

Antimicrobial Susceptibility Pattern of Urinary Pathogens in a Tertiary Care Hospital

Akshatha N.¹, Anjana Gopi², Supriya Christopher³, Mangala G.K.⁴

^{1, 2, 3} Department of Microbiology, Kempegowda Institute of Medical Sciences (KIMS), Bengaluru, Karnataka, India. ⁴Department of Microbiology, Jagadguru Jayadeva Murugarajendra Medical College (JJMMC), Davangere, Karnataka, India.

ABSTRACT

BACKGROUND

Urinary tract Infection (UTI) are the most common clinical conditions in general practice and gynaecological department. Men and women of all age groups are affected by UTI, but its overall prevalence is higher in women. The major causative agents are *Escherichia coli* and other Enterobacteriaceae. In majority of the cases, empirically treatment is started with antimicrobials before the urine culture and sensitivity reports become available. This has led to an increase in antibiotic resistance in urinary pathogens. Hence, the present study was undertaken to determine the antimicrobial susceptibility pattern of uropathogens to commonly used antimicrobials in treating UTIs.

METHODS

A total of 200 urine samples were obtained from patients with signs and symptoms suggestive of UTIs attending Bapuji and Chigateri General Hospital which are attached to Jagadguru Jayadeva Murugarajendra Medical College (JJMMC), Davangere for a period of 3 months that is from May 2016 to July 2016. Urine samples were processed within 2 hours of reaching the laboratory. Semi quantitative urine culture was done. Isolation and identification were done by performing standard biochemical tests and the antimicrobial susceptibility testing was done using the standard disc diffusion method by Kirby-Bauer technique.

RESULTS

There were 170 urinary isolates from 200 samples. Children less than 10 years were more affected 54 (27 %). Female patients were more, 119 (59.5 %) compared to males 81 (40.5 %). *Escherichia coli* was the most predominant isolate, 71 (41.8 %) followed by Enterococcus species 22 (1.9 %). Organisms were resistant to commonly used antibiotics i.e., cotrimoxazole, ciprofloxacin, norfloxacin and amoxicillin. Both gram negative and gram-positive isolates were sensitive to amikacin and nitrofurantoin.

CONCLUSIONS

In present study *Escherichia coli* is the predominant pathogen. Uncomplicated UTIs can be empirically treated by nitrofurantoin. Occurrence of treatment failure with commonly used antimicrobials is more often in Indian setting. Hence, antimicrobial susceptibility testing must be employed routinely.

KEY WORDS

UTIs, Uropathogens, *E. coli*, Antimicrobial Susceptibility Pattern

Corresponding Author:

Dr. Supriya Christopher,
Professor,

Department of Microbiology,
Kempegowda Institute of Medical Sciences
(KIMS), Banashankari 2nd Stage,
Bengaluru - 560070, Karnataka, India.
E-mail: supriyachristopher@hotmail.com

DOI: 10.14260/jemds/2021/189

How to Cite This Article:

Akshatha N, Gopi A, Christopher S, et al.
Antimicrobial susceptibility pattern of
urinary pathogens in a tertiary care
hospital. *J Evolution Med Dent Sci*
2021;10(12):878-882, DOI:
10.14260/jemds/2021/189

Submission 20-09-2020,
Peer Review 17-01-2021,
Acceptance 23-01-2021,
Published 22-03-2021.

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BACKGROUND

In general and gynaecological practices, urinary tract infection are common clinical conditions.^{1,2,3} Men and women of all age groups are affected by UTI, but its overall prevalence is higher in women i.e., 20 – 50 % of them will have a clinical episode during their lifetime.^{4,5,6} An estimated 20 % of all UTIs occur in men.⁷ At least one episode of UTI is seen in about 5 – 6 % of girls between their first grade to high school and nearly 80 % of them experience recurrent infections.¹

Each year about 150 million people are diagnosed with UTI worldwide, which are classified as complicated or uncomplicated.⁸ Complicated UTIs are infections that will prolong treatment need or there are therapeutic failure chances because of the urinary tract abnormalities that obstruct urine flow, the foreign body in situ (e.g., indwelling catheter, stone), or infection caused by multidrug resistant strains and also associated with co-morbid conditions. Infections in male patients are considered complicated. Uncomplicated UTI is seen in sexually active healthy female patients with normal structural and functional urinary tracts. In a healthy patient UTI involving the upper urinary tract, pyelonephritis can be considered uncomplicated.^{9,10}

