Original Article

Analysis of Antimicrobial Resistance Patterns and Clinical Outcomes in Geriatric Inpatients with Urinary Tract Infections

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ABSTRACT

Objectives: The primary objective was to analyse the antimicrobial resistance patterns amongst the elderly with UTI. The secondary objectives were to determine the clinical outcomes of such cases and to compare the duration of hospital stay and mortality rates between the drug resistant and sensitive cases.

Methods: It was a retrospective record analytical study conducted for a period of three months in geriatric patients admitted with urinary tract infection.

Results: *E.coli* was found to be the most common uropathogen. 56.4% of the organisms were resistant to one or more antibiotics. The percentage of multi-drug-resistant cases was 6.1%. The mean duration of hospital stay in patients with antimicrobial resistant infections was 8.83 days and 7.3 days in the non-antimicrobial resistant group. 89.10% of the patients in the antimicrobial resistant group succumbed to the infection and 10.9% of the patients survived.

Conclusion: Antimicrobial resistance (AMR) is an urgent global public health threat. UTIs (Urinary Tract Infections), being more common in the elderly due to physiological changes and comorbidities, are associated with high rates of drug resistance owing to misuse of drugs and spread of multi-drug-resistant organisms in the hospitals.

Keywords: Geriatric, Urinary Tract Infection, Antimicrobial Resistance.

INTRODUCTION

Antimicrobial resistance [AMR] is a global threat to health and healthcare systems. AMR could lead to negative impacts on patient outcomes such as increased length of hospital stay, functional decline, increased healthcare expenditure and all-cause mortality[1] Ageing, an inevitable process, is commonly measured by chronological age and, as a convention, a person aged 65 years or more is often referred to as 'elderly'. Older people, being more susceptible to AMR due to age-related physiological changes and comorbidities, have potentially higher risks of developing AMR-related illness owing to their higher exposure to infection from hospital and institutional settings.[2]

Due to high prevalence of AMR and having high rates of antimicrobial prescribing, Indian tertiary care centres have been recognised as reservoirs of resistant bacteria. Urinary Tract Infection (UTI) is more commonly reported in the elderly. The prevalence of UTI increases in both sexes with age, the female: male ratio being 2:1. Escherichia coli followed by Klebsiella pneumonia are the most common causative organisms. Asymptomatic bacteriuria in nursing homes is a frequent finding, especially in women; the cumulative prevalence being more in the nursing home residents than the elderly living in the community.[3]

Recurrent and complicated infections are also more common because of the higher frequency of predisposing anatomical and pathophysiological factors. This heterogeneity represents a compelling reason for their prompt treatment and adequate follow-up to look into the ultimate results of these infections.

According to census 2011, India has 104 million older people, constituting 8.6% of total population and is expected to increase tremendously over the coming years[4] Urinary tract infections [UTIs] are one of the most common infections in the hospitalised elderly which is associated with increased morbidity and mortality. Diagnosis, prevention and treatment can often be complex because clinical manifestations can be atypical and host defences diminish with age.

The common risk factors for UTIs in the elderly are atrophic urethritis, atrophic vaginitis, benign prostatic hyperplasia, prostate carcinoma, catheter use, chronic bacterial prostatitis, genitourinary calculi, renal and perinephric abscess formation, etc. Hence these high-risk geriatrics commonly referred to as 'frail elderly' ought to be made the target population of geriatric assessment and care management programs. Since there is paucity of evidence with respect to the treatment and end results among older people hospitalised with UTIs in India, this study aims to determine the antimicrobial resistance patterns and the clinical outcomes in the Indian population.

Objectives:

Primary: To analyse the antimicrobial resistance patterns amongst the ICU admitted geriatrics with UTI.

Secondary:

1. To determine the clinical outcomes of treatment of the antibiotic resistant cases.

2. To compare the length of hospital stay and mortality rates between resistant cases and non-resistant cases of UTI.

MATERIALS AND METHODS

Study design: Retrospective record analysis

Study period: 3 Months from March to May 2023.

