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SENSITIVITY PATTERN OF URINARY TRACT PATHOGENS

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ABSTRACT

The main aim of this study was to determine the sensitivity and resistance pattern of Urinary tract pathogens. Knowledge of sensitivity and resistance pattern of uropathogens in geographical locations is an important factor for choosing suitable antibacterial treatment. Patient information was obtained from medical record files. A total of 146 samples were analyzed. The organisms were isolated as the causative factors. *E.coli* (57.46%) *Klebsiella* (23.13%) and *Staphylococcus* (20.89%). Analysis of the samples showed that UTI was more common in females of younger age group as compared to males. The most common organism to cause UTI was found to be *E.coli* followed by *Klebsiella. E.coli* was found to be sensitive to Furazolidone (52%) and Nitrofurantoin (52%). Similarly Klebsiella to Furazolidone and Nitrofurantoin and *Staphylococcus* to Nitrofurantoin and Amikacin.

Key words: Urinary tract, Pathogens, Ueopathogen, *E.coli*

INTRODUCTION

A urinary tract infection (UTI) is a condition where one or more parts of the urinary system (the kidneys, ureters, bladder, and urethra) become infected after bacteria overcome the system's strong natural defenses.[1] In spite of these defenses, UTIs are the most common of all infections and can occur at any time in the life of an individual. Almost 95% of cases of UTIs are caused by bacteria that typically multiply at the opening of the urethra and travel up to the bladder. Much less often, bacteria spread to the kidney from the bloodstream.[2]

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***The Urinary System*: -** The urinary system helps maintain proper water and salt balance throughout the body and also expels urine from the body. It is made up of the following organs and structures.[2]The two kidneys, located on each side below the ribs and toward the middle of the back, play the major role in this process. They filter waste products, water, and salts from the blood to form urine. Urine passes from each kidney to the *bladder* through thin tubes called *ureters*.[3] Ureters empty into the bladder, which rests on top of the pelvic floor. This is a muscular structure similar to a sling running between the pubic bone in front to the base of the spine. The bladder stores the urine, which is then eliminated from the body via another tube called the *urethra*, the lowest part of the urinary tract. Some people with symptoms of cystitis have a bacterial count lower than that ordinarily found in UTI. Such patients are sometimes diagnosed with acute urethral syndrome.[3] This condition is usually caused by *E. coli* or other bacteria that cause cystitis, but in lower numbers, or by a sexually transmitted disease such as *Chlamydia* or gonorrhea.

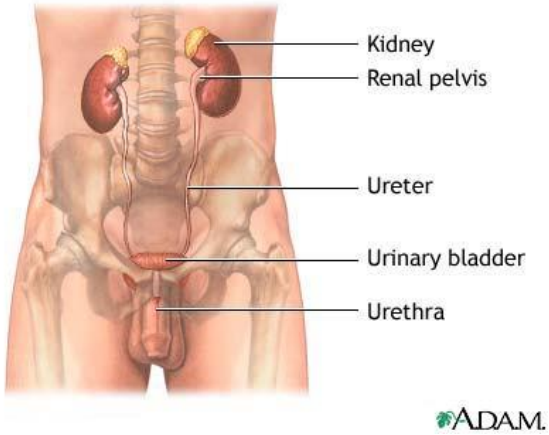

Figure 1:- Male Urinary System

Causes:-

The bacterial strains that cause UTIs include:-

Escherichia (E.) coli is responsible for 75 - 90% of uncomplicated cystitis cases in younger women and in more than half the cases in older women (over age 50). In most cases of UTI, *E. coli*, which originates as a harmless microorganism in the intestines[4], spreads to the vaginal passage, where it invades and colonizes the urinary tract. Some bacteria may be able to invade into deeper tissue in the bladder, where they survive to reinfect the patient after resolution of the previous infection.

Staphylococcus saprophyticus accounts for 5 - 15% of UTIs, mostly in younger women. Infections caused by this bacterium tend to have a seasonal variation, with a higher incidence in

the summer and fall than in the winter and spring. *Klebsiella*, *Enterococci* bacteria, and *Proteus mirabilis* account for most of remaining bacterial organisms that cause UTIs. They are generally found in UTIs in older women.[5] Rare bacterial causes of UTIs include *ureaplasma urealyticum* and *Mycoplasma hominis*, which are generally harmless organisms.

