Original Research Article

Bacterial pathogens causing UTI and their antibiotic sensitivity pattern: a study from a tertiary care hospital from South India

Sneka P.[1], Mangayarkarasi V.[2]

[1]Dr. P. Sneka, Assistant Professor, [2]Dr. V. Mangayarkarasi, Professor and HOD; both authors are affiliated with the Department of Microbiology, SRM Medical College Hospital and Research Centre, Kancheepuram, Tamil Nadu, India.

Corresponding Author: Dr. P. Sneka, Assistant Professor, Department of Microbiology, SRM Medical College Hospital and Research Centre, Kancheepuram, Tamil Nadu, India, Email Id : drsneka87@gmail.com

Abstract

Objectives: This study was conducted to find out the prevalence of pathogens causing UTI and their antibiotic sensitivity pattern. **Materials and Methods:** A Prospective study was carried out in the department of Microbiology for one year period from January to December 2018collaboratingwith the various clinical departments to determine the spectrum of organisms causing urinary tract infections and to determine their antibiotic susceptibility profile. **Results:** Among the 8303 samples tested significant bacteriuria was observed in 33.14%. The incidence of UTI was more common in females and in the age group of 31-40 years. In this study, 1931 (70.6%) gram negative bacilli and 756 (27.4%) gram positive cocci were isolated, among which *E.coli* (61.2%) was the commonest followed by *Klebsiella* (18.90%), *Pseudomonas* (8.02 %), *Acinetobacter* (4.4%), *Proteus* (3.7%) and *Citrobacter* (3.72%). Among the gram positive organisms *Entetrococcus* (87.4%) was the highest followed by *Coagulase negative staphylococcusaureus (CONS*) (7.9%) and *Staphlococcus aureus* (4.6%). Candida was isolated in 65cases (2.3%). Imipenem (100%) was the most susceptible antibiotic for *Enterobacteriaciae* followed by levofloxacin (83%) and Amikacin (82%). For the gram positive organisms Vancomycin (100%) and Linezolid (100%) was the most susceptible antibiotic followed by Nitrofurantoin (80%) and Gentamycin (60%). For both the gram positive and the gram negative organisms Nalidicacid, Norfloxacin, Cotrimoxazole and ampicillin were highly resistant and showed less than 30%sensitivity**. Conclusion**: Knowledge of the pattern of organisms causing UTI and their sensitivity pattern is important in choosing empirical drugs in the treatment of UTI.

Keywords: Antibiotic susceptibility, Significant bacteriuria, *E.coli*, *Staphylococcus aureus*, Urinary tract infection

Introduction

Urinary tract infection (UTI) is defined as presence and active multiplication of microorganisms within the urinary tract. It is one of the major health problems affecting both sexes of all age group. In contrast to men, women are more susceptible to UTI and this is mainly due to short urethra, absence of prostatic secretion, pregnancy and ease of contamination of the urinary tract with fecal flora [1]. They are the frequent cause of nosocomial infections in many hospitals [2].

Gram negative bacteria like *Escherichia coli*, Proteus species, Klebsiella species, *Pseudomonas aeruginosa*, *Acinetobacter*, *Serratia* and *Morganella morgagniae* isolated from 75-95% cases of uncomplicated UTI which is most common in young, sexually active, non pregnant, premenopausal women [3]. The remaining cases are associated with a variety of organisms, including the gram positive bacteria like Enterococcus, Staphylococcus especially coagulase negative staphylococci, *Streptococcus agalactiae* and other less frequently isolated organisms [4]. *E. coli* is responsible to most UTIs [5].

The distribution of antimicrobial susceptibility data of UTI-causing microorganisms changes from time to time and from place to place [6]. Drug resistance among bacteria causing UTI has increased since introduction to UTI chemotherapy [7].

The Infectious Disease Society of America recommends that physicians to keep updating information on local susceptibility pattern of organisms causing urinary tract infections and to monitor changes in their susceptibility which is a prerequisite for any hospital infection control program [8].

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UTIs are often treated with different broad-spectrum antibiotics. In the view of the increasing bacterial resistance, regular monitoring of resistance patterns is necessary to improve guidelines for empirical antibiotic therapy [9]. To ensure appropriate therapy, current local based knowledge of the organisms that cause UTI and their antibiotic susceptibility testing is mandatory [10].

