

Original Research Article

Cost effectiveness of screening tests for UTI in CKD population

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Abstract: UTI is the most common hospital acquired infections, accounting for 35% in hospitalized patients. Early diagnosis and prompt treatment of UTI in CKD patients is necessary to prevent grievous complications. The objective of this study is to determine diagnostic accuracy of multi dipstick tests for detecting UTI in CKD population and study spectrum of UTI in CKD. CKD patients attending Nephrology Department with Urinary tract infection symptoms are taken as study population from March 2014 to June 2014. Midstream urine samples were subjected to routine screening with dipsticks (leucocyte esterase, nitrite test). Wet mount examination for pus cells, Culture & sensitivity was performed. Of the 100 patients, M: F 51:49. Etiology of CKD was DN - 38, CIN - 25, Obstruction in 14, CGN - 29 ADPKD 4 and VUR 2. No. of patients in CKD stage 1- 7, stage2 - 16, stage3 -18, stage4 - 19 and stage 5 -39. Sensitivity of nitrite test 62, specificity 86, PPV 81, NPV 70%. Leucocyte esterase test sensitivity 92%, specificity 56%, PPV 68% and NPV 88%. Both tests combine sensitivity 92%, specificity 54%, PPV 67%, NPV 87%. Escherichia coli was found in 18, Klebsiella 14, enterococcus 9, pseudomonas 2, Staphylococcus aureus 2, candida 2 ,CONS 1, Streptococcus pyogenes 1 and citrobacter 1. Culture sterile in 50. In our population, UTIs are common in DN patients. CKD stages 4&5 constituted majority. Leucocyte esterase test has good sensitivity and NPV value compared to nitrite test hence leucocyte esterase as screening test can be entertained.

Keywords: UTI, CKD, Leukocyte esterase test, nitrite test, Escherichia coli.

INTRODUCTION

Urinary Tract infection (UTI) is a serious health problem affecting millions of people each year. According to Gilbert DN, the frequency of UTI in CKD patients is not different from the general population after doing adjustment for age [1].

Theoretically the risk of infection increases in CKD patients due to reasons like stones, papillary necrosis, neurogenic bladder and comorbidities with indwelling catheters. In renal diseases, a change in composition of urine, oliguria, anuria, albuminuria and hematuria is observed. The resultant changes in PH, osmolarity and urinary urea have their own effects in UTI. An accumulation of various uremic toxins inhibit the antimicrobial activity of granulocytes, macrophages and other defense reactions. These conditions may support the development of UTI in patients with renal disease [2, 3].

Acute bacterial infection can dramatically influence the progression of chronic renal disease on one hand and on the other hand chronic renal failure can alter the severity of an infection [4].

Early diagnosis and prompt treatment of urinary tract infections in CKD patients is necessary to prevent subsequent grievous complications such as sepsis, nephrectomy and death [5].

The aim of this study is to know the diagnostic accuracy of multi dipstick tests for detecting UTI in CKD patients and study their spectrum. Urine culture is the gold standard but is expensive and time consuming. In this context rapid diagnosis or exclusion of urinary tract infection is valuable. So this study attempts to evaluate the diagnostic accuracy of nitrite test as a measure of bacteriuria, leukocyte esterase test as a measure of pyuria using dipstick and compared with microscopy for pyuria. The diagnostic values of

hematuria, proteinuria and urine pH were also examined.

AIMS AND OBJECTIVES

- To evaluate the diagnostic accuracy of nitrite, leukocytes, hematuria, proteinuria, PH and microscopy as screening tests for UTI.
- To assess the incidence of U.T.I. in chronic kidney disease patients
- To isolate the infecting agents

MATERIALS AND METHODS

Source of Data:

Urine samples of patients with urinary tract infections attending Osmania General Hospital, Hyderabad. It is a prospective study done over a period of 5 months from March 2014 to July 2014

Inclusion criteria

- Patients with glomerular filtration rate ≥ 60 ml/min per 1.73m^2 with demonstrated kidney damage like persistent proteinuria, abnormal urine sediment, abnormal blood and urine chemistry and abnormal imaging studies (stage 1 & 2CKD) with symptoms of UTI.
- Patients with glomerular filtration rate < 60 ml/min per 1.73m^2 (which includes stage 3 30-59, stage 4 15-29, stage 5 <15 CKD patients) on dialysis with symptoms of UTI.