Inclusion criteria: All male and female inpatients ≥ 65 years admitted to M S Ramaiah Medical College Hospital and M S Ramaiah Memorial Hospital with a diagnosis of UTI, who have a urine culture report and an antimicrobial sensitivity test.

Exclusion criteria: Patients admitted to intensive care unit with a concomitant infections of other systems like respiratory tract infections, gastrointestinal infections, organ failure or any life-threatening condition.

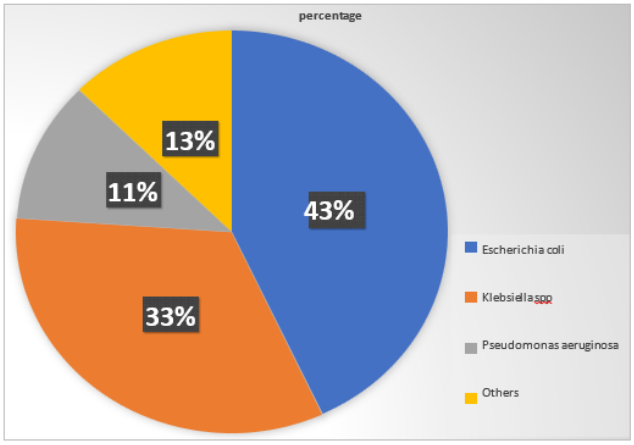
Sample size with proper justification: 273. From the literature review, in a study done by Nguyen HQ, Nguyen NTQ, Hughes CM, O'Neill C, it has been observed that the proportion of antibiotic resistance, among those aged 60 years and above with a primary diagnosis of UTI, was 6.88%. [2] In the present study expecting similar result with 95% confidence interval and 3% absolute precision, the study requires a minimum of 273 subjects.

After obtaining ethical clearance from the institutional ethical committee, data was collected, reviewed and interpreted from the digitalised records maintained at the Medical Records Department present in the M S Ramaiah Medical College Hospital. The study cohort was restricted to the inpatients aged 65 years and over, the age commonly used to define elderly for research purposes. All the UTI cases admitted to intensive care unit were considered as two independent groups namely the drug resistant and drug sensitive groups. The main centre of focus was determining the proportion of antibiotic resistance over three years (January 2020 till December 2022) and comparing the duration of hospital stay and the clinical outcomes between the antibiotic resistant and sensitive cases. The clinical outcomes could be either of the following: successful treatment with routine discharge; unsuccessfully treated cases getting transferred to other healthcare facilities like care homes (home healthcare), rehabilitation centres etc; inefficaciously treated cases landing in complications like bacteraemia if untreated or superinfections like Clostridium difficile infection if treated inappropriately; abortive cases succumbing to death.

RESULTS

Descriptive statistics of AMR and its clinical outcomes, like successful treatment with routine discharge or discharge of the ineffectively treated cases to other health care facilities or cases ending up in complications or mortality, were analysed and summarised in terms of percentage.

In this study, majority of the samples were culture positive (57.52%) amongst which Escherichia coli was the most common uropathogen isolated (42.61%) followed by Klebsiella spp (32.95%), Pseudomonas aeruginosa (11.36%) and others (12.5%).



Majority of the organisms (56.54%) were found to be resistant to one or more antibiotics. The most common antibiotics used for the treatment was ceftriaxone, cefoperazone and ciprofloxacin. The percentage of multidrug resistant cases was around 6.1%. The mean of duration of hospital stay was found to be 8.83 days in AMR cases compared to 7.3 days in non-AMR cases. The clinical outcomes were hemodynamically stable cases getting a routine discharge in AMR vs non-AMR cases were as follows: (48.45% vs 50.78%); succumbing to death (89.5% vs 10.5%); getting shifted/ transferred to another facility (77.77% vs 22.22%) and getting discharged against medical advice (77.77% vs 22.22%).

