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Research Article

Assessment of Certain Serum Proteins, pH and C Reactive Protein in Patients with Urinary Tract Infections in Owerri

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Received date: March 24, 2025; **Accepted date:** April 02, 2025; **Published date:** April 08, 2025

Citation: Egbeonu Nwamaka, Ikaraoha C. Ikechukwu, Johnkennedy Nnodim, (2025), Assessment of Certain Serum Proteins, pH and C Reactive Protein in Patients with Urinary Tract Infections in Owerri, *J Clinical Research Notes*, 6(3); **DOI**:**10.31579/2690-8816/167**

Abstract

The levels of certain serum proteins and C reactive proteins in Owerri patients suffering from urinary tract infections are assessed in this study. This research involved the recruitment of 150 individuals in total. Fifty respondents appeared to be in good health, while 100 patients had urinary tract infections. A statistical analysis and laboratory analysis were performed. CRP levels in UTI patients were noticeably higher (30.24 ± 5.40 mg/L) than in controls (23.74 ± 8.28 mg/L; p = 0.000), suggesting a strong inflammatory response. Urine pH increased significantly (7.17 ± 0.966 vs. 5.54 ± 0.76; p = 0.000), Serum albumin levels were significantly lower in UTI patients (45.41 ± 4.02 g/L) compared to controls (48.48 ± 3.09 g/L; p = 0.002), whereas total protein levels showed no significant difference (p = 0.766). Gender-based differences revealed higher total protein levels and CRP levels in female UTI patients than males.

Keywords: serum proteins; pH; C reactive protein; urinary tract infections; bladder

Introduction

Urinary tract infections or UTIs, are very common, particularly among older, pregnant, and lactating people. In their lifetime, one in two women and one in twenty men will get a UTI. By controlling the blood's water content and filtering waste products out of the blood, the kidneys create urine. The tubes called ureters connect each kidney to the bladder. Urine travels from the kidneys to the bladder through the ureters. The bladder "signals" the urge to urinate, and through the urethra tube, urine leaves the body. A serious kidney infection is less likely thanks to the urinary system. By preventing urine from flowing backward from the bladder to the kidneys, it does this [1].

A urinary tract infection (UTI) is an illness that affects a section of the urinary tract. Lower urinary tract infections may affect the bladder or urethra, whereas upper urinary tract infections harm the kidney. Signs of a lower urinary tract infection include pain when urinating, frequent and urgent urination even when the bladder is empty, and suprapubic tenderness. On the other hand, lower UTI symptoms like fever or flank pain are usually accompanied with kidney infection symptoms, which are more common. Blood in the pee is an uncommon occurrence. Patients' symptoms may be vague or nonspecific at the extremes of age (i.e. in extremely young or old patients). Escherichia coli is the most common cause of infections, while other bacteria or fungi can also infrequently cause them [2].

Risk factors include female anatomy, family history, diabetes, obesity, sexual activity, and catheterization. Urinary tract infections (UTIs) are not considered STIs (sexually transmitted illnesses), however sexual activity is a risk factor. Pyelonephritis is typically caused by ascending bladder infections, although it can also be caused by a blood-borne bacterial infection. Only the symptoms of young, healthy women can be used to make a diagnosis. Since germs can exist without causing sickness, diagnosing persons with vague symptoms can be difficult. When treatment fails or in complex cases, urine cultures can be useful [3]. It is important to keep in mind that hematuria is present in 68–91.7% of UTIs, and proteinuria is present in 63–80% of UTIs. The protein and albumin pads may therefore produce falsely positive results for UTI patients. Although blood includes protein, healthy kidneys should only filter extremely little amounts of protein from the urine because most protein molecules are too large for the kidneys to filter. Urine protein loss is uncommon [4].

When it happens, it's called "proteinuria. "Although there are many different proteins seen in urine, albumin is the one most strongly linked to kidney disease. Even though protein in urine is rarely visible, it can occasionally be detected with a simple dip-stick test or more sensitive lab testing. Sometimes renal disease and other health problems might be indicated by urine protein levels [5,6] Urinary tract infections (UTIs), which are the most common bacterial ailment in adult males and females, also have a high recurrence incidence. Despite the high frequency of UTIs, there is currently no accurate detection method for their prompt identification [7]. A common diagnostic method for UTIs, the urine dipstick has poor sensitivity and specificity. The average time to diagnose a patient is 72 hours, despite the fact that urine cultures are more accurate. Therefore, developing rapid, simple, and reliable point-of-care diagnostic tests for UTIs is crucial. Part of a UTI is an inflammatory disease. Urine from UTI patients has changed proteins. UTI biomarkers for diagnosis and/or prognosis may be found in urinary proteins [8,9,10].

