time, and up to 60-80% of the results are negative.

Objective: To determine the diagnostic accuracy of urinalysis (Urine DR) in detection of urinary tract infection (UTI) among suspected cases of UTI by taking urine culture as gold standard.

Materials And Methods: This cross sectional study was conducted at study was conducted at Department of Urology, Jinnah Postgraduate Medical Centre (JPMC) Karachi, from march 2021 to September 2021.

All patients who visited to JPMC Karachi and fulfilled the inclusion criteria and were included in the study after getting Informed consent. All patients were evaluated by urinalysis and urine culture. The results of urinalyses were recorded and compared with the results obtained on subsequent urine cultures. All of the specimens were obtained by the "clean-catch" method. All data and results were recorded on proforma and used electronically for research purpose.

Results: Mean \pm SD of age was 52.6 \pm 8.5 years. In distribution of gender, 60 (53.1%) patients were male while 53 (46.9%) were female patients. Diagnostic accuracy of urinalysis was 73.45% in diagnosis of urinary tract infection with sensitivity 76.47%, specificity 72.15% PPV 54.17% and NPV was found to be 87.69% by using urine culture findings as gold standard.

Conclusion: It is to be concluded that evaluating of urinary tract infection (UTI) with urinalysis (Urine DR) did not prove helpful and comparable to urine culture. Urine culture should be done in each and every suspected case of UTI.

Keywords: Bacteriuria, Diagnostic Accuracy, Sensitivity, Specificity, Urinalysis

INTRODUCTION

Urinary tract infections (UTIs) can be classified as upper tract (kidney) infection and lower tract

infection (confined to bladder, urethra and prostate). (1) UTI frequency has increased about 65% over the last 5 years. Urinary infections are common reason for hospital admission in elderly patients 75 and older. [2]. The infection can be uncomplicated or complicated. When it occurs in normal host, non-pregnant and no history of instrumentation (catheterization) called uncomplicated, all others are considered as complicated UTI. [3]. This study focuses on both uncomplicated and complicated UTI as well.

Diagnosis of UTI is made on clinical assessment as well as urine culture demonstrating number of particular microorganism above the 1000 colony forming unit/milliliter (CFU/ml) of urine which can be vary from 100 CFU/ml to 100,000 CFU/ml

[4]. Routine examination of urine (Urine DR) is most commonly done in emergency department to rule out urinary tract infection it is less time consuming.

For patients suspicious of urinary tract infection, however it significantly decrease patients stay time in emergency department. [5]. Urine analysis may also be helpful and necessary in disorders of kidneys and urinary tract, Diabetes and liver pathologies. [6].

Sample of urine collected usually as clean-catch method or by other alternative methods. In simple uncomplicated UTI (Acute Cystitis) treatment can be started on clinical grounds as many factors Support that routine urine culture is not necessary [7], such factors includes predictable uropathogens, reliable clinical diagnosis and low morbidity. A study done in Pakistan reported the prevalence of UTIs as 11.6% in the urine samples, showing the significance growth of uropathogenic bacteria [8]. Another study reported UTI as 41.10% [9]. Substituting a urinalysis for a urine culture and sensitivity test may be more time consuming and expensive, however, the accuracy of urinalysis is debatable. Accuracy of microscopic urine analysis in diagnosing urinary tract infection has been studied; these studies have shown that the diagnostic accuracy of urinalysis is satisfactory, and treatment can be started without the culture report [7-9].

Recently meta-analysis was done to establish sensitivity of Urine DR in urinary tract infections in symptomatic adults; it concluded that Urine DR has insufficient sensitivity to rule out UTI in patients with symptoms. [8]. No such studies have been done on adults in Southeast Asia. Only one study in Malaysia showed low sensitivity satisfactory, and treatment can be started without the culture report [7-9].

