Bacteriological Study of Urinary Tract Infection in Male Patients Undergoing Dialysis due to Chronic Kidney Disease in Tertiary Care Hospitals in Nepal

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Abstract
Chronic kidney disease (CKD) is a common problem among males compared to females due to stress, alcoholism, hypertension and diabetes mellitus. Due to urinary stagnation, alcalization of urine and absence of flushing action, the presence of urinary tract infection (UTI) in CKD of males is higher compared to normal males. Bacterial species causing UTI are Escherichia coli, Staphylococcus aureus, Streptococcus spp., Klebsiella spp., Micrococcus spp., Enterococcus spp., Proteus spp., Coagulase Negative Staphylococcus (CONS), etc. A total of 50 patients undergoing hemodialysis due to CKD at Western Regional Hospital and National Kidney Centre were recruited for the study during the period from 20th April to 13th September, 2012. Diagnosis of UTI was made by urinalysis and urine culture. Further identification of the spp. was done by biochemical tests. The presence of UTI in male with CKD was found to be 30%. And the bacterial spp. in diagnosis of UTI was 33.33%. E. coli which was predominating bacteria isolated followed by S. aureus, Klebsiella spp., S. spp. and CONS by 26.66%, 13.33%, 13.33%, and 13.33% respectively. E. coli was 100% sensitive to Nitrofurantoin and ciprofloxacin also Klebsiella spp. was 100% sensitive to Nitrofurantoin and Ciprofloxacin. Similarly, Nitrofurantoin and Gentamycin were 100% sensitive to S. aureus. With significant pyuria, the chance of isolation of bacteria was very high. Specific gravity measurement could predict the isolation of bacteria. In CKD patients with diabetes mellitus, with increase in urine sugar concentration, the chance of isolation of UTI-causing bacteria was significantly higher.

Keywords: CKD, UTI, hemodialysis, pyuria, E. coli

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INTRODUCTION
Urinary Tract Infection
A urinary tract infection (UTI) is a bacterial infection that affects part of the urinary tract. When it affects the lower urinary tract, it is known as a simple cystitis (a bladder infection) and when it affects the upper urinary tract it is known as pyelonephritis (a kidney infection). UTIs are among the most common bacterial infections that lead patients to seek medical care [1,2].

Epidemiology
One million patients visit the emergency department, and 100,000 hospital stays every year in the United States are due to UTIs. Approximately 10% of humans will have UTI at some time during their lives. Of note, UTIs are also the most common hospital-acquired infection, accounting for as many as 35% of nosocomial infections. The exact prevalence of UTIs is age and sex-dependent. During the first year of life, UTIs are less than 2% in males and females. The incidence of UTIs among the males remains relatively low after 1 year of age and approximately 60 years of age when the enlargement of the prostate interferes with emptying of the bladder. Therefore, UTI is predominantly a disease of females.

UTIs are important complications of diabetes, renal disease, renal transplantation, and structural and neurologic abnormalities that interfere with urine flow. UTIs are the leading
cause of Gram-negative sepsis in hospitalized patients and are the origin for about half of all nosocomial infections caused by urinary catheters [3].

Pathogenesis
The urethra has resident microflora that colonize its epithelium in the distal portion. Potential pathogens are Gram-negative aerobic bacilli (primarily Enterobacteriaceae) and occasional yeasts, are also present as transient colonizers. All areas of the urinary tract above the urethra in a healthy human are sterile. Urine is typically sterile, but noninvasive methods for collecting urine must rely on a specimen that has passed through a contaminated milieu. Therefore, quantitative cultures for diagnosis of UTIs have been used to discriminate between contamination, colonization and infection [3, 4, 5].

Bacteria can invade and cause UTI via two major routes: ascending and hematogenous pathways. For UTIs to occur by the ascending pathway enteric Gram-negative bacteria and other microorganisms that originate in the gastrointestinal tract must be able to colonize the vaginal cavity and/or the periurethral area. Once these organisms gain access to the bladder, they may multiply and then pass up the ureters to the kidneys. In most hospitalized patients, UTI is preceded by urinary catheterization or other manipulation of the urinary tract. With the insertion of catheter, the bacteria may be pushed along the urethra into the bladder or, with an indwelling catheter, may migrate along the track between the catheter and the urethral mucosal, gaining access to the bladder [5].