Investigating the variations in albumin and total protein among patients with UTIs is the primary objective of this study. Due to the paucity of data and contradictory patient reports on serum albumin and total protein levels, this study attempts to investigate these parameters in individuals with UTIs.

Materials and Methods

Study Area

The study was carried out in three different private laboratories in Imo State, Owerri, Nigeria.

Ethics, Advocacy, and Pre-Survey Contacts

The Ethical approval was obtained from the Federal Teaching Hospital, Owerri,

Study Population/Sample

Size

The study population consisted of patients aged 20 to 60 years who were confirmed to have urinary tract infections through culture. They were age-matched with apparently healthy individuals who were confirmed not to have UTIs via culture. A total of one hundred urinary tract-infected patients were recruited for the study, while 50 subjects were apparently healthy individuals.

Selection Criteria

Inclusion Criteria

(i) Subjects between the ages of 20-60 years.

(ii) Subjects who gave consent to participate in the study.

(iii) Subjects with no infection.

Exclusion Criteria

(i) Subjects below the age of 20 years and above the age of 60 years.

(ii) Subjects who did not give consent to participate in the study.

(iii) Subjects with infections.

Study Design

A case-control study was carried out among urinary tract-infected patients. The test group comprised 50 participants within the age range of 20-60 years, while the control group comprised 50 apparently healthy individuals whose ages matched the test population. A structured questionnaire was issued to them for the purpose of obtaining information regarding their medical and demographic characteristics, in addition to their hospital records. Those who qualified to participate in the research signed a written letter of consent.

Sample Collection

Blood and urine samples were collected to evaluate some serum proteins, hematological indices, proteinuria, and hematuria by a trained health care professional using aseptic measures. Blood samples were collected aseptically by venipuncture using a 5ml sterile disposable syringe and needle from all subjects and dispensed into a labeled plain dry specimen container. The samples were centrifuged at 3,000 rpm for 5 minutes after clotting to separate and obtain the serum. The sera were extracted using a Pasteur pipette, put into an appropriate specimen container, and stored at -20°C prior to use.

Laboratory Procedures

All reagents were commercially purchased, and the manufacturer's standard operational procedures (SOP) were strictly followed.

Determination of Serum Total Protein (Biuret Method) (Using Randox Total Protein Assay-Tp245)

Principle: The principle was based on the reaction between cupric ions in the reagent and the peptide bonds of the protein molecules in an alkaline solution to form blue-violet or purple-colored complexes. The absorbance of the color was measured using a spectrophotometer at 540 nm.

Determination of Serum Albumin (Bromocresol Green Method) (Using Randox Albumin Assay-AL145)

Principle: Under acidic conditions, serum albumin binds specifically with bromocresol green to form a green-colored complex. The absorbance was read at 640 nm.

Determination of C-Reactive Protein

Principle of C-Reactive Protein Test: The C-Reactive Protein test is based on the principle of latex agglutination. When latex particles complexed with human anti-C-reactive protein were mixed with a patient's serum containing C-reactive proteins, a visible agglutination reaction took place within 2 minutes.

Statistical Analysis

All data generated in this study were subjected to statistical analysis using SPSS version 23. Mean and standard deviation, Student's t-test, and correlation were determined. The level of significance was taken at $p<0.05$.

Results

4.1 Mean ± SD Values of Serum Total Protein, Albumin, CRP And Urine pH In All UTI Subjects Versus All Controls

There was a significantly higher (p = 0.000) Mean CRP in All UTI subjects (30.24 ± 5.40) compared to control subjects (23.74 ± 8.28). There was a significantly higher (p = 0.000) Mean Urine pH in All UTI subjects (7.17 ± 0.966) compared to control subjects (5.54 ± 0.76). There was a significantly lower (p = 0.002) Mean Albumin in All UTI subjects (45.41± 4.02) compared to All control subjects (48.48 ± 3.09). There was no significant difference (p = 0.766) in Mean Total Protein of All UTI subjects (68.55 ± 6.57) compared to Control subjects (68.20 ± 4.06) (Table 4.1).

