ABSTRACT

Urinary tract infections (UTIs) are the inflammatory disorders of the urinary tract caused by the abnormal growth of pathogens. Urinary tract infections can be community acquired or nosocomial. Symptoms of UTIs such as fever, burning sensations while urinating, LAP, itching, formation of blisters and ulcers in the genital area, genital and supra pubic pain, and pyuria generally depend on the age of the person infected the location of the urinary tract infected. E.coli is the major etiologic agent in causing UTI which accounts for up to 75%-90% of cases whereas Staphylococcus saprophyticus causes an estimated 5 - 1 5% of UTIs frequently in younger women. P. mirabilis, Klebsiella species, P. aeruginosa and Enterobacter species are less frequent offenders. Less commonly, Enterococci, G. vaginalis and U. urealyticum are also known agents in UTIs. Due to the rapidly evolving adaptive strategies of bacteria, the etiology of UTI and antibiotic resistance profile of bacterial uropathogens have changed considerably over the past years, both in community and nosocomial infections. Treatment of UTIs cases is often started empirically and therapy is based on information determined from the antimicrobial resistance pattern of the urinary pathogens.

Keywords: Urinary tract infection, pathogens, antibiotic, antibiotic sensitivity, E.coli, antibiotic resistance.

INTRODUCTION

Urinary tract infections (UTIs) are the inflammatory disorders of the urinary tract caused by the abnormal growth of pathogens. Urinary tract infection is known to cause short-term morbidity in terms of fever, dysuria, and lower abdominal pain (LAP) and may result in permanent scarring of the kidney. Urinary tract infections (UTI) affect any part of the urinary tract and include mainly cystitis (bladder infection), pyelonephritis (kidney infection) and urethritis (urethra infection) showing tissue damage, burning, painful urination, urgency and increased urinary frequency, suprapubic pain, pain in renal angle, fever and other systemic manifestations but asymptomatic cases may also occur.

Urinary tract infections can be community acquired or nosocomial. Community-acquired urinary tract infections (CA-UTIs) are defined as the infection of the urinary system that takes place in one’s life in the community setting or in the hospital environment with less than 48 hours of admission. Community-acquired UTI is the second most commonly encountered microbial infection in the community setting. Urinary tract infections may be asymptomatic, acute, chronic, and complicated or uncomplicated, and the clinical manifestations of UTIs depend on the portion of the urinary tract involved, the etiologic organisms, the severity of the infection, and the patient’s ability to mount an immune response to it. Both asymptomatic and symptomatic UTIs pose a serious threat to public health care, hence reducing the quality of life and resulting into work absenteeism.

Symptoms of UTIs such as fever, burning sensations while urinating, LAP, itching, formation of blisters and ulcers in the genital area, genital and supra pubic pain, and pyuria generally depend on the age of the person infected the location of the urinary tract infected. Urinary tract infection can be either symptomatic or asymptomatic. Patients with significant bacteriuria who have symptoms referable to the urinary tract are said to have symptomatic bacteriuria. Asymptomatic bacteriuria (ABU) is a condition characterized by presence of bacteria in two consecutive clear voided urine specimens both yielding positive cultures (≥105cfu/ml) of the same uropathogen, in a patient without classical symptoms. E.coli is the major etiologic agent in causing UTI, which accounts for up to 75%-90% of cases whereas Staphylococcus saprophyticus causes an estimated 5 - 15% of UTIs frequently in younger women. P. mirabilis, Klebsiella species, P. aeruginosa and Enterobacter species are less frequent offenders. Less commonly, Enterococci, G. vaginalis and U. urealyticum are also known agents in UTIs. Gram-positive organisms are even less common in which Group B Streptococcus, S.
aureus, S. saprophyticus and S. haemolyticus are recognized organisms.

Due to the rapidly evolving adaptive strategies of bacteria, the etiology of UTI and antibiotic resistance profile of bacterial uropathogens have changed considerably over the past years, both in community and nosocomial infections. Many studies conducted from the USA and Europe have revealed increasing antibiotic resistance among uropathogenic E. coli to ampicillin, trimethoprim, and sulfonamides. Apparent shift in the etiological agents of urinary tract infection and associated problem of antibiotic resistance amongst bacterial uropathogens from time to time and from one institution to another have initiated health institution to carry out continuous evaluation of UTI from the view point of their spectrum and drug susceptibility testing. Accurate identification of bacterial uropathogens and determining their drug susceptibility pattern are critical for efficient management of patients with UTI. They are also associated with significant clinical and financial benefits, via the reduction of mortality rates and overall hospitalization costs.

