ORIGINAL ARTICLE

Increasing Antibiotic Resistance in the Uropathogens

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Abstract

Objective: The main objective of our study was to determine the increasing resistance in the treatment of uropathogens among urinary tract infective patients of health center of Guru Nanak Dev University, Amritsar. **Materials and Methods:** The study was conducted in Guru Nanak Dev University by taking the samples from the suspected patients of urinary tract infection. Culturing and identification of the uropathogens were done by the standard procedures according to Clinical and Laboratory Standards Institute guidelines. Antimicrobial susceptibility test was done to check the antibiotic resistance against uropathogens in the treatment by standard guidelines. **Results:** Of 102 samples, 64 were found to be positive for the uropathogens. *Escherichia coli* was the most prominent uropathogen and fungi such as *Candida*. The predominant antibiotics used were belonging to the class of aminoglycosides, cephalosporins, fluoroquinolones, nitrofurans, and penicillin. **Conclusion:** The study indicates that most of the uropathogens isolated from the urinary tract infective patients were resistant to the major antibiotics which were used for the treatment. This resistance was due to the improper intake of the antibiotics and poor compliance of the patient. Hence, due to the resistance, it is very hard to treat the infected patient. For proper treatment, people should be aware of the antibiotic resistance and have to change their lifestyle to remove the cause of the antibiotic resistance.

Key words: Antibiotic resistance, midstream urine, nitrofurans, urinary tract infection, uropathogens

INTRODUCTION

In the routine outdoor patient, the most commonly spreading bacterial infection is urinary tract infection (UTI). Every year, approximately 150 million people are diagnosed with UTI.[1] UTI is the second most common infection which is caused mainly due to Gram-negative bacteria. Urine is a sterile fluid which is formed in the kidneys, and due to its nutritional components, it serves as one of the best culture media for the growth of major pathogens for UTI.

Every year, millions of people affected due to this serious health problem and it is one of the main causes of the Gram-negative bacteremia. Due to the non-judicious administration of the antibiotics, several types of changes occur in this infection from past years such as causes of the UTI and resistance of antibiotics against uropathogens.[2,3] The most common uropathogens present in the UTI patients are enteric Gram-negative bacteria, such as *Escherichia coli*, *Pseudomonas aeroginosa*, *Klebsiella pneumoniae, Shigella* spp., and *Proteus* spp., and sometimes fungi including *Candida albicans*. *E. coli* expresses a vacuolating cytotoxin which results in damage to kidney epithelium.[4] The presence of the uropathogens in the population varies with age of the patient, sex of the patient, sexual activity, and duration of the catheterization. Longer duration of the time of the catheterization is directly proportional to the risks of the UTI in patients. On the basis of the sex, UTI is more prone to the women as compared to the men due to the anatomical structure of the women genitourinary tract. UTI accounts for 35% of the hospital-acquired infections. The maximum number of women suffers from UTI at one point of their life and only one-third of the UTI cases are because of the recurrent infection.[5] UTI can be

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treated by the antibiotics, but nowadays it is one of the most common antibiotic-resistant infections. There are a number of factors responsible for the resistance of infection against antibiotics such as improper intake of the broad spectrum of antibiotics, long duration of hospitalization, insufficient health care, and immunosuppressant.[6,7] UTI is manifested by painful urination with burning sensation, abdominal pain, lower back pain, cloudy urine, and blood in the urine.

In today's era, the resistance of antibiotics against most of the uropathogens becomes one of the major concerns which occurs globally. From the past 10 years, this problem of the antibiotic resistance increased five-fold.[8,9] The result of a large number of antibiotic resistances against uropathogens is due to not proper intake of antibiotics as per subscription or poor compliance of patient. In today's era, due to Amp C enzymes and extended spectrum of beta-lactamase, resistance of fluoroquinolones against uropathogens such as *Klebsiella* and *E. coli* has been developed day to day.[10,11] On molecular basis, the resistance is due to some genetic particles such as transposons, plasmids, and integrons. They play a very vital role to increase the power of the resistance. As the continuous increase in the antibiotic resistance, remaining antimicrobial drugs have a higher likelihood of causing unwanted side effects such as gastrointestinal distress, kidney-related problems, nausea, and vomiting.

MATERIALS AND METHODS

Urine contains a variety of fluids, salts, and waste products. In healthy individual, the urine acts as a sterile fluid which is devoid of any kind of bacterial species. UTI gives a detail account of the condition in which there are microorganisms entrenched and reproduced asexually within the urinary tract. Various methods and materials are employed to the bacteriological study of these samples.

Specimen Collection

The specimen used for microbiological analysis is mid-stream urine sample, collected early morning. This sample is collected in sterile, wide-mouthed container. The samples were collected from the Health Center of Guru Nanak Dev University. Proper record of all the samples collected throughout the study was maintained. Required precautions were taken while collecting the sample, as well as for further analysis of the samples.

Isolation of UTI Ccausing Microorganisms

The urine sample brought from health center was immediately plated on MacConkey Agar Medium (HiMedia Lab. Pvt. Ltd. Mumbai) for isolation of various uropathogens.[12] Inoculated plates were under incubation of 24 h at 37°C. Results were recorded after incubation as lactose-fermenting/non-lactose-fermenting isolates and colony-forming Units/ml. The suspected samples were preserved, and along with this, the biochemical analysis was carried out.

Isolation of Pathogenic Bacteria

Identification was done by performing the following tests:

- Gram staining
- Eosin methylene blue test
- SIM agar test
- Methyl red
- Triple sugar iron test
- Voges–Proskauer test.

