Academic International Journal of Veterinary Medicine
ISSN: 2984-7753
Aca. Intl. J. Vet. Med. 2024;2(2) 01-10
Journal homepage: www.aipublishers.org/aijvm

The Role of Some Antibiotics on Male and Female Urinary Tract Infections

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(Received 20 June 2024, Revised 10 July 2024, Published 12 August 2024)

Abstract

Urinary tract infections (UTIs) are the most common infections that result in discomfort, fever, pain, and infections outside the intestines in people of all age groups. Annually, an estimated 150 million individuals worldwide experience the distressing condition of UTI. Approximately 10% of the global human population experiences a UTI at some point in their lifetime.

Methods: In this study, we analyzed the antimicrobial susceptibility patterns of the commonly isolated Gram-negative and Gram-positive bacteria from urine specimens examined at Imam Hussein Hospital and from a group of students at the College of Pharmacy at Al-Safwa University College in the holy city of Karbala, Iraq. After collecting urine samples, they were cultured in the culture media, and Gram stain was used to study the phenotypic characteristics of isolated bacteria. The types of bacteria causing urinary tract infections were diagnosed. After the diagnosis, antibiotic sensitivity discs were used.

Results: In this study, it was found that women have more urinary tract infections than men, and it was found that (Klebsiella, Escherichia coli, and Enterobacter) bacteria are the most common types of UTI; all types of bacteria discovered in this study are sensitive to the Amikacin antibiotic, on the other hand, all types of bacteria discovered in this study are resistant to the Ciprofloxacin antibiotic.

Keywords: Urinary Tract Infection, Bacterial, Antibiotics, Sensitive, Resistance.

How to cite: Israa J. Abdul-Rasul, Doaa Hashim Jawad, Tuqa Sabbar Rahi, Marwa Nasr Jawad. The Role of Some Antibiotics on Male and Female Urinary Tract Infections. *Aca. Intl. J. Vet. Med*. 2024;2(2) 01-10: https://doi.org/10.59675/V221

Introduction

Urinary tract infection (UTI) is a prevalent bacterial infection, affecting around 60% of women at some point in their lives. Among women who experience a UTI for the first time, 20–30% will have reoccurring infections. The user's text is a list containing the elements [1, 2].

UTIs continue to be quite prevalent. They are the predominant cause of infection in nursing home residents and the primary source of bacteremia in the elderly population. UTIs can develop in individuals with urinary tracts that have structural or functional abnormalities (complicated UTI) and in those with anatomically normal urinary tracts (uncomplicated UTI) [3]. Furthermore, they are a prevalent factor contributing to sudden and severe illness in infants and children [4].

Escherichia coli is the predominant species responsible for bacterial infections in the urinary system, making up about 80% of community-acquired infections in humans. Uncomplicated urinary tract infections (UTIs) refer to cystitis infections in non-pregnant adult women without structural or neurological issues. Approximately 40% of adult women will experience Signs of cystitis at some point in their lives, and there is a 25% chance of a second symptomatic episode occurring within 6–12 months [5].

Uropathogenic Escherichia coli are a distinct group of Escherichia coli that can inhabit the urinary tract and cause the signs of pyelonephritis and cystitis. It originally came from commensal Escherichia coli, which existed in the gastrointestinal system [5, 6]. UTI is chiefly caused by E. coli, and the primary source of the infectious Staphylococcus is the woman's fecal flora. Therefore, it can be said that the fecal-perineal route is the method of infection transmission [7,8].

Most infections begin when intestinal bacteria travel back to the kidneys and bladder via the urethra. This infection mechanism is considered more common among females because their urethra is comparatively shorter and larger, making spreading germs easier [9]. Anatomically, the female vagina and urethra are vulnerable to infection through other life activities such as sexual intercourse, pregnancy, and childbirth [10]. Fortunately, most urinary tract infections do not pose serious health threats and irreversible effects. Yet, kidney infections can still lead to severe consequences, such as tissue damage and a high risk of bacteremia [2].

