

Study of Physiological and Biochemical Changes of Patients with Urinary Tract Infection in AL- Ramadi City

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ABSTRACT

All individuals are susceptible to urinary tract infections (UTIs). However, the spread of the infection varies depending on age, gender, and some genetic factors. The aim of this study was to evaluate the physiological and biochemical changes in individuals with urinary tract infections in Anbar City. Seventy samples infected with UTI and (32) samples of control were collected during the period from July 2020 to February 2021. The patients were selected from three hospitals in Anbar Governorate (Al-Ramadi General Hospital, Hit Hospital, and Fallujah Hospital). For all participants, 10 ml of venous blood was collected. Complete blood picture tests, as well as liver enzymes and kidney function tests, serum RBS, total protein, albumin and globulin were estimated. The Results show that there were no significant differences between individuals with UTI and control in the levels of (GOT, ALT, GPT) and white blood cell counts. However, there were significant differences between the control group and UTI patients in the values of PCV (packed cell volume), Hb (hemoglobin), and ESR (erythrocyte sedimentation rate). Also, the results show a significant decrease in serum total protein, albumin and globulin levels in the UTI patients compared to the control. UTIs are a common health concern affecting both men and women. Recognizing the symptoms, seeking prompt medical attention, and adhering to treatment are vital steps in managing UTIs effectively and preventing complications. Understanding the differences between UTIs in men and women helps tailor appropriate management and preventive strategies for each population.

Introduction:

Urinary tract infection (UTI) is one of the common diseases in society, affecting both genders and various age groups. It is considered a major cause of morbidity in women, especially in the age range of 16 to 35 years. This age group represents the peak of sexual activity in women and is also the ideal age for marriage and pregnancy, along with associated interventions. The severity of UTI can range from asymptomatic to severe sepsis [1,2].

As for males, urinary tract infection (UTI) may occur occasionally around the age of 60 and is often attributed to various factors, with prostate enlargement being one of the most significant causes. UTI can sometimes lead to damage to kidney tissues or chronic renal impairment [3,4]. Bacteria are among the major causative factors of urinary tract inflammation and are regularly isolated from urine samples.

The most common bacteria responsible for UTIs are Gram-negative bacteria like *Escherichia coli*, followed by Gram-positive cocci. Polymorphs (multiple-shaped cells) are often present in conjunction with UTIs [5,6].

In Iraq, hospitals record numerous cases of UTIs daily, and kidney stones are also a considerable health concern, affecting a substantial number of individuals. In the Western world, approximately 12% of men and 5% of women suffer from kidney stones, making it a prevalent condition of the urinary system [6,7].

Enzymes and proteins are essential components of blood, and each has a specific composition and value that helps maintain the body's internal balance. Any changes in these components during illness can have serious consequences for the individual. Some physiological alterations have been observed in various groups of people with different medical conditions. Measuring the activity of enzymes in blood serum serves as a direct indicator of the body's physiological state [8,9].

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These and other reasons have prompted the study of physiological and biochemical changes associated with urinary tract inflammation to better understand its impact on human health.

Materials and Methods:

Seventy samples from patients with urinary tract infections and (32) control samples were collected during the period from July 2020 to February 2021. The samples included those from patients who visited the hospitals, those who were admitted, and those who were accompanying the patients in three hospitals in Anbar Governorate. These hospitals were Al-Ramadi General Hospital, Hit Hospital, and Fallujah Hospital. The samples comprised both blood and urine. Urine samples were collected from mid-stream urine for general urine tests. While 10 ml of venous blood was collected and divided into two parts: 2 ml was placed in an EDTA-containing tube for complete blood count (CBC) testing and the remaining blood was placed in a white tube for kidney and liver function tests.

Urine examination: A visual examination of the urine was conducted, which included assessing its color, and acidity, detecting the presence of albumin, and determining the glucose level. Subsequently, the samples were centrifuged using a central centrifuge at a speed of 3000 revolutions per minute for 15 minutes. A drop of the sediment was taken and placed on a slide, covered with a cover slide, and examined under 40x to observe pus cells, red blood cells, and crystals.

Complete blood picture (CBC):

White blood cell count The method used for counting white blood cells was the blood cell counter, and the "Turkes fluid" dilution was employed to calculate the white blood cell count according to the method (Sood, 1989) [10].

Hemoglobin concentration estimation

The method used to estimate the hemoglobin concentration in the blood sample involved using Drabkin's solution as a diluting solution, which contains potassium ferricyanide and potassium cyanide. These chemicals oxidize the iron in hemoglobin from a ferrous to a ferric state, forming methemoglobin with a brown color. The intensity of this color was measured at a wavelength of 540 nanometers (Henry, 1974) [11].