In a Turkish base study, urinalysis had a sensitivity of 55.8% with a specificity of 81.3% while PPV of 39.1% and NPV of 89.5% using only bacterial count (>44 cell/ml) for predicting significant bacterial. This specificity of 81.3% shown that 30% of the culture were negative who had positive finding of bacteria above the cut off value in urinalysis. (10) recently automated instruments have been used to see the urine for cells and particles without spinning. Detection of bacteria in urine can also be done with image analysis and flow cytometry. (10-12) It has been seen that in clinical microbiological laboratories, urine cultures are among the high workloads. As it is well known fact that UTIs are one of the commonest health problem not only in inpatient settings but also outpatient settings as well. So appropriate usage of urine cultures by health care providers not only help in proper care of the patients but very effective in operating laboratories.

Therefore, it is essential to explore the diagnostic need of urine culture and sensitivity when a comparatively cost-effective option of equal accuracy is available. Considering the cost effectiveness and technically easier option of urinalysis in tertiary care hospital in a developing country like Pakistan where there are significant cost considerations, we would like to compare the diagnostic role of urinalysis (Urine DR) in a cohort of patients with suspected urinary tract infections (UTI). As Previous studies from Pakistan have been conducted without calculating a sample size on scientific parameter, neither they follow the criteria of study design and nor they apply the proper sampling technique, that's why I conducted this study with proper protocols of the research methodology in our local setup in order to provide current and concrete statistics. There is a need of continued research for better results and to build up the conclusion so that current standard of care may be improved accordingly. This study will help us in

identifying the diagnostic accuracy of urinalysis (Urine DR) for early detection of UTI in order to avoid diagnostic delay.

MATERIAL AND METHODS

This Cross-Sectional descriptive study conducted at department of urology Jinnah Postgraduate Medical Center, Karachi from March 2021 to September 2021. After approval from the ethical review board committee. Patients of both genders from age 20 to 80 years who presented with acute onset of one or more symptoms e.g. Dysuria, hematuria, Suprapubic pain, Flank pain, Suprapubic pain, Lower urinary tract symptoms and urine retention. were included in this study. While patients with major comorbidities (HTN, DM, IHD), recent urological surgery, or immunodeficiency and not giving consent were excluded from the study. Sample size was calculated by using sensitivity and specificity of urinalysis (55.8% and 81.3%)[10] respectively, prevalence of UTIs (41.10%)[9] , margin of error (d)=12% for sensitivity and 8% for specificity, Confidence level (C.I)=95% then the estimated sample size was n=113. A procedure was explained with risks and benefit to patient and informed consent was taken. Patient's data like age, sex BMI were recorded on the prescribed proforma and patients were evaluated by urinalysis and urine culture. The results of urinalyses were recorded and compared with the results obtained on subsequent urine cultures by consultant pathologist. Urine specimens were obtained by the "clean-catch" method. After receiving the results, diagnosis was made and recorded on proforma. Confounding variables and biasness were controlled by strictly following the inclusion criteria. SPSS version-23 was used for Data analysis. (IBM Corp. Released 2012). IBM SPSS

Statistics for Windows, Version 21.0. Armonk, NY: IBM Corp). Mean and standard deviation were calculated for age. Frequency and percentages were calculated for gender and urinary tract infection on urinalysis and urine culture.

Sensitivity, specificity, positive predictive value, negative predictive value and diagnostic accuracy of urinalysis was calculated by using A2X2 contingency table and taking urine culture as gold standard. Effect modifiers were controlled through stratification of age and gender to see the effect of these on outcome variables. Post stratification, sensitivity, specificity, positive predictive value, negative predictive value, and diagnostic accuracy of urinalysis were assessed by taking urine culture as gold standard. For the graphical presentation of data, bar charts and pie-charts were used.

RESULTS

In this study 113 patients were included as per inclusion criteria. Mean age of the patients was 52.6±8.5 years. In distribution of gender, 60 (53.1%) patients were male while 53 (46.9%) were female patients. Urine tract infection was noted in 46(40.7%) of urine analysis. Urinary tract infection was diagnosed in 29 (25.7%) patients on urine culture findings (gold standard). Diagnostic accuracy of urinalysis was 73.45% in diagnosis of urinary tract infection with sensitivity 76.47%, specificity 72.15% PPV 54.17% and NPV was found to be 87.69% by using urine culture findings as gold standard. Stratification of age group (20---50 & > 50) and gender (male & female) were done with respect to urinalysis to find statistical difference from TABLE [3—4].