Bacteriuria along with urinary symptoms is UTI.¹¹ It involves both the upper and lower urinary tract or only the lower tract. Cystitis is the lower UTI characterised by dysuria, frequency, urgency and occasionally suprapubic tenderness.¹² UTI can be either asymptomatic bacteriuria or symptomatic infection with invasion of bacteria and urinary tract inflammation.¹³ Symptomatic bacteriuria is patient who have symptoms referable to the urinary tract. Asymptomatic bacteriuria is a patient without classical symptoms and presence of bacteria in two consecutive clear voided urine specimens both yielding positive cultures ($> 10^5$ cfu / mL) of the same pathogen¹⁴ Up to 90 % of the patients complain of symptoms of UTI among them one third or more patients do not have bacteriuria.¹⁵ The diagnosis of UTI by history alone is done by symptoms of dysuria and frequency which together raise the probability of UTI to more than 90 %.¹⁶

The major causative agents of UTIs are *Escherichia coli*^{17,18} and other Enterobacteriaceae. In some hospitalised patients, pseudomonas species and gram-positive cocci like Enterococcus species, coagulase negative staphylococci, *Staphylococcus aureus* are comparatively more common.^{13,19,20}

In majority of the cases, empirically treatment is started with antimicrobials before the availability of urine culture and sensitivity reports. This has led to an increase in antibiotic resistance in urinary pathogens. This is due to indiscriminate use of antibiotics, over the counter availability of higher antibiotics, poor sanitation, high prevalence of diarrhoea, overcrowding and poor facility to conduct antibiotic sensitivity surveillance in hospitals.^{21,22}

The overall idea of the aetiological agents causing urinary tract infections and their antibiotic resistance patterns may help the clinicians in starting the empirical treatment for UTIs using appropriate antibiotics. Hence, the present study is undertaken in finding out the UTI prevalence and to determine the antimicrobial susceptibility pattern of uropathogens to commonly used antimicrobials in treating UTIs.

METHODS

This is a descriptive study to determine the antimicrobial susceptibility pattern of urinary pathogens to commonly used antimicrobials in treating UTIs in a tertiary care hospital.

Study Area & Duration

By purposive / convenient sampling technique, 200 urine samples from patients with signs and symptoms suggestive of UTIs attending Bapuji and Chigateri General Hospital which are attached to JJM Medical College, Davangere are considered for the study. The duration of study was 3 months period from May 2016 to July 2016.

Processing of Sample

Urine samples were processed within 2 hours of reaching the laboratory. Using a standard calibrated bacteriological loop, semi quantitative urine culture was done. A well-mixed uncentrifuged urine with loop (0.001 mL) was taken and culture was done by inoculating on cysteine lactose electrolyte deficient medium (CLED). After which the culture was incubated at 37° C aerobically for 24 hours and colony count was considered by expressing as colony forming units (cfu) per millilitre (mL). A pure culture of a single bacterium with colony count of $\geq 10^5$ cfu / mL and microscopy findings of pus cells > 10 per oil immersion field is considered as significant bacteriuria.²³ The culture isolates were identified by performing the standard biochemical methods.²⁴

Isolates were tested for antimicrobial susceptibility testing by the standard Kirby-Bauer disc diffusion method according to Bauer et al.²⁵ The following standard antibiotic discs were used. Amikacin (30 mcg), amoxicillin (30 mcg), gentamycin (10 mcg), cotrimoxazole (25 mcg), nitrofurantoin (300 mcg), norfloxacin (10 mcg), ciprofloxacin (5 mcg), cefotaxime (30 mcg), nalidixic acid (mcg), linezolid (30 mcg), ceftazidime / clavulanic acid (30 / 10 mcg), cefoperazone / sulbactam (75 / 30 mcg) and ceftriaxone / sulbactam (30 / 15 mcg).

Antimicrobial discs were obtained from HiMedia Laboratories Pvt. Ltd, Mumbai, India. The results were interpreted according to Clinical and Laboratory Standards Institute guidelines (CLSI 2016).²⁶ The American type culture collection (ATCC) strains of *Escherichia coli* 25922, *Pseudomonas aeruginosa* 27853, *Enterococcus faecalis* 29212 and *Staphylococcus aureus* 25923 for antimicrobial discs were used as the quality control.

Statistical Analysis

Descriptive statistics was used which includes frequency / percentage of antimicrobial susceptibility pattern of urinary pathogens. Data entered in Microsoft Excel and statistical analysis was done from software SPSS version 20.