UTIs may also occur by the hematogenous, or blood-borne, route. Hematogenous spread usually occurs as a result of bacteremia. Any systemic infection can lead to seeding of the kidney, but certain organisms, such as Staphylococcus aureus Salmonella spp. are particularly invasive [5].

CAUSES
Bacteria
Escherichia coli are the cause of 80–85% of urinary tract infections, with Staphylococcus saprophyticus being the cause in 5–10%. Rarely may they be due to viral or fungal infections. Other bacterial causes include Klebsiella, Proteus, Pseudomonas, and Enterobacter. These are uncommon and typically related to abnormalities of the urinary system or urinary catheterization [6].

Sex
In young sexually active women, sexual activity is the cause of 75–90% of bladder infections, with the risk of infection related to the frequency of sex. The term “honeymoon cystitis” has been applied to this phenomenon of frequent UTIs during early marriage. In post-menopausal women, sexual activity does not affect the risk of developing a UTI. Spermicide use, independent of sexual frequency, increases the risk of UTIs. Women are more prone to UTIs than men because, in females, the urethra is much shorter and closer to the anus. As a woman’s estrogen levels decrease with menopause, her risk of urinary tract infections increases due to the loss of protective vaginal flora [6].

Urinary Catheters
Urinary catheterization increases the risk for urinary tract infections. The risk of bacteriuria (bacteria in the urine) is between 3 and 6% per day and prophylactic antibiotics are not effective in decreasing symptomatic infections. The risk of an associated infection can be decreased by catheterizing only when necessary, using aseptic technique for insertion, and maintaining unobstructed closed drainage of the catheter [6].

Others
A predisposition for bladder infections may run in families. Other risk factors include diabetes, being uncircumcised, and having a large prostate. Complicating factors are rather vague and include predisposing anatomic, functional, or metabolic abnormalities. A complicated UTI is more difficult to treat and usually requires more aggressive evaluation, treatment and follow-up.

In children, UTIs are associated with vesicoureteral reflux (an abnormal movement of urine from the bladder into ureters or kidneys) and constipation. Persons with spinal cord injury are at increased risk for urinary tract infection in part because of chronic use of catheter, and in part because of voiding dysfunction [7].
Chronic Renal Failure
A deterioration in renal function correlates with disturbances of various specific and nonspecific host defense reactions. In renal diseases, a change in the composition of urine in oliguria, anuria, albuminuria and hematuria is observed. The resultant changes in pH, osmolarity and urinary urea have their own effects in urinary tract infection. An accumulation of various uremic toxins inhibit the antimicrobial activity of granulocytes, macrophages and other defense reaction. These conditions may support the development of UTI in patients with renal disease [7, 8].

Chronic renal failure is defined as either a level of glomerular filtration rate (GFR) less than 15 mL/min/1.73 m², which is accompanied in most cases by signs and symptoms of uremia, or a need for initiation of renal replacement therapy.

Chronic renal failure is also defined as persistent elevation of plasma creatinine above 2 mg/dL, bilateral shrunken kidneys on ultrasound except in diabetic nephropathy, autosomal-dominant polycystic kidney disease, obstructive nephropathy, sickle cell disease, renal tumors where renal size may be normal/increased with loss of corticomedullary differentiation and increased parenchyma echogenicity and presence of clinical feature of uremia such as body weakness, anorexia, nausea and vomiting. Other features that suggest CRF include anemia, hypertension and bone disease [1].

Causes of Chronic Renal Failure
The major causes of chronic kidney disease, CKD are:

- Diabetes mellitus
- Hypertension
- Smoking
- Cardiovascular diseases (CVD)
- Age
- Chronic use of non-steroidal anti-inflammatory drugs (NSAIDs) and
- Obesity and socio-economic status.

CKD is more common in males compared to the females due to stress, alcoholism, etc., as also, prevalence of diabetes mellitus, hypertension, and smoking and cumulative risk factors of chronic vascular disease (CVD) [1, 2].

Diagnosis
In many CKD patients, previous renal disease or other underlying diseases are already known. A small number is present with CKD of unknown cause. In these patients, a cause is occasionally identified retrospectively. It is important to differentiate CKD from acute renal failure (ARF) because ARF can be reversible.