Sensitivity Test

After the confirmation of bacteria, various antibiotics were checked on the specific medium called Mueller Hinton medium (MHA) [Table 1].[13] Sterile Mueller-Hinton Agar is poured into Petri plates kept on the leveled surface. The depth of the medium should be 4 mm. After the medium has solidified, plates were dried for 30 min in an incubator to remove excess moisture from the surface. MHA is the microbiologically growth medium that is commonly used for antibiotic sensitivity testing.[14,15] Disk diffusion method was adopted by placing an antibiotic disk on the spread-cultured MHA Petri plates and incubated at 37°C for 24 h. Zone of inhibition was observed after the incubation.

RESULTS

Different types of Gram-negative bacteria were isolated and confirmed by Gram staining and other biochemical tests. The major cause of UTI identified by these tests is *E. coli*. The antibiotic susceptibility test was done for all the isolates by Kirby–Bauer method or disk diffusion method

Table 1: Antimicrobial classification used in the study

Group name	Name of the antimicrobials
Aminoglycosides	Amikacin, Gentamicin, Kanamycin, Streptomycin, Tobramycin, Nitilin
Cephalosporins	Cefixime, Cefepime, Cefoperazone/Sulbactam, Ceftazidime
Fluoroquinolones	Ciprofloxacin, Norfloxacin, Ofloxacin, Lomefloxacin, Nalidixic acid
Penicillin	Amoxicillin, Ampicillin, Oxacillin, Aztreonam, Meropenem, Piperacillin/Tazobactam, Amoxicillin/Sulbactam
Others	Lincomycin, Minocycline, Nitrofurantoin, Chloramphenicol, Trimethoprim

Table 2: Uropathogens isolated from the samples

Organisms isolated	Percentage
Escherichia coli	51
Pseudomonas aeruginosa	5
Klebsiella spp.	4
Candida spp.	2
Proteus spp.	1
Shigella spp.	1

Table 3: Antimicrobial resistance pattern

Antibiotics class	Antibiotics	Resistance (%)
Aminoglycosides	Amikacin	83
	Gentamicin	84
	Kanamycin	83
	Streptomycin	83
	Tobramycin	85
	Nitilin	82
Cephalosporin	Cefixime	84
	Cefepime	92
	Cefoperazone/sulbactam	82
	Ceftazidime	100
Fluoroquinolones	Ciprofloxacin	84
	Norfloxacin	81
	Ofloxacin	81
	Lomefloxacin	85
	Nalidixic acid	84
Penicillin	Amoxicillin	79
	Ampicillin	100
	Oxacillin	78
	Aztreonam	84
	Meropenem	81
	Piperacillin/Tazobactam	88
	Amoxycillin/Sulbactam	80
Others	Lincomycin	100
	Minocycline	80
	Nitrofurantoin	81
	Chloramphenicol	100
	Trimethoprim	73

with commercially available disk (HiMedia) of Amikacin, Gentamicin, Kanamycin, Tobramycin, Streptomycin, Ciprofloxacin, Nalidixic acid, Ofloxacin, Norfloxacin, Amoxicillin, Ampicillin, Oxacillin, Amoxicillin/Sulbactam, Piperacillin/Tazobactam, Cefixime, Minocycline, Lincomycin, Erythromycin, Nitrofurantoin, Trimethoprim, and Meropenem.

Of 102 samples, 64 samples were found positive for uropathogens [Table 2]. Most of the samples were *E. coli* positive and were resistance to Amikacin, Gentamicin, Kanamycin, Tobramycin, Netillin, Streptomycin, Ciprofloxacin, Lomefloxacin, Nalidixic acid, Ofloxacin, Norfloxacin, Amoxicillin, Ampicillin, Oxacillin, Amoxicillin/Sulbactam, Piperacillin/Tazobactam, Cefixime, Ceftazidime, Cefoperazone/Sulbactam, Tetracycline, Minocycline, Lincomycin, Erythromycin, Nitrofurantoin, Trimethoprim, and Meropenem [Table 3].

DISCUSSION

It has been argued that there is a direct relationship among susceptibility and specific medium for detection. As per susceptibility of different pathogens toward antibiotics indicated increasing resistance among fluoroquinolones, this has been occurred due to non-judicious administration of prescribed regimen and quantity. Some underdiagnosed samples for O157:H7 strain of *E. coli* may conclude the catastrophic outcome of the treatment.[16] Major presence of *E. coli* (O157:H7) and resistance toward generally recommended fluoroquinolones posed a blatant challenge to public health system.

In our record antibiotics (aminoglycosides, fluoroquinolones, cephalosporins, penicillin, and others) had shown complete resistance for most of the samples.[17,18] Therefore, it can be stated that disease control centers/primary care providers will have to look into the strategy again to combat increasing resistance pattern.

As we know that *E. coli* is a major threat in UTIs, we will have to control increasing resistance through surveillance and following cultural practices of samples of patients protecting our general health and economy (treatment) for resource-limiting countries like India.

CONCLUSION

This study provides an overview about the antibiotic-sensitive patterns and increasing antibiotic resistance against the most commonly used antibiotics for the treatment of UTI. To treat the patients in the early stage of the UTI, it is mandatory to know the causative agent and its antibiotic susceptibility. After knowing these two factors, patient is able to choose correct drug for the treatment. To reduce the emergence spread antimicrobial resistance, patient should have to take the antimicrobials in careful and appropriate manner or there is need to give the awareness to the people about the hazardous effect of the antimicrobial resistance and inappropriate antimicrobial use through public health organization campaigns. We should also have to take the antimicrobials by the prescription of the doctor after proper checkup. Reduction of antibiotic resistance leads to the easy and proper treatment.

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