Exclusion criteria

- Patients without renal disease suffering from UTI.
- Pregnant women
- Patients with asymptomatic bacteriuria.
- Patients already on antibiotics.

Sample Collection

The urine specimen for the present study was collected from a total of 130 patients who attended the IP/OP department of Nephrology at Osmania General Hospital, Hyderabad for a period of 5 months from March 2014 to July 2014. The patients were divided into 2 groups those having upper UTI and those having lower UTI. Upper UTI is the infection of kidneys, renal pelvis and ureters and is characterized by fever (often with chills) and flank pain. Lower UTI is the infection of urinary bladder and urethra and is characterized by frequency, urgency and dysuria. CKD was defined as estimated glomerular rate eGFR $<60\text{ml}/\text{min}/1.73\text{m}^2$. eGFR was estimated by modification of renal disease (MDRD) equation [17]. In this study, the total pathogens recovered were 50 and culture negative were 50. About 30 controls were included.

METHOD OF COLLECTION [8]

In women: The periurethral area and perineum are first cleaned with 2 or 3 gauze pads saturated with soapy water, using a forward to back motion. Followed by rinse with a sterile saline or water. The mid-stream

portion of urine is then collected in a sterile, wide mouthed container that can be covered with a tightly fitted lid.

In men: simple cleaning of urethral meatus immediately before voiding is sufficient. Then mid-stream urine sample is collected.

From catheterized patients:

First disinfect the area where the needle puncture is to be made. Urine is aspirated through the soft rubber connector between catheter and the collecting tubing using a no 28 needle and a syringe.

Sample processing:

All samples were completely processed within 1-2hrs after arrival, to avoid overgrowth of any contaminating bacteria. Culture was done for bacteria only. Fungal culture and culture for anaerobic organisms was not done. Sample was divided into 2 parts - one for screening tests and other for culture.

Screening tests:

Dipstick screening

A urine dipstick consists of reagent pads for semi quantitative assessment of glucose, protein, nitrite, leukocytes, specific gravity, urobilinogen, bilirubin, blood and PH in urine by displaying different colors. In this study, H10 Urinalysis strips (DIRUI Industrial co. Ltd) were used.

Microscopic Urinalysis

Direct wet mount: For presence of pus cells⁷.

Culture method:

Sample is well mixed and using a standard loop which delivers a volume of 0.001ml of urine was inoculated onto solid medium like blood agar and MacConkey agar by semi-quantitative method⁶. For this study, positive culture was defined as culture of a single bacterial species from the urine sample at a concentration of $\geq 10^5$ cfu/ml. Positive urine culture was further processed for identification.

Identification of organisms based on standard biochemical tests:

For Gram Positive Cocci.

- Coagulase Test [7].
- Mannitol salt agar [7].
- Aesculin Hydrolysis [7].
- Heat resistant test at 60°c .

For Gram Negative Bacilli:

- Catalase [8].
- Oxidase [8].
- Hanging Drop
- Indole test [7].
- Methyl red test [8].
- Voges-proskauer test [8].

- Indole test [7].
- Citrate utilization test [7].
- Urease test [7].
- Triple Sugar Iron Agar Test [8].

RESULTS

In CKD group, out of 100 patients 51(51%) were males, while 49(49%) were females with male to female ratio of 1:1.04. Patient’s age ranged from 1 day to 75 yrs old.