Abdominal ultrasound, in which the size of the kidneys is measured, is commonly performed. Kidneys with CKD are usually smaller (< 9 cm) than normal kidneys, with notable exceptions such as in diabetic nephropathy and polycystic kidney disease. Another diagnostic clue that helps differentiate CKD from ARF is a gradual rise in serum creatinine (over several months or years) as opposed to a sudden increase in the serum creatinine (several days to weeks). If these levels are unavailable (because the patient has been well and has had no blood tests), it is occasionally necessary to treat a patient briefly as having ARF until it has been established that the renal impairment is irreversible [8, 11].

Treatment
Hemodialysis, also called as an artificial kidney, has already been proven as an adjunct of life-saving therapy in case of acute renal failure and mainly chronic renal failure. Hemodialysis is done by cannulating the peripheral blood vessels (artery and vein) by the use of Scribner’s silastic teflon shunts for the case of CRF [9, 10].

MATERIALS AND METHODS
This chapter includes the type of study, identification of population and sample size, instruments and requirements used in study, data collection, and experimental work. This cross-sectional study was designed to study the bacteriology of UTI in male patients undergoing dialysis due to chronic kidney disease in tertiary care hospitals in Nepal. This study was conducted in the period from 20th April to 13th September, 2012. A total of 50 urine specimens from male patients were collected for research purpose.
Methods

Sampling Site
The research work was conducted in Manipal Teaching Hospital, Phulbari 8, Pokhara, Western Regional Hospital, Pokhara and National Kidney Centre, Kathmandu.

Sample Processing

Dipstick Screening Technique
Urine samples were tested by using multiple reagent strips for urinalysis. A urine dipstick consists of chemically treated paper, which displays different colors indicating the presence of sugar, protein, specific gravity and pH.

Microscopy

Procedure: Pour urine into a clean glass test tube. Centrifuge urine at appropriate speed and time. Decant the supernatant and re-suspend the remaining sediment. Place a drop of the re-suspended urine sediment onto a clean glass slide. Place slide on microscope stage and fix it properly with clips. Adjust the microscope condenser down and close the diaphragm so that the light is subdued. Scan sample using the low power (10X) objective. Change the objective to high dry and enumerate other elements seen in the urine specimen.

Microscopic pyuria is indicated at the presence of more than 5 WBC/HPF.

Culture and Sensitivity
All samples were inoculated on chromogenic media like MacConkey agar and incubated at 37 °C for 24 h in an incubator. The isolated organisms were identified with the appropriate count. Antimicrobial susceptibility of isolates was tested by the disk diffusion method using Mueller-Hinton agar for identified organisms.

Culture Media Preparation
Different culture media were prepared for isolation and sensitivity test. The media prepared were:
- Mueller-Hinton agar
- Blood agar
- MacConkey agar

Isolation of Uropathogens

Inoculation and Incubation
Surface streaking methods done on the standard choice of media used for initial inoculation of urine are: blood agar (non-selective media), and MacConkey. The proper procedure for inoculating urine specimens with a calibrated loop onto culture medium is as follows:

Inoculate urine on the MacConkey agar by making a single line streak down the middle of the plate from top to bottom. Beginning at the top of the plate, streak the urine back and forth across the inoculum line, filling the plate with streaking lines. On blood agar, beginning at the top of the plate, make a primary inoculum, rotate the plate at right angle and make the secondary streaking lines to produce isolated colonies. Incubate both culture plates at 35 to 37 °C in an aerobic atmosphere for 18–24 hrs.

Identification of Isolates

Colonial Morphology
Accurate and definitive microorganism identification, including bacterial identification and pathogen detection, is essential for correct disease diagnosis, treatment of infection and outbreaks associated with microbial infections.

According to the colonial morphology, bacteria can be identified as:
- Form – It is the shape of the colony, e.g., circular, filamentous, irregular or radiate, etc.
- Elevation – It is the cross sectional shape of the colony, e.g., flat, elevated, low convex, convex, and umbonate.
- Surface – It is the surface of the colony appeared, e.g., smooth, glistening, rough, dull (opposite of glistening), rugose (wrinkled), etc.
- Opacity – For example, transparent (clear), opaque, translucent (almost clear, but distorted vision, like looking through frosted glass), iridescent (changing colors in reflected light), etc.
- Consistency – Mucoid, firm frable, membranous, butyrous, etc.
- Chromogenesis (pigmentation) – For example, white, buff, red, purple, etc.
- Edges – Entire, ciliated, crenated, lobate, etc.