RESULTS

During the period of 3 months, out of the 200 urine samples, growth of 170 urinary isolates were considered leaving behind

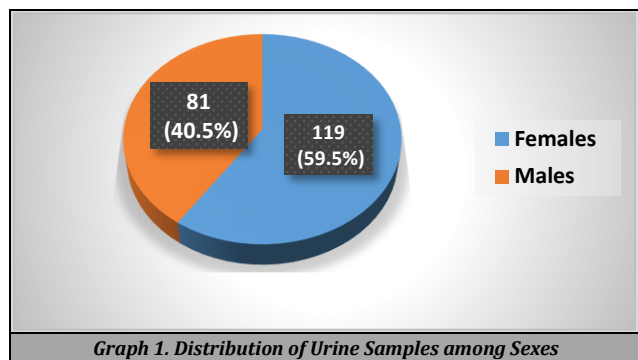
no growths, sample contamination and non-significant bacteriuria.

Age

Out of 200 urine samples, there were age group of people ranging from less than 10 years to more than 60 years. Of which children less than 10 years of age were more with UTI accounting for 54 (27 %) and age group of 11 - 20 years were least infected accounting for 13 (6.5 %).

Age in Years	No. of Patients with UTI	Percentage
< 10	54	27 %
11 - 20	13	6.5 %
21 - 30	39	19.5 %
31 - 40	25	12.5 %
41 - 50	18	09 %
51 - 60	18	09 %
> 60	33	16.5 %
Total	200	100 %

Table 1. Age Wise Distribution of Urine Samples



Gender

119 (59.5 %) were female patients and the remaining 81 (40.5 %) were male patients.

Isolates

Among 170 urinary isolates, gram-negative bacteria accounted for 125 (73.5 %) comprising of *Escherichia coli* 71 (41.8 %), pseudomonas species 20 (11.8 %), klebsiella species 25 (14.7 %), acinetobacter species 08 (4.7 %) and proteus species 01 (0.6 %). While gram-positive bacteria accounted for 45 (26.5 %) comprising of Enterococcus species 22 (12.9 %), *Staphylococcus aureus* 04 (2.3 %), coagulase negative staphylococcus (CoNS) 18 (10.6 %) and alpha-haemolytic streptococci (viridans streptococci) 01 (0.6 %). The predominant causative agent of UTI was *Escherichia coli* followed by klebsiella species, pseudomonas species and gram-positive bacteria. Among *S. aureus* 04 (2.3 %), methicillin sensitive *S. aureus* (MSSA) were 01 (0.6 %) and methicillin resistance *S. aureus* (MRSA) were 03 (1.7 %) and CoNS were 18 (10.6 %).

Antimicrobial Susceptibility Profiles of Bacterial Isolates

Overall, gram positive isolates showed high sensitivity to nitrofurantoin, ciprofloxacin, gentamycin and amikacin when compared to gram-negative isolates and enterococci.

E. coli was resistant to most commonly used antimicrobials i.e., cotrimoxazole, ciprofloxacin, nitrofurantoin and amoxicillin with a sensitivity pattern of 29.6 %, 16.9 %, 14 % and 1.4 % respectively. It showed high sensitivity to amikacin and nitrofurantoin (77.5 % each) followed by gentamycin (56.3 %).

Antimicrobials	No (%) Sensitive for <i>E. coli</i> (N = 71)	GNB's (N = 125)	GPC's (N = 45)
Amikacin	55 (77.5 %)	95 (76 %)	19 (42.2 %)
Nitrofurantoin	55 (77.5 %)	72 (58 %)	12 (26.6 %)
Gentamycin	40 (56.3 %)	72 (58 %)	17 (37.7 %)
Cotrimoxazole	21 (16.9 %)	40 (32 %)	16 (35.5 %)
Ciprofloxacin	12 (16.9 %)	39 (31 %)	17 (37.7 %)
Norfloxacin	10 (14 %)	30 (24 %)	04 (8.8 %)
Amoxicillin	01 (1.4 %)	02 (1.2 %)	12 (26.6 %)
Nalidixic acid	03 (4.2 %)	09 (7.2 %)	Linezolid (Lz) -04 (8.8 %)
Imipenem	14 (19.7 %)	22 (17.6 %)	02 (4.4 %)
Meropenem	01 (1.4 %)	06 (4.8 %)	01 (2.2 %)
Cefotaxime	10 (14 %)	26 (20.8 %)	Ctx-16 (35.5 %) Cefoxitin (Cx) -03 (6.6 %)
Ceftazidime / clavulanic acid	05 (7 %)	12 (9.6 %)	02 (4.4 %)
Cefoperazone / sulbactam	02 (2.8 %)	07 (5.6 %)	01 (2.2 %)
Ceftriaxone / sulbactam	03 (4.2 %)	06 (4.8 %)	01 (2.2 %)