Materials and Methods

Duration and type of study: A prospective study was conducted for an one year period from January 2017 to December 2018 at SRM Medical college hospital and research centre collaborating with Medicine, Paediatric, Obstetrics, Orthopedics, Urology, Surgery, Nephrology, General Medicine and Dermatology departments. Prior approval from the institutional ethical committee [Ethics clearance number 1286/IEC/2017] and informed consent was obtained from the patient. The study involved both the sexes and all age groups. A total of 8303 urine samples were collected.

Inclusion criteria: All patients with a presumptive diagnosis of UTI were included in the study.

Data collection procedure: After proper instruction clean catch mid stream urine (MSU) sample was collected in a wide mouthed sterile container. The collected samples were labeled and transported to the microbiology laboratory and processed within 2 hours. Urine was examined macroscopically for the colour and turbidity and wet mount for the number of pus cells, bacteria and budding yeast cells. Culture was done by inoculatingin Blood agar and Mac Conkey agar and incubating at 37°C for 18-24 hours. Growth of $>10^5$cfu/ml in the culture plates was considered positive. Further identification and confirmation was done by colony morphology, motility and biochemical tests as per the standard operating procedures.

Antibiotic susceptibility testing: Antibiotic susceptibility testing was done on Muller Hinton Agar by Kirby Bauer's disc diffusion method as per Clinical Laboratory Standards Institute (CLSI) guidelines. Identical colonies of bacterium was selected and inoculated in to peptone water broth and incubated for 2 hours at 37°C. After adjusting to 0.5 Mc Farlands standard the test organism was streaked on to Muller hinton agar plate by a sterile swab.

The following antibiotic discs (drug concentrations in µg) were used: Amikacin (30µg) Gentamicin (10µg), Ceftazidime (30µg), Cotrimoxazole (25µ), Norfloxacin (10µ), Levofloxacin (5µ), Ampicillin (10µg), Cefepime (30µg), Nalidixic acid (30µg), Nitrofurantoin (300µg), Imipenem (10µg) and Piperacillin-Tazobactum (10µg/100µg) were used for gram negative organisms. In addition Cefoxitin (30µg), Linezolid (30µg), high level Gentamicin (120µg) and Vancomycin (30µg) were used for gram positive organisms.

Quality control strains used were:

- *Staphylococcus aureus* ATCC 25923,
- *Enterococcus faecalis* ATCC 29212,
- *Escherichia coli* ATCC 25922,
- *Pseudomonas aeruginosa* ATCC 27853.

Results

The total number of urine samples received in the microbiology laboratory was 8303. Of the total 2752 (33.14%) were positive for growth. Out of the positive isolates 1931 (70.16%) samples yielded the growth of gram negative bacilli, 756 (27.47%) samples yielded the growth of gram positive cocci and 65 (2.36 %) samples yielded the growth of candida spp. Overall distribution of the pathogens causing UTI is shown in the **Figure 1**.

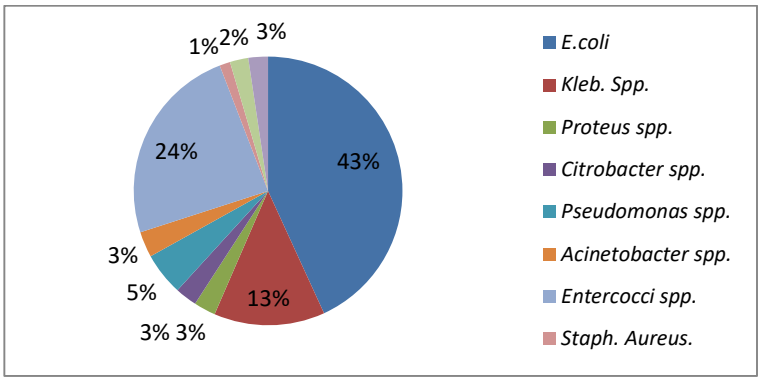

Figure-1: Distribution of isolates in UTI (N=2752)

The distribution of the gram-negative organisms causing UTI is depicted in **table 1**.

Table-1: Distribution of gram negative organisms causing UTI.

Organism	Total gram negatives (Total n=1931)	Percentage (%)
E.coli	1182	61.21
Klebsiella pneumonia	365	18.90
Pseudomonas aeruginosa	155	8.02
Acinetobacterspp	85	4.40
Proteus spp	72	3.72
Citrobacterspp	72	3.72

Table-2: Distribution of gram positive organisms causing UTI.

