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BACTERIOLOGICAL PROFILE AND ANTIMICROBIAL SUSCEPTIBILITY PATTERN OF URINARY TRACT INFECTIONS AMONG WOMEN OF REPRODUCTIVE AGE - A RETROSPECTIVE OBSERVATIONAL STUDY

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ABSTRACT

Background: Urinary tract infection (UTI) is the most common bacterial infections affecting women, particularly those in reproductive age group, due to various anatomical and physiological factors. The rapid emergence of antimicrobial resistance among uropathogens has become a major challenge in the effective management of UTIs, highlighting the need for periodic surveillance of causative organisms and their susceptibility patterns. **Objectives:** To determine the bacteriological profile and antimicrobial susceptibility pattern of urinary tract infections among women of reproductive age attending a tertiary care hospital. **Materials and Methods:** A retrospective observational study was conducted for a period of 6 months at a tertiary care hospital. The study included urine specimens received in the Department of Microbiology for culture and antimicrobial susceptibility testing from women belonging to the reproductive age group (15–44 years). Samples were processed using standard microbiological techniques, and isolates were identified by conventional methods. Antimicrobial susceptibility was performed using the Kirby–Bauer disk diffusion method according to standard laboratory guidelines. **Results:** Out of 256 urine samples analyzed, 98 (38.3%) yielded significant bacterial growth. Escherichia coli was the predominant pathogen (47%), followed by Staphylococcus aureus (12%) and Enterococcus species (12%). Nitrofurantoin was the most effective agent against both Gram-negative isolates and 'Gram-positive isolates. **Conclusion:** The study highlights Escherichia coli is the principal etiological agent of urinary tract infections among women of reproductive age. Routine urine culture with antimicrobial susceptibility testing remains essential for accurate diagnosis and targeted therapy.

KEYWORDS : Urinary Tract Infection, Women of Reproductive Age, Escherichia Coli, Antimicrobial Susceptibility.

INTRODUCTION

Urinary tract infection (UTI) is one of the most common bacterial infections encountered in clinical practice and remains a major public health concern worldwide[1,2]. It is estimated that nearly half of all women experience at least one episode of UTI during their lifetime,with approximately 20–30% developing recurrent infections[2,3]. UTIs contribute substantially to healthcare utilization, antibiotic consumption, and economic burden, particularly in low and middle-income countries[1,4].

Women of reproductive age are particularly susceptible to UTIs because of their anatomical and physiological characteristics, including a shorter urethra, proximity of the urethral opening to the anal region, hormonal influences, and increased sexual activity[2,5]. Other predisposing factors such as poor perineal hygiene, previous urinary tract infections, diabetes mellitus, urinary tract abnormalities, and frequent sexual intercourse further increase the risk of infection[3,5].

The majority of urinary tract infections occur through the ascending migration of microorganisms from the gastro-intestinal tract into the urinary system[1,6]. Escherichia coli remains the predominant uropathogen responsible for both community-acquired and hospital-acquired UTIs, accounting for nearly 70–90% of uncomplicated infections[2,6]. Other commonly isolated organisms include Klebsiella pneumoniae, Enterococcus species, Citrobacter species, Proteus species, Pseudomonas aeruginosa, Staphylococcus aureus and coagulase-negative Staphylococcus species[6,7]. The distribution of these pathogens varies depending on geographical location, patient characteristics and healthcare practices.

Urine culture remains the gold standard for the laboratory diagnosis of UTI because it enables accurate identification of the causative organism and determination of its antimicrobial susceptibility profile[8].Standard microbiological methods combined with antimicrobial susceptibility testing according to Clinical and Laboratory Standards Institute (CLSI) guidelines provide reliable information for selecting appropriate antimicrobial therapy and support antimicrobial stewardship programmes[8,9].

The rapid emergence of antimicrobial resistance among uropathogens has become a major challenge in the effective management of UTIs [4,9]. Increasing resistance to commonly prescribed antibiotics, including fluoroquinolones, cotrimoxazole, aminopenicillins, and third-generation cephalosporins, has limited empirical treatment options and contributed to treatment failures[4,10].

AIM AND OBJECTIVES

To determine the bacteriological profile and antimicrobial susceptibility pattern of urinary tract infections among women of reproductive age attending a tertiary care hospital.

