Prevalence of uropathogens in reproductive age group females and their antibiotic resistance pattern

Archana Sachan¹, Geeta Gupta²*, Gajendra Kumar Gupta³

¹Postgraduate Student, ²Associate Professor, ³Professor, ¹²Dept. of Microbiology, ³Dept. of Community Medicine, Santosh Medical College and Hospital, Ghaziabad, Uttar Pradesh, India

*Corresponding Author: Geeta Gupta
Email: geetagupta2011@gmail.com

Abstract

Introduction: Urinary Tract Infection (UTI) remains the most common bacterial infection in human population. The prevalence of UTI is much higher in females as compared to males. The present study was planned with the aim to find out prevalence of uropathogens and their antibiotic resistance pattern in reproductive age group females.

Materials and Methods: The present study was carried out in department of microbiology, Santosh Medical College and Hospital, Ghaziabad from Jan. 2018 to May 2018. Total 100 urine sample were processed for culture and sensitivity testing. Isolation of organism were done by inoculation of samples on Mac-Conkey Agar and Blood Agra media. After 24 hour of incubation at 37° C, each isolates were identified on the basis of morphology of colony in culture media, Gram stain, motility and biochemical reactions. Antibiotic sensitivity testing were carried out on Mueller Hinton Agar by Kirby Bauer method.

Results: The prevalence of uropathogen was found 36%. The Gram-negative bacteria were most common isolates in comparison to Gram-positive bacteria. E. coli was the most common isolates followed by S. saprophyticus. Gram-negative organism were found more sensitive to Amikacin, Piperacillin Tazobactum, Ampicillin sulbactum, Cefoperazone sulbactum and Nitrofurantoin. Gram-positive bacteria were found more sensitive to Piperacillin Tazobactum, Tetracycline, Ampicillin sulbactum and Linezolid. E. coli were found more sensitive to Amikacin, Ampicillin sulbactum, Piperacillin Tazobactum and Cefoperazone sulbactum.

Conclusion: Changing antimicrobial resistance pose challenge in treating urinary tract infections. Appropriate and judicious selection of antibiotic would limit the emerging drug resistant isolate in the future to treat this clinical condition successfully.

Keywords: Urinary Tract Infection, UTI, Uropathogens, reproductive age group females. Pregnant women, Antibiotic resistance, E. coli.

Introduction

Urinary Tract Infections (UTI) frequently occur in both community and hospital environment are of the most common bacterial infections in humans. The outcomes of urinary tract infections are increase hospitalization, increase patient treatment cost and mortality.¹ Bacteria can invade and cause UTI via two major routes ascending and hematogenous pathway. Ascending route is most common route of infection in females. Urinary tract infections are characterized as either upper or lower UTI primarily on the basis of anatomical location of infection. The lower UTI affecting the bladder and urethra and the upper UTI affecting the ureter and kidneys mainly.

Women are at three times greater risk for UTI then man because of short, straight anatomy of the urethra, and termination of female urethra beneath the labia resulting in colonization by colonic gram negative bacilli.² Most of the UTI are caused by gram-negative bacteria like E. coli, Proteus species, Klebsiella species, Pseudomonas aeruginosa, Acinetobacter, Serratia and Morganella morganii. UTI also caused by gram positive bacteria like Enterococcus, Staphylococcus specially coagulase negative Staphylococci and Streptococci agalactiae.³

E. coli are one of the most prevalent pathogens among gram-negative bacteria capable of causing complicated and uncomplicated UTI.⁴ UTI during pregnancy leads to low birth weight babies, increase perinatal mortality and premature births along with acute and chronic sequelae in mothers.⁵ Diagnosis and definitive treatment of UTI mainly based on bacteriological culture and antibiotic sensitivity. In past decade, indiscriminate use of antibiotics resulted in word wide rise of multdrug resistance cases.⁶ Hence, present study planned to find out the prevalence of urinary pathogens and their antibiotic resistance pattern in reproductive age group females to provide better cost effective treatment to female patients.

