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Bacteriological profile and sensitivity patterns in urine culture isolates

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Abstract:
Introduction: *UTIs are among the most common bacterial infections of adulthood. They pose a major public health problem due to the growing phenomenon of bacterial resistance to a wide range of antibiotics.UTI are the most common cause of nosocomial infections among the hospitalised patients and also they are the second commonest cause of community acquired infections. Infections are slowly becoming more difficult to treat and may lead to therapeutic dead-end. The emergence of resistance to antibiotics points towards the fact that it is very important to use evidence-based strategies for treatment. Therefore, it has become important to regularly monitor the antibiotic resistance and susceptibility patterns of uropathogens, so that there can be improvement in the guidelines for empirical antibiotic therapy to include antibiotics with low resistance, and this would help clinicians in the proper management of UTIs with the least number of therapeutic failures.*
Material and methods: *This is a retrospective observational study carried out in the Department of Microbiology in Marwari Hospitals, Guwahati for a period of six months from July 2023 to December 2023. A total of 947 urine samples were processed from patients of all age groups with suspected UTI symptoms. Urine culture was done by semi-quantitative technique. Results of urine culture were detected as significant and insignificant based on standard Kass criteria. Organisms were identified and antibiotic sensitivity test were performed as per Clinical and Laboratory Standards Institute (CLSI) guidelines.*
Results: *A total of 947 urine samples were analysed, out of which 171(18.05%) samples were found to have significant bacteriuria and the rest 776 (81.95%) were either insignificant bacteriuria or having mixed bacterial growth or were sterile urine. Among the culture positive samples, predominantly Gram negative bacteria (69%) were isolated followed by Gram positive bacteria (25.7%). E.coli was the predominant organism with 43.9% of the positive isolates. Among the positive urine culture, E. coli was most susceptible to Amikacin (97%), followed by Ertapenem (88%), Gentamicin (81%) and Nitrofurantoin(79%). On the other hand, it was the most resistant to Nalidixic acid (88%) followed by Ciprofloxacin (83%) and Ampicillin (79%).*
Conclusion: *Marked resistance has been observed with the commonly prescribed antibiotics. Therefore, the microbiological profile and antibiotic sensitivity pattern of the uropathogens should be considered before initiating empirical treatment of UTI patients.*

Keywords: *UTI, antibiotic resistance, nosocomial, antibiogram.*

1. INTRODUCTION:

Urinary tract infection (UTI) is the microbial colonization of urine and infections of the lower and upper urinary tract. UTIs are among the most common bacterial infections of adulthood. They pose a major public health problem due to the growing phenomenon of bacterial resistance to a wide range of antibiotics.(1) UTI are the most common cause of nosocomial infections among the hospitalised patients and also they are the second commonest cause of community acquired infections.(2)

In comparison with men, UTI is reported more in women. It could be due to the proximity of genital tract and urethra or anatomical predisposition or urothelial mucosa adherence to mucopolysaccharides lining or other host factors.(3)Though several microorganisms are attributed as causative agents of UTI like bacteria, fungi and viruses, bacterial infections are responsible for > 95% of UTI cases.

Enterobacteriaceae are causing more than 70% of UTIs, and among them the most important is *Escherichia coli*, found in 80% of cases. . *Enterococci, Staphylococci, Klebsiella, Proteus, Pseudomonas,* and *Enterobacter species* are more often isolated from inpatients, whereas there is a greater preponderance of *E. coli* in an outpatient population.(4)

For decades, antibiotics have been used for the treatment of bacterial infections successfully; however, over the past few years, the abuse of antibiotics has led to the emergence of antimicrobial resistance around the world and has become a serious global threat to the public health.(5,6) Recently, it has been reported that approximately 700,000 people worldwide die annually from antimicrobial resistance (AMR) infections and it has been predicted that this number would reach 10 million by 2050.(7) At present, β-lactam drugs are a key factor in the treatment of bacterial infections worldwide and account for almost 65% of antibiotic usage.(8) Nevertheless, it is unfortunate that, in recent years, resistance to this important class of antibiotics is also increasing globally.(9)