Variable (mean ± SD)	All UTI subjects (n=50)	All Control subjects (n=50)	t-value	p-value
Total Protein (mg/dl)	68.55 ± 6.57	68.20 ± 4.06	0.299	0.766
Lower 95% C.I	66.68	67.04		
Upper 95% C.I	70.41	69.35		
Albumin (mg/dl)	45.41± 4.02	48.48 ± 3.09	-4.081	0.000
Lower 95% C.I	44.27	47.60		
Upper 95% C.I	46.56	49.36		
CRP(mg/l)	30.24 ± 5.40	23.74 ± 8.28	5.638	0.000
Lower 95% C.I	28.70	21.38		
Upper 95% C.I	31.77	26.09		

Urine pH Lower 95% C.I Upper 95% C.I	7.17 ± 0.966 6.89 7.44	5.54 ± 0.76 5.32 5.75	9.548	0.000

Table 4.1: Mean ± SD Values of Serum Total Protein, Albumin, CRP And Urine pH In All UTI Subjects Versus All Controls

4.2 Mean ± SD Values of Serum Total Protein, Albumin, CRP And Urine pH In Male UTI Subjects Versus Male Controls

There was a significantly higher (p = 0.003) Mean CRP in Male UTI subjects (29.33 ± 4.51) compared to control subjects (24.43 ± 9.31). There was a significantly higher (p = 0.000) Mean Urine pH in Male UTI subjects (7.14 ± 0.95) compared to control subjects (5.48 ± 0.714). There was a significantly lower (p = 0.002) Mean Albumin in Male UTI subjects (44.64 ± 4.88) compared to control subjects (49.11 ± 3.61). There was no significant difference (p = 0.201) in Mean Total Protein in Male UTI subjects (67.82 ± 8.63) compared to Control subjects (70.41 ± 3.87). (Table 4.2).

Variable (mean ± SD)	Male UTI subjects (n=25)	Male Control subjects (n=25)	t-value	p-value
Total Protein (mg/dl) Lower 95% C.I Upper 95% C.I	67.82 ± 8.63 64.26 71.38	70.41 ± 3.87 68.81 72.01	-1.315	0.201
Albumin (mg/dl) Lower 95% C.I Upper 95% C.I	44.64 ± 4.88 42.62 46.66	49.11 ± 3.61 47.62 50.60	-3.438	0.002
CRP (mg/l) Lower 95% C.I Upper 95% C.I	29.33 ± 4.51 27.46 31.19	24.43 ± 9.31 20.58 28.27	3.249	0.003
Urine pH Lower 95% C.I Upper 95% C.I	7.14 ± 0.95 6.74 7.53	5.48 ± 0.714 5.18 5.77	6.481	0.000

Table 4.2: Mean ± SD Values of Serum Total Protein, Albumin, CRP And Urine pH In Male UTI Subjects Versus Male Controls

4.3 Mean ± SD Values of Serum Total Protein, Albumin, CRP And Urine pH In Female UTI Subjects Versus Female Controls

There was a significantly higher (p = 0.002) Mean Total Protein in Female UTI subjects (69.27 ± 3.54) compared to Control subjects (65.98 ± 2.92). There was a significantly higher (p = 0.000) Mean CRP in Female UTI subjects (31.15 ± 6.12) compared to control subjects (23.05 ± 1.44). There was a significantly higher (p = 0.000) Mean Urine pH in Female UTI subjects (7.20 ± 1.00) compared to control subjects (5.60 ± 0.81). There was a significantly lower (p = 0.021) Mean Albumin in Female UTI subjects (46.19 ± 2.81) compared to control subjects (47.85 ± 2.38) (Table 4.3).

Variable (mean ± SD)	Female UTI subjects (n=25)	Female Control Subjects (n=25)	t-value	p-value
Total Protein (mg/dl) Lower 95% C.I Upper 95% C.I	69.27 ± 3.54 67.81 70.74	65.98 ± 2.92 64.78 67.19	3.412	0.002
Albumin (mg/dl) Lower 95% C.I Upper 95% C.I	46.19 ± 2.81 45.03 47.35	47.85 ± 2.38 46.86 48.83	-2.479	0.021
CRP (mg/l) Lower 95% C.I Upper 95% C.I	31.15 ± 6.12 28.62 33.68	23.05 ± 1.44 20.05 26.04	4.724	0.000
Urine pH Lower 95% C.I Upper 95% C.I	7.20 ± 1.00 6.78 7.61	5.60 ± 0.81 5.26 5.93	6.928	0.000

