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ASSESSMENT OF THE RISK FACTORS AND CLINICAL PROFILE OF COMMUNITY-ACQUIRED URINARY TRACT INFECTIONS, DISTRIBUTION OF BACTERIAL STRAINS AND RESISTANCE PATTERN OF BACTERIA IN THE INDIAN POPULATION

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ABSTRACT

Background: For a prompt diagnosis and effective treatment of the illness, knowledge of the etiological profile of UTIs as well as the antibiotic resistance pattern of the causative organisms is essential.

Aim: The purpose of this study was to evaluate the clinical profile and risk factors for community-acquired UTIs in the context of India. The distribution of bacterial strains and the pattern of resistance exhibited by these microorganisms were also evaluated by the investigation.

Methods: 255 individuals with confirmed community-acquired UTIs (CA-UTIs) based on a positive urine culture were included in the study and evaluated for the disease's risk factors, symptomatology, clinical and microbiological characteristics. The study evaluated the resistance profiles of the pathogenic bacteria as well.

Results: 56.85% (n=145) of the 255 participants who were included were in the age range of 50 to 79 years old. The two most prevalent clinical symptoms were fever and dysuria. These characteristics, however, were not unique for predicting community-acquired UTIs. With 66.6% (n=170) of the cases indicating resistance to ESBL (extended-spectrum beta-lactamase), and 41.96% (n=107) of the cases reporting resistance, E. Coli was the most prevalent bacterium causing UTIs. 74.11% (n=189) of the individuals showed high resistance to fluoroquinolones, while 3.92% (n=10) of the subjects showed the lowest resistance to carbapenems.

Conclusion: The current study's conclusion is that a significant percentage of ESBL-positive microbes resistant to routinely used antibiotics are found in persons with community-acquired UTIs. This finding may cause concerns for future treatments of these patients.

Keywords: community-acquired urinary tract infections, antibiotic resistance, extended-spectrum beta-lactamase, UTI

INTRODUCTION

Any infection in the urinary system, including the urethrae, bladder, ureter, and/or kidney, is referred to as a urinary tract infection (UTI). UTI shows the germs in the afflicted individuals' urine. The three categories of urinary infections are UTI-A, UTI-B, and UTI-C, which represent symptomatic UTI with microbiologic confirmation, symptomatic UTI without microbiologic evidence, and asymptomatic UTI with bacteriuria, respectively.[1]

Urinary tract infections, or UTIs, are among the most prevalent infectious illnesses in the population when it comes to community dissemination. When this occurs, empirical antibiotic therapy is utilised to treat the infection. However, in order to implement this therapy, it is essential to understand prevalent uropathogens, their resistance patterns, and their susceptibilities to popular antibiotics used to treat community-acquired UTIs.[2]

When additional risk factors, such as immunosuppression, comorbidity, and advanced age, are present in addition to the infections in the afflicted people, treating these community-acquired UTIs becomes even more difficult.[3] Furthermore, given the pattern of resistance in the pathogenic organisms to the routinely recommended antibiotics; different doctors occasionally administer broad-spectrum antibiotics to the afflicted people instead of specific ones. Furthermore, the unfinished antibiotic course and the ill patients' noncompliance with the prescribed regimen contribute to the development of antibiotic resistance.[4]

Globally performed literature study in the past has shown how the etiologic characteristics of UTIs have changed over time. There are, however, little research in the literature on the relationship between UTI and antibiotic resistance in the Indian context.

To create guidelines for the empirical treatment of urinary tract infections until the culture sensitivity is unknown, it is essential to understand the current trends in uropathogens and their resistance to various antibiotics.[5] The current clinical investigation set out to evaluate prevalent clinical manifestations and risk variables associated with urinary tract infections (UTIs). The distribution of different bacterial strains isolated from simple and complex UTI cases observed in the community, as well as the pattern of antibiotic resistance prevalent in India, were also evaluated in this study.

MATERIAL AND METHODS

The goal of the current prospective clinical investigation was to evaluate the clinical profile and risk factors for community-acquired UTIs in the context of India. The study also assessed the distribution of bacterial strains in these subjects and the resistance pattern of these microorganisms. Prior to research participation, written and verbal informed permission was obtained from every participant.

