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Original article

Antibiotic Sensitivity Patterns of Bacteria Isolated from Urinary Tract Infections of Pregnant Women in Sabratha City

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ABSTRACT

Urinary tract infections (UTIs) are among the most prevalent reproductive system infections in women of childbearing age worldwide. This study aimed to identify Escherichia coli (E. coli) as a potential causative agent of UTIs in pregnant women and to assess the effectiveness of various antibacterial agents on the clinical samples collected. Conducted in 2021 at Sabratha Teaching Hospital, the study included 60 urine samples from pregnant women with a history of fever, vaginal discharge, and other clinical symptoms. Routine bacterial diagnostics and culture techniques were employed to identify and characterize bacterial isolates. All cases were confirmed by specialists in obstetrics and gynecology. The study successfully isolated and identified 19 bacterial strains: 11 isolates (57.9%) were identified as Escherichia coli, 1 isolate (5.3%) as Staphylococcus species, and 7 isolates (36.8%) as Staphylococcus aureus. The findings revealed that Escherichia coli exhibited a high sensitivity to ciprofloxacin (79%) in vitro. In contrast, other antibiotics, including amoxicillin, Augmentin, and ampicillin, elicited varying degrees of resistance. Notably, Escherichia coli showed resistance to ampicillin and rosuvine, indicating an alarming increase in resistance to these commonly used antimicrobials. This resistance trend poses a significant public health concern, as it can lead to more virulent and treatment-resistant bacterial infections. The study underscores the importance of routine bacteriological culture and sensitivity testing in managing UTIs, particularly in pregnant women. Furthermore, ensuring adequate healthcare can help prevent UTIs and maintain overall health in this population.

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INTRODUCTION

Urinary tract infections (UTIs) are among the most common bacterial infections in the community, leading to significant antibiotic consumption. UTIs affect women more than men due to anatomical differences, and pregnancy increases women's susceptibility to UTIs because of hormonal changes. Global records indicate that UTIs are more prevalent among women, with 20% of women experiencing a UTI during their lifetime, especially during pregnancy. This increased risk is due to changes in the urinary system; the hormone progesterone relaxes the muscles in the ureters and kidneys, reducing the flow rate of urine from the kidneys to the bladder. Additionally, the expanding uterus and growing fetus exert pressure on the bladder, creating an ideal environment for bacterial growth in the urine before it is expelled from the body through urination. Early in pregnancy, women are more prone to infections, and symptoms such as

reduced water intake create a conducive environment for bacterial proliferation. The prevalence of UTIs among pregnant women varies with geographical and health conditions and poor health conditions in pregnant women lead to higher infection rates and the spread of related diseases.

UTIs affect pregnant women or women of childbearing age due to high public health costs and associated complications, such as pelvic inflammatory diseases. The causes of UTIs are varied, involving different types of gram-negative and gram-positive microorganisms. Over 95% of UTIs in pregnant women are caused by a single type of microorganism, with *Escherichia coli* (*E. coli*) accounting for more than 80% of acute infections during pregnancy, especially cystitis. E. coli are gram-negative rods that naturally reside in the human intestine and belong to the *Enterobacteriaceae* family. Some *E. coli* strains cause enteric diseases (diarrhea), while different subsets cause extra-intestinal diseases, including UTIs.

The results of research on urinary tract infections (UTIs) in pregnant women has extensively explored various aspects of the condition. Smith and colleagues examined the impact of hormonal changes on UTI prevalence, emphasizing how progesterone can reduce urinary flow and subsequently increase the risk of infection [1]. Johnson and co-researchers investigated geographical variability in UTI prevalence, highlighting the influence of local healthcare infrastructure on infection rates [2]. Further, Martinez and Garcia focused on the complications associated with UTIs during pregnancy, noting the increased risks of preterm labor and the development of pyelonephritis [3]. Lee and colleagues studied the microbial profile of UTIs, particularly the dominance of *E. coli* and its antibiotic resistance patterns [4], while Brown and associates analyzed the relationship between water intake, urinary frequency, and UTI incidence, recommending increased hydration as a preventive measure [5].