Infections are slowly becoming more difficult to treat and may lead to therapeutic dead-end. (10) The emergence of resistance to antibiotics points towards the fact that it is very important to use evidence-based strategies for treatment. (11) In cases of UTI, treatment with antibiotics is generally started empirically before the results of urine culture and susceptibility testing are available. The use of antibiotics in an appropriate way in patients with UTI seems to reduce the length of hospital stay, and is thus favorable for patient outcomes and the costs of healthcare. (12)Therefore, it has become important to regularly monitor the antibiotic resistance and susceptibility patterns of uropathogens, so that there can be improvement in the guidelines for empirical antibiotic therapy to include antibiotics with low resistance, and this would help clinicians in the proper management of UTIs with the least number of therapeutic failures. (13)The antibiotic resistance patterns have shown large inter-regional differentiation. The appropriate choice of antibiotic needs to be modified based on the local susceptibility patterns(14).

Hence, the aim of this study was to isolate pathogenic agents involved in UTI and to determine their antibiotic susceptibility pattern.

2. MATERIALS AND METHODS:

This is a retrospective observational study carried out in the Department of Microbiology in Marwari Hospitals, Guwahati for a period of six months from July 2023 to December 2023.Our institute is a 162 bedded tertiary care hospital in the city of Guwahati since 1985. It covers around 50 lacs population of Guwahati city as well as periphery.

A total of 947 urine samples were processed from patients of all age groups with suspected UTI symptoms such as fever, dysuria, increased frequency of urination, loin pain. Samples from both inpatients and outpatients were included. The patients had clinical evidence of urinary tract infection as determined by their physician.

Clean catch midstream urine was collected from each patient into a sterile screw-capped universal container. The specimen was appropriately labeled, transported to the laboratory, and analyzed within 2 hours after collection. If there was a delay of more than 2 hours, samples were stored in refrigerator at 4-8° C till processed.

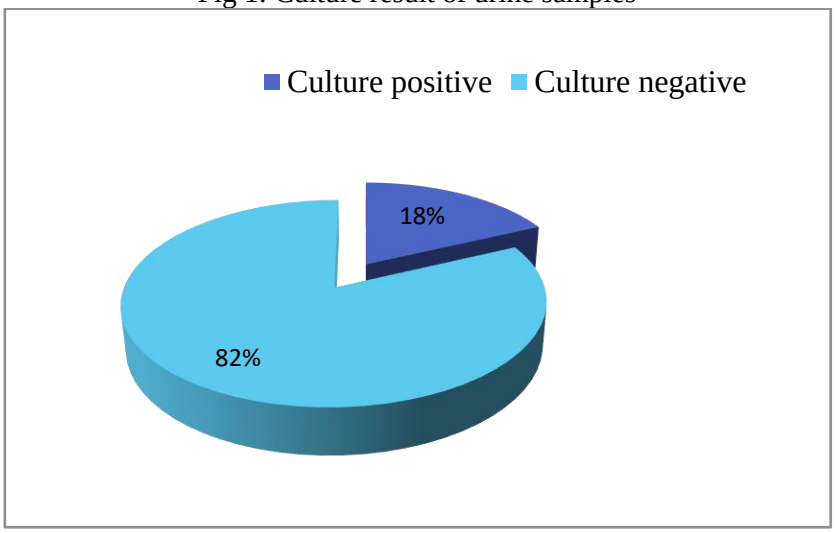
Urine culture was done by semi-quantitative technique. By means of a calibrated loop, a measured amount of urine was cultured on both CLED (Cystine Lactose Electrolyte deficient) agar and Mac Conkey's agar respectively and incubated at 37° C for 18-24 hours. Results of urine culture were detected as significant and insignificant based on standard Kass criteria. A growth of >=10^5 colony forming units (CFU)/ml was considered as active UTI with significant bacteruria and growth lesser than that was considered as insignificant. Cultures having more than three types of colonies were considered as contaminants.

Organisms were identified and antibiotic sensitivity test were performed as per Clinical and Laboratory Standards Institute (CLSI) guidelines. Vitek2 Compact system -VITEK2 GN, VITEK2 GP, VITEK2 YST and Antimicrobial Susceptibility Test (AST) cards were used for identification of organisms and antibiotic sensitivity test respectively. Microsoft Excel was used for the entry and analysis of the data. Mean susceptibility was calculated for the antibiotics for each organism.

