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Finding the Causative Organisms and Assessing Antimicrobial Sensitivity Patterns for Uncomplicated Urinary Tract Infections in Female Patients at a Tertiary Level Hospital

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Abstract

Introduction*: Urinary tract infections are a common reason for seeking medical attention in the community. The rapid increase in antibiotic resistance among uropathogens is limiting treatment options. Therefore, it is important to have knowledge of the current uropathogens and their antibiotic susceptibility for better treatment of urinary tract infections.*

Objective*: This study aims to find the causative organisms and assess antimicrobial sensitivity patterns for uncomplicated urinary tract infections in female patients at a tertiary hospital.*

Methods*: A retrospective study design was conducted at the Department of Pharmacology & Therapeutics in collaboration with the Department of Microbiology SBMC, Out Patient Department of Medicine, and Gynae & Obstetrics, SBMCH, Barishal, from January 2017 to December 2017. Mid-stream urine specimens were collected from 314 individuals age level 15 to 75, with suspected urinary tract infections for bacteriological identification and antimicrobial susceptibility testing among which, 200 patients were selected for the study. Data on socio-demographic, clinical and risk factors were also collected using a structured questionnaire.*

Results*: In this study, age of the subjects ranging from 15 to 75 years, majority subjects (38.4%) belonged to age group of 31-44 years. The mean age was found 42.6±11.4 years. Out of 200 cases, 80% cases hail from rural areas and 20.48% from urban site. The prevalence of UTI was 64%. The study showed significant bacteriuria. Escherichia Coli, Pseudomonas, Staphylococcus aureus (13.5%), and Enterobacter Sp. were common bacterial isolates.*

Conclusion*: Urinary tract infection is a problem among samples with a prevalence of 64%. All isolates have developed resistance to most of the commonly used antibiotics. Therefore, health education on the transmission and causes of urinary tract infections is recommended.*

Keywords*: Urinary tract infection, Antibiotic susceptibility, E. Coli, antibiotics, antibiotic resistance*

I. Introduction

Urinary Tract Infection (UTI) is the presence of significant bacteria in urine, regardless of the location of the infection in the urinary tract [1]. UTIs can range from the presence of bacteria in urine without symptoms to serious symptomatic illnesses such as urethritis (urethra), cystitis (bladder), ureteritis (ureters), and pyelonephritis (kidney) [2, 3]. It is the most common cause of morbidity in the general population and hospital visits [4, 5]. Globally, 150 million people are diagnosed with urinary tract infections (UTIs) annually [6, 7] which results in a healthcare expenditure of over 6 billion US dollars due to treatment and work loss [8]. Urinary tract infections (UTIs) can occur in people of all ages and genders [4, 9]. Due to anatomical position, physiological changes, vaginal intercourse, and the use of contraceptive methods such as spermicide and diaphragm, as well as the lack of prostatic fluid which acts as an antibacterial agent, almost 50% of women experience at least one episode of UTI during their lifetime [1, 10, 11]. Even though urinary tract infections (UTIs) occur less frequently in men than in women, they are more severe when they do occur [12, 13]. Despite these clear increased risks of UTI, clinicians lack scientifically valid methods to identify and ultimately treat patients with UTI complaints [14, 15]. Therefore, UTI can lead to serious complications such as frequent

recurrences, bacteremia, renal failure, and preterm delivery [16, 17]. UTI among university students are similar to the general population, and the majority of females experience recurrent infections within 1 year [18]. The prevalence of urinary tract infections (UTIs) among college students in India and Saudi Arabia was found to be 19.8% and 32.1% respectively [5, 19]. The prevalence of urinary tract infections (UTI) among university students in Africa, particularly in Nigeria, has been reported to be 28% [20]. UTIs are mainly caused by Gram-negative bacteria such as E. Coli (75–90%), Klebsiella spp., Proteus spp., and Gram-positive bacteria such as coagulase-negative staph (CoNS) and S. aureus [21]. In recent times, uropathogen isolates have shown a high level of resistance to almost all antibiotics globally [22], which is attributed to the misuse of antibiotics among university students [23–26]. Likewise, Bangladeshi patients are taking various antibiotics due to different illnesses. This study aims to find the causative organisms and assess antimicrobial sensitivity patterns for uncomplicated urinary tract infections in female patients. Ethical clearance and written consent were taken from the respective authority.

Objectives

- *General objective:* The objective of this research is to study the antimicrobial sensitivity patterns for uncomplicated urinary tract infections in female patients at a tertiary level hospital.
- *Specific objective*: This study aims to find out the causative organisms and assess antimicrobial sensitivity patterns for uncomplicated urinary tract infections in female patients.

II. Methodology

In this retrospective study 200 outpatients, who visited the Department of Medicine, and Gynae & Obstetrics, SBMCH, Barishal with the symptoms of UTI from January 2017 to December 2017 were selected for the study.

- *Inclusion criteria:* This study involves patients with clinical features of urinary tract infection (UTI), female patients. The patients were aged >15 years. They signed informed consent for inclusion in the study
- *Exclusion criteria*: Seriously ill patients, who needed ICU support, patients with features of UTI but without microbiological proof, pregnant women, women who received antibiotics within two months, with complicated urinary tract infections, and patients who were not interested in participating in this study were excluded of this research.