DISCUSSION

In this study, majority of the infections were found to be of Escherichia coli (42.61%) followed by Klebsiella species (32.95%). Drug-resistance was found to be 98.3% amongst the culture positive cases. Only 1.7% of the culture positive cases was found to be sensitive to the drugs used for their treatment.

In a retrospective observational study conducted on AMR among older inpatients primarily diagnosed with UTIs in the US from 2009-2016, the impact of antimicrobial resistance on all-cause inpatient mortality, discharge destination, length of stay and hospital expenditures was studied. The proportion of admissions with antimicrobial resistance increased, from 3.64% in 2009 to 6.88% in 2016(p 0.05), Klebsiella spp. (16.28% vs 16.26%; p> 0.05), Pseudomonas spp. (4.40% vs 13.36%; p= 0.001); Proteus-Providencia-Morganella group (4.56% vs. 10.96%; p = 0.001); Candida spp. (0.53% vs. 5.98%; p= 0.001). (5) A study was done to evaluate the uropathogenic bacterial flora and its antimicrobial susceptibility profile among patients of a hospital in Jaipur, India. Between July 2007-December 2009, 2012 consecutive urine specimens from symptomatic

UTI cases were processed in lab and antimicrobial susceptibility testing was performed using the Kerby-Bauer disc diffusion method. At the end of the study, pathogens were isolated from 346 (17.16%) of the 2012 patients among which Escherichia coli was the most frequently isolated community acquired uropathogen accounting for 61.84% of the total isolates. Extended spectrum beta lactamase (ESBL) production was observed in 23.83% of E. coli strains and 8.69% of Klebsiella strains. With the exception of Nitrofurantoin, resistance to the commonly used empirical oral antibiotics for UTI was high. It was therefore concluded that Nitrofurantoin should be used as empirical therapy for primary, uncomplicated UTIs.[6]

In a retrospective study conducted between January 2016 and December 2017 at the Caritas St. Josef Medical Centre Regensburg 1115 geriatric patients were included. A total of 150 patients over the age of 75 were identified as "group 2," comprising 13.5% of the overall patient cohort, and a total of 965 patients of 74 years and below as "group 1." 192 patients in group 1 showed nitrite-positive urine results (20.9%), in contrast to 57 patients in group 2 (41.6%, $p < 0.05$). 773 patients (82.1%) in group 1 had no antimicrobials prescribed in the last 30 days prior to the day of examination versus 111 (78.7%) in group 2. Fifty-seven patients (6.0%) had a documented indwelling device in the urinary tract (e.g., urinary catheter) on the day of examination in group 1 and 44 patients (30.3%) in group 2 ($p < 0.05$). Calculated antibiotic therapy was prescribed in 860 cases (91.9%) of group 1 and in 126 cases (88.7%) of group 2. Of these cases, in 25.0% of group 1, the chosen antibiotic substance was ciprofloxacin (34.9% in group 2, $p < 0.05$), and in 40.7% of group 1, the chosen antibiotic substance was fosfomycin (12.7% in group 2, $p < 0.05$).[7]

A cross-sectional study was conducted in Malaysia among 65+ aged patients with a confirmed diagnosis of UTI from 2014 to 2018. 460 participants were included wherein cystitis (37.6%) was the most prevalent UTI among the study population followed by asymptomatic bacteriuria (31.9%), pyelonephritis (13.9%), urosepsis (10.2%), and prostatitis (6.4%). Unasyn (ampicillin and sulbactam) was used to treat the UTIs followed by Bactrim (trimethoprim/sulfamethoxazole), and ciprofloxacin. The factors associated with the treatment outcomes of UTIs were gender (odd ratio [OR] = 1.628; p = 0.018), polypharmacy (OR = 0.647; p = 0.033), and presence of other comorbidities (OR = 2.004; p = 0.002) among the study population.[8]