Amikacin (AK) is an antibiotic medication used to treat a broad range of bacterial infections for over 8 decades. The main resistance mechanism to this class of antibiotics is an enzymatic modification by aminoglycoside-modifying enzymes, which can be classified into phosphotransferases, acetyl-transferases, and nucleotidyltransferases. This issue can be addressed by novel semisynthetic aminoglycosides developed during the 1970s. These compounds are characterized by resistivity to most aminoglycoside-modifying enzymes. Amikacin can be produced using the process of acylation in which the L-(−)-γ-amino-α-hydroxybutyryl side chain is attached to the C-1 amino group of the deoxystreptamine part of kanamycin A [11].

As mentioned above, AK is an effective antibiotic for treating bacterial infections resistant to aminoglycoside modifying enzymes, making it the most widely used semisynthetic aminoglycoside [12]. Whether used alone or in combination with other antibiotics, AK treats various severe infections caused by aerobic Gram-negative bacteria, Nocardia, and mycobacteria [13]. It is also a life-saving medication for newborn babies who suffer from serious infections after birth [14].

Ciprofloxacin is another class of antibiotic based on fluoroquinolone antibiotics. It also treats bacterial infections such as pneumonia and UTIs [15]. Being an FDA-approved antibiotic, it is prescribed for a wide variety of infections including UTIs, sexually transmitted soft tissue infections, chancroid, bone, gonorrhea, skin and prostatitis, joint infections, pneumonia, typhoid fever, lower respiratory tract infections, gastrointestinal infections, inhalation anthrax (as a preventive measure after exposure), salmonellosis, plague and acute bacterial exacerbation of chronic bronchitis [16] It represents an effective choice for patients who contract multiple infections or at risk of having Gram-negative infections due to certain circumstances [17].

Another alternative to the antibiotics mentioned above is Gentamicin, an aminoglycoside antibiotic used to treat different types of gram-negative infections. Effective treatment of bacterial infections such as UTIs, gastrointestinal tract infections, meningitis, and soft tissue infections also requires considering other factors, including symptom severity, patient age, local antimicrobial resistance patterns, and signs at presentation [18].

Levofloxacin is another antibacterial medication that is classified under the fluoroquinolone category. It has effective features in killing bacteria that cause skin infections, genitourinary tract infections, and respiratory diseases. It is one of the medications approved in the US and widely used to treat numerous respiratory tract infections, such as severe infectious exacerbations of acute bacterial sinusitis, chronic bronchitis, and nosocomial pneumonia. Besides, it is used for managing complicated and uncomplicated skin infections and post-inhalational anthrax. Moreover, levofloxacin treats genitourinary infections, including simple and severe UTIs, chronic prostatitis, and acute pyelonephritis [19].

2-Materials and Methods

2.1. Sample collection

Urine samples were collected from patients attending Imam Al-Hussein Hospital, peace be upon him, and students of Al-Safwa University College in the holy governorate of Karbala in Iraq to isolate bacteria, diagnose urinary system infections, and determine the types of bacteria that cause them.

2.2. The culture media:

2.2.1. Blood Agar base

This medium was prepared according to the instructions of the supplying company by dissolving 40 gm in a liter of distilled water and sterilizing it in an autoclave. After completing the sterilization process, it was cooled to a degree (45-50) C̊, and human blood was added to it at a rate of (3-5) %. This medium was used as a rich medium for the Isolation and identification of bacteria and fungi, as well as observation of hemolysis areas to detect the bacterial production of the hemolytic enzyme (Hemolysin).

2.2.2. MacConkey agar base

This medium was prepared according to the instructions of the supplied company by dissolving 51.5 gm in a liter of distilled water and sterilizing by autoclave. This medium was used to isolate Gram-negative bacteria and diagnose their ability to ferment the sugar lactose.

2.2.3. Mannitol salt Agar

This medium was prepared according to the instructions of the supplying company by dissolving 108 g in a liter of distilled water and sterilizing it by autoclave. It was used to isolate Staphylococcus aureus and diagnose it in terms of its ability to tolerate the medium's salinity and ferment mannitol sugar by turning the medium yellow.