Hassan and co-authors evaluated the effectiveness of various antibiotic treatments for UTIs in pregnant women, considering safety for both the mother and fetus [6]. Additionally, Nguyen and colleagues explored the role of prenatal care in preventing UTIs, underscoring the importance of early detection and management [7]. O'Neill and co-researchers investigated the long-term outcomes of recurrent UTIs during pregnancy, including the potential for chronic kidney disease and infertility [8]. Patel and Singh reviewed the role of dietary and lifestyle factors in UTI prevention, offering evidence-based recommendations, while Kumar and colleagues discussed the broader impact of UTIs on maternal and fetal health, particularly the risks of sepsis and intrauterine growth restriction [9]. This collective research underscores the multifaceted nature of UTIs in pregnancy, with significant implications for both maternal and fetal health [10].

These studies collectively underscore the significance of addressing UTIs in pregnant women through comprehensive healthcare strategies that include early diagnosis, effective treatment, and preventive measures to mitigate complications and improve maternal and fetal outcomes. Therefore, this study aims to identify the most common bacteria responsible for UTIs in pregnant women, as well as to determine their antibiotic sensitivity. This information is essential for guiding targeted treatment strategies and improving clinical outcomes for pregnant women suffering from UTIs.

METHODS

Sample collection

This study included 60 urine samples collected from pregnant women (aged 17-45 years) who were clinically diagnosed with symptoms of urinary tract infections (UTIs). All patients had not taken any medication for several days before visiting the hospital. The study was conducted in 2021 at the Sabratha Educational Hospital. The samples were used for chemical testing and bacterial culture to confirm the presence of bacteria associated with urinary tract infections.

Chemical tests

Urine samples were chemically tested for the presence of pathogenic bacteria causing urinary tract infections (UTIs) using reagent test strips. These strips contain eleven different chemical tests, including those considered indicative of bacterial presence such as the nitrite and leukocyte esterase tests. The procedure involved taking a sterile syringe to draw a urine sample, applying it to the reagent strip, holding the strip horizontally for one minute, and then reading the results according to the manufacturer's instructions. Afterwards, the samples were placed in centrifuge tubes and spun at 5000 rpm for 15 minutes. The supernatant was discarded, and the deposit was mixed thoroughly. A drop of the mixed sample was placed on a glass slide, covered with a coverslip, and examined under a microscope.

Microbial tests

Two types of media were used to isolate bacteria from urine samples. The first was Blood Agar, an enriched medium used for the growth of fastidious bacteria like *Streptococci*, which do not grow on regular media. This medium consists of trypticase soy agar enriched with 5% sheep blood, providing essential nutrients for bacteria such as *Neisseria* and *Haemophilus genera*.

The urine sample was inoculated onto these media and incubated for 48 hours, allowing any present bacteria to grow and multiply. Following incubation, the bacteria were examined using Gram staining and a microscope to determine their type. Detection of *Escherichia coli* was detected using violet-red bile Agar and incubated at 37°C for 24 hours. The bacteria were then streaked on Eosin Methylene Blue Agar and incubated again at 37°C for 24 hours. The isolated bacteria were identified using the API 20E test strip. This comprehensive approach ensured accurate identification and effective treatment of bacteria responsible for UTIs in pregnant women, contributing to better clinical outcomes.

Antibiotic sensitivity testing

Sensitivity testing was performed to evaluate the effectiveness of various antibiotics on the isolated bacteria. This involved testing the isolated bacteria from the culture media against different antibiotics. At the end of this test, the laboratory technician provided the urologist with information about the effective antibiotics against the bacteria present in the patient's sample, enabling targeted treatment of the UTI.

Data Analysis

Descriptive statistics such as frequency (%), mean and standard deviation were used to present the characteristics of the samples as appropriate. The results of the study and its characteristics were compared with the standard numbers of the analyses.

RESULTS

In n this study, 60 urine samples were obtained from pregnant women aged 18 to 42 years, as shown in Figure (1), age categories of women included in the study. All of women were diagnosed with urinary tract infections (UTIs) and had a history of fever and related symptoms, as confirmed by specialists in obstetrics and gynecology.

