Antimicrobial Sensitivity Pattern of Bacterial Isolates from Patients with Urinary Tract Infection in Kishoreganj District, Bangladesh

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Abstract

Urinary tract infections (UTIs) are a major public health concern in terms of morbidity and financial implications. A cross-sectional, descriptive study was conducted on 728 patients with urinary tract infection (UTI) in President Abdul Hamid Medical College & Hospital, Kishoreganj, Bangladesh, between September 2021 and August 2023. Clean-catch midstream urine specimens from the patients were inoculated on blood agar, McConkey Agar and chromogenic agar plates, which were incubated aerobically at 37⁰C overnight. Plates with colony count exceeding 105cfu/ml were subjected for identification. Antimicrobial sensitivity was tested using Kirby Bauer disc diffusion method. Of 728 urine samples, 210 (28.85%) had growth with urinary pathogens. The prevalence of UTI was high among females than males. Females of the reproductive age group (21-50years) constituted 60.9% of the total patients with UTI. However, the youngest age group (1-10 years) and elderly (51-70 years) males had a higher incidence of UTI (51.6% and 22.6% respectively) compared to the youngest and elderly females (10.1% and 7.2% respectively). The commonest isolates were *E. coli* (73%) and *Enterococci* (22%). *E. coli* showed high sensitivity to amikacin (86.9%) and gentamicin (72.5%) meanwhile *Enterococci* are highly sensitive to amikacin (76.6%), gentamicin (74.5%), ciprofloxacin (68.1%). To address the emerging challenges posed by *E. coli*, gentamicin, nitrofurantoin and imipenem are also effective options in addition to amikacin.

Keywords: Urinary tract infections, antibiotic sensitivity, bacterial isolates, Bangladesh

Introduction

Urinary tract infections (UTIs) represent a significant public health concern, both in terms of morbidity and financial implications, and account for the highest total healthcare costs among urological conditions, even surpassing those associated with chronic renal failure, including renal dialysis and transplantation.[1] UTIs are among the most prevalent conditions encountered in clinical practice today, with an estimated 150 million cases reported annually worldwide.[2] While UTIs affect individuals of all genders, clinical studies indicate a higher overall prevalence among women. In healthy women, uncomplicated UTIs have an incidence rate of 50 per 1,000 annually.[3] Approximately 50% of women will experience at least one episode of a UTI during their lifetime, with between 20% and 40% facing recurrent episodes.[4,5] Approximately 20% of all urinary tract infections (UTIs) occur in men.[6]

A UTI is defined by the presence of pathogenic organisms detected in the urine, urethra, bladder,

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kidney, or prostate. In most cases, an infection is indicated by the growth of more than 105 organisms per millilitre from a properly collected midstream clean-catch urine sample. However, significant bacteriuria may be absent in some instances of true UTI. In symptomatic patients, a lower bacterial count of 10^2 to 10^4 organisms per millilitre may also suggest an infection. For urine specimens obtained through suprapubic aspiration or in-and-out catheterization, as well as in samples from patients with an indwelling catheter, colony counts of 10^2 to 10^4 organisms per millilitre generally indicate infection. Conversely, colony counts exceeding 10^5 organisms per millilitre from midstream urine may occasionally result from specimen contamination, particularly when multiple species are present.[7] The predominant cause of uncomplicated urinary tract infections (UTIs) is *Escherichia coli*; however, other pathogens such as *enterococci*, *Staphylococcus saprophyticus*, *Klebsiella spp.*, and *Proteus mirabilis* may also be involved.[7,8] The widespread and often inappropriate use of antimicrobial agents has led to a significant rise in antibiotic resistance, a pressing concern on a global scale in recent years.[9] To facilitate appropriate treatment, it is crucial to have a comprehensive understanding of the organisms responsible for UTIs and their antibiotic susceptibility profiles.[10] This study aims to evaluate the evolving susceptibility of urinary pathogens to antimicrobial agents in the context of UTIs.

Methods

This cross-sectional, descriptive study was conducted on 728 patients with urinary tract infection (UTI) in President Abdul Hamid Medical College & Hospital, Kishoreganj, Bangladesh, between September 2021 and August 2023. Clean–catch midstream urine specimens from patients diagnosed clinically to be

having UTI based on symptoms were inoculated on blood agar and McConkey Agar and chromogenic agar plates, which were incubated aerobically at 37ºC overnight. Plates showing growth suggestive of significant bacteriuria, with colony count exceeding 10^5cfu/ml were subjected to standard biochemical tests for identification. Antimicrobial sensitivity testing was performed using Kirby Bauer disc diffusion method as described by the National Committee for Clinical Laboratory Standard (presently called Clinical Laboratory Standard Institute). Interpretation as 'Sensitive' or 'Resistant' was done based on the diameters of zone of inhibition of bacterial growth as recommended by disc manufacturer. The antibiotics used for susceptibility testing were: ciprofloxacin, cefixime, levofloxacin, lomifloxacin, ceftriaxone, cefepime, gentamicin, amikacin, nitrofurantoin, cotrimoxazole, and imipenem.