Table 2. Sensitivity Pattern of *E. coli*, Gram Negative and Gram-Positive Isolates (Lz, Ctx & Cx are for Enterococcus)

Microorganisms	Frequency	Percentage
<i>E. coli</i>	71	41.8
Klebsiella spp	25	14.7
Pseudomonas spp	20	11.8
Acinetobacter spp	08	4.7
Proteus spp	01	0.6
Total GNB's isolated	125	73.6
Enterococcus spp	22	12.9
CoNS	18	10.6
<i>S. aureus</i>	04	2.3
α-haemolytic streptococci	01	0.6
Total GPC's isolated	45	26.4
Total isolates both GNB and GPC	170	100

Table 3. Distribution of Various Pathogens Isolated from UTI Patients

DISCUSSION

Present study is conducted to determine the UTI prevalence, common etiological agents and their susceptibility profile. This gives valuable information in monitoring the antimicrobial resistance pattern among uropathogens and also to improve the treatment recommendations.

The age group analysis showed that young children aged less than 10 years had highest prevalence (27 %) of UTI. This is similar with the studies done by Umesh et al.²⁷ and Akash S²⁸ which states that in infants and children, UTI is the common serious bacterial infections which troubles the child and concerns the parents by presenting as asymptomatic bacteriuria to potentially life-threatening infection of the kidney.²⁹ Next age group which showed high prevalence was among female patients aged between 21 and 30 years (19.5 %) of UTI which is similar to studies done by Muktikesh Dash¹⁹ and Uma Gupta.¹³ The high incidence of symptomatic UTI is seen in sexually active young women and increased risk is seen with act of sexual coitus, usage of diaphragm with spermicide

and a recurrent UTIs history.⁹

In the present study, the prevalence of UTI is 85 %. It is higher among females (59.5 %) in comparison with the males (40.5 %). This is similar to other studies done by Muktikesh dash et al.¹⁹ Urvashi Chongtham,²¹ Zahra Tayebiet al.³⁰ and Sunil Kumar D Chavan which states this is because of sexual intercourse, the close distance of the urethral meatus to anus and short urethra of females.³¹

In this study, among gram negative bacilli (73.5 %), *E. coli* (41.8 %) is the commonest uropathogen responsible for UTI which is followed by klebsiella species (14.7 %). This finding were almost in agreement with other studies by Urvashi Chongtham²¹ who reported *E. coli* (43.16 %) and klebsiella species (17.89 %), and also studies by Uma Gupta¹³ and Muktikesh Dash.¹⁹ The next most common organism was Enterococcus species accounting for 12.9 % which is similar to those reported in previous studies.^{8,19} This finding was in agreement with other studies by Zahra Tayebi³⁰, Sunil Kumar D Chavan³¹ and "Katarzyna Hryniewicz.³²"

The Infectious Disease Society of America Guidelines states that as current standard empirical therapy, drugs such as fluoroquinolones, cotrimoxazole, nitrofurantoin and β lactams including amoxicillin clavulanic acid (Augmentin), cefdinir, cefaclor, cephalexin, cefpodoxime-proxetil can be given.³³

In the present study, *E. coli* showed low sensitivity to commonly used empirical antibiotics such as β lactams, fluoroquinolones and cotrimoxazole which is similar to study done by Muktikesh Dash.¹⁹ Aminoglycosides (gentamycin and amikacin) showed high sensitivity rate of 58 % & 80 % respectively for *E. coli*. In community-care setting, these are less commonly used as they need injectable route of administration.

In the present study, amikacin and nitrofurantoin showed high sensitivity rate which is similar to study done by Muktikesh Dash.¹⁹ Hence, nitrofurantoin can be used as the ideal antibiotic of choice for UTI. But its use as oral formulation is limited for complicated upper UTI or for those patients with systemic involvement.⁵

CONCLUSIONS

In specific geographical regions it is difficult to treat UTI empirically because of decreased susceptibility rates documented for common uropathogens. Hence, antimicrobial susceptibility patterns of uropathogens should be considered in antimicrobial selection for UTIs. Occurrence of treatment failure with commonly used antimicrobials is more common in Indian setting. Therefore, routine urine culture is advisable with antimicrobial susceptibility testing along with development of UTI guidelines.

Data sharing statement provided by the authors is available with the full text of this article at jemds.com.

Financial or other competing interests: None.

Disclosure forms provided by the authors are available with the full text of this article at jemds.com.

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