In view of this, identification and antimicrobial susceptibility testing of clinical isolates by means of fully automated systems have become a common practice in many laboratories. The VITEK 2 compact system is a new automated system designed to provide accurate identification and susceptibility testing results for most common clinical isolates of both Gram-positive and Gram-negative bacteria. Apart from accurate identification and susceptibility testing shortened turnaround times, improved specimen handling, enhanced quality control, reproducibility and the ability to track results are further advantages of the system. Unfortunately, health care providers, identification and drug susceptibility profile of bacterial uropathogens have been carried by conventional methods that appeared to be inferior to the fully automated systems.

Treatment of UTIs cases is often started empirically and therapy is based on information determined from the antimicrobial resistance pattern of the urinary pathogens. However, a large proportion of uncontrolled antibiotic usage has contributed to the emergence of resistant bacterial infections. As a result, the prevalence of antimicrobial resistance among urinary pathogens has been increasing worldwide. Associated resistance, i.e. the fact that a bacterium resistant to one antibiotic is often much more likely to be resistant to other antibiotics, drastically decreases our chances of getting a second empirical attempt right. Resistance rates to the most common prescribed drugs used in the treatment of UTIs vary considerably in different areas world-wide. The estimation of local etiology and susceptibility profile could support the most effective empirical treatment. Therefore, investigating epidemiology of UTIs (prevalence, risk factors, bacterial isolates and antibiotic sensitivity) is fundamental for care givers and health planners to guide the expected interventions.

Women are more prone to UTIs than men because in females, the urethra is much shorter and closer to the anus than in males and they lack the bacteriostatic properties of prostatic secretions. The female genital tract is closely related to the bladder and this relationship makes the spread of diseases possible from one tract to the other. Therapeutic decision should be based on accurate, up-to-date anti-microbial susceptibility pattern. Interim data have been published from a European multi-Centre survey that examined the prevalence and antimicrobial susceptibility of community acquired pathogens causing uncomplicated UTI in women. The duration of treatment for adult has received much attention. Traditionally, a course of 7-10 days has been advocated, still this is the recommendation for treating men.

The introduction of antimicrobial therapy has contributed significantly to the management of UTIs. The antimicrobial agents used in treatment of UTI include cell wall inhibitors like penicillin, third generation Cephalosporins (Cefotaxime, Cephradine, Ceftazidime and Cefaclor), DNA gyrase inhibitors like Floroquinolones (Ciprofloxacin, Ofloxacín, Sparfloxacin and Enoxacin) and Aminoglycosides (Amikacin, Gentamycin and Kanamycin) that are protein synthesis inhibitors. Inappropriate and extensive use of antibiotics has lead to the development of multidrug resistance among the pathogens. In patients with suspected UTI, antibiotic treatment is usually started empirically, before urine culture results are available. To ensure appropriate treatment, knowledge of the organisms that cause UTI and their antibiotic susceptibility is mandatory. The ever changing pattern of sensitivity indicates the importance of continuous investigation for updating relevant data for intended use as guidelines for appropriate treatment by the physicians.

Commonly Antibiotic used in treatment of Urinary Tract Infection:

**Oral Therapy:**

| AGENTS                  |
|-------------------------|
| **Sulfonamides**        |
| **Trimethoprim-sulfamethoxazole** |
| **Penicillins:**        |
| Ampicillin              |
| Amoxicillin-clavulanic Acid |
| **Cephalosporins:**    |
| Cephalexin              |
| Cefaclor               |
| Cefadroxil             |
| Cefuroxime             |
| Cefixime               |
| Cefprozil              |
| Cefpodoxime            |
Tetracyclines:
- Tetracycline
- Doxycycline
- Minocycline

Fluoroquinolones:
- Ciprofloxacin
- Norfloxacin
- Levofloxacin

Nitrofurantoin

Aminoglycosides:
- Azithromycin
- Amikacin
- Fosfomycin

Parenteral Therapy:

Agents

Aminoglycosides:
- Gentamicin
- Tobramycin
- Amikacin

Penicillin:
- Ampicillin
- Ampicillin-sulbactam
- Ticarcillin-clavulanate
- Piperacillin-tazobactam

Cephalosporins, first-, second-, and third-generation

Carbapenems/ Monobactams:
- Imipenem-cilastatin
- Meropenem
- Ertapenem
- Aztreonam

Fluoroquinolones:
- Ciprofloxacin
- Levofloxacin

Uses of Antibiotic Sensitivity Patterns:

Helps in learning the resistance pattern of the pathogen.