Data was collected, scrutinized and compiled. We used MS-Excel to analyze the data. Data was expressed as frequency and percentage and presented using tables and pie chart.

The study was approved by the Ethics Review Committee of President Abdul Hamid Medical College, Kishoreganj, Bangladesh

Results

Of the 728 urine samples processed, 210 (28.85%) gave significant growth of pathogens. The patients aged between 1 and 70 years. The prevalence of UTI is high among females (85%) than males (15%). Females of the reproductive age group (21-50years) constituted 60.9% of the total patients with UTI. However, the youngest age group (1-10years) and elderly (51-70years) males had a higher incidence of UTI (51.6% and 22.6% respectively) compared to the youngest and elderly females (10.1% and 7.2%

respectively) (Table-I). The commonest isolates were *Escherichia coli*, *Enterococci*, *Pseudomonas*, *Klebsiella* and *Staphylococcus* which were identified in 73%, 22%, 2%, 1%, 1% and 1% of isolates respectively (Fig.1).

Table-I: Age and gender distribution of patients with urinary tract infections (n=210)

Age group (in years)	Female Frequency (Percentage)	Male Frequency (Percentage)
1 – 10	18 (10.1)	16 (51.6)
11 – 20	39 (21.8)	2 (6.5)
21 – 30	68 (38)	4 (12.9)
31 – 40	28 (15.6)	1 (3.2)
41 – 50	13 (7.3)	1 (3.2)
51 – 60	9 (5.0)	4 (12.9)
61 – 70	4 (2.2)	3 (9.7)
Total	179 (85.2)	31 (14.8)
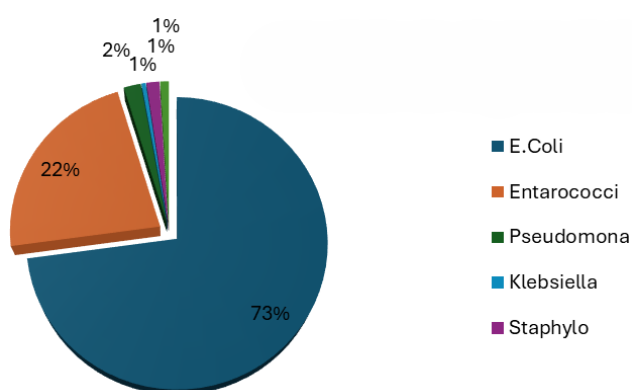
Fig. 1: Pie chart showing organisms isolated in UTI patients (n=210)

E. coli showed high sensitivity to amikacin (86.9%) and gentamicin (72.5%), followed by nitrofurantoin (51.6%), ciprofloxacin (41.2%) and imipenem (38.6%). *Enterococci* are highly sensitive to amikacin (76.6%), gentamicin (74.5%), ciprofloxacin (68.1%), nitrofurantoin (61.7%) and imipenem (48.9%). *Pseudomonas* showed highest sensitivity to amikacin, ciprofloxacin and gentamicin (100%), followed by

cefotaxime (75%) and ceftriaxone (50%). *Klebsiella* showed highest sensitivity to amikacin, cefepime, cefotaxime, ceftriaxone, ciprofloxacin, gentamicin, imipenem and nitrofurantoin (100%). *Staphylococcus aureus* showed highest sensitivity to amikacin, ciprofloxacin, gentamicin (100%), followed by cefotaxime, ceftriaxone, imipenem and nitrofurantoin (66.7%) (Table-II). More than 80% of the isolates are sensitive to amikacin, gentamicin, and ciprofloxacin, while 61% are sensitive to nitrofurantoin, 60.8% to imipenem, 56.6% to ceftriaxone and 54.2% to cefotaxime (Table-III).

Table-II: Antibiotic sensitivity pattern of isolated organisms in UTI (n=210)

Antibiotics	*E. Coli* (n=153)	*Enterococci* (n=47)	*Pseudomonas* (n=4)	*Klebsiella* (n=3)	*Staphylococcus* (n=3)
Amikacin	86.9%	76.6%	100%	100.0%	100%
Cefepime	4.6%	8.5%	-	100.0%	33.3%
Cefixime	-	-	25%	-	-
Cefotaxime	7.8%	21.3%	75%	100.0%	66.7%
Ceftriaxone	19.6%	46.8%	50%	100.0%	66.7%
Cefuroxime	5.9%	23.4%	-	-	-
Ciprofloxacin	41.2%	68.1%	100%	100.0%	100%
Co-trimoxazole	1.3%	2.1%	25%	-	-
Gentamicin	72.5%	74.5%	100%	100.0%	100%
Imipenem	38.6%	48.9%	50%	100.0%	66.7%
Levofloxacin	11.8%	8.5%	25%	-	-
Lomefloxacin	5.2%	23.4%	-	-	-
Nitrofurantoin	51.6%	61.7%	25%	100.0%	66.7%