Table 4.3: Mean ± SD Values of Serum Total Protein, Albumin, CRP And Urine pH In Female UTI Subjects Versus Female Controls

4.4 Mean ± SD Values of Serum Total Protein, Albumin, CRP And Urine pH In Male UTI Subjects Versus FemaleUTI Subjects

There was no significant difference (p = 0.418) Mean Total Protein in Male UTI subjects (67.82 ± 8.63) compared to Female UTI subjects (69.27 ± 3.54). There was no significant difference (p = 0.246) in Mean Albumin in Male UTI subjects (44.64 ± 4.88) compared to Female UTI subjects (46.19 ± 2.81). There was no significant difference (p = 0.146) in Mean CRP in Male UTI subjects (29.33 ± 4.51) compared to Female UTI subjects (31.15 ± 6.12).

There was no significant difference (p = 0.854) in Mean Urine pH in Male UTI subjects (5.48 ± 0.71) compared to Female UTI subjects (5.60 ± 0.81)

Variable (mean ± SD)	Male UTI subjects (n=25)	Female UTI subjects (n=25)	t-value	p-value
Total Protein (mg/dl)	67.82 ± 8.63	69.27 ± 3.54	-0.824	0.418
Lower 95% C.I	64.26	67.81		
Upper 95% C.I	71.38	70.74		
Albumin (mg/dl)	44.64 ± 4.88	46.19 ± 2.81	-1.190	0.246
Lower 95% C.I	42.62	45.03		
Upper 95% C.I	46.66	47.35		
CRP (mg/l)	29.33 ± 4.51	31.15 ± 6.12	-1.503	0.146
Lower 95% C.I	27.46	28.62		
Upper 95% C.I	31.19	33.68		
Urine pH	7.14 ± 0.95	7.20 ± 1.00	-0.186	0.854
Lower 95% C.I	6.74	6.78		
Upper 95% C.I	7.53	7.61		

(Table 4.4). Mean ± SD Values of Serum Total Protein, Albumin, CRP And Urine pH In Male UTI Subjects Versus Female UTI Subjects

4.5 Mean ± SD Values of Serum Total Protein, Albumin, CRP And Urine pH In Male Control Subjects Versus Female Control Subjects

There was a significantly higher (p = 0.002) Mean Total Protein in Male Control subjects (70.41 ± 3.87) compared to Female Control subjects (65.98 ± 2.92). There was a significantly lower (p = 0.021) Mean Albumin in Male Control subjects (49.11 ± 3.61) compared to Female control subjects (47.85 ± 2.38). There was a significantly higher (p = 0.000) Mean CRP inFemale UTI subjects (24.43 ± 9.31) compared to control subjects (23.05 ± 7.24). There was a significantly higher (p = 0.000) Mean Urine pH inFemale UTI subjects (5.48 ± 0.71) compared to control subjects (5.60 ± 0.81) (Table 4.5).

Variable (mean ± SD)	Male Control subjects (n=25)	Female Control subjects (n=25)	t-value	p-value
Total Protein (mg/dl)	70.41 ± 3.87	65.98 ± 2.92	4.414	0.000
Lower 95% C.I	68.81	64.78		
Upper 95% C.I	72.01	67.19		
Albumin (mg/dl)	49.11 ± 3.61	47.85 ± 2.38	1.537	0.137
Lower 95% C.I	47.62	46.86		
Upper 95% C.I	50.60	48.83		
CRP (mg/l)	24.43 ± 9.31	23.05 ± 7.24	0.545	0.524
Lower 95% C.I	20.58	20.05		
Upper 95% C.I	28.27	26.04		
Urine pH	5.48 ± 0.71	5.60 ± 0.81	-0.486	0.632
Lower 95% C.I				
Upper 95% C.I				

Table 4.5: Mean ± SD Values of Serum Total Protein, Albumin, CRP And Urine pH In Male Control Subjects Versus Female Control Subjects

Discussion

The current findings on serum total protein, albumin, C-reactive protein (CRP), and urine pH are compared with existing literature to highlight correlations and implications for clinical practice. Urinary tract infections (UTIs) are common bacterial infections that can cause significant physiological alterations, including changes in serum proteins, haematological indices, and urine parameters. Studies have looked at these biomarkers to improve diagnostic and prognostic approaches regarding UTI management.[11] Our data indicated significantly higher CRP levels in UTI individuals compared to controls This is consistent with research by [12], which found that systemic inflammatory responses caused CRP levels to rise in UTI patients.

