Section: Microbiology

Original Research Article

A STUDY OF UROPATHOGENS AND THEIR ANTIBIOGRAM AT A TERTIARY CARE HOSPITAL, WESTERN INDIA

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Abstract

Background: Urinary tract infection frequently affects the global community and hospitalized patients, due to underlying risk entities. Increasing drug resistance severely restricts antibiotic regimen leading to recurrence or complications. Aim and objective: This study was conducted to determine the existing profile of uropathogens and their antimicrobial sensitivity spectrum, at our hospital. **Materials and Methods:** The laboratory data of urine samples received in the microbiology laboratory over a period of one year, was analysed based on age, gender, identification of culture isolates and their antibiotic susceptibility. **Results:** Overall 406/2546 (15.9%) urine samples were culture positive. Agewise distribution showed that adults 369/406 (91%) were higher than children 37/406 (9%). Genderwise distribution revealed that females 249/406 (61%) were more as compared to males 157/406 (39%). Organismwise distribution indicated that Gram Negative Isolates constituted majority i.e.318/406(78.3%) and Gram Positive Isolates were 88/406(21.7%). Overall Ecoli was the predominant pathogen 183/406 (45%) followed by Enterococcus 76/406 (19%) and Klebsiella 68/406 (17%). As per Antibiotic susceptibility testing, Gram Negative Isolates showed maximum sensitivity to colistin (100%), fosfomycin (85%), amikacin (78%), gentamicin (76%), meropenem (77%), cefoperazone/sulbactum(76%) and piperacillin/tazobactum(72%) whereas Gram Positive Isolates showed maximum sensitivity to Linezolid(100%), vancomycin(100%), fosfomycin (75%) gentamicin(72%), nitrofurantoin(73%), tetracyclin(65%) and doxycycline(65%). Among the isolates, MDR comprised 243/406(60%) and ESBL producers were 162/406 (40%). **Conclusion:** Temporal variability in the antibiotic susceptibility trends demands regular local surveillance, to establish the present profile of pathogens and facilitate administration of potentially effective antibiotics for timely intervention and to avert serious sequelae.

INTRODUCTION

Urinary tract infection (UTI) constitutes an enormous health burden impacting the global population. The challenge of mitigation is intensified by the high recurrence rate and escalating antimicrobial resistance among uropathogens.[1] Misuse and overuse of antimicrobials are the main drivers in the development of drug-resistance. Failure to treat or frequent recurrence may lead to multiplication of pathogens which can ascend to the kidneys, causing pyelonephritis and eventually renal failure in the long term. As treatment and prevention of complications are time sensitive to diagnosis, alignment of rapid diagnosis, susceptibility testing and targeted treatment options should be integrated in the management protocol to enhance cure.[2,3] Clinically, UTIs are categorized as uncomplicated or complicated. Uncomplicated UTIs typically affect women, children and elderly patients who are otherwise healthy. Complicated UTIs are usually associated with indwelling catheters, urinary tract abnormalities, immunosuppression or exposure to antibiotics. The primary etiological pathogens include Gram-negative and Gram-positive bacteria, as well as fungi. Patient and community safety can be optimized by ensuring prescription of the best medication. Therefore, understanding the existing local distribution and antibiotic susceptibility patterns of uropathogens would facilitate appropriate therapy.[4,5]

Aim and Objective

To identify the uropathogens and determine their antibiotic sensitivity pattern, at our hospital.

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MATERIALS AND METHODS

Study Design

Retrospective cross-sectional observational study. Study site: Department of Microbiology of a tertiary care hospital. Study duration: January 2022 to March 2023.

Inclusion Criteria

Urine samples of all clinically suspected cases of urinary tract infection (OPD/Inpatients).

Exclusion Criteria

Contaminated samples.