MATERIALS AND METHODS

A retrospective observational study was conducted in the Department of Microbiology at a tertiary care hospital over a period of six months from January 2024 to June 2024. The study included urine specimens received in the Department of Microbiology for culture and antimicrobial susceptibility testing from women belonging to the reproductive age group (15–44 years).

Inclusion Criteria:

- All urine samples received for culture and antimicrobial susceptibility testing from women aged 15–44 years.
- Urine specimens with complete microbiological records.

Exclusion Criteria:

- Urine specimens received from females outside the reproductive age group.
- Urine samples obtained from antenatal women.
- Duplicate urine samples from the same patient during the study period.
- Inadequately labelled or contaminated urine specimens.

Sample Size

A total of 256 urine samples fulfilling the inclusion criteria were included in the study.

Sample Collection and Processing

Clean-catch midstream urine specimens collected in sterile, wide-mouthed, leak-proof containers were received in the microbiology laboratory. Samples were processed immediately upon receipt. Delayed specimens were refrigerated at 2–8°C until processing to prevent bacterial overgrowth.

Each urine specimen was subjected to direct Gram staining to assess the presence of pus cells and bacteria. The specimens were inoculated into the Nutrient agar, 5% Sheep Blood Agar, MacConkey Agar and Cystine Lactose Electrolyte Deficient (CLED) Agar. The inoculated plates were incubated aerobically at 37°C for 18–24 hours.

Identification of Bacterial Isolates

Growth of a single bacterial isolate with a colony count of $\geq 10^5$ colony-forming units (CFU)/mL was considered significant bacteriuria and included for further analysis. Mixed and insignificant bacterial growth were excluded from the study.

Bacterial isolates were identified using standard Microbiological procedures based on: Colony morphology, Gram staining, Motility and Conventional biochemical reactions as per standard operative procedures[11].

Antimicrobial Susceptibility Testing

Antimicrobial susceptibility testing was performed by Kirby–Bauer disc diffusion method on Mueller–Hinton agar and results were interpreted as Sensitive, Intermediate, or Resistant based on Clinical and Laboratory Standards Institute (CLSI) guidelines[8]. Quality control procedures were maintained using American Type Culture Collection (ATCC) reference strains as recommended by CLSI.

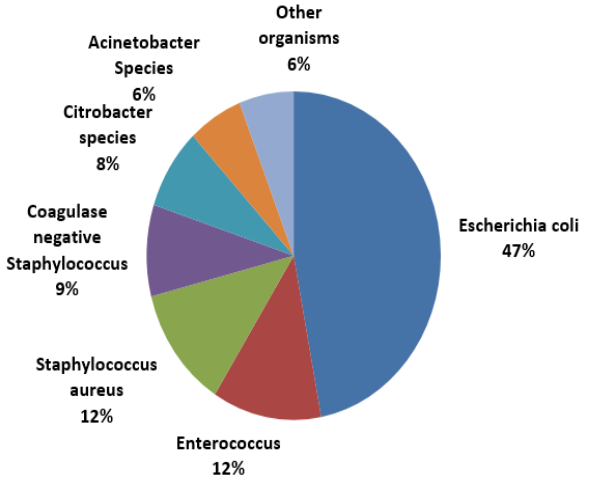
RESULTS

Among 256 urine samples, 98(38.3%) yielded significant bacterial growth, whereas 158(61.7%) samples showed either no growth or insignificant bacteriuria.

Among the 98 culture-positive isolates, Gram-negative bacteria constituted 66(67.3%) isolates, while Gram-positive bacteria accounted for 32 (32.7%) isolates.

Escherichia coli was the predominant bacterial isolate accounting for 47% of all culture-positive samples. Other commonly isolated organisms are Enterococcus species(12%), Staphylococcus aureus (12%), Coagulase-negative Staphylococcus(9%), Citrobacter species (8%), and Acinetobacter species (6%). The remaining 6% comprised other bacterial isolates such as Proteus species , Pseudomonas aeruginosa and Klebsiella species. (Graph 1)

GRAPH 1: Distribution of Bacterial Isolates



Among Gram-negative uropathogens, Nitrofurantoin(88.4%) demonstrated the highest susceptibility followed by Carbapenems(85.5%), Gentamicin(66.7%) and Piperacillin–tazobactam(58.3%). High resistance was observed against Norfloxacin (87.2%) and Penicillins(63.2%)

Table 1: Antibiotic susceptibility profile of Gram negative isolates

S.no	Antibiotics	Sensitive	Resistant
1.	Nitrofurantoin	88.4%	11.6%
2	Carbapenems	85.5%	14.5%
3	Gentamicin	66.7%	33.3%
4	Piperacillin-Tazobactum	58.3%	41.7%
5	Penicillins	36.8%	63.2%
6	Norfloxacin	12.8%	87.2%

Among Gram-positive organisms, Nitrofurantoin demonstrated the highest susceptibility(92.8%), followed by Linezolid(86.4%) and Gentamicin(65.2%) while Norfloxacin showed poor susceptibility(38%).