In a research done using articles from databases, it was found that the presence of an internal urinary catheter was associated with the development of urosepsis and septic shock. Older adults are particularly predisposed to sepsis due to their pre-existing comorbidities, repeated and lengthy hospitalisations, diminution of host defence mechanisms, the mortality rates ranging from 25% to 60%. Complicated UTIs are the most frequent cause of sepsis in older adults above 65 years of age. Studies showed a significant association between older age and female gender and the development of bacteremic UTI. All the studies reported Escherichia coli to be the most common organism isolated by culture. Factors identified from this review as possible predictors of mortality included urinary incontinence, presence of urinary catheter, functional dependency, number of comorbidities, source of infection, class of organisms, recent antibiotic therapy, appropriateness of initial empiric antibiotic therapy, and low serum albumin level.[9]

The results of this study are mostly similar to other such studies conducted worldwide. However, in developed countries there is a slightly better survival outcome compared to our set up due to strict and rational use of antibiotics. Thus, it is important to prescribe antimicrobials rationally in order to prevent the development of multi drug resistant organisms.

CONCLUSION

This study will help in implementing improved treatment strategies, customizing better management to every patient by exploring other lines of treatment like use of higher class/ advanced drugs, use of alternatives to indwelling urinary catheter or surgical options like renal transplant etc. This helps in decreasing the duration of hospital stay, thus bringing down the financial burden on the patient and improving the quality of living, hence reducing the unfavourable outcomes.

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REFERENCES

1. Friedman ND, Temkin E, Carmeli Y. The negative impact of antibiotic resistance. Clin Microbiol Infect. 2016 May;22(5):416-22. DOI:10.1016/j.cmi.2015.12.002;PMID: 26706614

2. Nguyen HQ, Nguyen NTQ, Hughes CM, O'Neill C. Trends and impact of antimicrobial resistance on older inpatients with urinary tract infections (UTIs): A national retrospective observational study. PLoS One. 2019 Oct 3;14(10). DOI: 10.1371/journal.pone.0223409; PMID: 31581222

3. Leihof RF, Nielsen KL, Frimodt-Møller N. Asymptomatic Bacteriuria (ABU) in Elderly: Prevalence, Virulence, Phylogeny, Antibiotic Resistance and Complement C3 in Urine. Microorganisms. 2021 Feb 14;9(2):390. DOI:10.3390/microorganisms9020390;PMID: 33672892

4. Gajdács M, Ábrók M, Lázár A, Burián K. Urinary Tract Infections in Elderly Patients: A 10-Year Study on Their Epidemiology and Antibiotic Resistance Based on the WHO Access, Watch, Reserve (AWaRe) Classification. Antibiotics (Basel). 2021 Sep 11;10(9):1098. DOI: 10.3390/antibiotics10091098; PMID: 34572680

5. Sood S, Gupta R. Antibiotic resistance pattern of community acquired uropathogens at a tertiary care hospital in Jaipur, Rajasthan. Indian J Community Med. 2012; 37:39–44. DOI: 10.4103/0970-0218.94023; PMID: 22529539

6. S. Karger AG, Basel. Geriatric patients and symptomatic urinary tract infections: Analysis of bacterial range and resistance rates at a third level of care hospital in Germany. Urol Int 2022; 106:298–303. DOI: 10.1159/000516677;PMID: 34175852

7. Akhtar A, Ahmad Hassali MA, Zainal H, Ali I and Khan AH (2021) A Cross-Sectional Assessment of Urinary Tract Infections Among Geriatric Patients: Prevalence, Medication Regimen Complexity and Factors Associated with Treatment Outcomes. Front. Public Health 9:657199. DOI: 10.3389/fpubh.2021.657199; PMID: 34733812

8. Peach BC, Garvan GJ, Garvan CS, Cimiotti JP. Risk Factors for Urosepsis in Older Adults: A Systematic Review. Gerontol Geriatr Med. 2016 Apr 6;2. DOI: 10.1177/2333721416638980**;** PMID: 28138493

9. Singh S, Bajorek B. Defining 'elderly' in clinical practice guidelines for pharmacotherapy. Pharm Pract (Granada). 2014 Oct;12(4):489-94. DOI: 10.4321/s1886-36552014000400007; PMID: PMID: 25580172