Methodology: The laboratory data of suspected urine samples received in the microbiology laboratory was analyzed, based on age, gender, culture positivity and antibiotic sensitivity profile. Midstream clean catch urine was collected in a sterile universal container. It was transported to the laboratory within 2 hours of collection and in case of expected delay was refrigerated at 4-8 deg C. After centrifuging, Gram stained smear was prepared and examined for the presence of pus cells, Gram-positive and Gram-negative organisms. Consequently, blood agar and Mc Conkey's agar were inoculated and incubated at 37 deg C for 24 hours. Further identification was based on colony morphology and appropriate biochemical tests. All the samples were processed using techniques, as per standard laboratory protocol. Antibiotic Susceptibility Testing was performed by Kirby-Bauer Disc diffusion method using Mueller-Hinton agar, as per Clinical and Laboratory Standards Institute (CLSI) guidelines.[6]

Antibiotics tested for Gram Negative Isolates were as follows:- Amoxicillin-clavulanate 20/10 µg, Ampicillin-sublactam 10/10 µg, Amikacin 30 µg, Aztreonam 30 µg, Cefuroxime 30 µg, Ceftriaxone 30 µg, Cefazolin 30 µg, Norfloxacin 10 µg, Nitrofurantoin 300 µg, Fosfomycin 200 µg, Cefotaxime 30 µg, Ceftazidime 30 µg, Cefoperazone 30 µg, Colistin/Polymyxin 15 µg, Doxycyclin 30 µg, Gentamycin/Tobramycin 10/10 µg, Piperacillin-Tazobactam 100/10 µg, Meropenem 10 µg, Imipenem 10 µg, Tigecycline 15 µg, Cotrimoxazole 1.25/23.75 µg.

Antibiotics tested for Gram Positive Isolates were as follows:-

Cefoxitin 30 µg, Clindamycin 2 µg, Cotrimoxazole 1.25/23.75 µg, Linezolid 30 µg, Penicillin 10 U, Vancomycin 30 µg, Tetracycline 30 µg, Doxycycline 30 µg, Ciprofloxacin 5 µg, Norfloxacin 10 µg, Nitrofurantoin 300 µg, Erythromycin 15 µg, Gentamycin 10 µg, Tigecycline 15 µg. The organisms used for quality assurance purpose were: 1. Staphylococcus aureus ATCC 25923 (BSL 2) 2. Escherichia coli ATCC 25922 (BSL 1) 3. Pseudomonas aeruginosa ATCC 27853 (BSL 2)

Detection of ESBL producers: Gram negative isolates were tested for ESBL production using Mueller Hinton agar medium. Ceftazidime (CA) 30 ug, ceftazidime/clavulanic acid (CAC) 30/10 ug; cefotaxime 30 ug cefotaxime/clavulanic acid 30/10 ug, were utilised for testing by Kirby- Bauer Disc Diffusion Method and incubated for 16-18 hours at 37 deg C. By using the disc combination method, CA/CAC were compared, for their ability to detect ESBL production phenotypically. The results were interpreted as follows: A ≥5 mm increase in the zone diameter for either of the antimicrobial agent, tested in combination with clavulanate v/s the zone diameter of the agent when tested alone, was considered to be indicative of ESBL production. For the purpose of quality control Klebsiella pneumonia ATCC 25922 and E. coli ATCC 25922 were included as reference strains.[6,7] For data entry and statistical analysis, recording of data was done in Microsoft Excel. Data analysis was performed using IBM SPSS statistics software version 28.

RESULTS

The overall urinary infection rate in our study was 406/2546 (15.9%). Age wise distribution showed that adults were higher, 369/406 (91%) compared to children 37/406 (9%) whereas gender wise distribution revealed that females were in majority 249/406 (61%) than males 157/406 (39%).[Table 1]

Organism wise distribution: Among of the total isolates (n=406), bacterial isolates constituted 404/406 (99.5%) and Candida were 2/406 (0.5%). Bacterial isolates were further classified as Gram Negative Isolates which constituted 318/406(78.3%) and Gram Positive Isolates 88/406 (21.7%). Overall Ecoli was the predominant uropathogen 183/406 (45%), followed by Enterococcus 76/406 (19%) and Klebsiella 68/406 (17%). [Table 2 & Fig 1]

Antibiogram results indicated that Gram Negative pathogens showed maximum sensitivity to colistin (100%), fosfomycin (85%), amikacin(78%), gentamicin(76%), meropenem(77%), cefoperazone/sulbactum(76%) and piperacillin/tazobactum(72%) and Gram Positive pathogens showed maximum sensitivity to linezolid(100%), vancomycin(100%), fosfomycin (75%) gentamicin(72%), nitrofurantoin(73%), tetracyclin(65%) and doxycycline(65%).[Fig 2 &3]

We found that Multidrug resistant (MDR) isolates comprised 243/406(60%) and ESBL producers among Gram negative uropathogens constituted 162/404 (40%).