The data was edited, cleaned, entered, and analyzed using the Statistical Package for the Social Sciences (SPSS) version 22. We conducted descriptive statistics, bivariate, and multivariate logistic regression. Bivariate logistic regression helped us examine the association between the outcome variable and each independent variable. We used binary logistic regression analysis to calculate the odds ratios (OR), including the Crude Odds Ratio (COR) and Adjusted Odds Ratio (AOR), to determine the degree of association between risk factors of symptomatic urinary tract infection. We also detected multicollinearity among independent variables using the standard errors for regression coefficients. Variables with a P-value ($P < 0.05$) and a 95% confidence interval were considered to have statistically significant differences. The ethical review committee of SBMCH, Barishal has approved the study. A well-informed written consent paper was signed by the patients.

III. Result

A total of 314 adult patients were evaluated for this study among which 200 (64%) were selected primarily [Table-1]. The study patients are of 15 years to 75 years old with the mean age of 42.6±11.4. 83.2% of the sample patients were married and 80% patients are from rural area [Table-2]. According to Table-3 the highest sensitivity was observed with imipenem (91.48%), followed by amikacin (87.23%), nitrofurantoin (85.10%), and gentamicin (85.10%). Moderate sensitivity was observed with ciprofloxacin (80.85%), cefixime (61.70%), and co-trimoxazole (46.80%). The lowest sensitivity was observed with amoxicillin (57.44%). The highest sensitivity was observed with cefixime (88.88%) and nitrofurantoin (94.44%). Moderate sensitivity was observed with ciprofloxacin (77.77%), imipenem (77.77%), and amikacin (83.33%). Lower sensitivity was observed with co-trimoxazole (33.33%) and amoxicillin (38.88%).

Table-1: Prevalence of UTI with Regard to the SocioDemographic Characteristic

Variables	**Significant Bacteriuria**			
	Yes	**Percentage**	**No**	**Percentage**
Female	200	64%	114	36.48%

Table-2: Sociodemographic characteristics of the study subjects (n=200)

Characteristics		**Frequency**	**Percentage**
Age	15-30	70	22.4%
	31-44	114	36.48%
	45-60	120	38.4%
	60-75	18	5.76%
	Mean± SD	42.6±11.4	
	Range	18-75	
Marital status	Single	54	17.28%
	Married	260	83.2%
Residence	Urban	64	20.48%
	Rural	250	80%

Table-3: Antimicrobial sensitivity pattern of isolated uropathogens.

Antimicrobials	**Gram-negative uropathogens**				**Gram-positive uropathogens**		
	E. coli	**Klebsiella pneumoniae**	**Proteus Sp.**	**Pseudomonas**	**Staph. saprophyticus**	**Enterobacter Sp.**	**Staph. aureus**
Co-trimoxazole	44/94 (46.80%)	12/36 (33.33%)	8/22 (36.36%)	6/14 (42.85%)	1/4 (40%)	10/18 (55.55%)	2/12 (16.66%)
Amoxicillin	54/94 (57.44%)	14/36 (38.88%)	6/22 (27.27%)	0/14 (0%)	2.5/4 (60%)	2/18 (11.11%)	8/12 (66.66%)
Cefixime	58/94 (61.70%)	32/36 (88.88%)	18/22 (81.81%)	10/14 (71.42%)	2.5/4 (60%)	14/18 (77.77%)	10/12 (83.33%)
Imipenem	86/94 (91.48%)	28/36 (77.77%)	4/22 (18.18%)	12/14 (85.71%)	3/4 (80%)	18/18 (100%)	8/12 (66.66%)
Nitrofurantoin	80/94 (85.10%)	34/36 (94.44%)	18/22 (81.81%)	12/14 (85.71%)	3/4 (80%)	18/18 (100%)	12/12 (100%)
Gentamicin	80/94 (85.10%)	30/36 (83.33%)	22/22 (100%)	10/14 (71.42%)	4/4 (80%)	14/18 (77.77%)	10/12 (83.33%)
Amikacin	82/94 (87.23%)	30/36 (83.33%)	20/22 (90.90%)	14/14 (100%)	3/4 (80%)	16/18 (88.88%)	10/12 (83.33%)
Ciprofloxacin	76/94 (80.85%)	28/36 (77.77%)	18/22 (81.81%)	12/14 (85.71%)	3/4 (80%)	16/18 (88.88%)	10/12 (83.33%)