Materials and Methods

A cross sectional study was carried out in the department of microbiology, Santosh Medical College and Hospital, Ghaziabad from January 2018 to May 2018. A total of 100 urine samples were collected from female patients clinically suspected of urinary tract infection. The women in reproductive age group 18 to 45 years with history of urinary tract infection were included in the study and only one sample was collected from each patient. The exclusion criteria were leaky or dirty container, delay in transportation of sample more than 2 hours, previous history of antibiotics, surgery or operative procedure. Midstream clean catch urine samples were collected and transported to microbiology laboratory for processing. Urine culture and antibiotic susceptibility testing was performed in laboratory. The urine culture was done using a sterile calibrated loop of 4 mm diameter delivering 10 microliter volume of urine. A loopful of well mixed uncentrifuged urine was inoculated on the Mac-Conkey Agar and Blood Agar media plates. All plates were incubated at 37° C aerobically for 24 hours.⁷ The bacterial growth was identify by Gram stain, motility and a set of biochemical test including catalase, coagulase, oxidase, indole, methyl red, Voges Proskauer, citrate, urease and triple sugar iron media.
Antimicrobial susceptibility testing was performed by 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 on the basis of diameter of zone of inhibition of bacteria growth on Mueller Hinton Agar plate as recommended by Hi Media disc manufacturer. Antibiotic discs used for susceptibility testing for gram negative bacteria were Amikacin (30 µgm), Ampicillin sulbactum (10 / 10 µgm), Ceftriaxone (30 µgm), Cefotaxime (30 µgm), Ciprofloxacin (5 µgm), Cefixime (5 µgm), Cefazidine (30 µgm), Cefoperazone sulbactum (75 / 30 µgm), Co-trimoxazole (25 µgm), Norfloxacin (10 µgm), Nitrofurantoin (300 µgm), Ofloxacin (5 µgm), Piperacillin tazobactam (100 / 10 µgm) and Imipenem (10 µgm). Antibiotic disc used for gram-positive bacteria includes Ceftazidine (30 µgm), Ciprofloxacin (5 µgm), Cloxacillin (100 µgm), Co-trimoxazole (25 µgm), Gentamicin (10 µgm), Norfloxacin (10 µgm), Nitrofurantoin (300 µgm), Penicillin (10 U), Piperacillin tazobactam (100 / 10 µgm), Tetracycline (30 µgm), Vancomycin (30 µgm) and Linezolid (30 µgm). Data collected and analysis was done using appropriate statistical methods.

Results and Discussions
In present study, the prevalence of uropathogens in reproductive age group female was found to be 36% (Table 1). B. Shanthi et al. (2018)9 found the higher prevalence rate due to their large sample size. The maximum number of cases were found in the age group 18 – 30 years and minimum number of cases were found in the age group 31 – 45 years (Table 2). The reason being women in this age group are more sexually active and more prone to develop UTI probably due to characteristic anatomy of the urethra and the effect of normal physiological changes that affects the urinary tract – short urethra, its close proximity to the anus, urethral trauma during intercourse, dilatation of urethra and stasis of urine during pregnancy. Out of 100 cases, 11 females were found pregnant and 89 were found non-pregnant. All 11 pregnant women were found culture positive due to a number of factors including urethral dilation, increase bladder volume and decrease bladder tone, along with decrease urethral tone, which contributes to increase urinary stasis and vesicoureteral reflex and up to 70% of pregnant women develop glycosuria, which favors bacterial growth in the urine.12

Gram-negative bacteria dominated over gram-positive bacteria as the etiological agent for UTI as shown in Table 3. E. coli was the most common isolates both in non-pregnant and pregnant women followed by Staphylococcus saprophyticus. The other micro-organisms isolated were Staphylococcus aureus, Klebsiella pneumoniae, Proteus mirabilis, Citrobacter freundii, Enterococcus faecalis. Out of total isolates, 50% were E. coli and 19.4% were Staphylococcus saprophyticus. Similar results were found by Goyal Ankur et al. 201513 Agersew Alemu et al. 201214 and Geeta Gupta et al. 2019.15

The gram-negative bacteria were found more sensitive to antibiotics Amikacin, Piperacillin Tazobactum, Ampicillin sulbactum, Cefoperazone sulbactum and Nitrofurantoin (Table 4). Similar results were found by B. Shanthi et al. (2018)9 and Obiogbolu et al. (2009).16 The gram-positive bacteria were found more sensitive to antibiotics Piperacillin Tazobactum, Tetracycline, Ampicillin sulbactum and Linezolid (Table 5). The most effective antibiotic for the E. coli was found to be Amikacin and Ampicillin sulbactum, Iram Shaifali et al. (2012)17 observe Nitrofurantoin followed by Amoxicillin, Nalidixic Acid and Co-Trimoxazole were sensitive. The most effective antibiotic for the S. saprophyticus was Tetracycline and Levofloxacine. Agedeji BA et al. (2009)18 found Gentamycin and Ofloxacin were the most active antibiotics and isolates showed high resistance to Co-Trimoxazole and Amoxicilin. The reason behind different antibiotic susceptibility pattern of isolates from other studies because sensitivity varies widely by region, OPD and IPD patients included in the study.