Table 1: Agewise & Genderwise Distribution

Agewise distribution	**Number (%)**
Adults	369/406 (91%)
Children	37/406 (9%)
Genderwise distribution	Number (%)
Women	249/406 (61%)

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Men	157/406 (39%)

Table 2: Organismwise Distribution (N=406)

Organisms	***Number (%)***
Gram Negative Isolates	318/406(78.3%)
Ecoli	183 (58%)
Klebsiella	68 (21%)
Pseudomonas	29 (9%)
Acinetobacter	17 (5%)
Enterobacter	8 (3%)
Proteus	7 (2%)
Morganella,Providencia, Citrobacter (4+1+1)	6 (2%)
Gram Positive Isolates	88/406(21.7%)
Enterococcus	76 (86%)
Staphylococcus+MRSA+Streptococcus+ Candida	7+2+1+2=12 (14%)

Table 3: Comparative Overall Positivity of Urine Samples

Study	**Place**	**Year**	**Overall positivity**
Our study	Mumbai	2023	15.9%
Mechal et al	Ethiopia	2021	32.8%
Patel et al	Ahmedabad	2019	45.69%
Sneka et al	Kancheepuram	2019	33%
Bhosle et al	Ujjain	2020	61%
Pardeshi et al	Mumbai	2018	33%
Kalal et al	Bangalore	2016	28%
Martin et al	Uganda	2019	32%
Mohapatra et al	Multicentric, India	2022	10%
Paul et al	Assam	2021	59%
Behera et al	Bhuvaneshwar	2022	12.6%

Table 4: Comparative Antibiotic Sensitivity Spectrum of Gram Negative Isolates

Study	**Place**	**Year**	**Greater Sensitivity in descending order**
Our study	Mumbai	2023	Colistin , fosfomycin , amikacin, gentamicin, meropenem
Faraz et al	Telangana	2021	Tigecycline, colistin, amikacin, fosfomycin, nitrofurantoin
Sneha et al	Kancheepuram	2019	Imipenem, levofloxacin,amikacin
Bhansali et al	Bangalore	2020	Nitrofurantoin
Pardeshi et al	Mumbai	2018	Meropenem, gentamicin, nitrofurantoin, cotrimoxazole
Mohapatra et al	Multicentric, India	2021	Fosfomycin
Behera et al	Bhuvaneshwar	2022	Gentamicin, ertapenem, nitrofurantoin

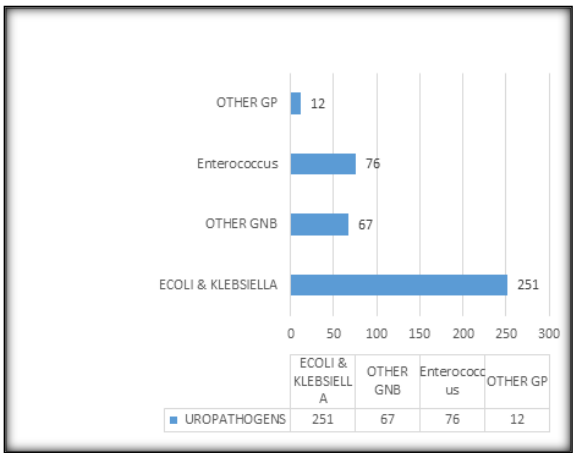

Figure 1: Overall Distribution of Isolates N=406

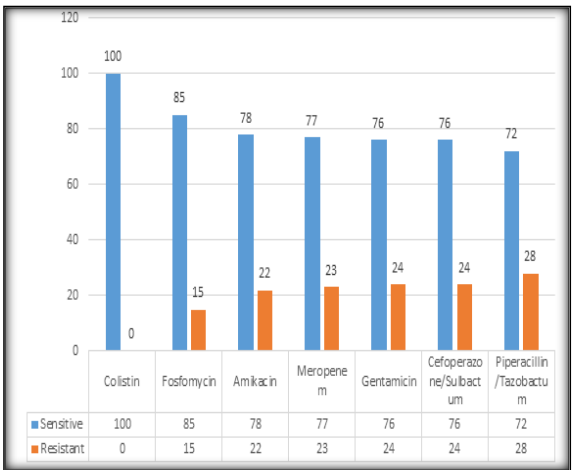

Figure 2: Antibiogram of Gram negative Isolates N=318

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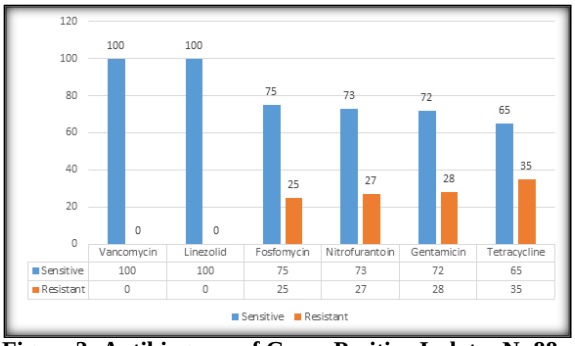