Measurement of packed red blood cell volume (PCV)

Capillary tubes and a blood separation device were used to measure the volume of packed red blood cells using a Hematocrit reader (Sood, 1989) [10].

Measurement of the erythrocyte sedimentation rate (ESR) The Westergren method was used to estimate the sedimentation rate (Henry, 1974) [11].

Estimation of liver enzymatic activity:

Estimation of the enzymatic activity of the amine transaminase group the method by Reitman et al., (1957) [12] was employed to estimate the enzymatic activity of AST and ALT, and their color intensity was measured at a wavelength of 510 nanometers.

Estimation of alkaline phosphatase activity the method (Reitman et al., 1957) [12], also known as the colorimetric method, was followed to estimate the alkaline phosphatase activity. This method measures the amount of phenol liberated by the enzyme's action on its substrate, Disodium phenyl Phosphate. The quantity of liberated phenol under specific conditions is considered a measure of the enzyme's activity, expressed in King-Armstrong Units (K.A.U), which represents the amount of enzyme that releases one gram of phenol in 15 minutes under optimal test conditions.

Serum Urea Estimation: Nessler's method was used to estimate the urea in blood serum and read the absorbance at a wavelength of 450 nanometers (El Amry, 1990) [13]. The urea concentration was determined according to the following equation:

$$\text{blood urea (mg/dl)} = \frac{(\text{Test} - \text{Blank})}{(\text{Standard} - \text{Blank})} \times 100$$

Creatinine Estimation in Serum: Creatinine was measured using the Jaffe method, which relies on the reaction of creatinine in the sample with alkaline picrate to produce a red-colored solution of creatinine picrate. The intensity of the color formed was measured at a wavelength of 522 nanometers (Kaplan, 1989) [14]. The concentration of creatinine was calculated according to the following equation:

$$\text{Creatinine (mg/dl)} = \frac{[(T-B)/(S-B)] \times \text{con. STD.}}$$

Estimation of Random blood sugar (RBS), Total protein, Albumin, and Globulin in Serum: Serum were utilized for the estimation of these biochemical parameters by ARTOS® semi-automatic biochemical analyser using kits.

Results:

The patients used in this study were distributed into (28) males and (42) females and control (12 males) and (20) females. The results show that females have a significantly higher infection rate with UTI than males, as shown in Table (1).

Table 1. Distributed of UTI patients and control groups according to gender.

Group		Patients	Control	Total
No.		70	32	102
Gender	Male	28	12	40
	%	40%	37.5%	
	Female	42	20	62
	%	60%	62.5	
P-value		0.024*		0.012*

*Mean significant difference at $P \leq 0.05$.

In this study, the age of patients was divided into four groups which were, less than 20 years (< 20y), from 20 years to 30 years (20y-30y) group, from 31 years to 39 years (30y-40y) group, and more than 40 years (>40y). The results showed that the majority of infections with UTI 47.1% were seen within the 20-30 y group, and fewer UTIs 12.85% were seen within the >40y group, the statistical analysis clarified significant differences at level ($p \leq 0.05$), as showed in the table (2).

Table 2. Distribution of UTI patients who were involved in this study according to age

Age (year)	No. of infection	percentage of infection	P-value
< 20y	17	24.2	0.008*
20y-30y	33	47.1	
30y-40y	11	15.7	
>40y	9	12.85	
Total	70	100%	

*Mean significant difference at $P \leq 0.05$.

Table (3) shows that patients who are in elementary education have a higher percentage (32%) of UTI infection than educated patients. Regarding occupation, the *Not Employer* were more affected by UTI (65.7%) than the employer (34.2%), with a significant difference at $P \leq 0.05$. There were no significant differences at $P \leq 0.05$, however, the patients in rural areas were more afflicted by UTI (54.2%) than patients in urban areas (45.7%), as shown in Table (3).

Table 3. Demographic characteristics of UTI patients involved in this study.

Characteristics	No.	%	P value
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Level of education	non-Education	31	44.2 ^a	0.007*
	High School	27	38.5 ^b	
	Achieve a Diploma and Beyond	12	17.1 ^c	
Total		70	100	
Occupation	Not Employer	46	65.7 ^a	0.02*
	Employer	24	34.2 ^b	
Total		70	100	
Residence	Rural	38	54.2	0.15 ^{NS}
	Urban	32	45.7	
Total		70	100	

* NS: non-significant differences at $P \leq 0.05$.

* (a, b, c): significant difference at $P \leq 0.05$.