Microscopical Morphology
Smears prepared from the bacterial colony were examined by staining methods.
**Gram Stain**
Gram stain is an empirical method of differentiating bacterial species into two large groups Gram-positive and Gram-negative based on the chemical and physical properties of their cell walls. The Gram stain is almost always the first step in the identification of a bacterial organism.

**Biochemical Identification of Uropathogens**

**Preparation of Media Used for Biochemical Testing**
Different culture media were prepared for biochemical tests. The media prepared were:
- Triple sugar iron agar
- Simmons citrate agar
- Motility indole urease (MIU)

**Various Biochemical Tests for Uropathogens**

**Catalase Test**
Catalase is an enzyme that decomposes hydrogen peroxide into oxygen and water. Excluding the Streptococci, most aerobic and facultative anaerobic bacteria possess catalytic activity. Hydrogen peroxide forms as one of the oxidative end products of aerobic carbohydrate metabolism. Catalase converts hydrogen peroxide into water and oxygen. The catalase test is commonly used to differentiate Streptococci (negative) for Staphylococci (positive).

**Procedure:** With loop or applicator stick, transfer cells from the center of a well-isolated colony to a glass slide. Add 1–2 drops of the 3% hydrogen peroxide to the bacterial cells.

**Interpretation:** Positive: rapid appearance of sustained gas bubbles; negative: no gas bubble production.

**Coagulase Test**
Coagulase is an enzyme that catalyzes the conversion of fibrinogen to fibrin in blood plasma. The network of fibrin formed in host tissue infected with coagulase-producing organisms serves to protect the bacterium from the defenses of the host. This characteristic is a primary indicator of virulence among Staphylococci. This test can be used to differentiate *S. aureus* from *Staphylococcus epidermidis* as well as *Streptococcus* organisms. Coagulation within 24 h is indicative of *S. aureus*.

**Procedure:** Heavily inoculate a tube containing 0.5 mL rabbit plasma with your unknown organism. Incubate the mixture at 37 °C. Examine the plasma tube for coagulation by gently tilting the tube. Observe tube(s) at 0.5, 1, 2, and 4-h intervals.

**Interpretation:** Positive: *S. aureus*; negative: *S. epidermidis*, *Streptococcus spp.*

**Oxidase Test**
The oxidase test is a test used in microbiology to determine if a bacterium produces certain cytochrome c oxidases that can, therefore, utilize oxygen for energy production with an electron transfer chain.

**Procedure:** Each disk was wet with about four inoculating loops of de-ionized water. A loop to aseptically transfer a large mass of pure bacteria was done to the disk. The disk was observed for up to 3 min. If the area of inoculation turns dark blue to maroon to almost black, then the result is positive. If a color change does not occur within 3 min, the result is negative.

**TSI Agar Test (Triple Sugar Iron Agar)**
TSI agar contains three sugars (dextrose, lactose and sucrose), phenol red for detecting carbohydrate fermentation and ferrous ammonium sulfate for detection of hydrogen sulfide production. Carbohydrate fermentation is detected by the presence of gas and a visible color change (from red to yellow) of the pH indicator, phenol red. The production of hydrogen sulfide is indicated by the presence of a precipitate that blackens the medium in the butt of the tube.

**SIM Test (Hydrogen Sulfide Indole and Motility)**
SIM agar is inoculated by stabbing culture on loop straight into agar. It is used to determine if organism can metabolize certain amino acids. It includes three tests which are as follows:

1. **Hydrogen Sulfide (H₂S):** Cystamins and Metathiamine contain sulfur, which allows formation of hydrogen sulfide if organism can metabolize them. Lead nitrate in agar traps
hydrogen sulfide, forming a black precipitant when lead sulfide is formed. Agar turns black in hydrogen sulfide if test is positive and negative is indicated by no change in color of the medium.

2. **Indole Test:** Aromatic amino acid tryptophan (a ring shaped amino acid with an amine group and indole) is present in the medium. If bacteria can break this molecule amino group and indole, the test is positive. After a bacterium has had time to grow, Kovac’s reagent will react with indole to form a bright red ring at the surface of the tube. If test is negative, no change will occur when Kovac’s reagent is added.

