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ORIGINAL ARTICLE

Correlation of microbiological cultures with renal profiles in patients suffering from chronic UTI in a tertiary care hospital in Pakistan.

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ABSTRACT… Objective: To correlate outcomes of urine culture with renal function tests in patients suffering from chronic UTI with the aim to detect early renal compromise associated with any specific pathogens. **Study Design:** Cross-sectional, Observational. **Setting:** Sadaf Yahya Hospital, Daska and Bahria University College of Medicine, Islamabad. **Period:** 15th January 2025 to 30th August 2025. **Methods:** The sample included adult female patients aged more than 18 years, with a history of chronic or recurrent UTIs. Demographic data, medical history, and past episodes of UTI were noted. Midstream urine specimens were inoculated and cultured. Microorganisms identification was done through gram staining, biochemical assays or automated identification systems. Venous blood samples were collected from each participant to assess renal function. **Results:** A total of 158 female patients were included in this study. The comparison of renal function parameters between chronic UTI patients was done using independent sample t-test. The serum Creatinine levels were significantly higher in the patients with positive culture [99.28 (18.12) µmol/L] compared to culture-negative patients [83.47 (14.41) µmol/L] with the p value less than 0.001. Comparison of renal function parameters among patients with chronic UTIs according to the type of urinary pathogen identified on culture using one-way ANOVA. Statistical analysis showed a significant difference in serum creatinine across pathogen groups ($p < 0.001$) whereas differences in serum urea and eGFR were not statistically significant. **Conclusion:** Patients with chronic UTI were associated with higher serum creatinine.

Key words: Antimicrobial Stewardship, Bacterial Culture, Multidrug Resistance (MDR), Renal Profile, UTI.

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INTRODUCTION

Chronic urinary tract infections (cUTIs) are recurrent or persistent infections of any part of the urinary tract (urethra, bladder, ureters, kidneys) that fail to resolve despite therapy or that recur frequently (commonly defined as ≥2 episodes in 6 months or ≥3 in 12 months).[1] Clinically they range from recurrent lower-tract cystitis to complicated upper-tract infections and can include asymptomatic bacteriuria in vulnerable groups. The pathogenesis commonly involves uropathogenic strains (most often Escherichia coli) with virulence factors that permit colonization, intracellular persistence and biofilm formation; host factors such as urinary stasis, anatomical abnormalities, renal impairment and immunosuppression convert otherwise simple infections into complicated or chronic forms [2]. Microbiological culture remains the diagnostic cornerstone and guides targeted therapy, while renal biochemical profiling (serum creatinine, eGFR, electrolytes, urinary markers) assesses kidney involvement and sequelae.[3]

UTIs are among the most common bacterial illnesses worldwide and carry a substantial global public-health and economic burden. The Global Burden of Disease analyses estimate hundreds of millions of incident UTI cases annually with rising absolute deaths, particularly affecting women and older adults.[4] Beyond morbidity, the rising prevalence of multidrug-resistant (MDR) uropathogens has complicated empirical therapy and increased costs, hospital stay and treatment failures — trends documented across multiple regions and systematic assessments.[5] These global patterns underscore why linking microbiological patterns with renal function is clinically and epidemiologically important: it helps identify patients at risk of renal deterioration,

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tailors antibiotic stewardship, and informs public-health responses.

In Pakistan, UTIs and antimicrobial resistance are major problems in both community and hospital settings. National and regional surveillance and systematic reviews show high rates of UTI as a presenting diagnosis and widespread resistance among common uropathogens to first-line agents, with carbapenem/nitrofurantoin/aminoglycoside susceptibility varying by center; recent tertiary-care studies from Punjab and other provinces document E. coli as the leading isolate with worrying multidrug resistance patterns.[6-8] Locally generated data that correlate culture results with renal profiles are sparse but urgently needed because chronic or recurrent infections in patients with impaired renal function (including CKD and dialysis cohorts) have distinct microbiology and outcomes.[9]

A study that systematically correlates urine culture results with renal biochemical profiles in chronic UTI patients at a tertiary hospital in Pakistan could provide multiple benefits. It would inform empiric antibiotic policies anchored to local susceptibility, help clinicians detect early renal compromise associated with specific pathogens or resistance profiles, enable targeted follow-up for high-risk patients, and supply policymakers with evidence to strengthen antimicrobial stewardship and CKD-care pathways. Overall, the integration of microbiology and assessment of the kidneys will be able to positively influence patient outcomes, decrease the use of inappropriate antibiotics, and inform local public-health measures.[10]