Provides the further information about the pathogen susceptibility.

Leads to the proper pharmacotherapy of the patients and reduce the chances of the antibiotic resistance in the population.

DISCUSSION

Urinary tract infections (UTI) are serious health problems affecting millions of people each year. They are the second most common type of infections in the body, accounting for about 8.3 million visits to the hospitals each year. UTIs are caused by the presence of bacteria in urine, although fungi and viruses could be involved. E. coli is the major etiological pathogen causing UTI which account for up to 90% cases. E. coli was sensitive to antibiotic gentamycin, nitrofurantoin. The sensitive antibiotic to Klebsiella isolates are gentamicin, piperacillin tazobactum E. coli and Klebsiella pneumoniae were resistance to ampicillin. Enterococcus was sensitive to vancomycin & linezolid. Staphylococcus aureus was sensitive to vancomycin and was similar to the other studies. Escherichia coli isolated was resistant to cephalosporin (83%,71%), fluoroquinolones (79%,73%)

Nitrofurantoin is the mostly use drug for UTI and is mostly sensitive to all the pathogen. But nitrofurantoin is mostly not given to elderly patients due to renal impairment which leads to sub therapeutic effects. It is most effective against the E. coli which is resistant to cephalosporin (83%,71%), fluoroquinolones (79%,73%)

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CONCLUSION

The major pathogens causing the urinary tract infection are E.coli, Proteus sp., Staphylococcus sp., Pseudomonas sp., Klebsiella spp. and Candida spp. The mostly found is E.coli and is susceptible to Amikacin, Nitrofurantoin and Gentamicin. Klebsiella spp. is susceptible to Gentamicin, Piparacillin and Tazobactum. Enterococcus is susceptible to Vancomycin and Linizolid. Staphylococcus is susceptible to Vancomycin. Pseudomonas sp. Are sensitive to Nitrofurantoin and Ciprofloxacin. Candida spp. are sensitive to Ketocanazole.

The use of antibiotic should be done through a proper regimen and it is important to check the antibiotic sensitivity before the prescription of the antibiotic for any pathogen. As it may lead to antibiotic resistance. So the antibiotics should be prescribed only after checking the sensitivity of antibiotic over a pathogen.
REFERENCES

1. Prakash D, Saxena RS. Distribution and antimicrobial susceptibility pattern of bacterial pathogens causing urinary tract infection in urban community of meerut city, India. ISRN Microbiol [Internet]. 2013;13:749629. Available from: http://dx.doi.org/10.1155/2013/749629

2. Amali O, Indinyero MD, Umeh EU, Awodi NO. Urinary tract infections among female students of the university of agriculture, Makurdi, Benue State, Nigeria. Internet Journal of Microbiology. 2018;7(1):1–5.

3. Hoberman A, Charron M, Hickey RW, Baskin M, Kearney DH, Wald ER. Imaging studies after a first febrile urinary tract infection in young children. N Engl J Med [Internet]. 2003;348(3):195–202. Available from: http://dx.doi.org/10.1056/NEJMoa021698

4. Camacho V, Estorch M, Fraga G, Mena E, Fuertes J, Hernández MA, et al. DMSA study performed during febrile urinary tract infection: a predictor of patient outcome? Eur J Nucl Med Mol Imaging [Internet]. 2004;31(6):862–6. Available from: http://dx.doi.org/10.1007/s00259-003-1410-z

5. Sabrina J. Antimicrobial resistance among producers and non-producers of extended spectrum beta-lactamases in urinary isolates at a tertiary Hospital in Tanzania. BMC Research Notes. 2010;3:348-53.

6. Lacovelli V, Gaziev G, Topazio L, Bove P, Vespasiani G, Finazzi AE. Nosocomial urinary tract infections: a review. Urologia. 2014;81(4):222–27.