IV. DISCUSSION

Urinary tract infections (UTIs) remain one of the most commonly diagnosed infectious diseases in the community [30, 31]. The overall prevalence of UTI in a study was 21.1%, done on 341 sample size [27], which aligns with previous findings in Ethiopia (23.32%) and Keffi, Nigeria (20%) [32, 33]; and Ogun state, Nigeria (25%) [34]; India (19.8%) [13] and (22%) [35]. However, our finding was 64% which higher than other earlier studies reported in southeast Nigeria (13.8%) [36]; Benin City, Nigeria (11%) [37] and Imo St ate University (28%) [20]. But it was lower compared to other studies done in Nigeria, such as and (8.25%) [38], and southeastern Nigeria (78%) [39]. This difference in the variation in the rate of UTI may be explained by differences in the methodology used and sexual behaviour. Sexually active individuals are more exposed to urinary tract infections due to ascending infection from the genitals to the urinary tract. Climatic and geographic variations might be attributed to cold climates, which can lead to a lack of personal and environmental hygiene among participants. In addition, the lack of sanitary materials in the university, such as access to water, and low socioeconomic status, are similar to previous findings in Iran [3]. 89.2% of the isolates were from female participants, supporting the implication that females are at high risk for UTI [10, 11]. The high prevalence of UTI among female participants may be due to the fact that females have a shorter and wider urethra, which is closer to the anus. Additionally, females lack prostatic fluid, which acts as an antimicrobial agent, and have a warm and moist urethra that could be more supportive for the optimal growth of bacteria compared to males [40]. Other factors such as the mechanical introduction of pathogens into the bladder and trauma during sexual intercourse could also contribute to the high prevalence of UTIs among females [41]. As studies have been documented in the general populations the etiologic agents of UTI mostly belong to gram-negative bacteria [15, 21].

The present study found that 63.5% of the isolates were gram-negative bacteria. Among these, E. Coli was the most frequently isolated bacterium, with a 48.6% isolation rate. This rate is consistent with earlier findings in other parts of Ethiopia (94.5% and 44.62%) as well as in Sudan (94.3%). The high isolation rate of E. Coli in this study may be due to contamination of the urinary tract from the rectal area and it could also be

due to E. Coli has various enhanced virulence factors specific for colonization and invasion of the urinary epithelium [32]. The second most common pathogen was Enterobacter sp. At 55.55%. Isolation rates of S. Aureus (13.5%) and K. Pneumoniae (0.1%) in our study were comparable to previous reports in Nigeria, 13.3% and 6.4% respectively [34]. Similar to previous studies conducted in Ethiopia [43], 2.8% of mixed bacterial pathogens were isolated in the present study. The study found that participants with a history of UTI had a significantly higher prevalence of UTI compared to those with no previous history of UTI ($p = 0.005$). This finding aligns with results reported in Ethiopia [29, 43] and another place [11]. The association may be explained by the presence of resistant strains from previous uropathogens.

According to previously documented results [1, 3, 11], our study found that female participants had a sevenfold increased risk of acquiring UTI. This could be due to females having a shorter, wider, and more direct urethra, a lack of prostatic fluid which acts as an antimicrobial, and a warm and moist urethra that could support the optimal growth of bacteria compared to males [34]. The study found a significant association between the history of catheterization and the presence of UTI ($p < 0.001$). This finding is consistent with a study conducted in Ethiopia [40]. The contamination during catheter insertion, frequent and long-term catheterization may contribute to the adherence of pathogens to the urinary tract. Additionally, sexual activity was also identified as a statistically significant risk factor for UTI. Females who had engaged in sexual intercourse three or more times per week were twice as likely to have urinary tract infections (UTIs) compared to females who had intercourse less than three times per week. This finding is consistent with the results of a previous study conducted in Ethiopia [29]. The association may be due to frequent contraceptive use and intercourse, pushing bacteria into the bladder [29]. In line with previously documented findings [2, 36, 44], age and history of antibiotic use showed no association with UTI in the current study. Furthermore, this contradicts the earlier report [42].

Generally, most gram-negative isolates in the present study were sensitive to ciprofloxacin (85.71%) and nitrofurantoin (94.44%). This finding is consistent with previous research conducted in Bangladesh [31] and Nigeria [36]. The antibiotics ciprofloxacin, amikacin, imipenem, nitrofurantoin, and cefixime were found to be effective against gram-negative isolates. Among the gram-positive isolates, S. Aureus exhibited a high resistance rate to co-trimoxazole and pseudomonas shows resistance to amoxicillin.

The high prevalence of multi-drug resistance (MDR) in this study may be attributed to the development of multiple resistant genes on mobile genetic elements [45]. Additionally, plasmids carrying genes that encode extended-spectrum beta-lactamases (ESBLS) often also carry genes that confer resistance to other antimicrobial agents [46]. Self-medication, a common practice in the study area [8], might contribute significantly to the higher prevalence of MDR [28].

Limitations

This was a single-centre study with a small population for a longer period. These may cause data loss and not provide the overall scenario of the county. A large-scale study needs to be conducted to reach a definitive conclusion. This study was conducted in a tertiary care hospital which may not represent a primary or secondary centre. Study samples were taken by a purposive method where personal biasness might arise.

V. Conclusion

In the present study, the overall prevalence of UTI was 21.1%. Being female, the previous history of catheterization, prior history of UTI and frequent sexual activity had a statistically significant association with the occurrence of UTI. E. coli was the most dominant isolate. Therefore, from this study, there is a significant increase in UTI and antibiotic resistance is arising.

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Conflicts of interest: N/A

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