Participants in the research had attended the institute with symptoms suggestive of a urinary tract infection (UTI), and positive urine cultures confirmed the diagnosis. patients with clinical symptoms of a urinary tract infection (UTI) but no microbial growth on the culture, patients unwilling to engage in the study, and subjects whose samples were contaminated were the exclusion criteria for the research. Subjects with vesicoureteral reflex and ileal loops were also excluded from the research, as were those who had taken any other antibiotic in the previous 48 hours or a single dosage in the previous 24 hours despite the positive urine culture.

A structured questionnaire that was done was used to collect the research's data, which included demographic and clinical information about the study subjects. The research participants' complex UTIs were categorised using the standards put out by Schaeffer and Rubenstein in 2003.[6] Either a clear midstream specimen or a suprapubic aspirate was obtained in order to identify and isolate the uropathogens. Where it was not possible to get midstream urine specimens, the participants' suprapubic aspirates were obtained. The sample was gathered in a wide-mouthed, leak-proof container that could store around 50 millilitres of the material. 10 µl of the uncentrifuged material was placed on the agar plate with a calibrated loop of 4 mm in diameter. It was then incubated for 24 hours at 35–37 degrees Celsius.

When a single organism cultivated more than 105 colony forming units (CFUs) per millilitre, the material was considered positive for a UTI. Using various biochemical reactions, the culture isolates of gram-positive and gram-negative organisms were further identified to the appropriate taxonomic level (genus or species). A modified Kirby-Bauer disc diffusion technique was employed to test antibiotic sensitivity with any possible growth, adhering to CLSI (Clinical and Laboratory Standards Institute) recommendations. The research examined the following antibiotics: imipenem, ciprofloxacin, meropenem, norfloxacin, ofloxacin, gentamicin, nitrofurantoin, and amikacin. Ceftriaxone (≤25 mm), cefotaxime (≤27 mm), aztreonam (≤27 mm), ceftazidime (≤22 mm), and cefpodoxime (≤17 mm) were employed to identify the ESBL (extended spectrum beta-lactamase).

An organism was thought to be ESBL positive if its zone of inhibition was less than the lowest of any antibiotic disc. The strain was tested against ceftazidime and clavulanic acid/ceftazidime for phenotypic confirmation. When a zone of

inhibition of more than 5 mm in diameter was seen for ceftazidime/clavulanic acid in comparison to ceftazidime, it was thought that ESBL generation was taking place. Klebsiella pneumoniae 700603 was used as the reference strain for ESBL positivity, while Escherichia coli ATCC 25922.7 was chosen for ESBL negativity. Oral cephalosporins and fluoroquinolones were begun in all hemodynamically stable participants to treat UTIs; parenteral third-generation cephalosporins were started in hemodynamically unstable subjects.

Parenteral carbapenem therapy was started in participants whose symptoms did not go away within 72 hours of starting the medication with the culture showing the ESBL-positive organisms. Antibiotics were given to each participant for a period of seven days. The medicines were continued for 48 hours after the fever abated in participants whose fever persisted even after seven days.

Version 21.0 of the SPSS programme was used to statistically analyse the collected data. The risk factors for UTI, symptomatology of the afflicted patients, antibiotic sensitivity and resistance, organisms producing UTI, gender, and age of the affected subjects were among the many variables evaluated.

RESULTS

The goal of the current prospective clinical investigation was to evaluate the clinical profile and risk factors for community-acquired UTI in the context of India.

The distribution of bacterial strains and the pattern of resistance exhibited by these microorganisms were also evaluated by the investigation. According to the gender and age distribution of the research participants, 19.60% of the subjects were between the ages of 50 and 59, followed by 18.03% of the subjects who were between the ages of 70 and 79 and 9.01% of the subjects who were between the ages of 20 and 29. A simple UTI was observed in 26 female participants, the bulk of whom were in the 20–29 age range (n = 10; 38.46% of the patients were in this age range), followed by the 40–49 age range (n = 6). As indicated by Table 1, a total of 143 men and 86 females were diagnosed with a complicated UTI. The bulk of the male patients were in the 60-69 year age group, comprising 22.37% (n = 32) and 22.09% (n = 19) of the total subjects. As shown in Table 2, the most common risk factor for UTI was diabetes mellitus, which was reported by 38.43% (n=98) of the study participants. Other common risk factors included renal stones in 1.96% (n=5), congenital anomalies in 3.92% (n=10), catheterization in 10.19% (n=26) of the participants, recurrent UTI in 7.84% (n=20), post-transplant cases in 1.56% (n=4) of the participants, and immunosuppression in 0.78% (n=2) of the study participants.