Organism	Total gram positives (Total n= 756)	Percentage (%)
Enterococcus spp	661	87.43
CONS	60	7.93
Staphylococcus aureus	35	4.62

Table-3: Age wise distribution of UTI

Age (in years)	Positive cultures	Percentage (%)
0-10	65	2.36
11-20	158	5.74
21-30	480	17.4
31-40	920	33.4
41-50	514	18.6
51-60	302	10.9
61-70	228	8.28
71-80	85	3.08

Table-4: Sex wise distribution of UTI.

Sex	Culture Positives	Percentage (%)
Female	1620	58.86
Male	1132	41.13

Table-5: Ward wise distribution of the positive cases

Ward	Total number	Percentage (%)
Medicine	417	15.15
Surgery	350	12.71
Paediatrics	762	27.68
Obstretics	891	32.37
Urology	214	7.7
Nephrology	116	4.2
Dermatology	02	0.07
	N = 2752	

Table-6: Overall sensitivity of the pathogens causing UTI.

Antibiotic	Sensitive	Resistant
Imipenem	100%	0%
Vancomycin	100%	0%
Linezolid	100%	0%
Amikacin	82%	18%
Gentamycin	35%	65%
Norfloxacin	20%	80%
Levofloxacin	83%	17%
Nitrofurantoin	66%	14%
Cotrimoxazole	12%	88%
Cefepime	78%	22%
Cefoxitin	84%	16%
Ampicillin	15%	85%
Nalidixic acid	28%	72%
Piperacillin-tazobactem	84%	16%
High level gentamycin	56%	44 %

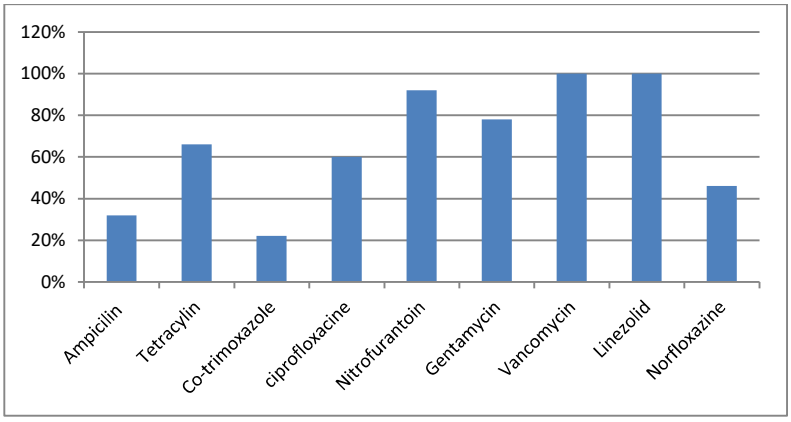

Figure 2: Antibiogram of the gram positive organisms

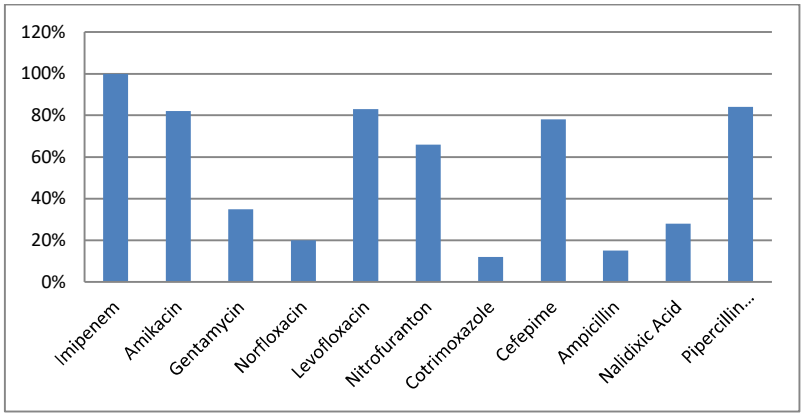

Figure 3: Antibiogam of the gram negative organisms

Among the gram positive cocci the highest was *Enterococcus spp* 661 (87.43%) followed by *CONS* 60 (7.93%z) and *Staphylococcus aureus* 35 (4.62%) as depicted in **Table 2**. *Candida* was grown in 65 (2.36) of the total samples received.