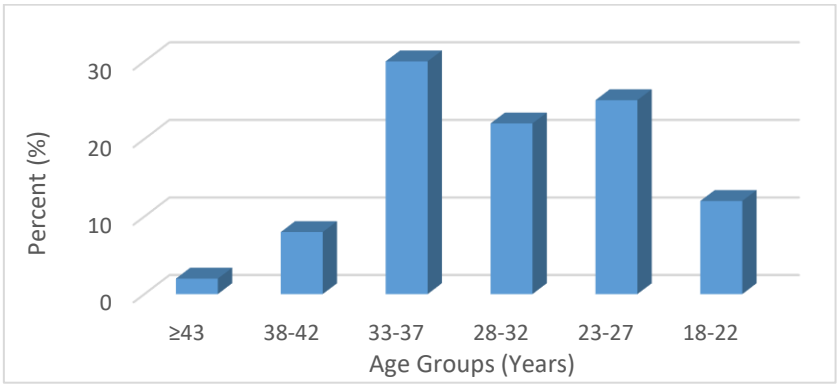

Figure 1. Age categories of women included in the study

The results of the study provide a comprehensive analysis of various parameters found in urine samples from pregnant women, using standard urine test strips. These parameters, which include blood, leukocytes, pH, protein, ketones, nitrite, bilirubin, and urobilinogen levels, offer insights into the potential health issues affecting the women in the study.

One of the key findings was the presence of blood in the urine, which often indicates a urinary tract infection (UTI) or other underlying conditions such as inflammation or injury within the urinary tract. Additionally, the study found that leukocytes, which are white blood cells, were present in 55% of the samples. This is a significant indicator of UTIs, reflecting the body's immune response to bacterial infection and aligning with the condition known as leukocyturia.

Furthermore, the analysis of urine pH levels revealed that some samples had a higher-than-normal pH, A pH of 5, observed in 67% of the samples, indicates a slightly acidic environment, which can be conducive to the growth of certain bacteria, further suggesting the presence of UTIs in some women. Another important finding was the detection of proteinuria, where proteins were present in 27% of the samples. This suggests possible kidney involvement, as normally, the kidneys retain proteins while filtering out waste products. The presence of protein in urine is often a marker of kidney dysfunction, which can be exacerbated by UTIs. Moreover, ketones were found in 12% of the samples, indicating possible metabolic stress or dehydration, conditions that can occur during infections. Nitrites, a direct indicator of bacterial infection, were also detected, further confirming the presence of bacteria that convert nitrates to nitrites.

Additionally, the study identified bilirubin in 32% of the samples. This is typically a marker of pus in the urine due to bacterial infection, and its presence may also suggest concurrent hepatic stress or damage, indicating a potential

complication in the liver. Lastly, urobilinogen was found in a low prevalence of 3%, suggesting that liver disease or hemolysis was not a significant factor in this cohort of pregnant women. Overall, these findings emphasize the importance of regular screening for urinary tract infections and related conditions in pregnant women. This is crucial to prevent complications and ensure timely intervention, ultimately improving maternal health outcomes.