Table #1:

Urine analysis	Urine culture findings(Gold standard)				
	Positive		Negative		
Positive	True positive (a) 26		False Positive (b) 22		
Negative	False (c) 8		True negative (d) 57		
Total	a+c 34		b+d 79		
95% confidence interval					
Lower					
Upper					
Sensitivity	a/(a+c)	0.7647	76.47	0.6221	0.9073
Specificity	d/(b+d)	0.7215	72.15	0.6227	0.8204
Prevalence of disease	(a+c)/(a+b+c+d)	0.3009	30.09	0.2163	0.3855
Positive predictive value	a/(a+b)	0.5417	54.17	0.4007	0.6826
Negative predictive value	d/(c+d)	0.8769	87.69	0.7971	0.9568
Overall accuracy	(a+d)/(a+b+c+d)	0.7345	73.45	0.6531	0.8159

Table #2: Stratification Of Age Group With Respect To Urinalysis Findings N=113

Age group [in years]	Urine culture findings(Gold standard)				
	Positive		Negative		
20—50 (n=38)	Urine Analysis		Positive	True positive (a) 7	False positive(b) 8
>50 (n=75)	Urine Analysis		Negative	False negative(c) 3	True negative(d) 20
			Positive	True positive (a) 19	False positive(b) 14
For age group 20—50(n=38)			Negative	False negative(c) 5	True negative(c) 37
			95% confidence interval		
Lower					
Upper					
Sensitivity	a/(a+c)	0.7000	70.00	0.4160	0.9840
Specificity	d/(b+d)	0.7143	71.43	0.5470	0.8816
Prevalence of disease	(a+c)/(a+b+c+d)	0.2632	26.32	0.1231	0.4032
Positive predictive value	a/(a+b)	0.4667	46.67	0.2142	0.7191
Negative predictive value	d/(c+d)	0.8696	86.96	0.7319	1.0072
Overall accuracy	(a+d)/(a+b+c+d)	0.7105	71.05	0.5663	0.8547
For age group >50 (n=75)					
95% confidence interval					
Lower					
Upper					
Sensitivity	a/(a+c)	0.7917	79.17	0.6292	0.9541
Specificity	d/(b+d)	0.7255	72.55	0.6030	0.8480
Prevalence of disease	(a+c)/(a+b+c+d)	0.3200	32.00	0.2144	0.4256
Positive predictive value	a/(a+b)	0.5758	57.58	0.4071	0.7444
Negative predictive value	d/(c+d)	0.8810	88.10	0.7830	0.9789
Overall accuracy	(a+d)/(a+b+c+d)	0.7467	74.67	0.5663	0.8547

Table #3: Stratification Of Gender With Respect To Urinalysis Findings N=113

Age group [in years]		Urine culture findings(Gold standard)			
		Urine Analysis		Positive	Negative
Male (n=60)	Urine Analysis	Positive	True positive (a) 18	False positive(b) 9	
		Negative	False negative(c) 7	True negative(d) 26	
Female (n=53)	Urine Analysis	Positive	True positive (a) 8	False positive(b) 13	
		Negative	False negative(c) 1	True negative(c) 31	
For Gender male (n=60)		95% confidence interval			
		Lower		Upper	
Sensitivity	a/(a+c)	0.7200	72.00	0.5440	0.8960
Specificity	d/(b+d)	0.7429	74.29	0.5981	0.8877
Prevalence of disease	(a+c)/(a+b+c+d)	0.4167	41.67	0.2919	0.5414
Positive predictive value	a/(a+b)	0.6667	66.67	0.4889	0.8445
Negative predictive value	d/(c+d)	0.7879	78.79	0.6484	0.9274
Overall accuracy	(a+d)/(a+b+c+d)	0.7333	73.33	0.6214	0.8452
For Gender female (n=53)		95% confidence interval			
		Lower		Upper	
Sensitivity	a/(a+c)	0.8889	88.89	0.6836	1.0942
Specificity	d/(b+d)	0.7045	70.45	0.5697	0.8394
Prevalence of disease	(a+c)/(a+b+c+d)	0.1698	16.98	0.0687	0.2709
Positive predictive value	a/(a+b)	0.3810	38.10	0.1732	0.5887
Negative predictive value	d/(c+d)	0.9688	96.88	0.9085	1.0290
Overall accuracy	(a+d)/(a+b+c+d)	0.7358	73.58	0.6172	0.8545