In terms of the pathogen distribution pattern and ESBL production, ESBL-negative E. coli was the most prevalent pathogen, appearing in 24.70% (n=63) complicated and 46.15% (n=12) uncomplicated UTI cases. Pseudomonas was the second most common pathogen, appearing in 21.83% (n=50) and 3.84% (n=1) cases of both complicated and uncomplicated UTI cases.

20.52% (n=47) and 7.69% (n=49) of the participants with complex and simple UTI cases had ESBL-positive Klebsiella, whereas 12.66% (n=29) and 3.84% (n=1) of the subjects had ESBL-negative Klebsiella. In 7.84% (n=20) and 26.92% (n=7) of the complicated and uncomplicated UTI cases, ESBL-positive E. Coli was cultured. Citrobacter freundii was observed in 3.13% (n=8) of the complicated UTI cases. Enterobacter spp. was observed in 2.35% (n=6) and 3.84% (n=1) of the complicated and uncomplicated UTI cases. Enterococcus faecalis was reported in 1.17% (n=3) and 3.84% (n=1) of the complicated and uncomplicated UTI cases. Providencia alkalifaciens was observed in 0.39% (n=1) and 3.84% (n=1) of the complicated UTI cases. Proteus vulgaris and Morganelle were observed in 0.39% (n=1) of the complicated UTI cases.

Resistance to ofloxacin and norfloxacin was seen in 76.85% (n=176) of the participants with severe UTI, and in 50% (n=13) and 46.15% (n=12) of the subjects with simple UTI, respectively, for the evaluation of the resistant pattern in uropathogens to various antibiotics. Resistance to imipenem and meropenem was shown in 3.93% (n=9) of patients with complex UTI and 3.84% (n=1) of persons with simple UTI, respectively. Resistance to nitrofurantoin was observed in 31% (n=71) and 7.69% (n=2) of participants with complicated and uncomplicated UTI, respectively. Gentamicin resistance was observed in 51.09% (n=117) and 30.76% (n=8) subjects with complicated and uncomplicated UTI cases, respectively. Cotrimoxazole resistance was observed in 34.06% (n=78) and 3.84% (n=1) subjects with complicated and uncomplicated UTI cases, and ciprofloxacin resistance was observed in 55.02% (n=126) and 50% (n=13) subjects with complicated and uncomplicated UTI cases, respectively as shown in Table 4.

DISCUSSION

According to the gender and age distribution of the research participants, 19.60% (n=50) of the subjects were in the 50–59 year old age range, followed by 18.03% (n=46) of the subjects in the 70–79 year old age range and 9.01% (n=23) of the subjects in the 20–29 year old age range. Twenty-six female participants, or 38.46% (n = 10) of the subjects, had an uncomplicated UTI. The remaining subjects, or 23.07% (n = 6), were primarily in the 40–49 age range. A total of 86 female and 143 male individuals with 22.37% (n=32) of the male subjects aged 60-69 and 22.09% (n=19) of the male subjects had a complicated UTI.

These findings were in line with studies conducted in 2010 by Micek St et al. and in 2003 by Prais D et al., in which the authors evaluated UTI participants using similar demographic data to the current investigation. According to the study's findings, diabetes mellitus was the most common risk factor for UTIs, having been reported by 38.43% (n=98) of the subjects. Other common risk factors included renal stones (1.96% (n=5), congenital anomalies (3.92% (n=10), catheterization (10.19% (n=26) subjects, recurrent history of urogenital instrumentation in 14.50% (n=37) subjects, and immunosuppression (0.78% (n=2) study subjects.

These findings were in line with research conducted in 2007 by D Francesco MA et al. and in 2005 by Al-Sweih N et al., where risk variables linked to urinary tract infections were shown to be identical to those in the current study. Regarding the distribution pattern of the pathogens and the production of ESBL, it was observed that the most prevalent pathogen was ESBL-negative E. Coli, which was found in 24.70% (n=63) complicated and 46.15% (n=12) uncomplicated cases of UTI. Pseudomonas was found in 21.83% (n=50) and 3.84% (n=1) cases of complicated and uncomplicated UTI cases, ESBL-positive Klebsiella in 20.52% (n=47) and 7.69% (n=49) complicated and uncomplicated UTI cases, and ESBL-negative Klebsiella in 12.66% (n=29) and 3.84% (n=1) subjects with complicated and uncomplicated UTI cases. ESBL-positive E. coli were cultured in 7.84% (n=20) and 26.92% (n=7) complicated and uncomplicated UTI cases, In cases of complicated and uncomplicated UTI, Citrobacter freundii was observed in 3.13% (n=8) subjects; Enterobacter spp. in 2.35% (n=6) and 3.84% (n=1) cases; Enterococcus faecalis in 1.17% (n=3) and 3.84% (n=1) cases; Providencia alkalifaciens in 0.39% (n=1) and 3.84% (n=1) cases; and Proteus vulgaris and Morganelle in 0.39% (n=1) of the complicated UTI cases. These results were consistent with the findings of Das RN et al. (2006) and Colonder R et al. (2001), where the authors reported the same pathogen dispersion pattern and ESBL production as in the current investigation.