The results in Table 4 and Figures (1, and 2) show that there were no significant differences in the levels of the studied enzymes (AST, ALT, ALP) and white blood cell counts between individuals with urinary tract inflammation (19, 10.3, 11.1) mg/dl respectively and the control group (7.6, 8.4, 5.1) mg/dl respectively. However, there were significant differences in the values of PCV (packed cell volume), Hb (hemoglobin), and ESR (erythrocyte sedimentation rate) between the control group (41.3 ± 2.8 %, 13.08 ± 2.1 g/dl, 17.1 ± 1.12 mg/dl) respectively and the individuals with urinary tract inflammation (36.92 . 4 %, 11.24 ± 1.3 g/dl, 42.1 ± 2.2 mg/dl) respectively.

Table 4. Mean of Hemoglobin concentration, WBC counts, PCV value, and ESR value in individuals with urinary tract infections compared to healthy individuals.

Parameter	UTI patients	Control	P- value
Hb mg/dl	11.24 ± 1.3^a	13.08 ± 2.1^b	0.004*
PCV%	36.9 ± 2.4^b	41.3 ± 2.8^a	0.003*
WBC	5170 ± 38^b	5630 ± 32^a	0.016*
ESR g/dl	42.1 ± 2.2^b	17.1 ± 1.12^a	0.028*

*Mean significant difference at $P \leq 0.05$.

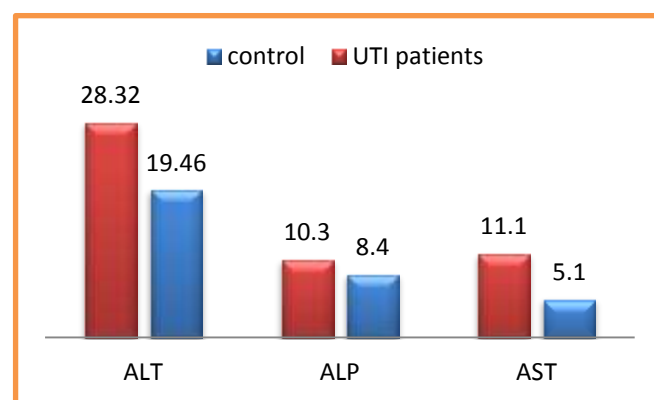


Figure 1. Mean of ALT, ALP, and AST in individuals with urinary tract infections compared to healthy individuals.

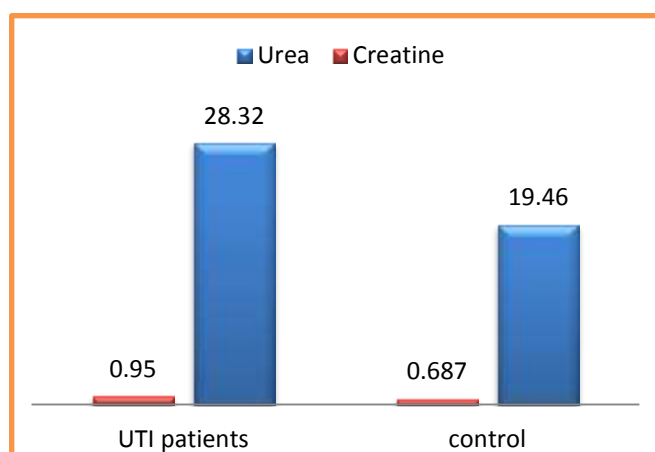


Figure 2. Mean blood serum urea level and creatinine concentration in individuals with urinary tract infections compared to healthy individuals.

Table (5) shows that the mean values of serum RBS were significantly elevated ($p \leq 0.05$) in UTI patients (138 ± 20.8) compared to the healthy control group (112 ± 14.8). There was a significant decrease in the serum total protein, albumin and globulin levels in the UTI patients (4.23 ± 1.64 , 1.63 ± 1.18 , 2.88 ± 0.2) respectively compared to the control group (6.62 ± 0.28 , 3.72 ± 0.32 , 3.83 ± 0.12).

Table 5. The mean levels of Biochemical changes in affected and healthy control.

Parameter	UTI patients	Control	P- value
RBS mg/dl	138 ± 20.8^a	112 ± 14.8^b	0.008*
Total proteins mg/dl	4.23 ± 1.64^b	6.62 ± 0.28^a	0.024*
Albumin mg/dl	1.63 ± 1.18^b	3.72 ± 0.32^a	0.013*
Globulin mg/dl	2.88 ± 0.2^b	3.83 ± 0.12^a	0.038*

*Mean significant difference at $P \leq 0.05$.