3. RESULT:

A total of 947 urine samples were analysed, out of which 171(18.05%) samples were found to have significant bacteriuria and the rest 776 (81.95%) were either insignificant bacteriuria or having mixed bacterial growth or were sterile urine.

Fig 1: Culture result of urine samples



Among the 171 positive samples, 139(81.3%) were from females and 32(18.7%) were from males.
The infection rate is high among the age group of 21-30 yrs which is 22.8% followed by 61-70 yrs (15.7%) and 31-40 yrs (14.6%) respectively.

Fig 2: Gender wise distribution of positive samples

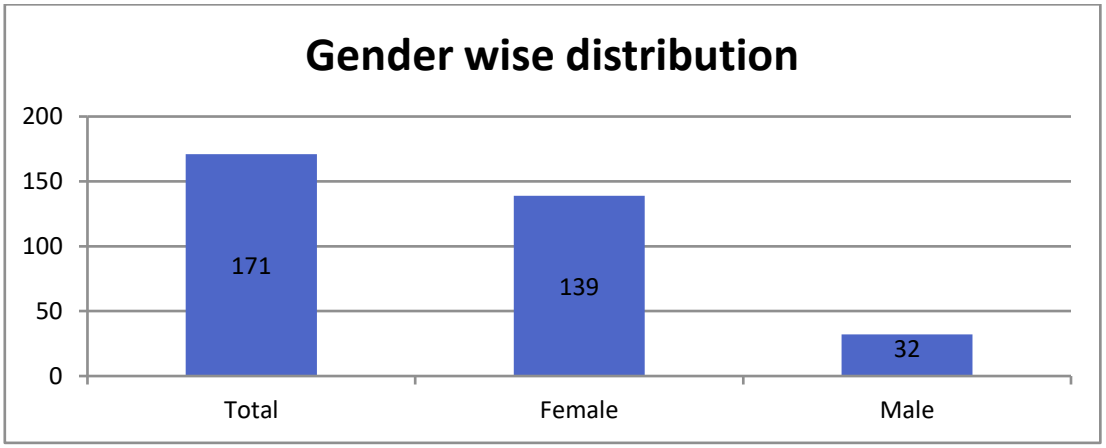
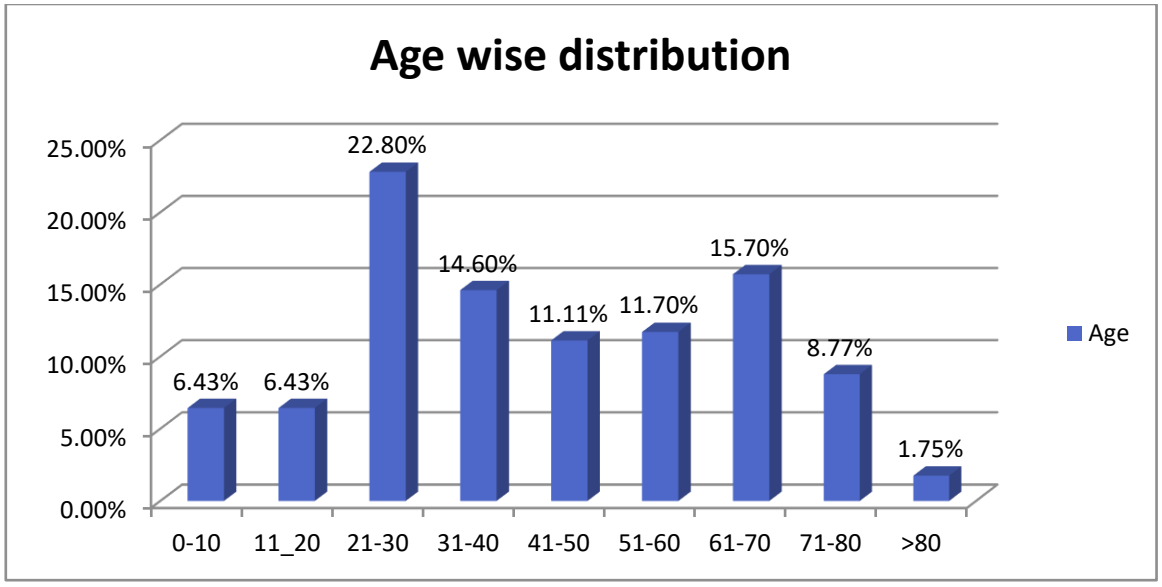


Fig 3: Age wise distribution of positive samples



Among the culture positive samples, predominantly Gram negative bacteria (69%) were isolated followed by Gram positive bacteria (25.7%) and fungi i.e. Candida (5.2%).