According to the study's findings, uropathogens' resistance to different antibiotics was assessed, and it was found that 76.85% (n=176) of the participants with severe UTIs and 50% (n=13) and 46.15% (n=12) of the subjects with simple UTIs, respectively, had resistance to ofloxacin and norfloxacin. Resistance to imipenem and meropenem was shown in 3.93% (n=9) of patients with complex UTI and 3.84% (n=1) of persons with simple UTI, respectively. Resistance to nitrofurantoin was observed in 31% (n=71) and 7.69% (n=2) of participants with complicated and uncomplicated UTI, respectively. Gentamicin resistance was observed in 51.09% (n=117) and 30.76% (n=8) subjects with complicated and uncomplicated UTI cases, respectively. Cotrimoxazole resistance was observed in 34.06% (n=78) and 3.84% (n=1) subjects with complicated and uncomplicated UTI cases, and ciprofloxacin resistance was observed in 55.02% (n=126) and 50% (n=13) subjects respectively from complicated and uncomplicated UTI cases to amikacin in 26.63% (n=61) and 19.23% (n=5) subjects with complicated and uncomplicated UTI respectively. The present study's results aligned with the research conducted by Taneja N et al. (2008) and Prakash V et al. (2009), which observed a similar resistance trend to antibiotics in uropathogens.

CONCLUSION

The current study, taking into account its limitations, comes to the conclusion that a large percentage of ESBL-positive microbes with resistance to the widely used antibiotics are detected in people with community-acquired UTI, which might cause concerns when treating these subjects in the future.

REFERENCES

1. Kahan NR, Chinitz DP, Waitman DA, Dushnitzky D, Kahan E, Shapiro M. Empiric treatment of uncomplicated urinary tract infection with fluoroquinolones in older women in Israel: another lost treatment option? *Ann Pharmacother.* 2006;40:2223–7.

2. Manges AR, Natarajan P, Solberg OD, Dietrich PS, Riley LW. The changing prevalence of drug-resistant Escherichia coli clonal groups in a community: evidence for community outbreaks of urinary tract infections. *Epidemiol Infect.* 2006;134:425–31.
3. Kothari A, Sagar V. Antibiotic resistance in pathogens causing community-acquired urinary tract infections in India: a multicenter study. *J Infect Developing Countries.* 2008;2:354–8.
4. Akram M, Shahid M, Khan AU. Etiology and antibiotic resistance patterns of community-acquired urinary tract infections in JNMC Hospital Aligarh, India. *Ann Clin Microbiol Antimicrob.* 2007;6:4.
5. Gonzalez CM, Schaeffer AJ. Treatment of urinary tract infection: what's old, what's new, and what works. *World J Urol.* 1999;6:372–82.
6. J N Ruben stein, A J Schaeffer. Managing complicated urinary tract infections- The urologic view. *Infect Dis Clin N Am.* 2003;17:333–51.
7. Clinical and Laboratory Standards Institute. Performance standards for antimicrobial susceptibility testing; 16th informational supplement. M100-S16. *Clinical and Laboratory Standards Institute, Wayne, PA.* 2006.
8. Micek ST, Welch EC, Khan J, Pervez M, Doherty JA, Reichley RM, et al. Empiric combination antibiotic therapy is associated with improved outcome against sepsis due to Gram-negative bacteria: a retrospective analysis. *Antimicrob Agents Chemother.* 2010;54:1742–8.
9. Prais D, Straussberg R, Avitzur Y, Nussinovitch M, Harel L, Amir J. Bacterial susceptibility to oral antibiotics in community-acquired UTI. *Arch Dis Child.* 2003;88:215–8.
10. De Francesco MA, Ravizzola G, Peroni L, Negrini R, Manca N. Urinary tract infections in Brescia, Italy: Etiology of uropathogens and antimicrobial resistance of common uropathogens. *Med Sci Monit.* 2007;13:136–44.
11. Al Sweih N, Jamal W, Rotimi VO. Spectrum and antibiotic resistance of uropathogens isolated from hospital and community patients with urinary tract infections in two large hospitals in Kuwait. *Med Princ Pract.* 2005;14:401–7.
12. Das RN, Chandrashekhar TS, Joshi HS, Gurung M, Shrestha N, Shivananda PG. Frequency and susceptibility profile of pathogens causing urinary tract infections at a tertiary care hospital in western Nepal. *Singapore Med J.* 2006;47:281–5.
13. Das RN, Chandrashekhar TS, Joshi HS, Gurung M, Shrestha N, Shivananda PG. Frequency and susceptibility profile of pathogens causing urinary tract infections at a tertiary care hospital in western Nepal. *Singapore Med J.* 2006;47:281–5.
14. Prakash V, Lewis JS 2nd, Herrera ML, Wickes BL, Jorgensen JH. Oral and parenteral therapeutic options for outpatient urinary infections caused by Enterobacteriaceae producing CTX-M extended-spectrum beta-lactamases. *Antimicrob Agents Chemother.* 2009;53:1278–80.
15. Taneja N, Rao P, Arora J, Dogra A. Occurrence of ESBL and Amp-C beta-lactamases and susceptibility to newer antimicrobial agents in complicated UTI. *Indian J Med Res.* 2008;127:85–8.