METHODS

This cross-sectional observational study took place at the Sadaf Yahya Hospital, Daska, and Bahria University College of Medicine from 15th January 2025 to 30th August 2025, having received approval from the Institutional Review Board (IRB) under reference number SYH-IRB/2024/047. An in-depth review of the literature was done to determine our study parameters. Based on this analysis, we came up with a sample size of 158 respondents using the World Health Organization (WHO) sample size calculator with the following assumptions: 95% level of confidence, 5% margin of error, and an estimated prevalence of the Urinary Tract Infection of 11.6% as indicated in earlier studies.[11]

Inclusion Criteria

The sample included adult female patients aged 18 years and older, with a history of chronic or recurrent UTIs, which are two or more incidences within the past six months.

Exclusion Criteria

Patients that had acute UTIs, chronic kidney disease (stage 3 or more in the past), used antibiotics in the two weeks, or pregnant or had indwelling urinary catheters were excluded.

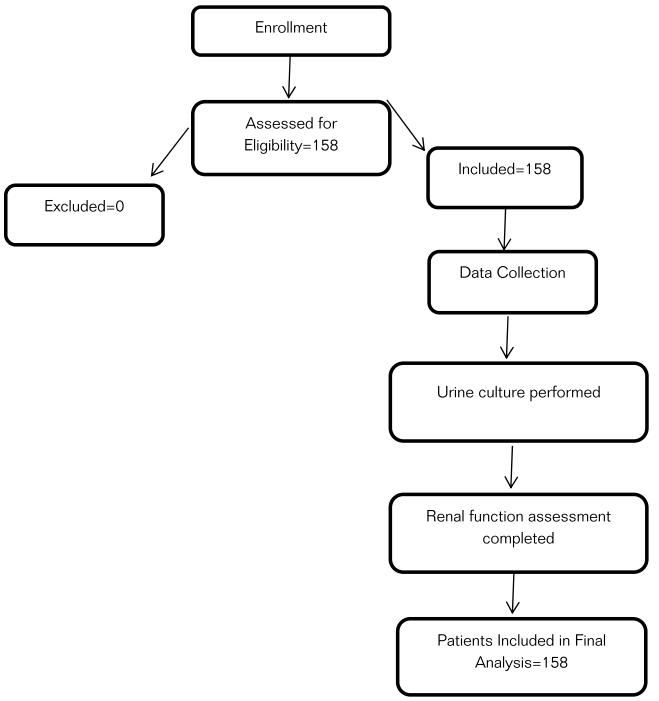
All the patients agreed in writing prior to the enrolment, and their confidentiality was ensured on all levels. Prior to the commencement of the study, the ethics committee at the institution was also given the go-ahead. Demographic data, medical history and comorbidities like diabetes and hypertension, past episodes of UTI were noted. Midstream urine specimens were transferred under sterile conditions and inoculated on blood agar and MacConkey agar plates and incubated at 37 °C after 24-48 hours. Considerable bacteriuria was considered 10^5 colony-forming units per milliliter (CFU/mL). Microorganisms identification was done through gram staining, biochemical assays or automated identification systems and identification of antibiotic susceptibility was done through the Kirby-Bauer disk diffusion. Multi-drug resistance (MDR) were observed and the data of the number of colonies and the type of pathogen were recorded. Venous blood samples were collected from each participant to assess renal function, including serum creatinine, blood urea nitrogen (BUN), estimated glomerular filtration rate (eGFR), and serum electrolytes (sodium, potassium, chloride, and bicarbonate).

Data were analyzed using SPSS version 26. The Shapiro-Wilk test was applied to check the normality of continuous variables including age, serum creatinine, serum urea, estimated glomerular filtration rate (eGFR), sodium, potassium, chloride and bicarbonate levels. Continuous variables were presented as mean and standard deviation while the categorical Variables such as diabetes, hypertension, fever, culture results, multidrug-

resistant (MDR) status and urinary pathogens were presented as frequency and percentages. An independent sample t-test was applied to mean serum creatinine, serum urea, eGFR, sodium, potassium, chloride and bicarbonate levels between culture positive and culture negative UTI patients. One-way ANOVA was applied to compare mean serum creatinine, serum urea and eGFR across different urinary pathogen groups (Escherichia coli, Klebsiella pneumoniae, Proteus mirabilis, Enterococcus faecalis, Pseudomonas aeruginosa, Staphylococcus saprophyticus and culture-negative patients). The $p<0.05$ was considered significant for all the analysis.