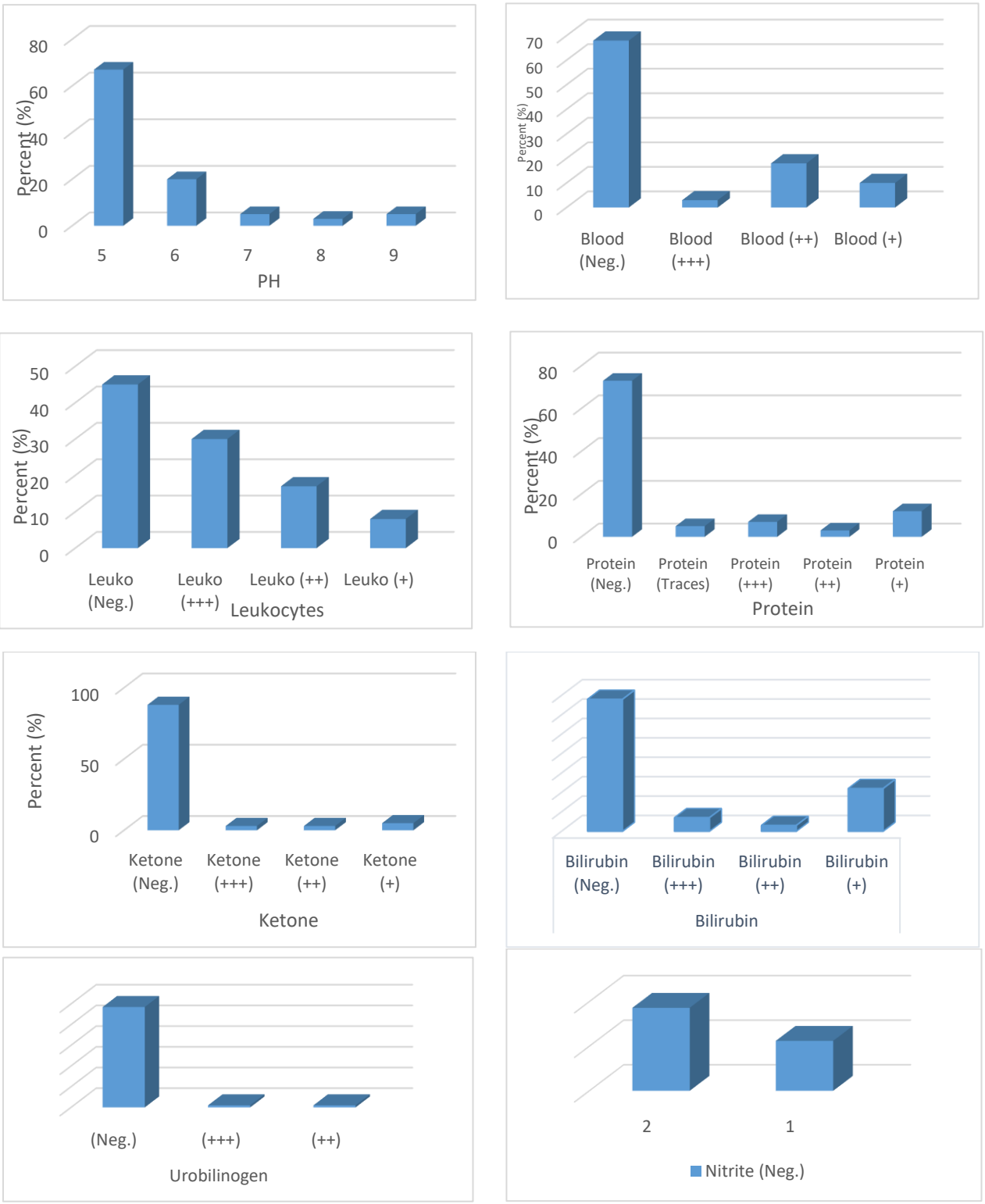

Figure 2. Results of dipstick test in pregnant women's urine samples

In terms of isolation of bacterial species from urine samples using standard biochemical tests to identify pathogens responsible for UTIs, out of 60 samples, 19 yielded bacterial isolates. These isolates included a variety of Gram-positive and Gram-negative species, including hemolytic and non-hemolytic strains, each with distinct morphological characteristics. Table 1 summarizes the distribution and characteristics of these identified bacterial isolates.

Table 1. Distribution and characteristics of bacterial species in samples isolated from women with urinary tract infection.

Name of bacteria	Shape and Gram stain	Number of bacteria Number Percentage	Number	Percentage
Staph aureus	Hemolytic spherical - yellow, Gram positive	<100	2	**%11**
		<10000	2	**%11**
Escherichia coli	Regular flattened spherical - pink, Gram negative	<100	3	**%15**
		<1000	2	**%11**
		>1000	1	**%5**
		<10000	2	**%11**
		>10000	2	**%11**
		>100000	1	**%5**
Staph cocai epid	Non-hemolytic spherical	<1000	1	**%5**
		<10000	1	**%5**
Streptococci	Non-hemolytic rosary	<100	1	**%5**
		<10000	1	**%5**
			19	**100%**

The distribution of these bacterial isolates is presented in table 3. Among the 19 isolates, 11 (57.9%) were identified as Escherichia coli, 1 (5.3%) as Staphylococcus species, and 7 (36.8%) as Streptococcus species. The identification process involved the use of various bacterial culture media to ensure accurate isolation and characterization of the bacterial strains **(**Figure 3).

