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Prevalence of Gram Positive and Gram Negative Bacteria in Urinary Tract Infection

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Annotation: Objective:

With the objective to identify both Gram-positive and Gram-negative species, the current study looks into the bacterial agents that cause urinary tract infections (UTIs). It also seeks to ascertain which age and gender groups among patients from Iraq's Wasit Governorate are most vulnerable to infection.

Methods:

Between October 2023 and January 2024, 128 urine samples were taken from patients at Al-Karama General Hospital who ranged in age from 2 to 75. Following aerobic cultivation of the samples on Blood agar and MacConkey agar, isolates were identified by morphology, Gram staining, and biochemical profiling. Records were kept of the patient's medical history and risk factors, including diabetes, catheter use, and prior antibiotic exposure.

Results:

Among the analyzed samples, 56% yielded bacterial growth. Staphylococcus spp. emerged as the predominant pathogen (41%), followed by E. coli (27%), Klebsiella spp. (12%), and Pseudomonas spp. (7%). Females exhibited a higher infection rate

(69%) compared to males (59%). The 2–22 age group showed the highest infection prevalence (41.8%). Diabetes and prior antibiotic exposure were significantly linked to increased infection rates.

Conclusions: The current study discovers a relationship between gram positive bacteria which are primarily responsible for urinary tract infections and less degree gram negative bacteria, with Escherichia coli accounting for the majority of these bacteria.

Keywords: Urinary tract infection, gram positive bacteria, gram negative bacteria.

1. Introduction

Urinary tract infections (UTIs) are among the most common bacterial range from uncomplicated (uUTIs) to complicated (cUTIs) [1]. Bacteria are the main causative agents of these infections [2]. Bacteria are common, single-celled, usually free-living creatures, they make up a substantial portion of prokaryotic microbes... Health professionals need to understand the important difference between gram positive and gram-negative bacteria [3]. The thick peptidoglycan cell wall that is present in gram-positive organisms helps to preserve the crystal violet dye used in the staining procedure, gram-negative organisms typically have an outer membrane, although this layer of peptidoglycan is thinner in them[4].

Gram-positive bacteria are a common cause of urinary tract infection (UTI), particularly among individuals who are elderly, pregnant, or who have other risk factors for urinary tract infections [5] . The most frequently isolated Gram-positive asymptomatic bacteriuria Staphylococcus aureus ,Staphylococcus saprophyticus, Staphylococcus haemolyticus, Staphylococcus hominis ,Streptococcus agalactiae and Enterococcus faecalis [6].

Bacteria that go up from the urethra to the bladder or, in the case of pyelonephritis, from the ureter to the kidney, are responsible for about 95% of UTIs. Hematogenous UTIs account for the remaining instances. UTIs can cause systemic illness, especially in elderly persons. Hospital-acquired urinary tract infections are usually caused by bacteremia [7].

The majority of bacteria that reside in the digestive system, vagina, and the area around the urethra—the anterior part of the urinary tract—enter the urethra and travel to the bladder and kidneys [8]. Most strains are part of the normal microbiota of the gut and are harmless or even beneficial to humans although these strains tend to be less studied than the pathogenic [9]. Some strains of E. coli benefit their hosts by producing vitamin K2 or by preventing the colonization of the intestine by pathogenic bacteria [10]. Klebsiella is a genus of Gram-negative, oxidase-negative, rod-shaped bacteria with a prominent polysaccharide-based capsule. species are found everywhere in nature [11]. Bacteria, the main cause of UTIs, are 95% [12].

2. Materials and Method

study Design and Subjects

Between October 2023 and January 2024, this study was carried out in the Al-Karama General Hospital in the Wasit Governorate. The study included 128 male and female UTI patients between the ages of 2 and 75. These people were chosen because, according to laboratory and clinical examination results, they had a positive UTI status. Furthermore, 50 healthy people without a history of UTI who were as closely matched by age and gender as feasible made up the control group for comparison. From the patient record, demographic data such as age, gender, and pertinent medical history (such as diabetes, catheterization, or previous UTIs) were gathered.