A considerable rise in urine pH among UTI individuals compared to controls is similar with findings by [13] who reported alkaline urine in patients with bacterial infections, particularly those caused by urea-splitting bacteria like Proteus mirabilis.

Male UTI patients and healthy controls differ significantly in a few biochemical indicators, according to the investigation. In particular, compared to control participants, male UTI subjects had lower mean albumin levels, higher mean C-reactive protein (CRP) levels, and higher urine pH. The mean amounts of total protein in the two groups did not differ significantly.

This is consistent with the findings of [14], which likewise found no discernible variation in the groups' levels of total protein. Male UTI individuals had higher mean CRP levels than controls, which may indicate that UTIs are linked to an increased inflammatory response. Elevated levels of CRP, an acute-phase protein that rises in response to inflammation, are frequently seen in bacterial infections, particularly urinary tract infections. Higher CRP levels have been shown in studies to help differentiate between upper and lower UTIs, and they are frequently linked to acute pyelonephritis [2]. Male UTI participants' mean urine pH was noticeably higher than that of controls, suggesting that infected people's urine is becoming more alkaline. Urea-splitting bacteria, such Proteus mirabilis, can cause alkaline urine by producing ammonia and raising the pH of the urine. This change in urine pH is a known feature of several bacterial urinary tract infections. This is in accordance with research by [15], who found that individuals with bacterial infections—especially those brought on by urea-splitting bacteria such Proteus mirabilis—had alkaline urine. The body's acute-phase reaction to infection may be reflected in the male UTI sufferers' reported drop in mean albumin levels as compared to controls.

While the synthesis of other proteins, such as albumin, is downregulated during such reactions, the liver produces more acute-phase proteins, such as CRP [16]. Lower serum albumin levels can also result from increased urine albumin excretion caused by UTIs. Similar patterns were noted by [9], who hypothesized that systemic inflammation and increased urine protein loss may be connected to hypoalbuminemia in UTIs. When albumin levels fall, other serum proteins may rise to make up for it, preserving overall total protein levels, as indicated by the lack of a significant difference in mean total protein levels between male UTI subjects and controls. The increased synthesis of acute-phase proteins, which are a component of the body's early reaction to infection, may be the cause of this compensatory [20].

Therefore, the results of higher CRP, higher urine pH, and lower albumin levels in male UTI patients are consistent with the body of knowledge regarding the inflammatory and physiological alterations linked to UTIs. A complicated interaction between protein synthesis and degradation during the acute phase response to infection is suggested by the maintenance of total protein levels in spite of decreased albumin. When comparing female patients with urinary tract infections (UTIs) to healthy controls, the research shows notable changes in biochemical markers. These results provide information on the pathophysiological alterations linked to UTIs and are consistent with the report of [7].

When compared to control patients, female UTI subjects had significantly higher mean total protein levels, which may indicate a systemic reaction to infection. Increased production of acute-phase proteins, like C-reactive protein (CRP), during the inflammatory response to UTIs may lead to elevated total protein levels. This is in line with research by [9], which showed that systemic inflammatory responses in UTI patients resulted in higher CRP levels. The inflammatory nature of UTIs is highlighted by the notable increase in mean CRP levels in female UTI sufferers when compared to controls. Elevated levels of CRP, a well-known indicator of inflammation, are frequently linked to bacterial infections, especially urinary tract infections. Research has indicated that CRP's function as a marker in UTI patients is supported by the fact that its plasma levels might rise noticeably during bacterial infections.

Female UTI subjects' mean urine pH significantly increased as compared to controls, suggesting that infected people's urine is becoming more alkaline. The presence of urea-splitting bacteria, like Proteus mirabilis, which generate ammonia and raise urine pH, may be the cause of this alkalization. UTIs brought on by these bacteria have been linked to elevated urine pH, which aids in the pathophysiology of the illness. When compared to the controls, the observed considerable decrease in mean albumin levels in female UTI subjects raises the possibility of systemic inflammation or renal involvement. Reduced hepatic synthesis during acute-phase reactions or increased urine albumin loss from renal impairment can also cause hypoalbuminemia in UTI patients. Research has shown that UTIs can cause albuminuria, which emphasizes how crucial it is to keep an eye on these patients' albumin levels.