3. **Motility Test:** If organism is motility positive, it will spread throughout the medium from the stab and in bacteria with negative motility, growth is seen only in stabbed area of medium.

**Citrate Test**
The surface of citrate agar (green) slant is streaked with bacteria agar containing citric acid, which is a tricarboxylic acid (has 3 carboxyl groups) and Bram Cresol agar. Bacteria with citrate permease can uptake citric acid, causing alkaline end products that change pH indicator to blue. If test is positive, slant changes to blue and if negative, slant remains green.

**Urease Test**
Urea broth (orange), which contains phenol red indicator in low concentration, is medium for test. Urea, which is usually toxic, is the end product of amino acid metabolism. Some organisms contain urease, which allows them to break down urea to form CO₂ and ammonia. Ammonia reacts with water to form ammonium hydroxide. Broth becomes red-purple color if test is positive due to production of ammonium hydroxide. If negative, broth remains orange.

**Antimicrobial Susceptibility Testing**
Antimicrobial susceptibility of isolates was tested by the Kirby-Bauer disk diffusion method using Mueller-Hinton medium. antimicrobial agents tested were Ciprofloxacin, Norfloxacin, Nitrofurantoin, Gentamicin, Amikacin, Cefazolin, Erythromycin, nalidixic acid, Cefotaxime, Cotri-Moxazole, Amoxicillin, etc. These antibiotics were chosen as they are the antibiotics of choice in the treatment of UTI.

**RESULTS**
This cross-sectional study was conducted on a group of 50 male patients undergoing dialysis due to chronic kidney disease in Nepal.

**Urinalysis**
**Dipstick Results**
After doing routine tests on urine samples, it was found that 24 samples were acidic, 22 were alkaline and four were neutral in PH (Table 1).

<table>
<thead>
<tr>
<th>Protein in urine</th>
<th>Sugar in urine</th>
</tr>
</thead>
<tbody>
<tr>
<td>Nil</td>
<td>22</td>
</tr>
<tr>
<td>Trace</td>
<td>11</td>
</tr>
<tr>
<td>1 +</td>
<td>10</td>
</tr>
<tr>
<td>2 +</td>
<td>3</td>
</tr>
<tr>
<td>3 +</td>
<td>3</td>
</tr>
<tr>
<td>4 +</td>
<td>1</td>
</tr>
<tr>
<td>Total</td>
<td>50</td>
</tr>
</tbody>
</table>

**Microscopy Results**
Microscopic examination for WBCs, RBCs, epithelial cells and presence of casts and crystals help in determination of pyuria and find the type of urinary tract infection in suspected females. Out of all these, 50 patients were positive to pyuria (Figure 1).
The microscopic study also defined the presence of sulphonamide casts in three samples, amorphous phosphate in one sample and Hyaline cast yeast cells in six samples. The absence of any crystals and casts were seen in 42 urine samples.

**Culture Results**

![Culture Growth](image)

*Fig. 2: Organism Grown in Culture.*

According to data presented in Figure 2, out of these, 30 or 60.0% cases showed no growth upon culture, 15 cases or 30.0% were found to have significant bacterial growth, 2 or 4.0% were found to have multiple growth and 3 or 6.0% cases were found to have insignificant growth causing UTI.

![Organism Isolated from Urine Culture](image)

*Fig. 3: Organism Isolated from Urine Culture.*

A total of five species of bacteria were isolated in the significant growth. These species were *E. coli* 5 (33.33%), *S. aureus* 4 (26.66%), *CONS* 2 (13.33%), *S. pyogenes* 2 (13.33%) and *Klebsiella* spp. 2 (13.33%).