2.1 Samples :

A midstream urine Samples were collected in a sterile screw-cap containers from all participants and immediately subjected to aerobic culture on Blood agar and MacConkey medium and general urine examination was also conducted for the samples.

2.2 Culture media:

The culture media used in this study are listed in table (2-3) were prepared according to the manufacturer's instructions on their containers and sterilized according to the suitable method.

Culture media	Purpose	Manufacturing	Origin
MacConkey agar	Differential and selective medium	Oxoid	UK
Blood agar base	Enrichment medium	Biomark	india
Blood agar base			
Brain heart infusion broth	Enrichment and preservation medium	Mast	UK
Mannitol salt agar		Differential and selective medium	UK
Nutrient agar	Enrichment medium	Oxoid	UK

2.3. 2.4 Kits :

The kits used in this study are shown in table (2-3).

Kit type	Manufacturer	Origin
VITEK-2 AST-P580 VITEK-2 GP-ID	BioMérieux	France
Epi 20	MAST	UK

Culture of Clinical Specimens and Identification of Bacteria

Gram staining, colony morphology, and a battery of biochemical tests, such as the catalase, oxidase, and indole tests, were used to identify the bacterial isolates .Standard microbiological procedures were followed in the identification of E. Coli, Klebsiella species, Pseudomonas species, Staphylococcus species, and other uropathogens. For specimen collection, only individuals who had back discomfort, fever, frequent or painful urination, or other signs of a urinary tract infection were included [13]. From every positive culture, one colony was chosen for identification, and the bacterial characteristics—such as size, shape, color, pigment production, translucency, edge, elevation, and texture—were evaluated using colony morphology.

Following the usual protocols described by [14], Gram staining was used to ascertain the bacterial morphology and distinguish between Gram-positive and Gram-negative species. The bacterial pathogens were isolated and their identities confirmed using biochemical assays such as the EPI-20 test, oxidase test, mannitol fermentation, tube coagulase test, and catalase test [15].

3: Results:

The result of the study is that the bacteria spread at a rate of 128/84, meaning that only 44 no growth people in our study did not have the bacteria spread. The samples showed that the prevalence was distributed E coli 23 , normal flora 5 , staph spp 34 , heavy growth 6 , Pseudomonas 6 , Klebsiella 10. The percentages were E coli 27% , normal flora 12% , staph spp 41% , heavy growth and Pseudomonas 7% , Klebsiella 12% as shown in Table (2)

Table (2) The percentages of bacteria species

Bacteria species	The percentages
No growth	44%
staph spp	41%
E coli	27%
normal flora	12%
Klebsiella	12%
Pseudomonas	7%

4-3. Gender of patients for infected cases:

The gender of the patients (male and female) for 128 cases, including 69 females 59 males, representing 54.87% and 45.13% cases, respectively as shown in Table (3).

Table (3) the percentage Gender of patients

3. Numerical results

Male	59
Female	69

3-4 Age of patients in relation to injury

The ages of the patients ranged from 2 to 85 years and were divided into four groups: the first group (2-22 years) with 35 cases, the second group (23-43 years) with 52 cases, the third group (44-64 years) with 26 cases, and the third group (23-43 years) with 52 cases. (44-64 years) with 26 cases. The fourth group (65-85) numbered 15 cases, with a percentage of 41.8, 27.4, 20.4 and 11.4, respectively, as shown in table

Groupe age	N	percentage
2-22 years	35	41.8
23-43 years	52	27.4
44-64 years	26	20.4
65-85 years	15	11.4

4. Discussion

Prevalence of Gram-Positive and Gram-Negative Bacteria

The results of this study revealed a 56% bacterial infection rate, with Gram-positive bacteria (41%) being more prevalent than Gram-negative bacteria (27%) in urinary tract infections (UTIs). Staphylococcus spp. was the most frequently isolated pathogen (41%), followed by Escherichia coli (27%). Other Gram-negative bacteria, such as Klebsiella spp. (12%) and Pseudomonas spp. (7%), were also identified. Normal flora was found in 12% of the samples.