FIGURE-1

Patient flow diagram (n=158)



RESULTS

A total of 158 female patients suffering from chronic UTI were included in this study. The mean age of the participants was 43.66 (12.91) years. Demographic, clinical and microbiological characteristics of all patients included in the study are described in detail in Table-I.

The comparison of renal function parameters between culture positive and culture negative chronic UTI patients using independent sample t-test is shown in Table-II.

TABLE-I

Demographic, clinical and microbiological characteristics of patients with chronic UTI (n=158)

Variables		Mean (SD)
Age (years)		43.66 (12.91)
Serum Creatinine (µmol/L)		95.18 (18.54)
Serum Urea (mmol/L)		5.53 (1.22)
eGFR		105.08 (8.04)
Sodium (mmol/L)		138.84 (2.80)
Potassium (mmol/L)		4.10 (0.36)
Chloride (mmol/L)		103.04 (3.34)
Bicarbonate (mmol/L)		24.05 (2.17)
		n (%)
Diabetes	No	117 (74.1%)
	Yes	41 (25.9%)
Hypertension	No	99 (62.7%)
	Yes	59 (37.3%)
Previous UTI Episodes	2	93 (58.9%)
	3	51 (32.3%)
	4	11 (7.0%)
	5	3 (1.9%)
Fever	No	119 (75.3%)
	Yes	39 (24.7%)
Culture Results	Negative	41 (25.9%)
	Positive	117 (74.1%)
Pathogens	None	41 (25.9%)
	Escherichia coli	58 (36.7%)
	Klebsiella pneumoniae	19 (12.0%)
	Proteus mirabilis	12 (7.6%)
	Enterococcus faecalis	12 (7.6%)
	Pseudomonas aeruginosa	9 (5.7%)
	Staphylococcus saprophyticus	7 (4.4%)
MDR Status	No	135 (85.4%)
	Yes	23 (14.5%
Colony Count	0	41 (25.9%)
	10^5 to10^6	43 (27.2%)
	$>10^6$	74 (46.8%)

The serum Creatinine levels were significantly higher in the patients with positive culture [99.28 (18.12) µmol/L] compared to culture-negative patients [83.47 (14.41) µmol/L] with the p value less than

0.001. The serum Urea was higher in the culture positive UTI participants [5.64 (1.20) mmol/L] than culture-negative patients [5.21 (1.24) mmol/L] but the difference was not statistically significant (p=0.054). Other renal parameters (mean eGFR, sodium, potassium, chloride and bicarbonate levels) showed no significant difference (p>0.05) between culture positive and culture negative chronic UTI patients.

The Table-III presents a comparison of renal function parameters among patients with chronic UTIs according to the type of urinary pathogen identified on culture using one-way ANOVA. The mean serum creatinine was highest in patients infected with Enterococcus faecalis [105.18 (16.55) µmol/L] and Klebsiella pneumoniae [104.48 (13.90) µmol/L], while the lowest was observed in culture-negative patients [83.47 (14.41) µmol/L]. Serum urea levels were slightly elevated in patients with E. faecalis [6.14 (1.24) mmol/L] and Proteus mirabilis [6.04 (0.87) mmol/L] compared to culture-negative patients [5.21 (1.24) mmol/L]. The eGFR was relatively comparable across all pathogen groups. Statistical analysis showed a significant difference in serum creatinine across pathogen groups ($p < 0.001$) whereas differences in serum urea ($p = 0.182$) and eGFR ($p = 0.192$) were not statistically significant.

DISCUSSION

Chronic urinary tract infections (cUTIs) are a clinical issue whose ramifications extend beyond its symptomatic recurrence: chronic infection and recurrent antibiotic exposures may also be linked to renal functions that may change very subtly but significantly. We found a high culture-positivity rate (74.1%) with Escherichia coli dominant in our 158 female patients with chronic UTI and statistically significant positive relationship between culture positivity (and some pathogens) and high serum creatinine. The results support the idea that recurrent bacteriuria is not entirely a problem of quality of life but can indicate an early onset of renal involvement in a patient subgroup, which contributes to the concept of microbiological and renal evaluation.[12]

TABLE-II

Comparison of renal function parameters between culture positive and culture negative chronic UTI Patients (n=158)

	Culture Results		P-Value
	Negative (n=41) Mean (SD)	Positive (n=117) Mean (SD)	
Serum Creatinine (µmol/L)	83.47 (14.41)	99.28 (18.12)	<0.001
Serum Urea (mmol/L)	5.21 (1.24)	5.64 (1.20)	0.054
eGFR	106.50 (104.58)	104.58 (8.33)	0.188
Sodium (mmol/L)	139.03 (2.77)	138.78 (2.81)	0.626
Potassium (mmol/L)	4.08 (0.35)	4.1 (0.37)	0.747
Chloride (mmol/L)	103.58 (3.26)	102.85 (3.37)	0.231
Bicarbonate (mmol/L)	23.78 (2.22)	24.14 (2.15)	0.353