The samples collected were from age group of 10 months to 84 years. The mean age of positive culture was between 31-40 years as shown in **Table 3.**

Of the positive culture samples the majority were females 1620 (58.86%) when compared to 1132 males (41.13%) as shown in **Table 4.**

The total number of positive case were more from more obstetricsward (32.37 %) followed by paediatric (27.68%), Medicine (15.15%), Surgery (12.71%), Urology (7.7%), Nephrology (4.2%) and dermatology (0.07%) as shown in **Table 5.**

For the gram positive organisms the most susceptible antibiotic was Vancomycin and Linezolid and the least susceptible was Cotrimoxazole, Ampicillin and Norfloxacin as shown in **Figure 2.**

In the case of gram negative organisms the most susceptible antibiotic was Imipenem followed by Levofloxacin and Amikacin. The least susceptible antibiotics were Cotrimoxazole, Ampicillin and Norfloxacin as shown in F**igure 3**

Discussion

UTIs are one of the most common infection diagnosed worldwide. Availability of new antimicrobials has improved the management of UTIs. However, the management of UTIs has become difficult due to the emergence of antimicrobial drug resistance.

The prevalence rate in this study was 33.14% which is relatively higher than studies conducted in other parts of India [11, 12]. The prevalence rate is similar to study by Shanthi et al showing 32% [13] and studies from northeast India showing a prevalence rate of 30% [14]. Gram negative organisms (70.16%) causing UTI was higher when compared to gram positive organisms (27.14%) [12].

Among the gram negative organisms *E.coli* (61.21%) was the most common organism isolated followed by *klebsiella pneumoniae* (18.90%), *Pseudomonas aeruginosa* (8.02%), *Acinetobacter spp* (4.40%), *Proteus spp* (3.72%) and *citrobacterspp* (3.72%). Other authors observed *E. coli* as the most common isolated organism in their studies also [12, 13, 14, 15]. This indicates there is no much change in the pathogens causing UTI. However, the isolation rates are lower when compared to other studies [16, 17, 18]. The possible explanation could be either low prevalence in the area or a few patients would have received their first dose of antibiotic before collecting the sample. Statistically significant difference was observed between genders as majority of the pathogens were isolated from females (P<0.001).

This is similar to other national and international studies showing higher prevalence in females [11, 13, 16]. The reason behind this high prevalence of UTI in females is due to close proximity of the urethral meatus to the anus, shorter urethra, sexual intercourse, incontinence, and bad toilet [19, 20, 21]. Statically significant association was observed for prevalence of uropathogens among age groups (P=0.011) where uropathogens were more from obstretrics (32.37%) followed by paediatric (27.68%) in this study, which is similar to studies by Desai et al [22] from Mumbai and Ullahet from Pakistan [23], whereas studies by Sarasu et al showed higher percentage from paediatric age group followed by obstretrics [16].

Overall, resistance among the isolates was maximum for Cotrimoxazole (88%) followed by Norfloxacin (80%) as shown in Table 6. This could be because of frequent prescription of these drugs as the first-line treatment of UTI in the hospital. Similar results were reported by Chongtham et al. A generalized reduction in bacterial susceptibility toward quinolones has been observed which could be because it is one of the drugs of choice for the treatment of UTI [14]. This finding was also consistent with a study done in Karnataka by Eswarappa M et al who reported a high rate of resistance against quinolones [11].

The resistance to cotrimoxazole in this study is high compared to studies from other parts of the world [24, 25].Amikacin and Levofloxacin were highly susceptible and showed a resistance of 18%, 17% respectively, whereas Gentamycin was susceptible in only 35% cases.

A generalized reduction in the activity for Ampicillin was seen in both the gram positive and gram negativeisolates causing UTI. For *Pseudomonas aeroginosa*, Piperacillin-tazobactem was highly effective and showed only 16% resistance. All the gram positive cocci isolated in the study were sensitive to Vancomycin and Linezolid (100%) but other studies have shown low level resistance to these drugs [15, 26]. Majority of the gram positive cocci were sensitive to

nitrofurantoin (92%). In the case of gram negative organisms the resistance to Norfloxacin and cotrimoxazole was high and is 54% and 78% respectively. The resistance pattern observed in this study is similar to the study by Naik et al from Karnataka [27]. Drug resistance among uropathogens has increased over the past few decades because of their widespread indiscriminate use, easy availability, and over the counter sale.

Conclusion

It is important to know the most common organism causing UTI in a particular hospital setting. The knowledge of antimicrobial pattern of routinely isolated uropathogens in that particular hospital may provide guidance to clinicians regarding the empirical treatment of UTI. Data on the changing or increasing antibiotic resistance would guide the clinicians in preventing the unnecessary use, misuse or overuse of antibiotics. All these measures will curtail the emergence of drug resistance.

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Findings: Nil; **Conflict of Interest**: None initiated
Permission from IRB: Yes

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