Age range	**Uncomplicated UTI (females)**		**Complicated UTI**				**Total**	
	n	**%**	**Male (n=143)**	**%**	**Females (n=86)**	**%**	**N=255**	**%**
0-9	2	7.69	11	7.69	2	2.32	15	5.88
10-19	2	7.69	4	2.79	4	4.65	10	3.92
20-29	10	38.46	8	5.59	5	5.81	23	9.01
30-39	4	15.38	9	6.29	4	4.65	17	6.66
40-49	6	23.07	12	8.39	5	5.81	23	9.01
50-59	2	7.69	29	20.27	19	22.09	50	19.60
60-69			32	22.37	19	22.09	51	20
70-79			27	18.88	19	22.09	46	18.03
80-89			9	6.29	7	8.13	16	6.27
90-99			2	1.39	2	2.32	3	1.17
Total	26	100	143	100	86	100	255	100

Table 1: Gender and age-wise distribution of uncomplicated and complicated UTIs in study subjects

Risk factors	N=255	%
Renal stones	5	1.96
Recurrent UTI	20	7.84
Recurrent history of urogenital instrumentation	37	14.50
Post-transplant	4	1.56
Immunosuppression	2	0.78
Diabetes mellitus	98	38.43
Congenital anomalies	10	3.92
Catheterization	26	10.19

Table 2: Risk factors in study subjects with UTI

Organisms	Complicated		Uncomplicated		Total	
	N=229	%	N=26	%	N=255	%
Pseudomonas	50	21.83	1	3.84	51	20
Providencia alkalifaciens	1	0.39	1	3.84	2	0.78
Proteus vulgaris	1	0.39	0	-	1	0.39
Morganelle	1	0.39	0	-	1	0.39
ESBL-negative *Klebsiella*	29	12.66	1	3.84	30	11.76
ESBL-positive *Klebsiella*	47	20.52	2	7.69	49	19.21
ESBL-negative E. coli	63	24.70	12	46.15	75	29.41
ESBL-positive E. coli	20	7.84	7	26.92	27	10.58
Enterococcus faecalis	3	1.17	1	3.84	4	1.56

Table 3: Distribution pattern of the pathogens and ESBL production

Organisms	Complicated		Uncomplicated		Total	
	N=229	%	N=26	%	N=255	%
Ofloxacin	176	76.85	13	50	189	74.11
Norfloxacin	176	76.85	12	46.15	188	73.72
Nitrofurantoin	71	31	2	7.69	79	30.98
Gentamicin	117	51.09	8	30.76	125	49.01
Cotrimoxazole	78	34.06	1	3.84	79	30.98
Ciprofloxacin	126	55.02	13	50	139	54.50
Amikacin	61	26.63	5	19.23	66	25.88

Table 4: Resistance pattern in uropathogens to different antibiotics