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Relationship Between Pseudomonas aeruginosa Infection and Some Physiological Parameter in Patients with UTIs

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ABSTRACT

The study started in November 2023 and ended in March 2024. The study concentrates on the relationship between urinary tract infections caused by Pseudomonas aeruginosa and some biochemical criteria (triglycerides, cholesterol, liver enzymes). A total of 110 blood samples were collected from patients at Al-Qurna General Hospital in Basra province to diagnose the bacterial species causing the infection and isolating the pseudomonas aeroginosa bacteria, which is one of the most common types of urinary tract infections. Triglyceride level (TG) showed a significant decrease ($P< 0.01$) in UTI-P. aeruginosa patients (99.4±6.31: 90.43 ± 8.85 mg/dl) compared to the control group (148.65 ± 6.64 mg/dl). Cholesterol concentration also recorded a significant decrease ($P< 0.01$) in UTI-P. aeruginosa (113.52 ± 6.03: 119.41 ± 8.5 mg/dl) compared to the control group (148.65 ± 6.64: 162.91 ± 5.14 mg/dl). AST of UTI-P. aeruginosa patients rise ($P<0.01$) (25.12 ± 1.68: 37.52 ± 3.12 U/L) compared to the control group (13.84 ± 2.17: 11.84 ± 2.51 U/L). ALT enzyme level of UTI-P. aeruginosa patients recorded higher ($P< 0.01$) value (38.15 ± 2.58: 41.57 ± 3.15 U/L) compared to the control group (16.28 ± 1.82: 13.4 ± 1.37 U/L). As well as ALP enzyme level of UTI-P. aeruginosa patients showed similar trend (82.45 ± 3.15: 92.11 ± 5.62 U/L) in comparison with the control group (57.02 ± 2.14: 51.42 ± 5.19 U/L).

1. Introduction

Urinary tract infections are common diseases in our societies that affect both males and females in all age groups. There are several factors increase the rate of bacterial infections such as (lifestyle, age, sex, diabetes) [1]. In addition, hormonal changes that occur in a pregnant woman, especially during the first months of pregnancy, may increase the risk of these infections [2]. Infections that affect people who do not have functional or congenital abnormalities in the urinary tract are called uncomplicated urinary tract infections.

Through numerous studies, it has been observed that women with diabetes are more likely to develop urinary tract infections than men in the same age group [3]. *Pseudomonas aeruginosa* is one of the most important types of bacteria causing this infection, both acute and chronic, as it ranks third in

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terms of pathological importance as a cause of urinary tract infections after E. coli and C. *pneumonia* in terms of importance. Pseudomonas aeroginosa is a type of bacteria negative for the tincture, opportunistic and pathogenic, with forms resembling single small bars or short chains, [4] it is characterized by biofilm composition and is highly resistant to certain antibiotics because of its ability to produce beta-lactamc enzyme, which gives it high resistance to several antibiotics. Chronic infections caused by biofilm bacteria are highly resistant to traditional treatments [5]. The indiscriminate and incorrect use of antibiotics is one of the causes of the emergence of antibiotic-resistant bacterial strains [6].

These bacteria are one of the pathogens that can be transmitted through hospitals that give high infection rates and a mortality rate of up to 40% and are considered to be deadly bacteria for patients with immunodeficiency as well as are common in cases (burn wounds, diabetic sores, corneal ulcers, surgical wounds) [7]. Recent studies have confirmed that urinary tract infections can affect infants as young as 2 to 12 months [8]. UTIs can develop into kidney fibrosis, especially if they are accompanied by congenital abnormalities [9]. The infection may spread to other organs of the body in the bladder and urethra and become serious complications for the patient when the condition is neglected and left untreated [10].

The study aimed to estimate relationship between urinary tract infections caused by *Pseudomonas aeruginosa* and some blood characteristics and serum biochemical criteria (triglycerides, cholesterol, liver enzymes).

2. Materials and methods

2.1. Collection of samples

110 blood samples were collected from patients with urinary tract infections who visited Qurna General Hospital in Basra province during the period from October 2023 to March 2024.

2.2. Isolation and Diagnosis

The samples were implanted on prepared implant media and laboratory tests were conducted to diagnose bacteria and isolate samples containing *Psudomonas aeruginosa* and through two tests.

2.2.1. Microscopic Diagnosis

This diagnosis is made by dyeing the segments of bacterial samples with a gram dye and recognizing the shape and arrangement of bacterial cells and their interaction with the dye.

2.2.2. Phenotypic diagnosis

Includes the diagnosis of the shape and size of bacterial colonies and their effects on the implant media. Blood agar medium is used to determine the shape of bacterial colonies and to detect pseudo-laryngeal bacteria. Macconkey agar is used to distinguish between lactose fermented and lactose-fermented bacteria. Selected bacterial isolates were grown on MacConkey agar slant and stored in a refrigerator at 24°C. Isolates were renewed monthly in the same manner throughout the study to maintain sample activity

2.3. Confirmatory diagnosis

Confirmation testing of bacterial samples was carried out by Vitek 2.