Symptoms:-

Symptoms of lower urinary tract infections usually begin suddenly and may include one or more of the following signs:

- The urge to urinate frequently, which may recur immediately after the bladder, is emptied[6].
- A painful burning sensation. (If this is the only symptom, then the infection is most likely urethritis, an infection limited to the urethra).[7]
- Discomfort or pressure in the lower abdomen. The abdomen can feel bloated.[8]
- The urine often has a strong smell, looks cloudy, or contains blood. This is a sign of *pyuria*, or a high white blood cell count in the urine, and is a very reliable indicator of urinary tract infections.[6,9]
- Occasionally, fever develops.

RISK FACTORS

Specific Risk Factors in Women:-

Structure of the Female Urinary Tract: - In general, the higher risk in women is mostly due to the shortness of the female urethra, which is 1.5 inches compared to 8 inches in me Bacteria from fecal matter can be easily transferred to the vagina or the urethra.

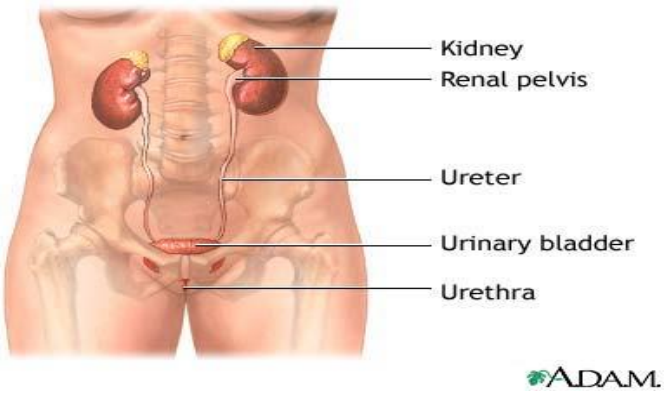

Figure 2:-Female Urinary System

Sexual Behavior: - Frequent or recent sexual activity is the most important risk factor for urinary tract infection in young women. Nearly 80% of all urinary tract infections occur within

24 hours of intercourse.[10] (Sexual activity is less associated with cystitis in women after menopause).UTIs are very rare in celibate women. It is important to stress, however, that UTIs are *NOT* sexually transmitted infections, although these infections (Chlamydia *trachomatis*, gonorrhea, or herpes simplex virus) may increase the risk for UTIs.

In general, however, it is the physical act of intercourse itself that produces conditions that increase susceptibility to the UTI bacteria, with some factors increasing the risk:

- Women having sex for the first time or who have intense and frequent sex after periods of abstinence are at risk for a condition called "honeymoon cystitis".[10,11]
- A sudden increase in the frequency of sexual intercourse poses a significant risk for UTI, particularly if a diaphragm is used.[11]
- Recent changes in sexual partners.
- Sexual position (such as the woman on top) can contribute to the risk.

Specific Risk Factors in Men:-

Men become more susceptible to UTIs after 50 years of age, when they begin to develop prostate problems. Benign prostatic hyperplasia (BPH), enlargement of the prostate gland, can produce obstruction in the urinary tract and increase the risk for infection. In men, recurrent urinary tract infections are also associated with prostatitis, an infection of the prostate gland that is caused by *E. coli*. Although only about 20% of UTIs occur in men, these infections can cause more serious problems than they do in women. Urethra length is approximately 25–50 mm (1–2 in) long in females, versus about 20 cm (8 in) in males.[10] Men with UTIs are far more likely to be hospitalized than women.[10]

Specific Risk Factors in Children:-

Each year, about 3% of American children develop urinary tract infections. During the first few months of life, UTIs are more common in boys than in girls. Boys who are uncircumcised are about 10 - 12 times more likely than circumcised boys to develop UTIs by the time they are 1 year old. After the age of 2 years, [12] UTIs are far more common in girls. Throughout childhood, the risk of UTIs is about 2% for boys and 8% for girls. As with adults, *Escherichia coli* (*E. coli)* is the most common cause of UTIs in children.[13]