Among the patients, 82(82%) were confirmed to have upper UTI and 18(18%) were found to have lower UTI. The average ages of upper and lower UTI’s are 40.7±18.4 and 36.4±16.7 respectively. There is no significant difference in ages of patients who suffered from upper and lower UTI’s. Females are more prone to have upper UTI (1:1.22) than males. Male to female ratio of lower UTI is 1:0.5. Figure 1 showing the age and sex distribution of upper and lower UTI.

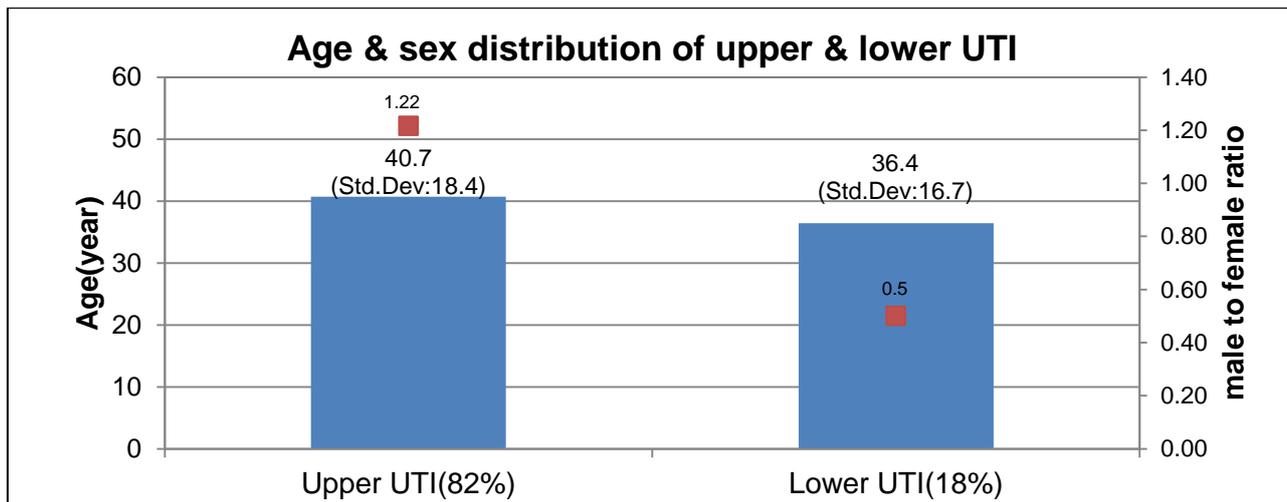


Fig 1: Age and sex distribution of upper and lower UTI

Out of these patients, 7 patients had stage 1 CKD(7%), 16 patients had stage 2 CKD (16%),18 patients had stage 3 CKD (18%),19 patients had stage 4 CKD (19%) and 39 patients had stage 5 CKD

(39%).Table 3 shows percentage of patients in each stage of CKD. Maximum patients are in stage 5 or end stage renal disease.

Table-3: Percentage distribution of patients in each stage of CKD.

S. No.	Stage of CKD (Based on eGFR)	% of CKD patients
1	Stage - 1 (≥ 90 ml/min)	7
2	Stage - 2 (60-89ml/min)	16
3	Stage - 3 (30-59ml/min)	18
4	Stage - 4 (15-29ml/min)	19
5	Stage - 5 (< 15 ml/min)	39

Causes of renal failure in CKD patients are Diabetes (38%), Chronic interstitial Nephritis (25%), obstructive uropathy(14%), Chronic Glomerulonephritis (8%), Adult polycystic kidney disease(4%), Vesico

ureteric reflux(2%), Hypertension(2%) and other causes(8%). Most common cause is Diabetic Nephropathy (38%).Table 5 shows etiology of CKD and percentage of patients in each cause.