DISCUSSION

Urinary tract infections can be community acquired or hospital acquired (Nosocomial) and among the most common bacterial infections. These infections generally are self-limiting, if occurs in normal individual but can recur. Urinary microorganisms have some specialized characteristics, like production of siderophores, toxins and adhesins enable them invade and colonies urinary tract and can be transferred from one individual to other by direct contact, food and water Use of antibiotics not only results in quick elevation of symptoms but also clearing bacteria as well. With the increase trend of antibiotics usage, gut and vaginal normal flora are being affected badly.

Currently antibiotic resistant is increasing for uropathogens, so to explore alternative strategies are need of time for UTI management. In literature, accuracy of both dipstick and urinalysis have used to detect UTIs without considering process of clinical assessment.(13-15). Due to inappropriate relationship among symptoms, pyuria and bacteriuria, diagnosing the UTI is a bit difficult. (16-18) Lower urinary tract symptoms like incontinence, frequency and urgency are very common especially in elderly population and have been reported equally irrespective of bacteriuria.(18) In community or in hospital settings most common bacterial infection encountered once in life is UTI,(19). In a properly collected urine sample (i-e: mid-stream and clean catch sample) growth of bacteria > 105 colony forming unit per milliliter(CFU/ml) indicate infection. Escherichia coli is the most common pathogen accounting for 80-90% of UTIs while other organisms like proteus mirabilis, pseudomonas species, Klebsiella pneumonia, streptococci, staphylococcus along with certain viruses parasites and fungi are also responsible for UTIs.(20)

The results of our study correlate with multiple studies conducted worldwide by various researchers. Some of them are discussed here. Of 113 patients, mean age in our study was 52.6±8.5 years. Shah MA et al reported the mean age to be 54.33±16.42 years [21]. The result in the following study was found to be consistent with the previous studies. In our study, male patients were found to be 60 (53.1%) while 53 (46.9%) patients were female. According to the findings of Shah MA, et al, 27.85% of the patients were male while 72.15% of the patients were female [21]. In this study, urinary tract infection on urinalysis was found in 46 (40.7%) patients. There were 84 (21%) UTI patients found in the study of Sultan RV, et al [22]. Percentage of urinary tract infection on urine culture were found to be 29 (25.7%) positive

whereas 84 (74.3%) were found negative in this study. Another study reported the urine culture positivity in UTI patients as 40 (38.5%) [23] whereas the study of Baral R, et al reported that 42 (20.8%) were urine culture positive [24]. In present study, diagnostic accuracy of urinalysis in the following study was 73.45% in diagnosis of urinary tract infection with sensitivity 76.47%, specificity 72.15%, PPV 54.17% and NPV was found to be 87.69% by using urine culture findings as gold standard. Another study found out the diagnostic accuracy of urinalysis with sensitivity 47.0%, specificity of 91.1%, PPV value of 53.3% (95% confidence interval = 40.8 – 65.3), NPV of 88.8% (95% confidence interval = 85.0 – 91.8) [25]. Tivapasi MT, et al using culture as the gold standard, reported diagnostic accuracy 94.9%, sensitivity 58.5%, specificity 98.3% [26].

In our study, stratification of age group (20--- 50 & > 50) and gender (male & female) was done with respect to urinalysis.

CONCLUSION

It is seen that evaluation of urinary tract infection (UTI) with urinalysis did not prove helpful and comparable to urine culture. Urine culture is gold standard and should be done in each and every suspected case of UTI. Additional multicenter studies are required probably with large sample size with more parameters validate our study findings.

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