**Table 2: Distribution of Uropathogens among the Positive UTI Samples.**

<table>
<thead>
<tr>
<th>Microorganism</th>
<th>Number</th>
<th>Percentage (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td><em>E. coli</em></td>
<td>5</td>
<td>33.33</td>
</tr>
<tr>
<td><em>S. aureus</em></td>
<td>4</td>
<td>26.66</td>
</tr>
<tr>
<td><em>Klebsiella</em> spp.</td>
<td>2</td>
<td>13.33</td>
</tr>
<tr>
<td>CONS</td>
<td>2</td>
<td>13.33</td>
</tr>
<tr>
<td>Streptococcus spp.</td>
<td>2</td>
<td>13.33</td>
</tr>
</tbody>
</table>

Data presented in Table 2 showed that *E. coli* was the most predominant pathogen with 33.33% followed by *S. aureus* with 26.66%, *Streptococcus* spp. *CONS and Klebsiella* spp. by 13.33%, 13.33% and 13.33%, respectively.
Table 3: Distribution of Gram-positive and Gram-negative Bacteria among Uropathogens.

<table>
<thead>
<tr>
<th></th>
<th>Gram +ve</th>
<th>Gram −ve</th>
</tr>
</thead>
<tbody>
<tr>
<td><em>S. aureus</em> (26.67%)</td>
<td><em>E. coli</em> (33.33%)</td>
<td></td>
</tr>
<tr>
<td><em>CONS</em> (13.33%)</td>
<td><em>Klebsiella spp.</em> (13.33%)</td>
<td></td>
</tr>
<tr>
<td><em>Streptococcus</em> spp. (13.33%)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Total (53.33%)</td>
<td>Total (46.66%)</td>
<td></td>
</tr>
</tbody>
</table>

Table 3 describes that Gram-positive bacteria was the most common of uropathogens responsible for UTI with a 53.33% percentage in comparison to 46.66% for Gram-negative bacteria, as shown in Table 3.

Antibiotic Sensitivity

**Sensitivity of Escherichia coli to Common Antibiotics**

![Fig. 4: Sensitivity of Escherichia coli.](image)

*E. coli*, the most common isolates in this study were found to be most sensitive to NIT and Cp all by 100% and followed by COT 60.0% and sensitivity to antibiotics NA, NX and CTX was 0.0%.

Antibiotics used for *Klebsiella* spp. were NA, CTX, COT, NIT, NX and Cp. Among them NIT and Cp were all followed by 100%, COT 50.0% and other antibiotics NA, NX and CTX were sensitive by 0%.

**Sensitivity of Klebsiella spp. to Common Antibiotics**

![Fig. 5: Sensitivity of Klebsiella spp.](image)
Sensitivity of *Staphylococcus aureus* to Common Antibiotics

![Graph showing sensitivity of Staphylococcus aureus to various antibiotics](image)

**Fig. 6**: Sensitivity of *Staphylococcus aureus*.

Antibiotics for *S. aureus* were Cz, CTX, Ak, G, NIT and AMX. Among them G and NIT were 100% sensitive, while CTX and Cz were 75.0% sensitive. Other antibiotics AMX and Ak were 0% sensitive.

Sensitivity of CONS to Common Antibiotics

![Graph showing sensitivity of CONS to various antibiotics](image)

**Fig. 7**: Sensitivity of CONS.

Antibiotics frequently used for this organism were AMX, COT, G, NIT, NX and Cz. Among them, G and NIT were found to be the most sensitive having 100%, followed by COT and Cz 50.0% sensitive, and antibiotics NX and AMX were sensitive by 0%.

Sensitivity of *Streptococcus* spp. to Common Antibiotics

![Graph showing sensitivity of Streptococcus spp. to various antibiotics](image)

**Fig. 8**: Sensitivity of *Streptococcus* spp.

Antibiotics frequently used for this organism were AMX, G, COT, NIT, NX and Cz. Among them, G and NIT were found to be the most sensitive having 100%, followed by COT and Cz 50.0% sensitive, and antibiotics NX and AMX were sensitive by 0%.
**Urine Sugar versus Growth and No Growth**

**Table 4: Urine Sugar versus Growth and No Growth.**

<table>
<thead>
<tr>
<th>Urine sugar</th>
<th>Growth</th>
<th>No growth</th>
</tr>
</thead>
<tbody>
<tr>
<td>Nil</td>
<td>8</td>
<td>17</td>
</tr>
<tr>
<td>Trace</td>
<td>2</td>
<td>11</td>
</tr>
<tr>
<td>1 +</td>
<td>2</td>
<td>6</td>
</tr>
<tr>
<td>2 +</td>
<td>2</td>
<td>0</td>
</tr>
<tr>
<td>3 +</td>
<td>1</td>
<td>0</td>
</tr>
<tr>
<td>4 +</td>
<td>0</td>
<td>1</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>15</strong></td>
<td><strong>35</strong></td>
</tr>
</tbody>
</table>

Table 4 describes the pattern of glucose in urine versus the growth and no growth of bacteria. With increasing concentration of sugar, the chance of isolation of bacteria from urine was increased. From nil to concentrated sugar, *E. coli* was isolated regularly. *S. aureus* only grew on urine with nil sugar while CONS grew at trace and concentrated urine sugar.