Table 5: Percentage of patients in each cause of CKD

S. No.	Etiology	%
1	Diabetes	38
2	Chronic interstitial Nephritis	25
3	Obstructive uropathy	14
4	Chronic Glomerulonephritis	8
5	Adult polycystic kidney disease	4
6	Vesico ureteric reflux	2
7	Hypertension	2
8	Others	7

SCREENING TEST RESULTS:

Dips stick results:

The leukocyte esterase test showed a sensitivity of 92% but only 56% specificity. The nitrite test was highly specific 87% but had a sensitivity of only 62%. Used together these two tests achieved sensitivity of

92% but with a specificity of only 54%. The sensitivity and specificity of hematuria are 54% and 68% respectively. Table 5 shows performance characteristics of Leukocyte Esterase, Nitrite, Hematuria and Proteinuria in the diagnosis of UTI.

Table 5: Performance characteristics of dipstick Leukocyte Esterase, Nitrite, Hematuria and Proteinuria in the detection of UTI

Test	Results	No. of samples	Culture positive no.	Sensitivity (%)	Specificity (%)	Positive predictive value (%)	Negative predictive Value (%)	X ²	P Value
Leukocyte esterase	negative	32	4	92	56	68	88	10.53	0.001
	positive	68	46						
Nitrite	negative	64	21	62	86	81	70	6.57	0.010
	positive	36	29						
Leukocyte esterase + Nitrite	both negative	31	4	92	54	67	87	9.857	0.001
	Either or Both positive	69	46						
Hematuria	negative	57	23	54	68	63	60	1.621	0.203
	positive	43	27						
Proteinuria	negative	25	7	86	36	57	72	2.403	0.121
	positive	75	43						

Microscopy Results

The diagnostic accuracy of pyuria in the identification of a positive urine culture of $\geq 10^5$ cfu/ml is shown in the Table 6.

The sensitivity and specificity of pyuria as the screening test is 46% and 92% respectively. The positive predictive value and negative predictive value are 85% and 63% respectively.

Table 6: Performance of microscopy for pyuria in diagnosing UTI

Test	Results	No. of Samples with pus cells	No. of Samples Culture positive	Sensitivity (%)	Specificity	Positive Predictive Value	Negative Predictive Value	X ²	P Value
Microscopy	>5	34	29	58%	90%	85%	68%	7.882	0.004

Culture results:

Out of 100 patients, 50 gave pure growth of 10^5 cfu/ml or more organisms/ml. The remaining 50 samples were reported as having no significant growth (culture negative samples).The main organisms isolated from culture positive cases were Escherichia coli-

18(36%), klebsiella spp-14(28%), Enterococcus-9(18%), Pseudomonas spp-2(4%), Staphylococcus aureus-2(4%), Candida spp-2(4%), Citrobacter spp-1(2%), Coagulase negative staphylococcus-1(2%) and Streptococcus pyogenes respectively. Table 7 shows the causative organisms.

Table 7: Causative organisms of UTI

S.No.	Organism	%
1	Escherichia coli	18
2	Klebsiella	14
3	Enterococcus	9
4	Pseudomonas	2
5	Staph aureus	2
6	Candida	2
7	CONS	1
8	Strep pyogenes	1
9	Citrobacter	1
10	Culture Negative	50

DISCUSSION

Urinary tract infection is the most common bacterial infection in humans. The incidence of the commonly seen infectious complications is approximately 3 times greater among CKD patients who have not yet initiated dialysis than in the general population, with UTI, pneumonia and sepsis in descending order of prevalence [18]. In this study, we compared dipstick and microscopy with culture for diagnosis of UTI.