Table 1: Showing growth pattern among pregnant and non-pregnant women

| S. No. | Growth | Pregnant | Non-Pregnant | Total |
|--------|--------|----------|--------------|-------|
| 1      | Present| 11       | 25           | 36    |
| 2      | Absent | -        | 64           | 64    |
| Total  |        | 11       | 89           | 100   |

Table 2: Showing age group wise distribution of pregnant and non-pregnant women

| S. No. | Age Group (Yrs) | Pregnant | Non-Pregnant | Total |
|--------|-----------------|----------|--------------|-------|
| 1      | 18 – 30         | 11       | 25           | 36    |
| 2      | 31 – 40         | -        | 35           | 35    |
| 3      | 41 – 45         | -        | 29           | 29    |
| Total  |                  | 11       | 89           | 100   |
Table 3: Distribution of isolated microorganisms in culture

| S. No. | Micro-organism        | No. of Women | Total |
|-------|-----------------------|--------------|-------|
|       |                       | Pregnant     | Non-Pregnant |       |
| 1     | E. coli               | 06           | 12   | 18  |
| 2     | S. saprophyticus      | 04           | 03   | 07  |
| 3     | S. aureus             | --           | 04   | 04  |
| 4     | Proteus species       | --           | 02   | 02  |
| 5     | Citrobacter freundii  | --           | 02   | 02  |
| 6     | Enterococcus          | --           | 01   | 01  |
| 7     | Klebsiella pneumoniae | --           | 01   | 01  |
| 8     | CONS                  | 01           | --   | 01  |
| 9     | No Organism Isolated  | --           | 64   | 64  |
|       | Total                 | 11           | 89   | 100 |

Table 4: Antibiotic susceptibility pattern of Gram-negative organisms. (N=23)

| S. No. | Antibiotic     | Sensitive N (%) | Intermediate N (%) | Resistant N (%) |
|-------|----------------|-----------------|-------------------|-----------------|
| 1     | Ampicillin     | 13 (56.52)      | 0 (0)             | 6 (26.08)       |
| 2     | Piperacillin   | 13 (56.52)      | 1 (4.34)          | 0 (0)           |
| 3     | Ceftriaxone    | 2 (8.69)        | 1 (4.34)          | 0 (0)           |
| 4     | Ceftazidime    | 5 (21.73)       | 0 (0)             | 9 (39.13)       |
| 5     | Tetracycline   | 7 (30.43)       | 0 (0)             | 10 (43.42)      |
| 6     | Nitrofurantoin | 8 (34.78)       | 2 (8.69)          | 2 (8.69)        |
| 7     | Ciprofloxacin  | 1 (4.34)        | 1 (4.34)          | 4 (17.30)       |
| 8     | Amikacin       | 16 (69.56)      | 1 (4.34)          | 0 (0)           |
| 9     | Levofloxacin   | 3 (13.04)       | 2 (8.69)          | 4 (17.30)       |
| 10    | Co-Trimoxazole | 6 (26.08)       | 0 (0)             | 5 (21.73)       |
| 11    | Meropenem      | 2 (8.69)        | 1 (4.34)          | 4 (17.30)       |
| 12    | Imipenem       | 3 (13.04)       | 1 (4.34)          | 0 (0)           |
| 13    | Cefoperazone sulbactum | 12 (52.17) | 2 (8.69) | 0 (0) |

Table 5: Antibiotic susceptibility pattern of Gram-Positive organisms. (N=13)

| S. No. | Antibiotic         | Sensitive N (%) | Intermediate N (%) | Resistant N (%) |
|-------|--------------------|-----------------|-------------------|-----------------|
| 1     | Amoxicillin        | 2 (15.38)       | 0 (0)             | 0 (0)           |
| 2     | Co-Trimoxazole     | 5 (38.46)       | 2 (15.38)         | 3 (23.07)       |
| 3     | Ofloxacin          | 4 (30.76)       | 0 (0)             | 1 (7.69)        |
| 4     | Linezolid          | 9 (69.23)       | 0 (0)             | 0 (0)           |
| 5     | Vancomycin         | 2 (15.38)       | 1 (7.69)          | 0 (0)           |
| 6     | Ampicillin sulbactum | 10 (76.92)   | 0 (0)             | 1 (7.69)        |
| 7     | Tetracycline       | 11 (84.61)      | 0 (0)             | 1 (7.69)        |
| 8     | Levofloxacin       | 9 (69.23)       | 0 (0)             | 0 (0)           |
| 9     | Piperacillin Tazobactum | 1 (7.69) | 0 (0) | 0 (0) |
| 10    | Ciprofloxacin      | 9 (69.23)       | 1 (7.69)          | 1 (7.69)        |

Conclusion
The present study raised awareness regarding high vulnerability of women in reproductive age group for urinary tract infections. The pregnant women were found more prone to develop UTI in comparison to the non-pregnant women. The study provide information regarding uropathogens and their antibiotic susceptibility pattern. Gram-negative bacteria were found more common isolates in comparison to gram positive bacteria causing UTI. Analyzing antibiotic susceptibility pattern of uropathogens will help to overcome the therapeutic dilemmas and to guide in selection of appropriate antibiotics for empirical treatment to the patients.