2.2.4. Muller – Hinton Agar

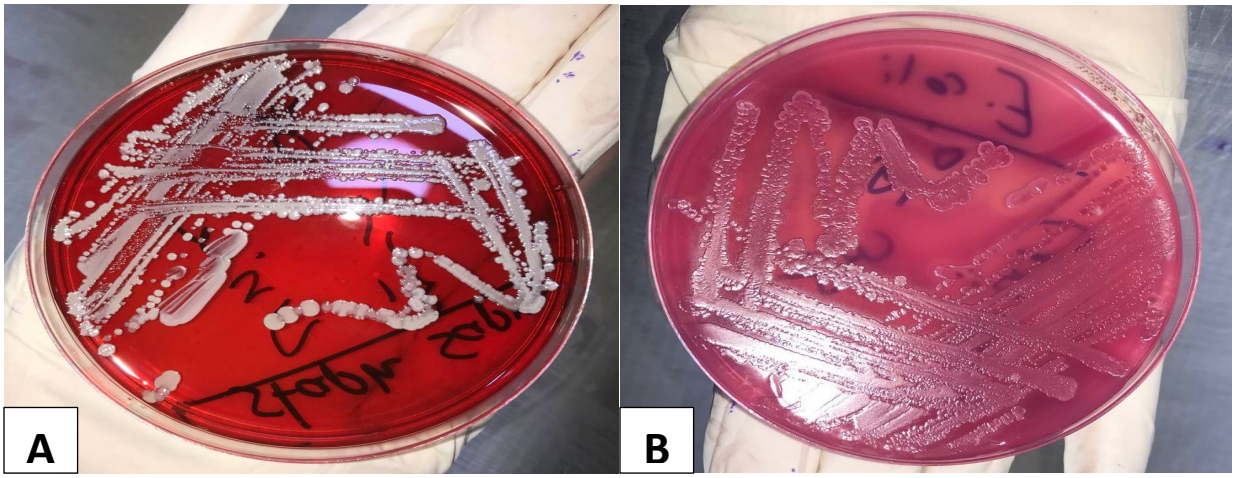
This medium was prepared according to the instructions of the supplying company by dissolving 38 g of the medium in a liter of distilled water and sterilizing it by autoclave; after completing the sterilization process, it was cooled to (45-50) ^{o}C and poured into sterilized Petri dishes. Plates were used to grow bacterial isolates and test the inhibitory activity of the microorganisms under study.

2.2.5. Brain – Heart infusion broth

This medium was prepared according to the instructions of the supplied company by dissolving 37 g of the liquid nutrient medium in a liter of distilled water, distributing it in tubes, and sterilizing it in an autoclave. This medium was used to grow and activate bacteria, as well as using it to preserve bacterial and fungal isolates by adding 15% glycerol to 85% of the liquid medium after sterilization.

2.2.6. Eosin Methylene Blue Agar (EMB)

Suspend 36 grams of EMB Agar in 1000 ml of distilled water. Heat to dissolve the medium completely. Dispense and sterilize by autoclaving at 15 lbs. pressure (121 °C) for 15 minutes. Avoid overheating. Cool to 50 °C and shake the medium to oxidize the methylene blue (i.e., to restore its blue color) and suspend the flocculent precipitate (according to the SIGMA company).