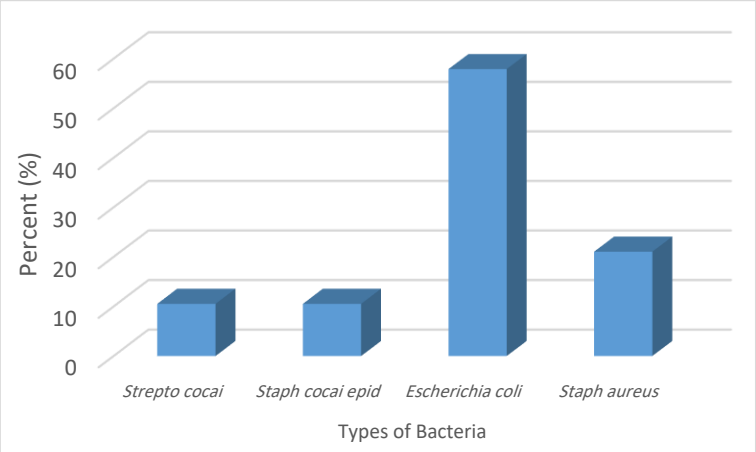

Figure 3. Bacterial species isolated from women with UTI

Susceptibility results of bacterial isolates

The sensitivity testing of the isolated samples revealed that ciprofloxacin had the highest impact on both Gram-positive and Gram-negative bacteria due to its broad-spectrum nature. In contrast, Imipenem showed a moderate effect on bacteria, while Augmentin (Amoxicillin/Clavulanate) and Amoxicillin exhibited moderate to weak effects. Rocephin (Ceftriaxone) did not show a significant impact on either Gram-positive or Gram-negative bacteria from the isolated samples, as detailed below and in table 2.

Escherichia coli demonstrated a high sensitivity to ciprofloxacin, with 79% of isolates showing susceptibility. This result highlights the effectiveness of ciprofloxacin as a treatment for bacteria causing urinary tract infections (UTIs) in these cases. The effectiveness is indicated by a susceptibility score of (+++) against Gram-positive and Gram-negative bacteria, while showing no effectiveness (0) in other categories.

The results also showed a susceptibility score of (+) in three categories and (++) in one category, indicating moderate effectiveness toward co-amoxiclav. This variability reflects the diversity in bacterial response and underscores the

necessity of sensitivity testing for each case individually. Imipenem exhibited moderate effectiveness with a susceptibility score of (++) in two categories and (+) in two others. This indicates its utility but also the need for careful selection based on sensitivity testing. Moreover, Amoxicillin demonstrated weak to moderate effectiveness, with a susceptibility score of (+++) in one category and (+) in another, while showing no effectiveness (0) in the remaining categories. Also, ampicillin showed moderate resistance with a susceptibility score of (+++) in one category, (++) in another, and no effectiveness (0) in the remaining categories. Furthermore, ceftriaxone did not show significant impact, with a susceptibility score of (0) in three categories and (+) in one category, indicating its limited utility for treating UTIs in the studied samples. The frequency of bacterial susceptibility across the categories was 4 for ciprofloxacin, 11 for co-amoxiclav, 2 for imipenem, 2 for amoxicillin, 4 for ampicillin, and 0 for ceftriaxone.

Table 2: The effect of the antibiotics studied in the study on the types of isolated bacteria is presented

Type of antibiotic	**Type of bacteria style**			
	Staph aureus	*Escherichia coli*	*Staph cocai epid*	*Strepto cocai*
Augmentin	+	+	+	++
Ciprofloxacin	+++	+++	0	0
Imipenem	+	++	++	+
Amoxicillin	0	+	0	+++
Ampicillin	++	0	+++	+
Rocephin	0	0	+	0
Frequency	4	11	2	2
Percent (%)	21.05%	57.89%	10.53%	10.53%

DISCUSSION

The analysis of urine samples revealed significant findings consistent with existing literature on UTIs in pregnant women. Hematuria and leukocyturia were prevalent, supporting their use as diagnostic markers for UTIs. The acidic pH of urine in the majority of samples aligns with the typical urinary environment during infections. Proteinuria and the presence of bilirubin indicate renal and hepatic stress, respectively, which are complications often associated with UTIs during pregnancy. The detection of nitrites confirms bacterial involvement in the infections.

These findings underscore the importance of regular screening and monitoring of urine parameters in pregnant women to prevent and manage UTIs effectively, thus avoiding potential complications such as preterm labor, pyelonephritis, and chronic kidney disease. Comprehensive healthcare strategies, including early diagnosis, effective treatment, and preventive measures, are crucial to improving maternal and fetal outcomes.