The present study revealed that the number of female patients were higher than that of males, 51(51%) versus 49(49%). Patient's age ranged from 1 day to 75yrs old. Females are more prone to urinary tract infections due to shortness of urethra which is close to the vagina and anus, the lack of prostatic fluid which has antibacterial activity or the use of spermicides and/or diaphragms [19]. Geriatric population are more prone to UTI because of suppressed immunity [20]. In a study by Chih-yen-HSIAO *et al.*; [14] they found that although the patients were mostly seniors, patients who had upper UTIs (59+/-16.54 yrs) were younger than those with lower UTIs (71.18+/-14.77yrs). They also found that there were more females than males in both upper and lower UTI groups. Amer Azhar *et al.*; [16] also found that infection rate were more in females than males in both CKD and non CKD groups. Others like Gupta p and Manjunath GN *et al.*; [20, 21] also did similar studies.

In this study, out of 100 patients 82(82%) were confirmed to have upper UTI and 18(18%) were found to have lower UTI. Most common cause of upper UTI is diabetes. In this study cause of renal failure among CKD patients include diabetic nephropathy (38%), chronic interstitial nephritis (25%), obstructive uropathy (14%), chronic glomerulonephritis (8%), adult polycystic kidney disease (4%), vesico ureteric reflux (2%), hypertension (2%) and others 7%. Similar studies done by Falahs Manhal *et al.*; [13] showed that 37 (92.5%) of the patients were with hypertension and only 3 (7.5%) were with diabetes mellitus. Mojgan Mortazavi *et al.*; [22] showed that the underlying disorder was diabetes mellitus in 50% and hypertension in 20% of patients on long term hemodialysis.

In the present study, dipstick and microscopic urinalysis results were compared with urine culture which were used as reference standards to determine the presence or absence of UTI. Urine culture has the disadvantage of taking at least 48 hours to give result. More rapid methods of UTI diagnosis are therefore desirable.

Dipstick tests have the advantage of being quick and easy to perform and can be carried out in primary care giving an immediate result. In this study, the leukocyte esterase test using dipstick showed a

sensitivity of 92% but only 56% specificity. The positive predictive value and negative predictive value are 68% and 88% respectively. 22 of the leukocyte esterase positive samples (68) have no growth in culture. This may be due to the presence of leukocyturia in patients with interstitial nephritis. In these cases, there was significant leukocyturia with no accompanying bacteriuria. It may also be due to interference in the reagent strip such as the contamination of urine with strong oxidizing agents, which could have caused a false positive leukocyte esterase test [10]. 4 were leukocyte esterase negative but with growth in urine culture. This may be due to high concentration of protein, glucose, oxalic acid or ascorbic acid which caused a false negative leukocyte esterase test [10]. The results of LE test in this study made it valid when used alone as a screening test

In this study, the nitrite test has a sensitivity of 62% but with a high specificity (86%). The positive predictive value and negative predictive value are 81% and 70% respectively. The nitrite test depends on the conversion of nitrates to nitrites by bacteria in the bladder and so is best performed using an early morning urine sample [11]. Out of 36 nitrite positive samples in this study 7 were culture negative. This can be due to post collection bacterial proliferation, which has produced measurable amount of nitrite. Out of 64 nitrite negative samples, 18 were culture positive. This can be attributed to the growth of non-nitrate reducing bacteria and yeasts in the culture. Unfortunately, some organisms especially Gram positive ones do not convert nitrates into nitrites [11]. Because of this nitrite test has poor sensitivity in the diagnosis of UTI. These results are typical of previous reports [24-26]. The rest of urine specimens which were nitrite positive but were culture negative may have come from patients with low nitrate diet. This is a limitation of this study in as much as not all patients who undergo urinalysis are instructed by their physicians to observe nitrate rich diet 3 days before specimen collection.

The nitrite test had a low sensitivity and predictive values but had a high specificity in this study. It has a poor agreement with the culture results which makes this test invalid when used alone as a screening test for UTI. Its high specificity however makes the test of value when one is ruling out UTI. A negative nitrite test does not rule out a UTI, but a positive one strongly suggests infection.

Used together these two tests achieved a sensitivity of 92% but with a specificity of only 54%. The positive predictive value and negative predictive value are 67% and 87% respectively. The positive results of LE and NT on 23 culture negative samples could be again attributed to post collection bacterial proliferation. The combined leukocyte esterase nitrite tests have high sensitivity, but low specificity and

predictive values. So the combined test can be used as a screening test for UTI.