Discussion:

A common occurrence is a urinary tract infection (UTI), which usually originates in the lower urinary tract encompassing the urethra and bladder [15]. If left untreated, these infections may progress to the upper urinary tract involving the ureters and kidneys, leading to significant kidney damage. UTIs can also result in various complications such as bladder infection (cystitis), urethra infection (urethritis), kidney infection (pyelonephritis), and ureter infection (ureteritis) [16]. The results show that females have a significantly higher rate of infection with UTI than males due to fluctuations in hormones in females, particularly during menstruation and pregnancy, which can impact their vulnerability to

urinary tract infections (UTIs). Changes in hormone levels can disrupt the balance of vaginal flora and render the urinary tract more susceptible to infection [17]. In addition, anatomical and physiological distinctions between the male and female urinary systems play a role. The female urethra is shorter and located closer to the anus, making it more susceptible to bacterial entry and UTIs. Furthermore, certain conditions more prevalent in females, such as pregnancy and menopause, can increase their susceptibility to UTIs [18]. Pregnant women may experience urinary stasis, while postmenopausal women might undergo vaginal environment changes that elevate the risk of infection [17, 19].

The results show that non-education patients have a higher percentage of UTI infection than educated patients. UTIs The more afflicted patients in rural areas than in urban areas. The link between education and the occurrence of UTIs could stem from socioeconomic aspects [17,20]. Well-educated individuals frequently enjoy improved access to healthcare and maintain better hygiene practices, thereby lowering their susceptibility to infections. Educated individuals may also possess higher health literacy, enabling them to comprehend and adhere to preventive measures against UTIs [21]. Additionally, cultural and behavioural factors, such as disparities in customs and lifestyles between rural and urban populations, may influence UTI prevalence. For instance, reliance on traditional remedies, dietary patterns, or clothing preferences may contribute to this [22].

C. albicans has been said to be a leading cause of yeast infections in women of infancy in the reproductive tract, and this is attributable to their virulent factors, including dimorphism and phenotypic switching. *C. albicans* also manufacture proteases and phosphatases to improve their adherence to human epithelia [17]. Although UTIs primarily impact the urinary system, severe or untreated cases might indirectly affect liver function and the complete blood count (CBC) [23].

These results show significant differences between the control group and individuals with urinary tract infections in terms of PCV, Hb, and ESR values. These findings are consistent with Al-Jabiry (2010), who reported a significant decrease in red blood cells, hemoglobin, and PCV among affected women compared to healthy individuals [24]. However, these results do not agree with Salman et al., (2022), who

found no statistically significant differences in red blood cell levels across all groups [25].

A CBC is a blood examination that provides information about different elements of the blood. Unless a UTI has progressed to an advanced stage or caused systemic complications like bacteremia or sepsis, it typically does not directly impact the CBC results. However, when dealing with severe UTIs or systemic infections, the CBC might reveal signs of infection or inflammation [16]. Common CBC findings associated with severe infections could include an increased count of white blood cells (leukocytosis), which occurs as the body responds to the infection by producing more white blood cells to fight the invading bacteria. Moreover, in certain cases, chronic or severe infections can lead to anemia due to reduced red blood cell production or increased destruction [26]. For the most part, UTIs are confined to the urinary system and can be effectively treated with antibiotics in uncomplicated cases [27]. The results of this study demonstrated that urinary tract inflammation does not affect certain physiological indicators such as the concentration of GOT, GPT, ALP, urea, and creatinine in affected individuals compared to healthy individuals. These findings align with Ahmed (2016), who found no significant difference in AST and ALT levels between affected women and control groups [27]. However, these results differ from Muhsin et al. (2013), who reported increased ALT and AST activities in affected women compared to healthy women [28].

In some cases, untreated or severe UTIs can lead to complications that affect the liver. The most common complication that could impact liver function is pyelonephritis. Pyelonephritis is a type of UTI that involves infection and inflammation of the kidneys. When the kidneys are infected, the bacteria can spread to the bloodstream, causing a condition called bacteremia. Bacteria in the bloodstream can reach the liver, leading to liver infections (hepatic abscess) or affecting liver function. In addition, severe or recurrent UTIs can cause systemic inflammation and an immune response that may indirectly affect liver function. This is more likely to occur in people with underlying health conditions or weakened immune systems [28-29,3]. Urinary tract infections (UTIs) can exert various effects on kidney function, particularly if left untreated or recurring [30,31]. The kidneys play a critical role in filtering waste products, excess fluids, and electrolytes from the bloodstream to produce urine. Prolonged inflammation from untreated UTIs

can result in kidney tissue scarring, impairing their ability to filter blood efficiently. This can give rise to chronic kidney disease (CKD), which leads to a gradual loss of kidney function [16,32].