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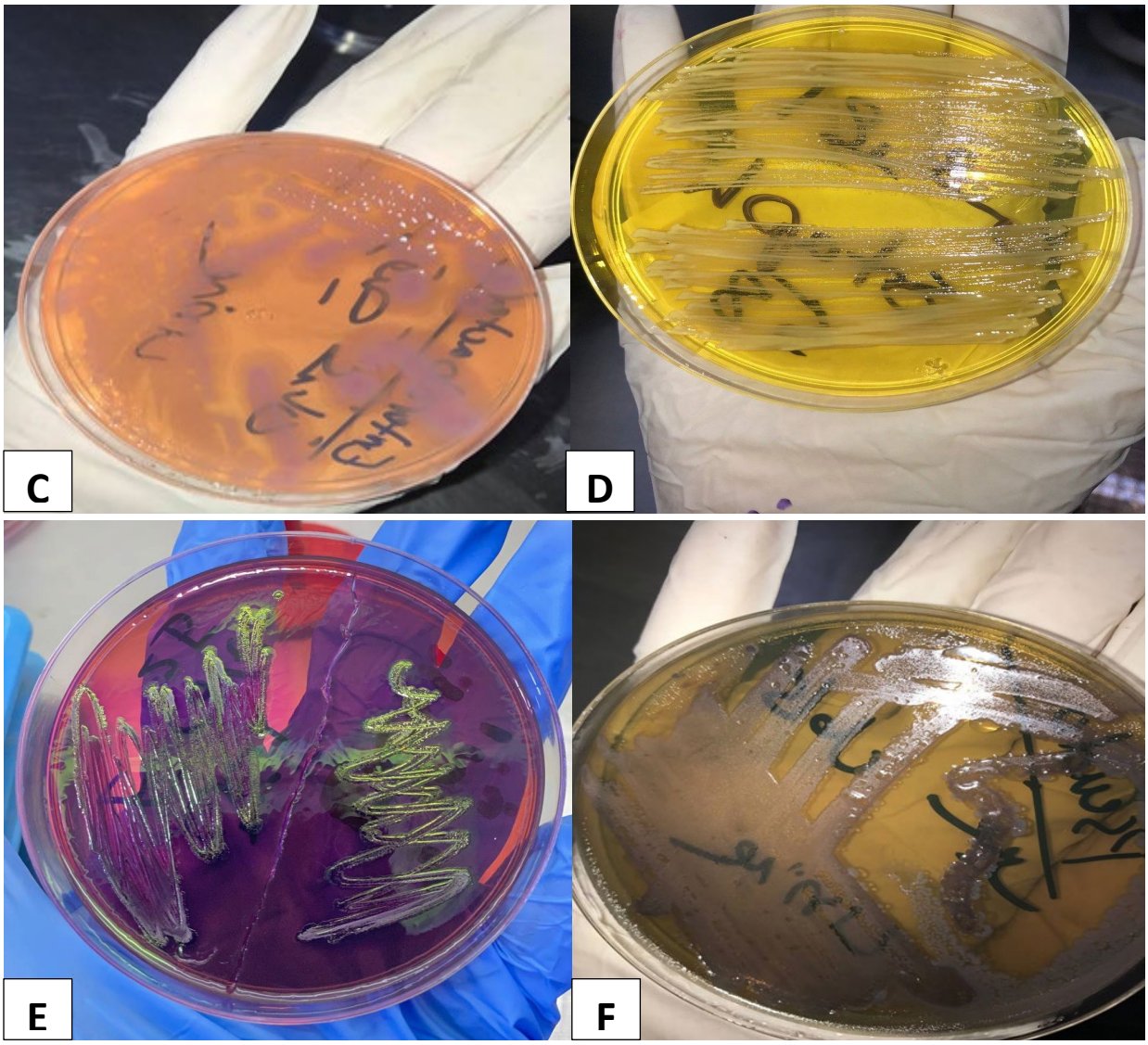

Figure (1): *The culture media used in this study (A-Blood agar B-MacConkey agar C-MacConkey agar D-mannitol agar E- EMB agar F-Nutrient agar*

2.2.3. Isolation and identification of bacteria

2.2.3.1. Gram stain

This stain was used to study the phenotypic characteristics of isolated bacteria.

Microscopic tests 2.2.3.2.

Colonies growing on solid blood agar medium were picked and stained with Gram's stain to identify the shape of the cells and their aggregations.

3- Results and Desiccation:

3.1. Isolation of some microorganisms causing urinary tract infection:

During the study period, 100 samples were collected from different people in the holy city of Karbala. Those samples were planted on MacConkey agar, mannitol salt agar, blood agar, and EMB and incubated at 37ºC for 24 hours. Depending on the results of the diagnosis, which will be mentioned later, the isolation process resulted in obtaining different types of microorganisms.

It was found that the number of infections with UTI in women is higher than that of males, depending on Figure (2). UTI is mainly caused by E. coli, with the woman's fecal flora serving as an immediate source of the infecting E. coli; this suggests that the infection spreads by the fecal-perineal-urethral route [8]. UTI is a prevalent bacterial infection, affecting around 60% of women at some point in their lives. Additionally, 20–30% of women who experience their first UTI will have reoccurring infections. Most of these cases cannot be accounted for by anatomical or functional abnormalities [7, 8].
Most infections occur when bacteria from the intestinal flora travel backward through the urethra to the bladder and kidneys; this is particularly common in females with a shorter and wider urethra that allows for easier transfer of microorganisms. The structure of the vagina and female urethra makes it more vulnerable to trauma during a sexual relationship, as well as the introduction of bacteria into the bladder during childbirth or pregnancy [2].