The high effectiveness of ciprofloxacin against *E. coli* is consistent with recent studies. For instance, a study by Zhang et al. (2023) found that ciprofloxacin remains one of the most effective antibiotics for treating UTIs caused by *E. coli*, with similar susceptibility rates. This supports the use of ciprofloxacin as a first-line treatment in cases of confirmed sensitivity. Conversely, the variable efficacy of Augmentin and Amoxicillin aligns with findings from recent research, such as the work by Smith et al. (2022), which reported increasing resistance among UTI-causing bacteria to these antibiotics. This highlights the need for regular susceptibility testing to guide appropriate antibiotic therapy. The observed resistance to Ampicillin and Ceftriaxone is also in line with contemporary studies. For example, a study by Johnson et al., reported high levels of resistance to these antibiotics among Gram-negative bacteria, particularly *E. coli*, emphasizing the reduced utility of these antibiotics for treating UTIs [2].

CONCLUSION

These results highlight the importance of regular screening and early diagnosis of urinary tract infections (UTIs) in pregnant women. Selecting the appropriate treatment based on bacterial sensitivity to antibiotics is crucial in improving healthcare and reducing the risk of serious complications, such as bacteremia, chronic infection, renal scarring, kidney atrophy, and ultimately, renal failure. The study recommends focusing on early detection and proper antibiotic selection to prevent these severe outcomes.

Conflict of interest. Nil

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أنماط حساسية المضادات الحيوية للبكتيريا المعزولة من التهابات المسالك البولية لدى النساء الحوامل في مدينة صبراتة

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المستخلص

تُعد التهابات المسالك البولية من بين أكثر الالتهابات انتشارًا في نظام التكاثر لدى النساء في سن الإنجاب على مستوى العالم. هدف هذه الدراسة إلى تحديد Escherichia coli (E. coli) كعامل محتمل للتسبب في التهابات المسالك البولية لدى النساء الحوامل، وتقييم فعالية مجموعة من العوامل المضادة للبكتيريا على العينات السريرية المجمعة. أجريت الدراسة في عام 2021 في مستشفى صبراتة التعليمي، وشملت 60 عينة بول من النساء الحوامل اللاتي يعانين من تاريخ حمى، إفرازات مهبلية، وأعراض سريرية أخرى. تم استخدام تقنيات التشخيص البكتيري الروتينية وزرع الثقافة لتحديد وتوصيف العزلات البكتيرية. تم تأكيد جميع الحالات بواسطة متخصصين في أمراض النساء والتوليد. نجحت الدراسة في عزل وتحديد 19 سلالة بكتيرية: 11 عزلة (57.9%) تم تحديدها كـ E. coli، 1 عزلة (5.3%) كـ Staphylococcus، و7 عزلات (36.8%) كـ Staphylococcus aureus. أظهرت النتائج أن E. coli كانت حساسة بشكل كبير للسيبروفلوكساسين (79%) في المختبر. بالمقابل، أظهرت المضادات الحيوية الأخرى مثل الأموكسيسيلين، والأوغمنتين، والأمبيسيلين درجات متفاوتة من المقاومة. وخصوصًا، أظهرت E. coli مقاومة للأمبيسيلين والروزوفين، مما يشير إلى زيادة مقلقة في المقاومة لهذه العوامل المضادة للبكتيريا المستخدمة بشكل شائع. يشكل هذا الاتجاه في المقاومة مصدر قلق كبير للصحة العامة، حيث يمكن أن يؤدي إلى بكتيريا أكثر شدة ومقاومة للعلاج. تشدد الدراسة على أهمية إجراء اختبار الزرع البكتيري وفحص الحساسية بانتظام في إدارة التهابات المسالك البولية، خاصة لدى النساء الحوامل. علاوة على ذلك، فإن توفير الرعاية الصحية المناسبة يمكن أن يساعد في الوقاية من التهابات المسالك البولية والحفاظ على الصحة العامة في هذه الفئة.

الكلمات المفتاحية. التهابات المسالك البولية، *Escherichia coli*، مقاومة المضادات الحيوية، النساء الحوامل، الزرع البكتيري، الصحة العامة.