In more severe cases, an untreated UTI can lead to a kidney infection, which may escalate to sepsis, a life-threatening condition. Sepsis arises when the body's immune response triggers widespread inflammation and organ dysfunction, including the kidneys. This can severely impair kidney function and possibly lead to acute kidney injury (AKI) or even kidney failure [17, 33].

Additionally, UTIs in some instances can be related to urinary tract obstructions, such as kidney stones or structural abnormalities. These obstructions can hinder urine flow, increasing the risk of kidney infections and damage [25,32-33]. Certain types of UTIs can even cause glomerulonephritis, an inflammation of the glomeruli—the kidney's filtering units. Glomerulonephritis can lead to protein and blood leaking into the urine and adversely affecting kidney function [28,17]. The results show that mean values of RBS were significantly elevated in UTI patients compared to the healthy control. There was a significant decrease in the serum total protein, albumin and globulin levels in the UTI patients compared to the control group. The hypoproteinemia observed in the current study may result from protein loss through urine. Cristea et al., (18) documented a significant decrease in serum albumin levels in individuals with urinary tract infections, primarily caused by elevated urinary albumin levels. In the analysis of urine samples, the microscopic examination of sediment revealed the presence of pus cells, indicating the presence of pyuria.

Conclusion:

Urinary tract infections are common bacterial infections that affect both men and women. They can occur in any part of the urinary system, including the kidneys, ureters, bladder, and urethra. UTIs are more prevalent in women compared to men due to their shorter urethra, which allows bacteria to reach the bladder more easily. Factors like sexual activity, pregnancy, and the use of certain contraceptive methods can also increase the risk of UTIs in women. While, UTIs are relatively rare in young, healthy men but can become more common in older age or those with risk factors such as an enlarged prostate or urinary catheterization. In men, UTIs may be indicative of underlying urinary tract abnormalities

and require thorough evaluation. Prompt diagnosis and appropriate treatment are crucial to prevent the infection from spreading to the kidneys.

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دراسة التغيرات الفسيولوجية والكيميائية للمرضى المصابين بعدوى المسالك البولية في مدينة الرمادي

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الخلاصة:

جميع الأفراد عُرضة للإصابة بالتهابات المسالك البولية (UTIs). ومع ذلك، يتفاوت انتشار العدوى اعتمادًا على العمر والجنس وبعض العوامل الوراثية. هدفت هذه الدراسة إلى تقييم التغيرات الفسيولوجية والكيميائية في الأفراد الذين يعانون من التهابات المسالك البولية في مدينة الأنبار. تم جمع سبعين عينة مصابة بـ UTI و 32 عينة ضابطة خلال الفترة من يوليو 2020 إلى فبراير 2021. تم اختيار المرضى من ثلاثة مستشفيات في محافظة الأنبار (مستشفى الرمادي العام ومستشفى هيت ومستشفى الفلوجة). تم جمع 10 مل من الدم الوريدي لجميع المشاركين. تم قياس صورة الدم الكاملة، بالإضافة إلى اختبارات إنزيمات الكبد ووظائف الكلى والبروتين الكلى في المصل، الألبومين والكلوبيولين. أظهرت النتائج أنه لا توجد فروق ذات دلالة بين الأفراد الذين يعانون من التهاب المسالك البولية ومجموعة السيطرة في مستويات الإنزيمات المدروسة (GOT, ALT, GPT) وعدد خلايا الدم البيضاء. ومع ذلك، كانت هناك فروق ذات دلالة بين مجموعة السيطرة والأفراد الذين يعانون من التهاب المسالك البولية في قيم PCV (حجم الكريات الحمراء المعبأة) و Hb (الهيموغلوبين) و ESR (معدل ترسيب كريات الدم الحمراء). كما أظهرت النتائج انخفاضاً معنوياً في مستويات البروتين الكلى والألبومين والكلوبيولين في مصل الدم لدى مرضى التهاب المسالك البولية مقارنة مع السيطرة. التهابات المسالك البولية هي مشكلة صحية شائعة تؤثر على الرجال والنساء على حد سواء. التعرف على الأعراض والبحث عن العناية الطبية الفورية والالتزام بالعلاج خطوات حيوية في إدارة التهابات المسالك البولية بفعالية والوقاية من المضاعفات. فهم الفروق بين التهابات المسالك البولية في الرجال والنساء يساعد في تصميم استراتيجيات إدارة ووقائية مناسبة لكل فئة من السكان.

الكلمات المفتاحية: العدوى في المسالك البولية، GOT، GPT، وظيفة الكلى.