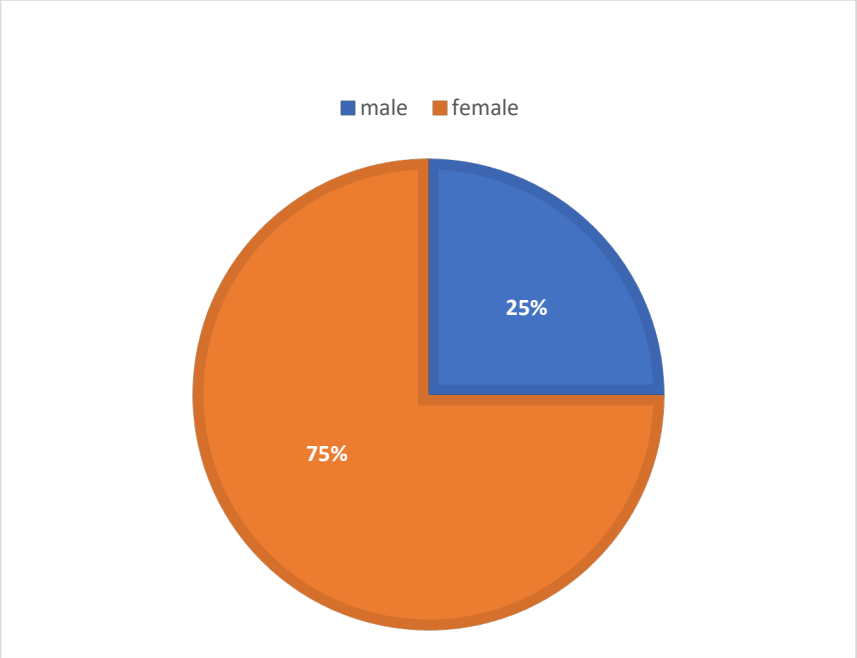

Figure (2): ***The percentage of infection between females and males in infected samples***

3.2. Types of dominant microorganisms isolated from different infections of the urinary tract infection

It was found that the percentage of infection with Enterobacter and Escherichia coli bacteria is the highest compared to the percentage of infection with other types of infective bacteria in male samples, shown in Figure (3).

Figure (4) shows that the percentage of infection with Klebsiella, Escherichia coli, and Entro bacteria is the highest compared to the percentage of infection with other types of infective bacteria in female samples.

The primary bacterium responsible for most cases of lower UTI is E. coli, which accounts for 80-90% of cases. The infecting organisms in approximately 95% of patients with acute pyelonephritis are typically Gram-negative isolates such as Klebsiella and Proteus [20]. Some Gram-positive organisms like Staphylococci and Streptococcus can also be found in these cases [21].

E. coli is the primary culprit behind uncomplicated UTIs, while antibiotic resistant Enterobacteriaceae, enterococci, and Candida species are frequently responsible for severe UTIs [3]. In 2006, Biswas et al.

conducted a study in Uttaranchal, India, to examine the occurrence of antimicrobial resistance in urine isolates. They found that Escherichia coli was present in 67.5% of the samples, and over 35% of the isolates demonstrated resistance to routinely used antibiotics for treating urinary tract infections [22].