The sensitivity and specificity of pyuria are 58% and 90% respectively. The positive predictive value and negative predictive value are 85% and 68%. Virtually every disease of urinary tract may cause pyuria. In patients with asymptomatic bacteriuria, it helps to differentiate between true infection and transient colonization and in symptomatic non bacteriuric patients; it may indicate infection by unusual pathogens that do not grow in usual cultures, simulating aseptic pyuria [28]. In summary, the presence of pyuria in patients without kidney disease is highly suggestive of UTI, especially in symptomatic patients. In patients with CKD, especially those on dialysis, the role of pyuria in diagnosis of UTI is uncertain.

Cabaluna and associates were the first group that studied the relationship between pyuria and UTI in a small group of 25 dialysis patients. Their results showed that pyuria is a common finding that often occurs in the absence of infection. Unfortunately, the interpretation of their results is difficult as pyuria was defined on a scale of "white cell clumps" which was not precisely defined. Of interest nonetheless, was the observation that pyuria was predominantly lymphocytic and developed only after progression to end stage disease requiring dialysis [29]. Therefore this paper is relevant in that it demonstrated that urine may lose characteristics of the original pathology after the initiation of dialysis. Other investigators have explored the problem in follow up to Cabaluna's observations.

The following are some of the studies available on leukocyte esterase, nitrite dipstick and pyuria in chronic kidney disease patients. Rajiv vij *et al.*; [12] demonstrated that nitrite dipstick had excellent specificity but dismal sensitivity but in contrast to this study they told that leukocyte esterase dipstick performed less well than pyuria. They evaluated different cut off values of pyuria (more than 5, 10, 50 and 100 leukocytes per HPF) and their relations with UTI. They found that pyuria had adequate sensitivity but poor specificity and therefore high negative predictive value but low positive predictive value.

The prevalence of pyuria in their study was 51% using cut off values of >10 leukocytes/hpf. The specificity of pyuria increased with the increased cut off value, while sensitivity decreased. They showed the prevalence of pyuria in hemodialysis patients as 37(using 5 or 10 WBC/Hpf). They reported that different pyuria cut off did not seem to have enough sensitivity and specificity to be used as detecting test for UTI.

Mojgan Mortazavi *et al.*; [22] found that 50% of the patients had a positive pyuria and urine cultures

of 35.5% of them were positive. They found that pyuria had a sensitivity of 100% and a specificity of 61.8%. The positive and negative predictive values were 35.5% and 100% respectively. Although pyuria had high sensitivity and negative predictive value, the low positive predictive value and specificity do not allow elimination of the need for urine culturing. They concluded that pyuria was not a good marker for UTI detection.

Saitoh and colleagues [9] evaluated 182 patients on hemodialysis and found pyuria (defined as the presence of > than 10 leukocytes/Hpf) in urine samples of 38% patients, only 27% of whom had positive culture. They suggested that pyuria is not a good marker for UTI in oliguric patients, as it held a negative correlation with urinary volume.

Hyodo and co-workers [30] compared 75 patients on hemodialysis with 133 healthy volunteers using a cut off ≥ 10 cells/hpf. Leukocyturia was detected in 26 of 39(66%) patients with urine output of <200ml/day and in 3 of 19(16%) of those with urinary output >500ml/day. Rates of bacteriuria were 59 and 21% respectively. Despite the fact that this finding was not replicated in a third study, it is plausible that low urine volume is an important factor leading to high prevalence of pyuria in dialysis patients and it is reasonable to take this factor into account when interpreting pyuria in individual dialysis patients. They concluded that pyuria was not a good marker for UTI detection in patients on hemodialysis.