Vesicoureteral Reflux VUR: - Vesicoureteral reflux (VUR) affects about 10% of all children. It is the source of urinary tract infections in 30 - 50% of childhood cases.[14] This is a structural defect of the valve-like mechanism between the ureter and bladder that allows urine to flow backward, carrying infection from the bladder up into the kidneys. VUR also puts children at risk

for recurrence. Such recurrences nearly always occur within the first 6 months after the first UTI.[14]

Treatment:-

Antibiotics are the main treatment for all UTIs. A variety of antibiotics are available, and choices depend on many factors, including whether the infection is complicated or uncomplicated or primary or recurrent.[15] Treatment decisions are also based on the type of patient (man or woman, a pregnant or nonpregnant woman, child, hospitalized or nonhospitalized patient, person with diabetes). Treatment should not necessarily be based on the actual bacteria count. For example, if a woman has symptoms, even if bacterial count is low or normal, infection is probably present, and the doctor should consider antibiotic treatment.[16]

Treating Moderate-to-Severe Kidney Infections*:* - Patients with moderate-to-severe acute kidney infection and those with severe symptoms or other complications may need to be hospitalized.[17] In such cases, antibiotics are usually given intravenously for 3 - 5 days or until symptoms are relieved and patients have not shown any signs of fever for 24 - 48 hours. If fever and back pain continue after 72 hours of antibiotic administration, the doctor will usually order imaging tests to see if abscesses, obstructions, or other abnormalities are present.

Treating Chronic Kidney Infections: - Patients with chronic pyelonephritis are often treated with long-term antibiotics, even during periods when they have no symptoms. Children with acute kidney infection are treated with oral cefixime (Suprax) or a short course (2 - 4 days) of an intravenous (IV) antibiotic (typically gentamicin, given in one daily dose). An oral antibiotic then follows the IV.

Medications

Although antibiotics are the first treatment choice for urinary tract infections, antibiotic-resistant strains of *E. coli*, the most common cause of UTIs, are increasing worldwide. As more bacteria have become resistant to the standard UTI treatment trimethoprim-sulfamethoxazole (TMP-SMX) [18], more doctors have prescribed quinolone antibiotics to treat UTIs. In some areas, quinolones have now overtaken TMP-SMX as the most commonly prescribed antibiotic for UTIs. Researchers are concerned that resistance may develop to these drugs as well.[17]

Antimicrobial Susceptibility Testing:-

Antimicrobial Susceptibility testing was performed using the disk diffusion method as described by the National Committee for Clinical Laboratory Standards.[18] Antimicrobial agents (disks) tested and reported were obtained from their respective manufacturers and included: Penicillin G

(10U)[19], Ampicillin (10 µg), Oxacillin (1µg), Ampicillin/Clavulanic acid(30µg) Piperacillin/tazobactam(110/10µg)[7],Cephalothin(30µg),Cefuroxime(30µg),Cefoxitin(30µg),Ceftriaxone(30µg), Cefotaxime(30µg), Ceftazidime(30µg), Imipenem(10µg), Ciprofloxacin(5µg) ,Nalidixicacid,Gentamicin(10µg),Gentamicin(200µg),Amikacin(30µg),Vancomycin(30µg),Teicoplanin(30µg), Trimethoprim/Sulfamethoxazole(25/23.75 µg).

E. coli ATCC25922, *Staphylococcus aureus* ATCC29213, *Pseudomonas aeruginosa* ATCC27853, *E. faecalis* ATCC29212[20], *E. coli* BCC2132, and *E. coli* ATCC 35218, were used as quality control strains. Interpretative criteria for each antimicrobial tested were those recommended by NCCLS-2000.[16]

RESULTS AND DISCUSSION

Bacterial organisms were collected from 146 patients during the study. There were 78.7% females and 21.3% males. Male female ratio was 1:6. The predominant organism was *E.coli* which was responsible for (57.46%) of the infection. *Klebsiella* was responsible for (23.13%) of infections while the rest were accounted for by *Staphylococcus* (20.89%). The analysis of isolates is shown in Table-1.