TABLE-III

Comparison of serum creatinine, urea and eGFR across different urinary pathogens in chronic UTI Patients (n=158)

Renal Parameters	Type of pathogens							
	None	E. coli	K. Pneumoniae	P. Mirabilis	E. Faecalis	P. Aeruginosa	S. Saprophyticus	P-Value
Creatinine	83.47 (14.41)	97.28 (18.46)	104.48 (13.90)	101.13 (22.79)	105.18 (16.55)	94.63 (17.81)	94.50 (19.82)	<0.001
Urea	5.21 (1.24)	5.61 (1.15)	5.33 (1.40)	6.04 (0.87)	6.14 (1.24)	5.52 (1.59)	5.32 (0.93)	0.182
eGFR	106.51 (7.08)	103.46 (7.95)	102.92 (8.95)	105.92 (4.77)	106.72 (9.77)	106.37 (9.30)	110.17 (9.61)	0.192

Our local pattern of distribution of pathogens and the patterns of resistance to antimicrobial agents are identical with the current hospital-wide reports in Pakistan indicating that E. coli is the most prevalent uropathogen and that there has been an increase in resistance to antimicrobial agents in members of the Enterobacterales and non-fermenters.[13,14] The high culture-positivity in symptomatic women and variable and rising rates of MDR lend credence to cross-sectional audits and regional surveillance highlighting the necessity to use culture-guided therapy in recurrent cases; our prevalence of MDR (14.5%), falls within the range of recent Pakistani series. These similarities suggest that our one-center data are possible to reflect more general nationwide trends and emphasize the urgency or the necessity to local antibiograms in order to make informed empiric prescriptions.[15]

Compared to the international literature, our findings are congruent with the recent reviews and epidemiological studies that associate repetitive UTIs with incremental renal risk and emphasize the presence of Klebsiella and Enterococcus organisms that are frequently observed in patients with stronger biochemical malfunctions.[16] The very high UTI incidence and clinical outcomes of MDR uropathogens are also reported in large global burden studies and contemporary reviews, which act as complicating factors and augment the risk of treatment failure, which is one of the mechanisms that can plausibly explain the renal perturbations we observed (higher mean creatinine with certain pathogens).[17] Such international records provide biological feasibility of the assumption that frequent or ill-controlled infections may be a cause of renal stress, in the absence of overt CKD.[18,19]

In general, the study offers clinically relevant, practical implications. The fact that positive urine cultures (and certain pathogen) correlate with a minor increase in creatinine level makes the case of regular renal monitoring in chronic UTI patients and supports the necessity of culture-conformable antibiotics and antimicrobial stewardship as the means of eliminating both resistance and possible renal outcomes.[20] A specific follow-up of patients who are infected with the most hazardous organisms (such as Enterococcus and Klebsiella) would allow making the referral of the patient to nephrology sooner, avoid unnecessary progression, and maximize the use of antibiotics, the advantages of which, of course, are not limited to the success of the specific patient, but to the health-system reduction of resources.[21]

LIMITATIONS

This was a single-center, cross-sectional study with a moderate sample size, which limits causal inference and generalizability. We included only female patients and excluded those with established CKD (stage ≥3), so findings cannot be extended to men or patients with advanced renal impairment. Longitudinal data to track renal trajectory after infection were not collected.

CONCLUSION

In patients with chronic UTI seen at our tertiary care center, culture-positive infections — particularly those caused by Klebsiella and Enterococcus species — were associated with higher serum creatinine. These data support routine urine culture and concurrent renal profiling in recurrent UTI management and strengthen the case for local antibiogram-driven therapy and stewardship to protect renal health and limit the spread of resistant uropathogens.

CONFLICT OF INTEREST

The authors declare no conflict of interest.

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AUTHORSHIP AND CONTRIBUTION DECLARATION	
1	**Shameela Majeed:** Revision of manuscript, results comilation.
2	**Nawwal Naeem Chaudhary:** Proof reading.
3	**Nazia Khan:** Data collection.
4	**Aleena Khalid:** Data analysis.
5	**Ama tul Naval:** Data entry.
6	**Mian Bilal Ahmad:** Critical revisions.
7	**Junaid Sarwar:** Drafting.