2.4. Chemical diagnosis of pseudosaryngeal isolates

Biochemical tests were performed on bacterial samples to determine their ability to produce enzymes and these tests included Catalase test, Urease test, Oxidase test, Indole test, and Methyl red test.

2.5. Hematological parameters

The Automated Hematology Analyzer 5- Part) was used to examine the parameters of the blood (RBC, MCV, PLT).

2.6. Biochemical tests

Biochemical tests (TG, AST, ALT, ALP) were performed by the chemical analysis device AU480 Chemistry Analyzer)) according to the manufacturer's instructions for each device.

2.7. Statistical analysis

The results were evaluated statistically using the (ANOVA) GOSS-Sampson program [11] to determine the significant differences between the means of studied traits at a level of statistical significance (0.01). The main text starts at the top of the page and continues in a one-column format. Place an indentation for each paragraph starting from the first in all sections or subsections. There is no space between paragraphs within the text. Add an 11-point space after the text in each section or subsection.

3. Results and Discussion

The study included 110 blood and urine samples collected from patients with urinary tract infections. Table, 1 showed that urine samples culture on special media (blood agar, MacConkey agar), 66 positive samples for bacterial growth (63.3%) of the total samples against 44 negative samples (36.7%).

Table 1. Distribution of study samples according to urinary tract infection

+Ve Culture	-Ve Culture	Total
66 (63.3%)	44 (36.7%)	110 (100%)

The results confirmed that females are more likely to develop urinary tract infections than males as shown in the table .2. Ayan & Stephen [12] indicated that there are several physiological reasons (short urethral length) behind these differences.

Table 2. The percentage of infection among males and females

Coli	Female	Total
24 (36.4%)	42 (63.6%)	110 (100%)

3.1. Isolate Psudomonas aeruginosa

3.1.1. Microscopic examination

After the microscopic examination of samples of bacteria dye in a gram dye, it was found that the proportion of pseudomonas aeruginosa isolates was the third highest percentage of isolated bacterial infections, where the percentage of isolates reached 51% of the total isolates studied as shown in Table .3

Table 3. Isolation rates of Gram-negative bacteria

Gram negative bacteria	No.	%
E. coli	34	51.5
K. pneumonia	9	13.6
p. aeruginosa	7	10.6
Other types (7)	16	24.2
Total	66	100

3.1.2. Morphological Examination

These isolates appeared on the centre of the blood agar in the form of large, dark-coloured colonies surrounded by a transparent region indicating the decomposition of the blood type (β-haemolytic).
It regularly appears pale or colourless and has a grape-like comfort characteristic of the Zinjar [13].

3.1.3. Chemical tests

Table 3 includes the results of biochemical tests for Pseudomonas aeruginosa for (oxidase, catalase, urease, methyl red, and indole).

Table 4. Chemical testes for Pseudomonas aeruginosa

Bacteria	MR/VP	Urease	Indole	Catalase	Oxidase
P. aeruginosa	-	+	-	+	+

3.1.4. Confirmation diagnosis with the Vitek 2

The results of Viteke2 were identical to the biochemical diagnosis.

3.2. Physiological criteria

3.2.1. Blood parameter

Table. 5 shows that the ESR values recorded a significant increase ($P<0.01$) in patients with urinary tract infections, as they were (12.42±1.04:17.13±3.93) compared to the control group, which was (3.83±1.18:5.83±1.18). Inflammation may affect the liver, thus causing an increase in ESR levels. In general, the ESR value is considered an indicator of general inflammation in the body, which may be caused by infection, anaemia, or an autoimmune disease. It cannot be considered a diagnostic indicator for urinary tract infections, so it is included in a group of medical tests that the patient undergoes [14].
PLT counts were significantly lower ($P\leq0.01$) in patients with urinary tract infections, ranging from 246.4±7.28 to 213.4±10.05, compared to the control group, which ranged from 392.1±3.22 to 315.1±8.13. The present result is consistent with that of [15], who found that urinary tract infections can affect the number of platelets, and that changes in the number of platelets are considered an indicator of infection in women. Severe infections can affect the production of these platelets or cause an increase in their destruction [16].
The number of red blood cells (RBC) showed a significant decrease ($P\leq0.01$) in patients with urinary tract infections, reaching 4.22±0.16: 3.71±0.14, compared to the control group, which recorded 4.93±0.14: 4.31±0.11. This indicates that bacterial infections produced a severe immune response, represented by a decrease in the production of red blood cells, and is consistent with [17].