Figure 3: Antibiogram of Gram Positive Isolates N=88

DISCUSSION

In our study the overall urinary infection rate was 406/2546 (15.9%). Mohapatra et al and Behera et al noted similar findings 10% and 12.6% respectively.[8,9] However higher rate was reported by numerous other studies from Ethiopia, Ahmedabad, Kancheepuram, Ujjain, Mumbai, Uganda and Assam [Table 3].[10,11,12,13,14,5,15,3]

As per our study the agewise distribution indicated number of adults to be higher 369/406 (91%) than children 37/406 (9%), which was also reported by Mohapatra et al.[8]

As per our findings, genderwise distribution revealed that females were in majority 249/406 (61%) as compared to males 157/406 (39%). Higher infection rate in women was also reported by Malik et al 77% and Pardeshi 66%.[16,14] Women have been conventionally predisposed to infection due to the anatomical location and shorter length of urethra especially during childbearing age.

In our study organismwise distribution showed that Gram Negative Isolates comprised 318/406(78.3%) which was greater than Gram Positive Isolates 88/406(21.7%). Higher Gram negative uropathogens as compared to Gram positive organisms was also noted by Sneka et al (Gram negative 71% and Gram positive 27%) and Bhosle et al (Gram negative 89% and Gram positive 11%).[12,13]

We found that overall Ecoli was the predominant pathogen 183/406 (45%) followed by Enterococcus 76/406 (19%) and Klebsiella 68/406 (17%). Ecoli was also reported as the major pathogen in numerous other studies: figures similar to our study were reported by Faraz et al 49% and Martin et al 41%; lower rate was reported by Mechal et al 36% and Patel et al 36% whereas higher figures were observed by Sneka et al 61%, Bhansali et al 56%, Pardeshi et al 53%,Kalal et al 54% and Mohapatra et al 68%.[17,15,10,11,12,18,14,5,8]

As per our findings, the antibiotic susceptibility test results revealed that Gram Negative Isolates showed maximum sensitivity to colistin (100%), fosfomycin (85%), amikacin (78%), gentamicin (76%), meropenem (77%), cefoperazone/sulbactum (76%) and piperacillin/tazobactum (72%). Thus colistin proved to be most effective. Others studies have reported varying findings with highest susceptibility to myriad drugs such as tigecycline, imipenem, nitrofurantoin, meropenem, fosfomycim and gentamicin, as depicted in Table 4.

In our study, Gram Positive Isolates showed maximum sensitivity to linezolid (100%), vancomycin (100%), fosfomycin (75%) gentamicin (72%), nitrofurantoin (73%), tetracyclin (65%) and doxycycline(65%),which was concurrent with the sensitivity profile reported by Sneka et al.[12]

Tackling Multidrug resistant (MDR) strains is a clinical challenge. We found that Multidrug resistant (MDR) isolates comprised 243/406(60%). Lower rate of MDR was reported by Bishoff et al 36.5% as opposed to higher number noted by Malik et al 83% and Mechal et al (80.3%).[19,16,10]

ESBL producers among Gram negative uropathogens constituted 162/404 (40%) which was similar to Mohapatra et al 44.8% and Behera et al 43% but higher than Paul et al 26%.[8,9,3]

Limitations

The correlation with specific underlying predisposing entities was not done. This is essential while establishing the definitive role of underlying factors in the investigation of urinary infection. A detailed analysis of the potential drivers and risk entities is crucial to gain insight about its impact within the several vulnerable groups. The understanding of pathogenic mechanisms will enhance timely therapeutic interventions and targeted management strategies.

CONCLUSION

Urinary tract infection is a significant health burden impacting the global community. Tackling the major risk entities and drug resistance is fundamental to management. Early diagnosis and periodic local surveillance of the antibiotic spectrum has a pivotal role in mitigating serious sequelae. Future interventions such combination therapies as well as vaccines and small molecules to target virulence factors need to be explored for focused interventions.

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