7. Olowe OA, Ojo-Johnson BB, Makaujoa OL, Olowe RA, Mabayoje VO. Detection of bacteriuria among human immunodeficiency virus seropositive individuals in Osogbo, south-western Nigeria. Eur J Microbiol Immunol (Bp) [Internet]. 2015;5(1):126–30. Available from: http://dx.doi.org/10.1556/EUJMI-D-14-00036

8. Loh K, Sivalingam N. Urinary tract infections in pregnancy. Malays Fam Physician. 2007;2(2):54–7.

9. 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 [Internet]. 2006;134(2):425–31. Available from: http://dx.doi.org/10.1017/s0950268805005005

10. Doern GV, Vautour R, Gaudet M, Levy B. Clinical impact of rapid in vitro susceptibility testing and bacterial identification. J Clin Microbiol [Internet]. 1994;32(7):1757–62. Available from: http://dx.doi.org/10.1128/jcm.32.7.1757-1762.1994

11. Donay J-L, Mathieu D, Fernandes P, Prégemarain C, Bruel P, Warnnier A, et al. Evaluation of the automated phoenix system for potential routine use in the clinical microbiology laboratory. J Clin Microbiol [Internet]. 2004;42(4):1542–6. Available from: http://dx.doi.org/10.1128/JCM.42.4.1542-1546.2004

12. Wilson ML, Gaido L. Laboratory diagnosis of urinary tract infections in adult patients. Clin Infect Dis [Internet]. 2004;38(8):1150–8. Available from: http://dx.doi.org/10.1086/383029

13. Kripke C. Duration of therapy for women with uncomplicated UTI. Am Fam Physician. 2005;72(11):2219.

14. Sundqvist M, Kahlmeter G. Pre-emptive culturing will improve the chance of getting it right when empirical therapy of urinary tract infections fails. J Antimicrob Chemother. 2020;64:227–228.

15. Farajinia S, Alikhani MY, Ghoshtalou R, Naghili B, Nakhibband A. Causative agents and antimicrobial susceptibilities of urinary tract infections in the northwest of Iran. Int J Infect Dis [Internet]. 2009;13(2):140–4. Available from: http://dx.doi.org/10.1016/j.ijid.2008.04.014

16. Clinical correlations: urinary tract in Medical Microbiology. 20th ed. London: UK, Prentice Hall Int Inc;

17. Kumar V, K. AA, N.F. The lower urinary tract and male genital system, chapter 21 in “Robbins and Cotran Pathologic basis of disease.” Aster J. C.

18. Kahlmeter G. The ECOSENS Project: a prospective, multinational, multicentre epidemiological survey of the prevalence and antimicrobial susceptibility of urinary tract pathogens—interim report. J Antimicrob Chemother [Internet]. 2000;46(90001):15–22. Available from: http://dx.doi.org/10.1093/jac/46.suppl_1.15

19. Nagaraj S, Kalal BS, Kamath N, Muralidharan S. Microbiological and antimicrobial profile of pathogens associated with pediatric urinary tract infection: one year retrospective study from a tertiary care teaching hospital. Nat J Lab Med. 2014;3(1):31-39.

20. Ashkenazi S, Even-Tov S, Samra Z, Dinari G. Uropathogens of various childhood populations and their antibiotic susceptibility. Pediatr Infect Dis J [Internet]. 1991;10(10):742–6. Available from: http://dx.doi.org/10.1097/00006454-199110000-00005

21. Dipiro JT, l. R, C. G, G. B, Michiel L. Pharmacotherapy a pathophysiological approach. 7th ed.

22. Rezwana Haque, Most. Laila Akter and Md. Abdus Salam. Prevalence and susceptibility of uropathogens: a recent report from a teaching hospital in Bangladesh, Bangladesh, Haque et al. BMC Res Notes 2015;8:416.

23. Savitha Nagaraj, BhuvaNeSh Sukhlal, Nivedita KaMath, SethuMadhavaN, MuralidharAn, Microbiological and Antimicrobial Profile of Pathogens Associated with Pediatric Urinary Tract Infection: A One Year Retrospective Study from A Tertiary Care Teaching Hospital, National Journal of Laboratory Medicine. 2014;3(1): 4-7.

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