

Urinary Tract Infections: Epidemiology, Mechanisms of Infection, and Treatment

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ABSTRACT

Purpose: The main purpose of this study was to determine the mechanism of infection and the response of preferred antibiotic treatment during this study.

Study: This study was conducted from February to March 2022. The approval for this randomized study was taken by the Ethical Committee of the concerned hospital. Written informed consent was signed by all participants. Total of 110 participants who reported problems with UTIs were part of this study. Levofloxacin 750 mg per day for five days and ciprofloxacin 500 mg twice per day for ten days were given to patients for treatment.

Results: The total number of patients was 110, 65 (59.09%) males and 45 (40.90%) females having a mean age of 28 ± 5 , urinary tract abnormalities were observed in 28 (25.45%) patients including obstruction in 16 (14.54%) patients, stone in 8 (7.27%) cases, the neurogenic bladder was in 4 (3.63%) patients and poly-microbial etiology was in 25 (22.72%) and catheterized patients was 35 (31.81%) in which chronic catheter cases were 15 (13.63%), intermittent catheter cases were 20 (18.18%), and Complicated UTIs was found in 22 (20.02%). 55 patients were treated with levofloxacin 51 (46.36%) reported a positive response and 51 (46.36%) were not cured with a p-value of 0.05. 55 patients were treated with ciprofloxacin of which 48 (43.63%) patients were cured and 7 (6.36%) were not cured with a p-value of 0.05. The number of patients treated with levofloxacin had a higher cured percentage 46.36% than those treated with Ciprofloxacin.

Conclusion: Eventually, this study demonstrated that UTIs of all the microorganisms detected during the study can be cured with levofloxacin and ciprofloxacin. While ciprofloxacin was slightly less effective in a few cases than levofloxacin.

Keywords: Urinary tract infection (UTIs), Ciprofloxacin, levofloxacin, infection treatment

INTRODUCTION

Worldwide urinary tract infections (UTIs) have been affecting more than 150 million people each year.¹ Clinically, it's divided into uncomplicated and complicated UTIs. As uncomplicated UTIs have no structural or neurological damage and the affected individuals seem healthy.²⁻³ While it's discrimination based on lower and upper UTIs problems of cystitis and pyelonephritis.⁴ Cystitis has a potent association with many risk factors like female gender, sexual activity, vaginal infection, and other diseases including diabetes and obesity along the genetic factors.⁵ Although complicated UTIs can be defined with risk factors associated with or cause urinary tract obstruction, urinary retention because of neurological disorder, renal failure, transplantation, and other factors foreign bodies, calculi, etc.⁶ The bacteria (gram positive and gram negative) and certain fungi might be causative agents for UTIs.⁷ Most patients are treated with antibiotics that lead to changes in normal microflora of the vagina and gastrointestinal tract as well as in the production of multidrug-resistant microorganisms.⁸ Although, women are suspected to develop UTIs because of the shorter urethra while older adults are at higher risk of cystitis due to alteration of bladder abnormalities. Commonly, pregnant women are at great risk to suffer from urinary tract infections, untreated asymptomatic bacteriuria increases the chances of premature delivery, pyelonephritis, and fetal mortality.⁹ Oral amoxicillin is used to treat the asymptomatic and symptomatic bacteriuria in pregnant women probably for ten days or recommend nitrofurantoin for 7 days.¹⁰ Moreover, for UTIs treatment trimethoprim, is prior to use except for women who show resistance while following the local guidelines. Escherichia coli is more frequently found in female patients than in males diagnosed with urinary tract infections. Morganella morganii is commonly observed in patients who undergo Urological devices.¹¹ Pseudomonas aeruginosa, Staphylococci, Candida species, and many other organisms isolated from infected people.¹²

In this study we have focused on epidemiology, mechanism of action of catheter-associated infection as well as treated the participants with antibiotics.

METHODOLOGY

This study was conducted from February to March 2022. The approval for this randomized study was taken by the Ethical Committee of the concerned hospital. Written informed consent was signed by all participants. Total of 110 participants who reported problems with UTIs were part of this study. Levofloxacin 750 mg per day for five days and ciprofloxacin 500 mg twice per day for ten days were given to patients for treatment.

Inclusion Criteria: Patients of age 20 to 35 years were part of the study. Patients diagnosed with Acute pyelonephritis (AP) and UTIs with 10^5 colony forming units. CFUs were included. Moreover, people have a history of

- Fever, nausea, vomiting, dysuria
- Flank pain or cost vertebral angle tenderness
- Patients reported complicated factor neurogenic bladder, partial obstruction, and distorted urethral structure

Exclusion criteria

- People had a history of surgery
- Chronic pyelonephritis
- People with complete obstruction were also excluded from this study

Mechanism of pathogenesis associated with catheter urinary tract infection: Urinary tract infections associated with catheter conciliated by Proteus mirabilis that based on the appearance of Pili (mannose- resistant Proteus like) for its attachment to develop the biofilm in the bladder and on the surface of the catheter. Ensuuing the urease formation that leads to the development of calcium crystals and starts the precipitation of magnesium ammonium phosphate in urine because of hydrolysis of CO_2 and ammonia, this process increases the pH. The attached bacteria on the catheter use crystal and produced the crystalline biofilm; it acts as a safeguard to protect from the host immune system and from antibiotics. On the other hand, it causes trouble with urine drainage and reflux problem. It leads to developing pyelonephritis, shock as well as septicemia. Although, bacteria toxins production starts damaging the tissues and bacteria spreads to the kidneys. Bacterial toxins induced the pores and enter the cell membranes to

destabilize the host cell and destroy tissues. Catheter implantation causes inflammation of the bladder and releases fibrinogen that begins to accumulate. Enterococcus faecalis uses the fibrinogen as food and make a biofilm that protects bacteria from the host immune system.