Table-III: Overall sensitivity patterns of antibiotics used against uropathogens isolated

Antibiotics	Sensitivity
Amikacin	92.7%
Cefepime	36.6%
Cefixime	25.0%
Cefotaxime	54.2%
Ceftriaxone	56.6%
Cefuroxime	14.6%
Ciprofloxacin	81.9%
Co-trimoxazole	9.5%
Gentamicin	89.4%
Imipenem	60.8%
Levofloxacin	15.1%
Lomefloxacin	14.3%
Nitrofurantoin	61.0%

Discussion

The present study was done in a remote district based private tertiary level hospital in Bangladesh. We observed that the prevalence of UTI is high among females (85%) than males (15%). Females of the reproductive age group (21–50 years) constituted 60.9% of the total patients with UTI. It has been reported that adult women have a higher prevalence of UTI than men, principally due to anatomical and physical factors. Among males an increased prevalence of UTI was recorded in young age group 1–10 years (51.6%) than elderly age group (22.6%); the results of our study differ from the findings by Biswas et al.,[11] which was done in an urban setting. This is probably because difference of a remote district based population and population from urban areas. Moreover, children often have underdeveloped bladder control, leading to incomplete emptying, which increases the risk of bacterial colonization and their less mature immune system making them more susceptible to infections. Our study demonstrated that E. coli was the leading uropathogen being responsible for 73% of UTI. This is in consistence with findings of other studies in which E. coli was the most frequently reported isolate from patients with UTIs.[11,12] Following E. coli, our study shows Enterococcus species (22%) and Pseudomonas (2%) as the other common uropathogens. Our findings are in congruence with the findings of the study done by Dias Neto et al.[13]. In the present study, amikacin was found the most effective antibiotic against E. coli (86.9%), which is supported by Schaeffer et al.[14] Our study showed that E. coli had higher sensitivity for less commonly used drugs such as imipenem, amikacin, gentamicin and nitrofurantoin. The findings are supported by the results reported by Sharmin et al., as similar sensitivity patterns of imipenem, ceftazidime and amikacin were observed against UTI isolates of E. coli in Bangladesh.[15] However, E. coli was found least effective to most used oral drugs like cefepime, lomefloxacin, co-trimoxazole cefuroxime, cefotaxime. Antibiotic abuse and practicing incomplete antibiotic regimen have considerably promoted the dissemination of multidrug resistant bacteria.[16]

The study reveals that Gentamicin is the second most effective antibiotic after Amikacin. The sensitivity for E. coli and Enterococci are 72.5% and 74.5% respectively. Ciprofloxacin and Nitrofurantoin showed strong activity against 81.9% and 61% of all isolated organisms and was very active E.coli and Enterococci particularly. However, Co-trimoxazole, Lomefloxacin, Cefuroxime and Levofloxacin are weakly effective against all uropathogens. The sensitivity is found 9.5%, 14.3%, 14.6% and 15.1% respectively. In a study in Netherlands, the level of sensitivity towards Co-trimoxazole and Ciprofloxacin was 7.2% and 61.2% that was lower than our study and towards Nitrofurantoin 92.2% that was higher than our study.[17] Infection frequency of Pseudomonas, Klebsiella and

Staphylococcus were found to be very few in this study. The similarities and differences in the type and distribution of uropathogens may result from different environmental conditions and host factors, and from some practices such as healthcare and education programmers, socioeconomic standards and hygiene practices in each country.[18]

With the evidence from our study, we may suggest that amikacin, gentamicin, ciprofloxacin, nitrofurantoin, imipenem, ceftriaxone, and cefotaxime to be prescribed as the empirical treatment for UTI. However, by keeping the emerging antimicrobial resistance in mind, it is strongly recommended that the antibiotic therapy should only be commenced after the culture and sensitivity report from the microbiology laboratory. This would not only help in the sensible use of antibiotics but also would restrain the spreading of antimicrobial resistant strains in the community as well as in the hospital.[18]

Conclusion

Our data suggests that the rate of culture-positive uropathogens was notably high, particularly among adult female patients. *E. coli* was identified as the most prevalent causative agent and continues to show susceptibility to amikacin. This antibiotic should be the drug of choice for treating uncomplicated urinary tract infections. Our results also indicate the necessity of routinely monitor the antibiotic susceptibility of bacterial isolates in our country. To address the emerging challenges posed by *E. coli* in recent years, gentamicin, nitrofurantoin and imipenem are also found as effective options in addition to amikacin.

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