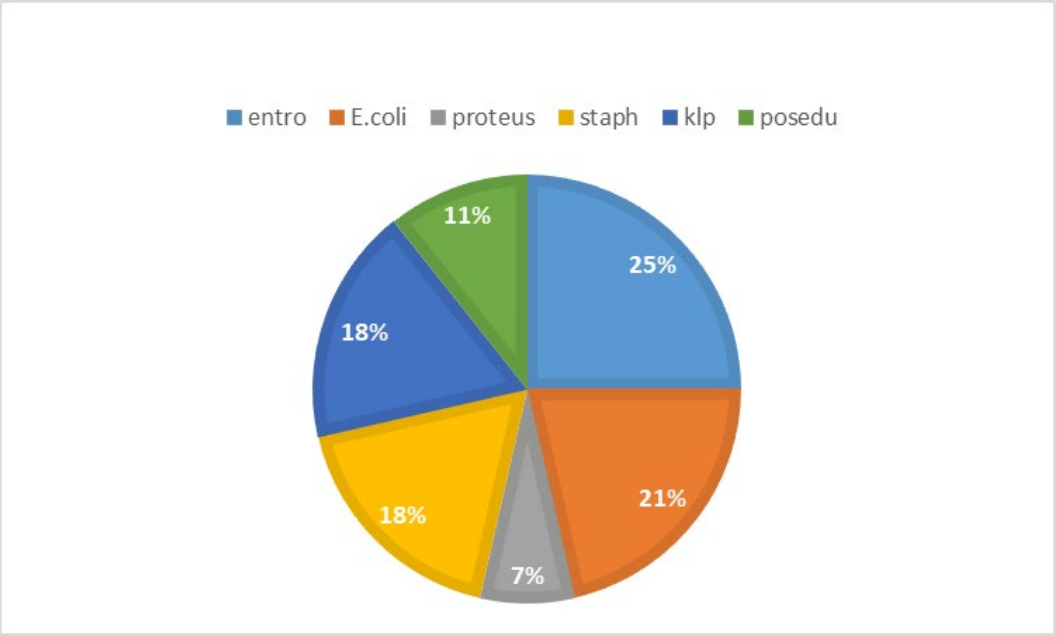

Figure (3): ***Types of pathogenic bacteria in infected male samples***

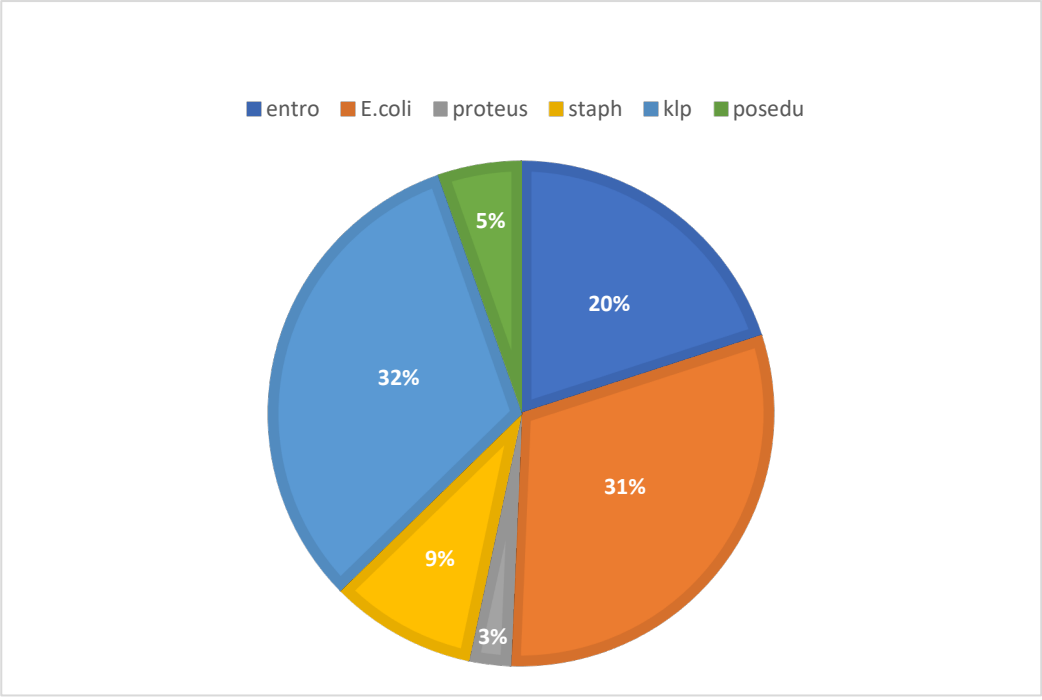

Figure (4): ***Types of pathogenic bacteria in samples of infected female***

3.3. Testing the sensitivity of bacterial isolates that cause urinary tract infection to antibiotics Testing the sensitivity of Klebsiella and Escherichia coli isolates to antibiotics:

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The results shown in Table (1) showed that all isolates were sensitive to the antigens (Amikacin, Gentamicin and Levofloxacin) and found resistance to (Ciprofloxacin) antibiotic.

Testing the sensitivity of Enterobacter isolates to antibiotics:
The results shown in Table (1) showed that all isolates were sensitive to the antigens (Amikacin, Levofloxacin) and found resistance to (Gentamicin and ciprofloxacin) antibiotic.