Table-1-: Isolated Bacteria from the Patients

Type of organism	No. of cases	Percentage
Escherichia coli	81	57.46%
Klebsilla	36	23.13%
Staphylococcus	29	20.89%

In the present study the pattern of pathogens causing UTI and their antibiotic sensitivity pattern is analyzed. *E.coli* was the most frequent species isolated in this study. *E.coli* had a sensitivity rate of 52% to Furazolidone, 52% to Nitrofurantoin, 50.66% for Gatifloxacin, 30.66% to Levofloxacin and the least 24% to Co-trimoxazole where as it has shown highest resistance to Cefexime about 49.33% and Amoxicillin 46.66%.

Klebsiella showed the highest sensitivity to Furazolidone (87.09%) Nitrofurantoin (70.96%) and Ampicillin (45.16%) where as highest resistance to Amoxicillin (70.96%) and Co-trimoxazole (58.06%).

Staphylococcus had the highest sensitivity to Furazolidone (72%) Nitrofurantoin (50%) and Gatifloxacin (42.85%) where as highest resistance to Co-trimoxazole (64.28%) and Ampicillin (57.14%).The slow, but persistent decrease in sensitivity of *E.coli* to Cefexime and Amoxicillin is worrying because these antibiotics have proven very effective for the treatment of UTI. *Klebsiella* is rarely encountered in cases of community-acquired UTI. It was detected in 23.13%

samples in this study and exhibited good susceptibility to most antibiotic tested except the aminopenicillins, Ampicillin/Clavulanic acid and the first-generation Cephalosporin-Cephalothin.Nevertheless Klebsiella species were more resistant to Amoxicillin than *E.coli* in this study.Sensitivity and Resistance Pattern of Causative Organisms was shown in Figure 3 to 8. High resistance rates to oral antibiotics in our study may be due to the uncontrolled consumption of antibiotics. On the other hand resistance to Amikacin, Ciprofloxacin, and Nitrofurantoin are low likely reflecting lower usage of these drugs.