Funding: Nil.

Conflict of Interest: None declared.

References
1. Dipiro JT, Talbert RL, Yee GC, Matzke GR, Wells BG, Posey LM. Pharmacotherapy: A pathophysiologic approach. 8th Edi. Mc Graw-Hill, New York 2011.
2. Akinkugbe FM, Familusi FB, Akinkugbe O. Urinary tract infection in infancy and early childhood. East Afr Med J 1973;59:514-20.
3. Mohamed Shaaban T, Hassan Ghazlan A, Marwa Maghraby ME. Susceptibility of bacteria infecting urinary tract to some antibiotics and essential oils. J Appl Pharmac Sci 2012;2(4):90-8.
4. Rodríguez-Bano J, Navarro MD, Romero L, Muniain MA, Perea EJ. Clinical and molecular epidemiology of extended spectrum beta-lactamase-producing Escheria coli as a cause of nosocomial infection or colonization: implications for control. *Clin Infect Dis* 2006;42:37-45.

5. Kurdydyk LM, Kelly K, Harding KM, Mirwaldt P, Thompson L. Role of cervicovaginal antibody in the pathogenesis of recurrent urinary tract infection in women. *Infect Immun* 1980;29(1):76-82.

6. DH Tambekar, SR Gulhane, VK Khandelwal, MN Dudhane. Antimicrobial susceptibility of some urinary tract pathogens to commonly used antibiotics. *Afr J Biotech* 2006;5(17):1562-5.

7. Belly A, Eorbes Daniel, Samm Alice S. Bailey and Scott’s Diagnostic Microbiology, 12 Edi. 2007;p 257.

8. National Committee for clinical laboratory standards methods for disc susceptibility tests for bacteria that grow aerobically NCCLS document M2 – A7 Wayne. National Committee for clinical laboratory standards 7th Ed. 2000.

9. B. Shanthi, R Selvi and A Madhumathy. Antimicrobial Susceptibility pattern of Escherichia coli from patients with urinary tract infection in a tertiary care hospital. *Int J Curr Microbiol App Sci* 2018;7(1):289-94.

10. Dash M, Padhi S, Mohanti I, Panda P and Parida B. Antimicrobial resistance in pathogen causing urinary tract infections in a rural community of Odisha, India. *J Fam Com Med* 2013;20(1):20.

11. Kothari A and Sagar V. Antibiotic resistance in pathogens causing community acquired urinary tract infections in India; a multicenter study. *J Infect Dev Count* 2008;2(5):354-8.

12. Van Brummen HJ, Bruinse HW, Vander Bom JG, Heintz AP, Vander Vaart CH. How do the prevalences of urogenital symptoms change during pregnancy? *Neurourol Urodyn* 2006;20:135-9.

13. Goyal Ankur. Prevalence of Asymptomatic urinary tract infections in the tree trimesters of pregnancy. ISSN: 2319-7706 Special issue – 1 (2015):110-7.

14. Agersew Alemu, Feleke Moges, Yitayal Shiferaw, Ketema Tafess, Afework Kassu, Belay Anagaw, et al. Bacterial profile and drug susceptibility pattern of urinary tract infection in pregnant women at University of Gondar Teaching Hospital, Northwest Ethiopia. BMC Research Notes 2012;5:197.

15. Geeta Gupta, Gajendra K Gupta. Spectrum of uropathogens and their antimicrobial susceptibility pattern: A need of hospital antibiogram. *Int J Contemp Microbiol* 2019;5(1):27-33.

16. Obiogbolu CH, Okonko IO, Anyamera CO, Adeedeji AO, Akanbi AO, Ogun AA, et al. Incidence of urinary tract infections among pregnant women in Akwametropolis, Southeastern Nigeria. *Sci Res Essay* 2009;4(8):820-4.

17. Iram Shaifali, Gupta U, Mahmood SE and Ahmed J. Antibiotic susceptibility pattern of urinary pathogens in female outpatients. *N Am J Med Sci* 2012;4(4):163-9.

18. Adeedeji BA, Abdulkidir OA. Etiology and antimicrobial resistance pattern of bacterial agents of urinary tract infections in students of tertiary institution in Yola Metropolis. *Adv Biol Res* 2009;3(3-4):67-70.