These results are in line with the study by [17], which focused on the notable biochemical changes in female UTI patients. The systemic inflammatory response and possible renal consequences linked to UTIs are reflected in increases in total protein, CRP, and urine pH as well as decreases in albumin levels. By giving important information on the severity and course of the infection, monitoring these measures can help with UTI assessment and management. When compared to control persons, patients with urinary tract infections (UTIs) exhibit notable changes in their blood and urine parameters. These results are consistent with a publication by [4] that sheds light on the pathophysiological alterations linked to UTIs.

This study also found that the mean CRP level was significantly higher in UTI subjects than in controls. Elevated CRP levels are a common indicator of systemic inflammation and can help distinguish between upper and lower UTIs, with higher levels typically associated with upper UTIs. The body's acute-phase response to infection is reflected in the elevated CRP. The mean urine pH was significantly higher in UTI subjects than in controls. The presence of urea-splitting bacteria, like Proteus mirabilis, can cause urine to become alkaline, which can favor certain pathogens and may have an impact on the development of urinary calculi. Also, there was substantial decrease in mean serum albumin was reported in UTI individuals compared to controls. One possible explanation for hypoalbuminemia in UTI patients is systemic inflammation, which raises vascular permeability and causes albumin loss. Lower serum albumin levels may also result from protein loss through urine brought on by glomerular or tubular injury during illness. The mean total protein levels of UTI subjects and controls did not differ significantly, though, indicating that other serum proteins may make up for the loss of albumin and keep overall protein levels stable [18]. Gender-specific data analysis revealed that male UTI subjects had significantly higher mean urine pH and CRP levels than male controls ($p = 0.000$). Additionally, their mean albumin levels were much lower.

Male and female UTI subjects showed no significant differences in mean total protein, albumin, CRP, or urine pH levels, suggesting that the biochemical response to UTIs is comparable between genders. It is noted that CRP is an acute-phase protein that increases in response to inflammation. The significantly higher mean CRP levels observed in both male and female UTI subjects compared to their respective control groups align with existing research indicating elevated CRP levels during UTIs. Female UTI subjects also showed a significantly lower mean albumin and a significantly higher mean total protein, CRP, and urine pH in comparison to female controls.

According to studies, CRP levels can help differentiate between upper and lower UTIs, with greater levels typically being linked to upper UTIs. However, the UTI classification is not specified in the existing data, which may have an impact on CRP levels. The research indicating that some uropathogens can change urine pH is supported by the observed rise in mean urine pH in UTI subjects when compared to controls. For example, by hydrolyzing urea into ammonia, urease-producing bacteria such as Proteus mirabilis can raise the pH of urine. The precise infections implicated in these cases, however, were not identified, which might have shed more light on the pH changes. An acute-phase response, in which albumin levels fall during inflammation or infection, may be the cause of the considerably decreased mean albumin levels in both male and female UTI sufferers when compared to controls.

Increased vascular permeability and albumin redistribution during inflammatory conditions can both lead to hypoalbuminemia. Serum albumin levels may be lowered as a result of urine albumin loss brought on by renal involvement in UTIs [11].

While there was no discernible difference between male UTI individuals and their controls, the results indicate that female UTI subjects had a considerably greater mean total protein than their female counterparts. Albumin and globulins make up total serum protein; as part of the immunological response to infections, globulin levels, especially immunoglobulins, may rise. The mean values of total protein, albumin, CRP, and urine pH did not significantly differ between male and female UTI individuals. This implies that in this cohort, the metabolic reactions to UTIs are comparable for both sexes. Males showed considerably greater mean total protein levels than females in control subjects, nevertheless, which is consistent with research suggesting that males may have higher blood protein concentrations. Therefore, the biochemical alterations seen in UTI patients are in line with inflammatory reactions and the findings of [19].

Conclusion

Significant hematological and biochemical changes in patients with UTIs are highlighted in this study. Increased white blood cell counts and elevated C-reactive protein (CRP) values highlight the systemic inflammatory response to UTIs. Increased vascular permeability and possible renal involvement during infection could be the cause of the observed drop in serum albumin levels. Furthermore, the existence of urea-splitting bacteria, like Proteus mirabilis, which can alkalinize urine, is suggested by the rise in urine pH. These results are consistent between male and female patients, suggesting that both sexes have the same metabolic reaction to UTIs. A compensatory rise in other serum proteins, perhaps acute-phase reactants, is implied by the maintenance of total protein levels in spite of decreased albumin.

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DOI:10.31579/ 2690-8816/167