Table 5. Some blood indicators in the studied groups (Mean± SE)

Haematological parameters	Groups	No.	Male	Female
ESR (mml/1hr)	Control	40	3.83±1.18	5.83±1.18
	P. aeruginosa	7	12.42±1.04	17.13±3.93

Plt (mml/1hr)	Control	40	392.1±3.22	315.1±8.13
	P. aeruginosa	7	246.4±7.28	215.4±10.05
RBC (10^6 / µL)	Control	40	4.93 and 0.14	4.31±0.11
	P. aeruginosa	7	4.22±0.16	3.71±0.14

3.2.2 Biochemical parameter

Table 6. shows both triglyceride and cholesterol levels of UTI patients decreased significantly ($P<0.01$). Cholesterol levels were (113.52±6.03: 119.41±8.5mg/ dl) whereas, that of control group was 148.65/6.64:162.91/5.14 mg/dl. The triglyceride values were 90.43 137.2:8.85 8.1:99.4 mg/dl versus to that of control group (129.3:6.31:9.07 mg/dl). This decrease may be due to diabetes or nutritional deficiencies [18]. It also might be due to medications for the treatment of urinary tract infections that may affect the metabolism of fats and cholesterol. The other possible is a change in the nutrition of the individual and this is consistent with the study [19].

4. Conclusion

The results of the current study showed a clear association between infection with the bacteria Pseudomonas aeruginosa, which causes urinary tract infections, and changes in some biochemical indicators. It turned out that the incidence rate was higher among females compared to males.

A significant decrease ($P< 0.01$) was observed in triglyceride and cholesterol levels in those affected compared to the control group, indicating the effect of infection on lipid metabolism. In contrast, liver enzyme results (AST, ALT, ALP) showed significant elevation in UTI-P. aeruginosa patients, indicating impaired liver function as a result of bacterial infection.

These results show the importance of monitoring biochemical indicators in patients with urinary tract infections, especially when infected with P. aeruginosa, because of their potential role in assessing the severity of the disease and guiding the treatment plan.

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العلاقة بين عدوى الزائفة الزنجارية وبعض المعايير الفسيولوجية لمرضى التهابات المسالك البولية

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التهابات المسالك البولية UTI، الدهون الثلاثية، AST، ALP، ALT، الكوليسترول.

الملخص

بدأت الدراسة في شهر تشرين الثاني ٢٠٢٣ وانتهت في شهر اذار ٢٠٢٤. تهدف الدراسة تقدير العلاقة بين التهابات المسالك البولية الناجم عن الإصابة ببكتيريا الزائفة الزنجارية وبعض المعاييرالكيموحيوية (الدهون الثلاثية، الكولسترول، انزيمات الكبد) وتم جمع ١١٠ عينة دم وادرار من مرضى مراجعين لمستشفى القرنة العام في محافظة البصرة آنذاك وذلك لغرض تشخيص الأنواع البكتيرية المسببة للعدوى وعزل بكتيريا الزائفة الزنجارية التي تعتبر احدى أكثر الأنواع شيوعاً في إصابات المسالك البولية. بينت النتائج ان ٦٦(٦٣,٣٪) عينة ادرار كانت تضم نمو بكتيري و٤٤(٣٦,٧٪) عينة ادرار خالية من النمو البكتيري تم استبعاد العينات الخالية من النمو البكتيري اما العينات التي تضم نمو بكتيري فقد كان عدد الذكور من تلك العينات ٢٤ (٣٦,٤٪) اما عدد الاناث المصابات ٤٢(٦٣,٦٪) حيث كانت نسبة الإصابة بالنساء اعلى من نسبة إصابات الذكور. أظهرت نتائج الدهون الثلاثية(TG) انخفاضاً معنوياً (P< 0.01) في مرضى UTI-P.*aeruginosa* اذ بلغت (6.31±99.4 :8.85± 90.43) mg/dl مقارنة بمجموعة السيطرة التي سجلت (±6.64 148.65) mg/dl. كما سجل تركيز الكولسترول انخفاضاً معنوياً (P< 0.01) في مرضى UTI-P.*aeruginosa* حيث بلغت (٨,٥±٦,٠٣:١١٩,٤١±١١٣,٥٢)mg/dl) بالمقارنة بمجموعة السيطرة التي سجلت (٥,١٤±٦,٦٤:١٦٢,٩١±١٤٨,٦٥) اما انزيمات الكبد فقد سجلت AST ارتفاعاً معنوياً (P< 0.01) لدى مرضى UTI-P.aeruginosa اذ بلغت (٣,١٢±١,٦٨:٣٧,٥٢±٢٥,١٢)U/L) مقارنة بمجموعة السيطرة التي سجلت (٢,٥١±٢,١٧:١١,٨٤±١٣,٨٤)U/L) اما مستويات انزيم ALT فقد سجلت فروقات معنوية (P< 0.01) لدى مرضى UTI-P.*aeruginosa* اذ بلغت (٣,١٥±٢,٥٨:٤١,٥٧±٣٨,١٥)U/L) بالمقارنة بمجموعة السيطرة التي بلغت (١,٣٧±١,٨٢:١٣,٤±١٦,٢٨)U/L) اما مستويات انزيم ALPفقد سجلت فروقات معنوية (P< 0.01) لدى مرضى U/L(82.45±3.15:92.11±5.62 UTI-P.*aeruginosa*) مقارنةً بمجموعة السيطرة التي بلغت (٥,١٩±٢,١٤:٥١,٤٢±٥٧,٠٢)U/L)

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