Statistical Analysis was performed using statistic software 8.1. The data was presented in the number of percentages and a p-value less than 0.05 shows significant results and a p-value higher than 0.05 shows a non-significant response.

RESULTS

The total number of patients was 110, 65 (59.09%) males and 45 (40.90%) females having a mean age of 28 ± 5 , urinary tract abnormalities were observed in 28 (25.45%) patients including obstruction in 16 (14.54%) patients, stone in 8 (7.27%) cases, the neurogenic bladder was in 4 (3.63%) patients and poly-microbial etiology was in 25 (22.72%) and catheterized patients was 35 (31.81%) in which chronic catheter cases were 15 (13.63%), intermittent catheter cases were 20 (18.18%), and Complicated UTIs was found in 22 (20.02%). Data of all the patients were given in table 1.

Table 2. Represents 55 patients were treated with levofloxacin, 51 (46.36%) reported a positive response, and 51 (46.36%) were not cured with a p-value of 0.05. 55 patients were treated with ciprofloxacin of which 48 (43.63%) patients were cured and 7 (6.36%) were not cured with a p-value of 0.05. The number of patients treated with levofloxacin had a higher cured percentage 46.36% than those treated with Ciprofloxacin.

Table 3. Represents the microbial-related data where 15 cases of chronic catheter isolated with different microbes in which Pseudomonas aeruginosa was found in 3 (20%), E.coli isolated from 3 (20%) cases, Enterococcus species in 5 (33.33%), Coagulase-negative staphylococcus in 4 (26.66%) cases, and Providencia species in 1 (6.66%).

Table 1: General Characteristic of Study

Characteristic	Number of patients 110 (%)
Gender	
Male	65 (59.09%)
Female	45 (40.90%)
Age (Mean+ S.D) years	28 ± 5
Urinary Tract abnormalities	28 (25.45%)
Obstruction	16 (14.54%)
Stone	8 (7.27%)
Neurogenic bladder	4 (3.63%)
Poly microbial	25 (22.72%)
Catheterized	35 (31.81%)
Chronic catheter cases	15 (13.63%)
Intermittent catheter cases	20 (18.18%)
Complicated UTI	22 (20.02%)

Tables 2: Patients response with levofloxacin and ciprofloxacin

Treatment	Number of patients cured	Number of patients not cured	P-value
Levofloxacin	51 (46.36%)	4 (3.63%)	0.05
Ciprofloxacin	48 (43.63%)	7 (6.36%)	0.05

Table 3: Isolated organisms with complicated urinary tract infections

Organism isolated	Chronic catheter cases n=15	Intermittent catheter cases n=20	Complicated UTI cases n=22
Pseudomonas aeruginosa	3 (20%)	6 (30.00%)	3 (13.63%)
Escherichia coli	3 (20%)	4 (20.00%)	7 (31.81%)
Enterococcus species	5 (33.33%)	3 (15.00%)	3 (13.63%)
Coagulase-negative staphylococcus	4 (26.66%)	3 (15.00%)	4 (18.18%)
Providencia species	1 (6.66%)	4 (20.00%)	5 (22.72%)

Similarly, in 20 intermittent catheter cases, Pseudomonas aeruginosa was isolated from 6 (30.00%) cases, E.coli isolated from 4 (20.00%) cases, Enterococcus species in 3 (15.00%) Coagulase-negative staphylococcus in 3 (15.00%) cases, and Providencia species in 4 (20.00%) cases.

Complicated UTI cases includes Pseudomonas aeruginosa 3 (13.63%) cases, E.coli were diagnosed 7 (31.81%) patients, Enterococcus species in 3 (13.63%) patients, Coagulase-negative staphylococcus in 4 (18.18%) patients, and Providencia species in 5 (22.72%) cases.

DISCUSSION

Among the common bacterial infections UTIs is one of them, ensuing the billion dollars expenses in health care department every years.¹³ Currently, for UTIs infections, recommended medication for treatment is antibiotics such as trimethoprim-sulfamethoxazole, ciprofloxacin, and ampicillin. However, antibiotic resistance development is another important and growing factor that brings a 25% change in the management of UTI treatment.¹⁴ Worldwide antibiotic resistance is a substantial threat to the safety of patients. The development of infection because of antibiotic resistance can lead to more damage to patients' health.¹⁵

In this study variety of infecting organisms were isolated from different patients in which Escherichia coli was the most common organism found in complicated UTIs cases. Pseudomonas aeruginosa was the second most micro-organism detected in 6 cases out of 20 cases of intermittent catheters while the third most was Enterococcus species found in 5 cases of chronic catheter factor. In females after menopause estrogen levels begin to decline that bringing chemical and structural alterations like decreasing the urinary flow, enhancing the residual volume, and raising vaginal pH high causing loss of lactobacilli in the vagina which enhanced the chances to develop urinary tract infection.¹⁶ In the cross-sectional study of UTIs in adult females demonstrated that 14% was prevalent in bacteriuria, and Escherichia coli 34.5% was the main organism detected to lead the infection, antibiotic was used to treat both situations.¹⁸ A clinical study demonstrated that the administration of levofloxacin for five days is more effective than ciprofloxacin for the treatment of AP. Moreover, they concluded that short-term therapy is more effective than long-term therapy.¹⁷ In this study we use levofloxacin and ciprofloxacin both to treat the different organisms. Ciprofloxacin was slightly more effective than levofloxacin. Moreover, we studied the mechanism of action of infection which needs more research and studies to explain

CONCLUSION

This study concluded that the cauterized cases were higher in number that cases the infection in patients. Urinary infection because of all the microorganisms detected during study can be cured with levofloxacin and ciprofloxacin.

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