Eisinger and colleagues [31] assessed the prevalence of pyuria and UTI in patients with CKD. They observed only 1 of 9 patients with a positive pyuria had a positive culture. They suggested that leukocyturia ≥ 10 cells/hpf in end stage renal disease patients does not strongly correlate with the presence of infection. They stated that counting WBC'S in urine specimen seems not a very productive way of anticipating the growth of urinary pathogens. Orłowska *et al.*; [32] analysed 43 asymptomatic patients on CAPD and demonstrated that pyuria was present in 67% of patients with UTI and only 13% of patients with negative urine culture. They concluded that pyuria is a good marker for detection of UTI in CKD patients.

Kim and Corwin [27] reported that the value of pyuria as a marker of UTI in dialysis patients is questionable. This is because of several clinical factors that may confound this relationship. Confounding clinical factors include: the presence of low urine volume, bladder stasis and the underlying aetiology of kidney disease. The latter factor leading to terminal kidney failure is associated with sterile pyuria owing to chronic parenchymal inflammation.

In a study done by Ramazan *et al.*; [11] when only leukocyte esterase was taken into consideration, sensitivity and specificity was 65% and 64% respectively. When leukocyte esterase or blood or nitrite is taken into consideration, sensitivity increased to 80% from 65%, however specificity decreased to 60% from 64% due to increased false positives. In the same way, when WBC or RBC or bacteria taken into consideration, sensitivity increased to 91% from 87%, however specificity decreased to 68% from 71% due to increased false positives.

Other studies done in CKD patients who were on dialysis like Chaudhry A *et al.*; [33] showed that pyuria was a good marker for detection of UTI. They showed that 70% of patients with a positive pyuria had a positive culture. In this study, only patients with a urinary output of >300ml/day were included. As a result, it was likely that excluded patients with a low urinary output had a different pattern of UTI, therefore the results of their may not be applicable for all patients on hemodialysis.

Falabs Manhal *et al.*; [13] found sensitivity and specificity of pyuria as 60% and 80% respectively in hemodialysis patients. The positive and negative predictive values are 64% and 77% respectively. They concluded that pyuria was a good marker for significant bacteriuria in these patients. Overall, the urinalysis is a mediocre test for the diagnosis of UTI in CKD patients.

The prevalence of documented UTI in these studies varied between 11 & 70%. The most consistent observation is pyuria's high negative predictive value for UTI. Because of the lower specificity caused by the occurrence of sterile pyuria in several of the causes of CKD, the positive predictive value of pyuria is noticeably lower. Therefore, the absence of pyuria in an asymptomatic patient speaks strongly against the presence of infection, although it should not be relied upon in symptomatic patients, in whom a urine culture must be obtained.

To conclude in our case, though pyuria has high specificity and positive predictive value, it is our impression that the available data justify formal evaluation of pyuria with a urine culture, as there is excessive variability in the co-existence of UTI (11-70%) [9, 31-33]. On the other hand urine dipsticks for nitrite and leukocyte esterase can be used as screening tests according to this study. Leukocyte esterase alone or combined leukocyte esterase and nitrite has a sensitivity of 92% in our study, so they can be used as screening tests for UTI.

In this study, Hematuria was even less sensitive (54%) and specific (68%) to UTI. The positive and negative predictive value is 63% and 60% respectively. Urine dipstick for hematuria tests the

peroxidase activity of erythrocytes, not for the actual presence of the physical RBC. Myoglobin and hemoglobin produce a false positive dipstick test for hematuria because these substances also will catalyse this reaction; these are the end products of hemolysed RBC's or muscle break down. High doses of vitamin c will inhibit this process and can invalidate the dipstick for this test. Dehydration and exercise will give a false positive dipstick for true hematuria. Drugs like captopril use, urine pH of less than 5.1 and proteinuria may produce a false negative dipstick analysis for blood [23].