Table 2: Antibiotic susceptibility profile of Gram Positive isolates

S.no	Antibiotics	Sensitive	Resistant
1.	Nitrofurantoin	92.8%	7.2%
2	Linezolid	86.4%	13.6%
3	Gentamicin	65.2%	34.8%
4	Norfloxacin	38%	62%

DISCUSSION

Urinary tract infections (UTIs) remains the major cause of morbidity among women, particularly those in the reproductive age group. Various anatomical and physiological factors predispose to UTIs such as shorter urethra, hormonal factors, and increased sexual activity.

In the present study, 38.3% of urine samples yielded significant bacterial growth. Similar culture positivity rates have been reported in previous Indian studies, although the prevalence varies depending on the study population, geographical region, sample collection techniques, and diagnostic criteria. Gram-negative bacteria accounted for 67.3% of the isolates, while Gram-positive bacteria constituted 32.7%. This predominance of is consistent with the several other studies conducted in India and other countries[1–4]. This is because of Gram-negative bacilli possess multiple virulence factors, including adhesins, fimbriae, hemolysins, siderophores, and biofilm-forming ability, which facilitate colonization of the urinary tract and contribute to persistent infection.

The present study identified Escherichia coli as the predominant uropathogen, accounting for 47% of all isolates. This observation is consistent with the study Flores-Mireleset al., Simoni et al., and the European Association of Urology guidelines, all of them recognized that E. coli was the leading cause of uncomplicated urinary tract infections [1,2,5].

Among Gram-positive organisms, Staphylococcus aureus and Enterococcus species each accounted for 12% of isolates, while coagulase-negative Staphylococcus represented 9%. Although these are less common than Gram-negative bacilli, they are increasingly recognized as important uropathogens, particularly among patients with recurrent infections, previous antibiotic exposure, urinary catheterization, and underlying urinary tract abnormalities.

Antimicrobial susceptibility testing demonstrated that Nitrofurantoin shows excellent activity against Gram-negative isolates, followed by carbapenems and gentamicin. These findings are in agreement with several studies, which continue to report high susceptibility of urinary E. coli isolates to Nitrofurantoin[6–8]. Nitrofurantoin achieves high urinary concentrations and has a relatively low propensity for resistance development, making it an effective first-line agent for uncomplicated lower urinary tract infections.

Carbapenems exhibited high susceptibility against Gram-negative isolates, reflecting their continued effectiveness against multidrug-resistant organisms. But carbapenems should be reserved only for severe or complicated infections because inappropriate use may promote the risk of Carbapenem-resistant Enterobacterales.

Among Gram-positive isolates Nitrofurantoin and Linezolid exhibited excellent activity. Although linezolid remains highly effective against resistant Gram-positive organisms, it should be reserved for selected clinical situations to preserve its long-term efficacy and minimize the development of resistance. Gentamicin shows the mid range of susceptibility to the gram positive isolates.

In contrast, Norfloxacin demonstrated poor susceptibility, with high levels of resistance among both Gram-negative and Gram-positive isolates. Similar resistance patterns have been documented in recent studies[7–10].This is due to widespread empirical use of fluoroquinolones. Increasing resistance to fluoroquinolones limits their usefulness as empirical agents and emphasizes the need for antibiotic selection based on culture and sensitivity.

The observed antimicrobial susceptibility profile in the present study highlights the importance of generating institution-specific antibiograms. Our findings indicates that a substantial proportion of women presenting with symptoms suggestive of UTI had microbiologically confirmed infection, emphasizing the continued importance of urine culture and sensitivity in the diagnosis and management of UTIs.

CONCLUSION

The study highlights Escherichia coli is the principal etiological agent of urinary tract infections among women of reproductive age. Routine urine culture with antimicrobial susceptibility testing remains essential for accurate diagnosis and targeted therapy. Empirical treatment solely based on clinical presentation may contribute to inappropriate antibiotic use and further accelerate antimicrobial resistance.

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