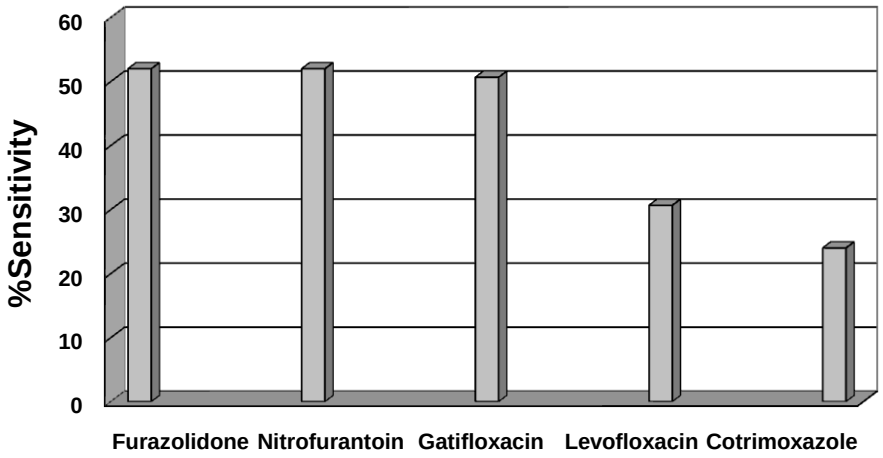

Figure-3 %Sensitivity pattern Of *E.coli*

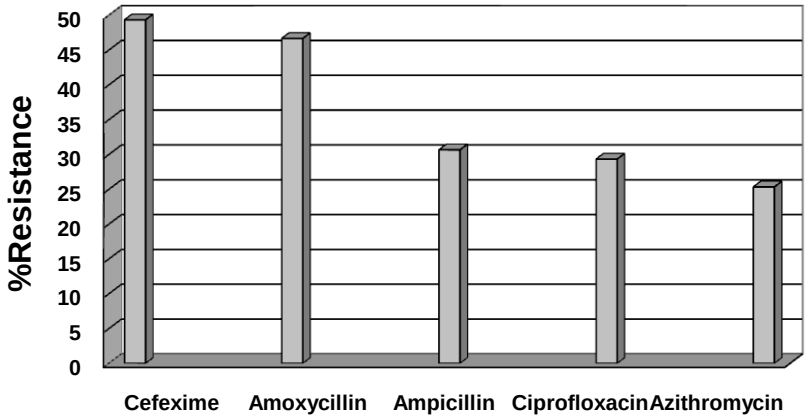

Figure -4 %Resistance pattern of E.*coli*

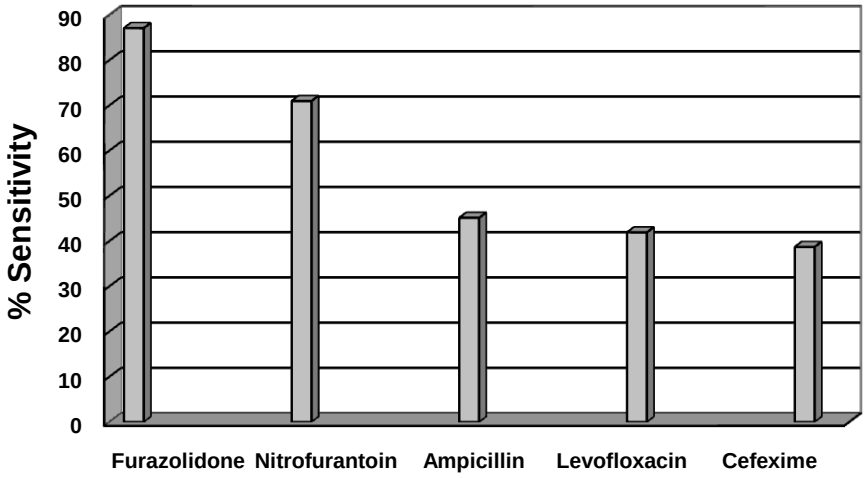

Figure -5 %Sensitivity pattern of *Klebsiella*

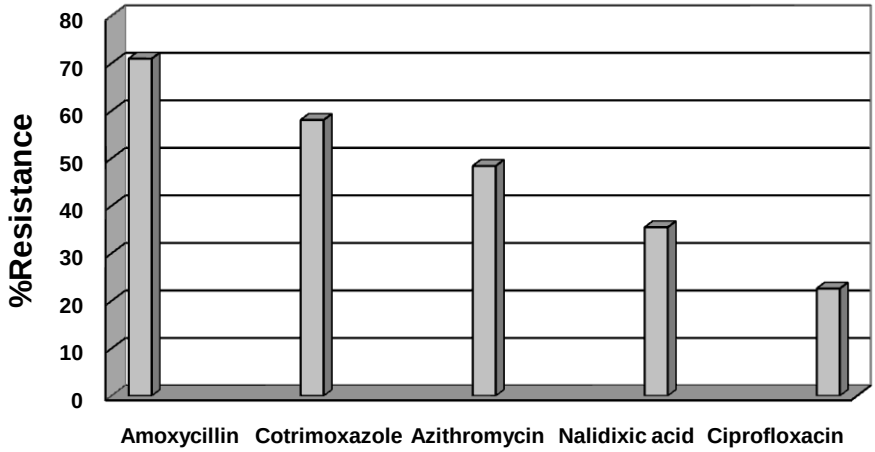

Figure -6 %Resistance of *Klebsiella*

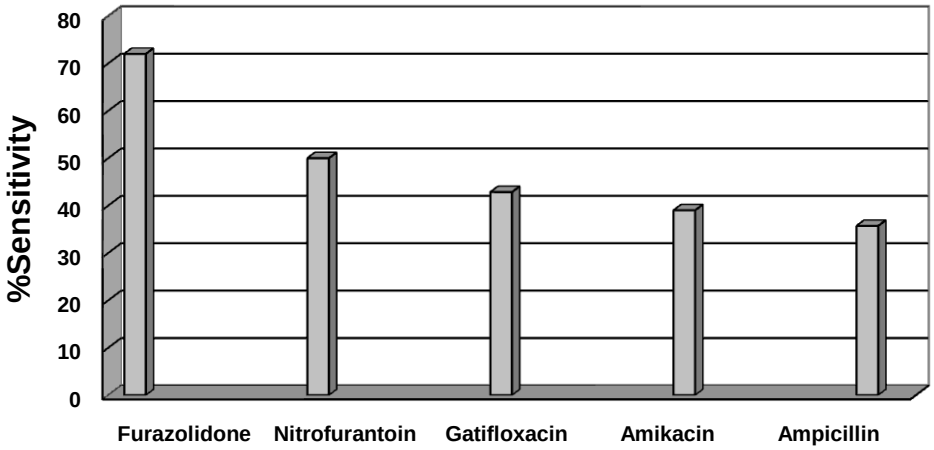

Figure-7 %Sensitivity of Staphylococcus

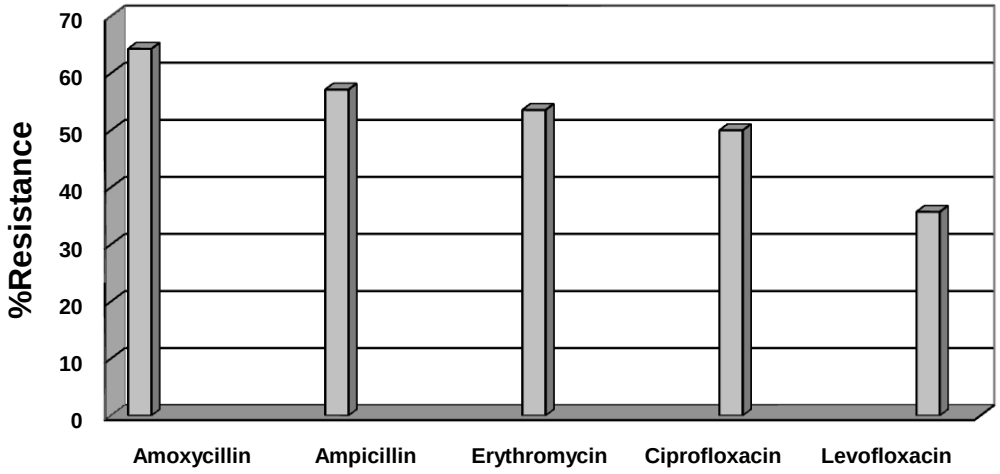

Figure -8 %Resistance of Staphylococcus

Our study demonstrates extremely low susceptibility to the first line agents Ampicillin, Furazolidone, Nitrofurantoin etc. As these oral agents usually achieve high urinary concentrations, the in vitro resistance may not result in treatment failure. However recent studies have demonstrated therapeutic failure in more than 50% of patients infected with Co-trimoxazole resistant urinary pathogens.

CONCLUSION

This study of sensitivity and resistance pattern of urinary tract pathogens for specific antibiotics reveals an idea about the susceptibility of the pathogen to a respective antibiotic. In the above study the high incidence of resistance to **Ampicillin** and **Amoxicillin** in the present study may be attributed to the easy access to and indiscriminate use of these drugs. With this pattern of resistance it is recommended that **Ampicillin** and **Amoxicillin** should not be used as First-line agents in the treatment of Urinary tract infections. This type of study is utilized by physicians to make out the choice of drug that is to be used as a First line agent. Since a very high percentage of isolates in this study were sensitive to **Nitrofurantoin,** this drug would be a better choice of UTI therapy. The appropriate use of antibiotics however with the knowledge of the sensitivity pattern would help to reduce the rate of morbidity as well as limit the increasing rate of drug resistance among bacteria. It is the recommendation of this study that constant evaluation of the antibiotic sensitivity pattern of UTI pathogens for commonly used antimicrobial agents in a particular environment be carried out in order to improve the treatment of the Urinary tract infection.

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