Proteinuria has a sensitivity of 86% and specificity of 36%. The positive and negative predictive values are 57% and 72% respectively. The dipstick test for proteins is sensitive almost entirely to albumin, it will not detect low Concentration of globulins or the Bence Jones proteins associated with multiple myeloma. Concentrated early morning urine may give false impression of significant proteinuria. Prolonged standing can produce proteinuria. Iodinated radiocontrast agents and highly alkaline urine may turn the dipstick falsely positive [24]. These are some limiting factors for detection of hematuria and proteinuria using dipstick. Neither hematuria nor proteinuria had any diagnostic value in this study.

The range of PH in our study was 5-7.5. In general urine PH reflects serum PH, but the primary and normal function of the kidney is to acidify the urine. Normal serum PH is 7.4, but the normal urinary PH ranges from 4.5 to 8. The urine PH can be related to diet. Acid urine can be the result of ingestion of fruits that acidify the urine. Diets high in citrate and in citrus fruits, legumes and vegetables can cause alkaline urine. Meat eaters tend to have more acidic urine and vegetarians tend to have alkaline urine. In the presence of a documented UTI, alkaline urine may suggest infection with a urea splitting organism such as proteus [24]. This study tells that atypical pH doesn't have any diagnostic value.

Patients with kidney failure are more prone to developing UTI for a number of reasons. First of all, the mere act of passing urine tends to flush out the urinary tract of infectious agents so they cannot gain a foothold and cause problems. Once the kidneys fail and production of urine is decreased this normal flushing action is gone. UTIs usually are caused by bacteria which normally inhabit the bowel and spread to the urinary tract by local extension. Patients with chronic kidney disease have abnormalities in their immune system which impairs their ability to fight infection [34].

In this study, 50 samples gave pure growth. The main organisms isolated from culture positive cases were *Escherichia coli* (18%), *klebsiella* (14%),

Enterococcus (9%), pseudomonas (2%), staphylococcus citrobacter (1%). Suresh jaiswal *et al.*; [15] found Escherichia coli as the predominant organism in male patients undergoing dialysis due to CKD, seen in 33.33% of the culture positive cases followed by Staphylococcus aureus (26.66%), Coagulase negative staphylococcus (13.33%), Streptococcus pyogenes (13.33%) and Klebsiella spp (13.33%).

Similar findings were seen in study done by Chih-yen HSIAO *et al.*; [14] who found Escherichia coli as the predominant organism regardless of the sex followed by proteus, klebsiella, enterococcus, pseudomonas and staphylococcus. In addition they found that there was no statistical difference in the bacteria cultured from upper or lower UTIs. Falah S Manhal *et al.*; [13] revealed 15% patients had been infected with Escherichia coli, 12.5% with klebsiella species, and 2.5% with Acinetobacter, α hemolytic streptococci, coagulase negative staphylococci and proteus species. In a similar study done by Roberts JA *et al.*; [35] the most frequent cause of upper UTI was also Escherichia coli. According to Jung Y S *et al.*; [36] the most common cause of acute pyelonephritis was Escherichia coli (58.3%) followed by Klebsiella pneumonia (12.7%). Their study also showed that chronic renal failure does not seem to influence the isolation rates of different uropathogens or their susceptibility patterns to antimicrobials in patients with community acquired acute pyelonephritis that presented as a positive urine culture.

CONCLUSION

- i. To summarize, the prevalence of UTI is more in females compared to males.
- ii. The leukocyte esterase test and combined leukocyte esterase and nitrite tests using dipstick have high sensitivities and were found to be statically significant. So they can be used as screening tests for detecting UTI.
- iii. The Nitrite test has higher specificity and was found to be statistically significant. So it is useful when one is ruling out UTI.
- iv. Though microscopy for pyuria is highly specific in this study. The available data show excessive variability in the co-existence of UTI. So, it is suggested to evaluate pyuria with a urine culture.
- v. Hematuria, proteinuria and atypical PH show poor agreement with culture results and were found to be statically insignificant to be used as screening tests for UTI.

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