Testing the sensitivity of Staphylococcus isolates to antibiotics:
The results shown in Table (1) showed that all isolates were sensitive to the antigens (Amikacin) and found resistance to (Gentamicin, Levofloxacin, Ciprofloxacin) antibiotic.

Testing the sensitivity of Proteus isolates to antibiotics:
The results shown in Table (1) showed that all isolates were sensitive to the antigens (Amikacin, Ciprofloxacin) and found resistance to (Gentamicin) antibiotic and Intermediate to (Levofloxacin) antibiotic.

Testing the sensitivity of Pseudomonas isolates to antibiotics:
The results shown in Table (1) showed that all isolates were sensitive to the antigens (Amikacin, Gentamicin) and found resistance to (Levofloxacin, Ciprofloxacin) antibiotic.

Table (1): showed effect of antibiotics sensitivity discs on pathogenic bacteria in this study

Name of bacteria	AK		GM		LV		CI	
	zone		zone		zone		zone	
Klp	20-22 mm	S	17-23 mm	S	18-20 mm	S	13- 15 mm	R
E.coli	25-23 mm	S	19-29 mm	S	17-31 mm	S	9-13 mm	R
Entroe	17-20 mm	S	10-12 mm	R	17-30 mm	S	7-15 mm	R
Staph	18-25 mm	S	9-12 mm	R	13-15 mm	R	12-15mm	R
Proteus	19-26 mm	S	≤ 12 mm	R	14-16 mm	I	21-36 mm	S
p.sedu	18-22 mm	S	15-26 mm	S	12-15 mm	R	11-14 mm	R

* S-sensitive *R-resistance * I – Intermediate

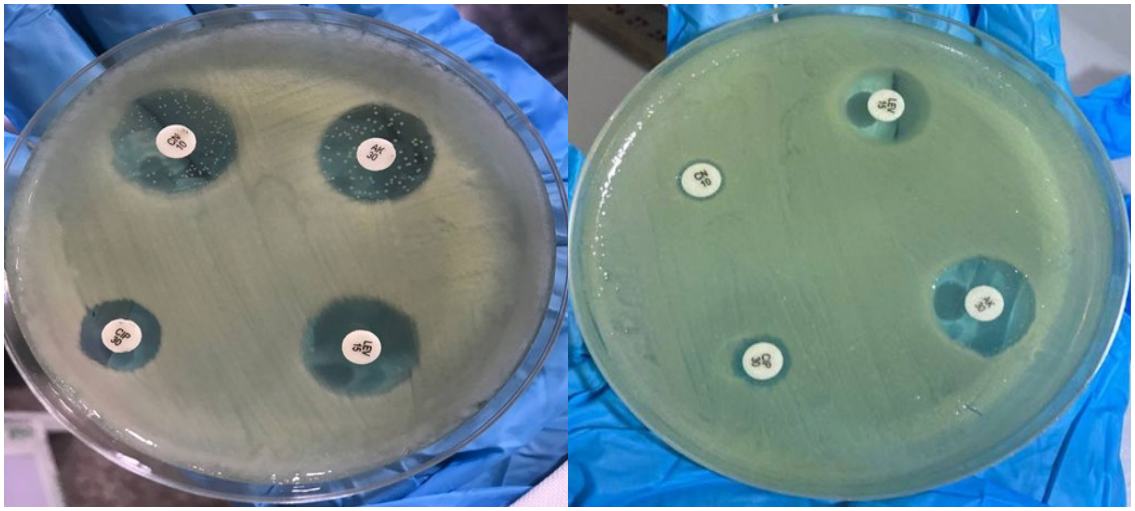

Figure (5): ***Antibiotics sensitivity discs***

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4. Conclusion

1- In this study, it was found that women have more urinary tract infections than men.
2- It was found that (Klebsiella, Escherichia coli, and Enterobacter) bacteria are the most common types of UTIs.
3- All types of bacteria discovered in this study are sensitive to Amikacin antibiotic; on the other hand, all types of bacteria discovered in this study are resistant to Ciprofloxacin antibiotic.

Availability of data and material

All data and materials of the study are available whenever required.

Conflict of interest

We have no conflict of interest.

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