E.coli was the predominant organism with 43.9% of the positive isolates. *Klebsiella sp.* occupied the second position with 15.8% isolates followed by *Enterococcus sp.with 14* % isolates. The organisms with the lowest prevalence were *Citrobacter koseri*, *Proteus sp* and *Enterobacter sp.*

Fig 4: Types of bacteria isolated from urine samples

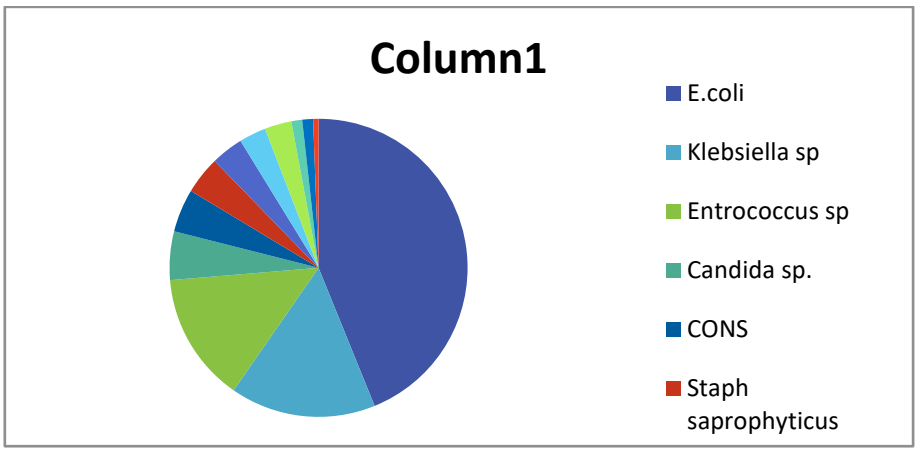


Table1: Types of bacteria isolated from urine samples

Bacteria	No of isolates	Percent
E.coli	75	43.9
Klebsiella sp	27	15.8
Enterococcus sp	24	14
Candida sp.	9	5.2
CONS	8	4.7
Staph saprophyticus	7	4.1
Acinetobacter baumannii	6	3.5
Pseudomonas aeruginosa	5	2.9
Staph aureus	5	2.9
Proteus sp	2	1.2
Enterobacter sp	2	1.2
Citrobacter koseri	1	0.6

Among the positive urine culture, *E. coli* was most susceptible to Amikacin (97%), followed by Ertapenem (88%), Gentamicin (81%) and Nitrofurantoin(79%). On the other hand, it was the most resistant to Nalidixic acid (88%) followed by Ciprofloxacin (83%) and Ampicillin (79%).

Klebsiella species had the highest sensitivity to Amikacin (78%) and Gentamicin (74%) followed by Ertapenem and Cotrimoxazole (67%). It was most resistant to Nitrofurantoin (70%) followed by Cefalotin(63%) and cefixime (59%).

Enterococcus sp. was susceptible to a number of antibiotics including Tigecycline (87.5%), Teicoplanin(87.5%) and Linezolid and Nitrofurantoin(67%). It had the highest resistance to Erythromycin (87.5%) followed by Ciprofloxacin (75%) and Levofloxacin (67%).

Table 2: Gram Negative Isolates and their susceptibility pattern to antibiotics.