**pH versus Bacterial Growth and No Growth**

**Table 5: Urine pH versus Bacterial Growth and No Growth.**

<table>
<thead>
<tr>
<th>Urine pH</th>
<th>Growth</th>
<th>No growth</th>
</tr>
</thead>
<tbody>
<tr>
<td>5–5.9</td>
<td>0</td>
<td>1</td>
</tr>
<tr>
<td>6–6.9</td>
<td>5</td>
<td>16</td>
</tr>
<tr>
<td>7–7.9</td>
<td>4</td>
<td>11</td>
</tr>
<tr>
<td>8–8.9</td>
<td>4</td>
<td>5</td>
</tr>
<tr>
<td>9–9.9</td>
<td>2</td>
<td>2</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>15</strong></td>
<td><strong>35</strong></td>
</tr>
</tbody>
</table>

Table 5 describes the pattern of urine pH versus bacterial growth and no growth. From the table above at higher pH, the relative frequency of bacterial isolate is high compared to that at lower pH.
Pus Cells versus Bacterial Growth and No Growth

Table 6: Pus Cells versus Bacterial Growth and No Growth.

<table>
<thead>
<tr>
<th>WBC</th>
<th>Growth</th>
<th>No growth</th>
</tr>
</thead>
<tbody>
<tr>
<td>&lt; 5/HPF</td>
<td>E. coli (1)</td>
<td>14</td>
</tr>
<tr>
<td></td>
<td>Streptococcus spp. (1)</td>
<td></td>
</tr>
<tr>
<td></td>
<td>CONS (1)</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Klebsiella spp. (1)</td>
<td></td>
</tr>
<tr>
<td>5–10/HPF</td>
<td>S. aureus (3)</td>
<td>16</td>
</tr>
<tr>
<td></td>
<td>E. coli (1)</td>
<td></td>
</tr>
<tr>
<td></td>
<td>CONS (1)</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Streptococcus spp. (1)</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Klebsiella spp. (1)</td>
<td></td>
</tr>
<tr>
<td>Plenty</td>
<td>S. aureus (1)</td>
<td>5</td>
</tr>
<tr>
<td></td>
<td>E. coli (3)</td>
<td></td>
</tr>
<tr>
<td>Total</td>
<td>15</td>
<td>35</td>
</tr>
</tbody>
</table>

On the Table 6 above, with WBC < 5/HPF there was growth of four bacteria, namely, *E. coli*, *S. pyogenes*, CONS and *Klebsiella* spp. With WBC 5–10/HPF, there was growth of seven bacteria, namely, *S. aureus* (3), *E. coli* (1), CONS (1), *Streptococcus* spp. (1), and *Klebsiella* spp. (1). Similarly, with plenty of WBC there was growth of four bacteria, namely, *S. aureus* (1) and *E. coli* (3).

CONCLUSIONS
Males undergoing hemodialysis due to CKD have significantly high prevalence of UTI. *E. coli* is the most predominant bacteria causing UTI followed by *S. aureus*, *Klebsiella* spp., CONS and *S. pyogenes*. The most sensitive antibiotics against UTI in male patients with CKD undergoing dialysis are Nitrofurantoin, Ciprofloxacin, Co-Trimoxazole and Gentamycin.

RECOMMENDATIONS
Asymptomatic UTI is very common in such patients; so, regular urine routine examination and culture is suggested in them to diagnose UTI. After diagnosis of UTI, active treatment should be started to prevent morbidity and mortality in them. Empirical treatment with an antibiotic should be started and urine culture including all positive confirmed cases of UTI either for *E. coli*, *S. aureus*, or other uropathogens performed to guide the choice of antibiotics. To include all the causative microbes causing UTI in CKD patients, a study recruiting a large number of patients should be done.

REFERENCES
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