It is noteworthy that Staphylococcus species predominate in this study, in contrast to global trends where E. coli usually predominates in UTI cases. As an example, a study by [16] found that E. coli was the leading cause of UTIs worldwide. Similarly, [17]. E. coli was identified as the most prevalent uropathogen in Iraq. The comparatively larger percentage of Staphylococcus species in this study, however, might be a sign of a rising trend in hospital-acquired infections. It is well

known that Staphylococcus species, especially Staphylococcus aureus, flourish in hospital settings where antibiotic resistance is more prevalent [17].

On the other hand, Gram-negative bacteria, such as E. coli, Klebsiella spp., and Pseudomonas spp., continue to be important uropathogens, especially in patients with underlying conditions or those using urinary catheters [15]. The presence of E. coli in 27% of the samples in this study aligns with its reputation as a leading pathogen in UTIs [6]. Klebsiella spp., while less frequent (12%), is still an important pathogen, particularly in hospital settings, where it is associated with increased antibiotic resistance)[18].

4.1 Age and Gender Distribution of UTIs

The study also revealed a clear age and gender distribution of UTIs. The highest prevalence was observed in the 2-22 years age group (41.8%), followed by 23-43 years (27.4%), 44-64 years (20.4%), and 65-75 years (11.4%). These findings are consistent with previous studies showing that younger individuals, particularly sexually active women, are more susceptible to UTIs due to anatomical factors, such as the shorter urethra in females, which makes it easier for bacteria to ascend into the urinary tract [19].

In terms of age, the higher prevalence in the younger group may be attributed to sexual activity, which is a known risk factor for UTIs, particularly among women [16]. Hormonal changes also play a role in increasing susceptibility, especially among women in their reproductive years[17].

For males, the incidence of UTIs was lower than females (59% vs. 69%), which aligns with global findings that show women are more vulnerable to UTIs due to their anatomical characteristics. However, older males, particularly those above 60 years of age, tend to have a higher risk of UTIs due to conditions like prostatic enlargement and urinary retention, which are common in older men [20],[21].

Risk Factors

The study also identified significant risk factors for UTIs. Diabetes and previous antibiotic use were strongly associated with higher infection rates. This is consistent with [19]., who found that diabetes impairs immune function, making individuals more susceptible to infections, including UTIs. Excessive antibiotic use can also alter the normal flora, making it easier for opportunistic pathogens like Staphylococcus spp. to proliferate [18].

Comparison with Previous Studies

When comparing these findings with other studies in Iraq, such as [17] it is evident that E. coli is typically the dominant pathogen. However,[19]. this study's relatively higher proportion of Staphylococcus spp. suggests a potential shift in infection trends in Iraq, where Gram-positive bacteria are increasingly prevalent. In contrast [10]. in Babylon reported a higher prevalence of Klebsiella spp. and Pseudomonas spp., which could be explained by the difference in settings—hospital-based studies tend to report higher rates of these pathogens, especially in immunocompromised patients[23]

Age Group Comparisons:

In the younger adults (2-22 years), studies such as in [2] have similarly reported high rates of E. coli infections, which was also observed in this study.

Among middle-aged adults (23-43 years), UTIs are often associated with sexual activity and contraceptive use [19]., factors not specifically assessed in this study.

In the older age group (65-75 years), UTI incidence rises due to age-related factors such as urinary retention, incontinence, and weakened immune function [16]., which aligns with the findings of this study where the elderly group had the lowest infection rate.

Conclusion

With notable differences in the incidence of Gram-positive and Gram-negative bacteria, this study emphasizes the complicated character of UTIs in the Wasit Governorate. Staphylococcus species were more prevalent in this study, which could be a sign of an increase in hospital-associated illnesses. whereas in younger people, E. coli continues to be the predominant infection. Significant factors affecting infection rates were age, gender, and underlying medical problems such as diabetes. To further guide treatment regimens, more research is required to examine the genetic traits and resistance profiles of uropathogens in the area.

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