Antibiotics	**Bacterial isolates**						
	E. coli	*Kleb*	*Acin*	*Pseu*	*Prot*	*Ente*	*Citr*
AMPICILLIN	21	R	-	-	50	R	R
AMOXYCLAV	64	55.5	-	-	50	0	100

AMIKACIN	97	78	83	100	100	50	100
CEFTAZIDIME	56	55.5	100	100	50	100	100
CEFALOTIN	21	37	-	-	50	0	100
CEFIXIME	31	41	-	-	50	0	100
CIPROFLOXACIN	17	52	67	100	100	50	100
CEFTRIAXONE	39	52	67	-	50	0	100
CEFOXITIN	72	52	-	-	50	0	100
COTRIMOXAZOLE	48	67	50	-	100	50	100
ERTAPENEM	88	67	-	-	100	50	100
GENTAMICIN	81	74	83	100	100	50	100
NALIDIXIC ACID	12	44	-	-	0	100	100
NITROFURANTOIN	79	30	-	-	0	0	100
NORFLOXACIN	43	55.5	-	100	100	100	100
OFLOXACIN	37	55	-	100	100	100	100
PIPERACILIN-TAZOBACTAM	75	55.5	50	100	100	50	100
TICARCILLIN	23	R	40	40	50	R	R

Table 3: Gram Positive Isolates and their susceptibility pattern to antibiotics.

Antibiotics	**Bacterial isolates**			
	Enterococcus sp	*Staphylococcus sp*	*Staphylococcus saprophyticus*	*Staphylococcus aureus*
CIPROFLOXACIN	25	25	43	60
CLINDAMYCIN	-	0	43	60
COTRIMOXAZOLE	-	62.5	86	80
DAPTOMYCIN	42	62.5	80	100
ERYTHROMYCIN	12.5	0	40	14
GENTAMICIN	67	75	86	40
LEVOFLOXACIN	33	25	43	60
LINEZOLID	67	75	100	80
NITROFURANTOIN	67	75	100	100
OXACILLIN	-	0	14	20
PENICILLIN	67	0	0	0
RIFAMPICIN	-	62.5	100	80
TETRACYCLINE	33	62.5	100	60
TEICOPLANIN	83	75	100	80
TIGECYCLINE	87.5	87.5	100	100
VANCOMYCIN	62.5	75	100	80

4. DISCUSSION: In developing countries urinary tract infection (UTI) is one of the most commonly diagnosed disease among the patients seeking medical treatment with frequency of 180 per 10,000 (11). Our study shows the prevalence rate of 18.05% which was similar to studies conducted in Kathmandu medical college & hospital and Shankarapur hospital which reported a prevalence rate of 13.8% and 17.4% respectively (15,16).

Among the culture positive samples, female patients were 81.3% and male patients were 18.7%. Several other studies showed similar findings.(15,16)

The infection rate was highest in the age group of 21-30 yrs(22.8%) which is comparable to studies done by Subedi et al, Banerjee et al and Shahina et al (16,17,18).

The most common organism isolated in our study was E.coli(43.9%) followed by Klebsiella species(15.8%). These findings are similar to the studies by Pradhan et al (15), Rijal et al (19) and Kothari et al (20).

Regarding antibiotic susceptibility, Nitrofurantoin is a urinary antiseptic that is used in UTI and it acts by inhibiting various enzymes and thus damaging bacterial DNA. In this study nitrofurantoin shows a sensitivity of 79% which is comparable with the results of the study done by Nashtar SB (21) with a sensitivity of 80% and Mahdi BM et al (22) with a sensitivity of 85%.

In our study the most sensitive antibiotic was found to be Amikacin (97%). This result is comparable to various studies like the study done by Raza S et al(23), Rakesh et al (24) and Kumar et al (2) which also reported Amikacin as the most sensitive antibiotic.

In this study, E.coli was found to be most resistant to Nalidixic acid (88%) which is also reported by Pradhan B et al (15). The second most resistant antibiotic was ciprofloxacin(83%) which is similar to the resistance profile in the study done by Behera PK et al (25) and Haque R et al (26).

5. CONCLUSION :

Urinary tract infection is the most common bacterial infection seen in clinical practice. Female patients in the reproductive age group are the most vulnerable population group to develop UTI. E.coli remains to be the most frequent bacterial uropathogen causing urinary infections.

Marked resistance has been observed with the commonly prescribed antibiotics. Therefore, the microbiological profile and antibiotic sensitivity pattern of the uropathogens should be considered before initiating empirical treatment of UTI patients. Studies should be conducted routinely to identify common bacteria causing UTI and antibiotic policy should be formulated to help the clinicians in proper management of UTIs and to prevent development of drug resistance.

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