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Investigating the Prevalence of Urinary Tract Involvement in COVID-19 Patients

Dr. Ali Riyad Hassan[1], Dr. Murtadha Qahtan Hashim[2] & Dr. Ali Mohammedsalih Hussein Alzobaie[3]

[1,3]M.B.Ch.B., F.I.C.M.S.\ (Urology), Iraqi Ministry of Health, Karbala Health Directorate, Safeer Al-Imam Al-Hussein (A.S.) Surgical Hospital, Karbala, Iraq.

[2]M.B.Ch.B., F.I.C.M.S.\ (Urology), Iraqi Ministry of Health, Karbala Health Directorate, Imam Hussain Medical Teaching City, Department of Urology, Karbala, Iraq

Abstract: Background: Patients suffer greatly from urinary tract symptoms and infections (UTIs), especially in cases where coexistence of diseases is high and The main aim of this study is to survey the morphological, clinical, microbiological, imaging, and outcome characteristics of Iraqi patients experiencing LUTS/UTIs and to find out the relationship between comorbid conditions and these patients where The study used a cross-sectional method to analyze 166 patients who were checked for urinary symptoms or UTIs as well as in our study The information gathered consisted of demographics (age, gender, hospitalization status), symptomatology (nocturia, frequency, urgency, incontinence), urinalysis abnormalities, imaging findings, IPSS-like symptom scores, comorbidities also The groups' statistical comparisons were made using suitable tests to assess the associations where The cohort's average age was 58 years ±15, with a male-to-female ratio of 55.4% (n=92) and a hospitalization rate of 67.5% (n=112). The most frequently reported symptoms were nocturia (43.4%), frequency (34.9%), urgency (25.3%), and incontinence (16.9%), while 19.3% of respondents indicated no symptoms at all as well as find Abnormalities were found in 59% of urinalyses (hematuria 22.9%, proteinuria 31.3%, leukocyturia 24.1%, pyuria 13.3%); the remaining 41% were considered normal in addition to The severity scale similar to IPSS depicted high symptom burden: 62 patients (average 4.2) were categorized as mild, 68 as moderate (average 12.5), and 36 as severe (average 24.1) The majority of imaging results (77.1%) were normal, with a minor percentage showing hydronephrosis (4.8%) and bladder wall thickening (8.4%). Hospital length of stay (12.4 vs. 7.2 days), ICU admission (25.0% vs. 7.4%), and mortality (10.7% vs. 3.7%) were all worse for patients who were involved. To improve definitions (particularly for "involved" vs. "non-involved" and ABU) and assess intervention tactics, more prospective research is necessary.

Keywords: Covid-19 patients, iraqi patients, luts/utis, hospitalization, symptomatology, urgency.

INTRODUCTION

The pandemic spread of coronavirus disease 2019 (COVID-19), which is caused by severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2), has led to active research of the multi-organ manifestations of the disease. Although the respiratory system is the major victim, there is an emerging body of evidence that shows SARS-CoV-2 can impact various non-respiratory systems, such as the urinary system. COVID-19-related urinary tract involvement is on a continuum, including acute kidney injury (AKI) and proteinuria, on one side, and direct urinary viral finding, on the other side, and lower urinary tract symptoms, in some cases [Huang, C. *et al*., 2020]. The rational synthesis of information on the prevalence, pathophysiology, clinical importance, and chronic renal outcomes of COVID-19 patients necessitates the incorporation of data on the diverse populations and research designs (cohort studies, case series, autopsy reports, and mechanistic studies). [Xu, Z. *et al*., 2020; Zou, X. *et al*., 2020]

Epidemiology and prevalence indicators across various cohorts. The initial indicators of epidemiology and prevalence of AKI among hospitalized COVID-19 patients led to the identification of the renal system as a high-risk organ in severe disease. Megameta-analyses and multi-center cohorts had repeatedly reported AKI as a frequent complication, especially in patients with severe disease, who had to be put on intensive care unit (ICU) or mechanical ventilation. The prevalence of AKI has been largely reported in COVID-19 patients, depending on the patient populations (critically ill vs. general inpatients), AKI diagnostic criteria (KDIGO vs. other criteria), baseline renal function, and practices in managing AKI. In a few systematic reviews, the prevalence of AKI was between about 15 and more than 40 percent in hospitalized cohorts, and much higher in the ICU. [Varga, Z. *et al*., 2020; Grover, S. *et al*., 2011; Kaya, Y. *et al*., 2021] The fact that COVID-19 recovery is followed by the appearance of data on chronic kidney disease (CKD) further complicates the situation and questions the possibility of the SARS-CoV-2-related nephropathy as a contributor to the incidence of CKD in the general population [Mumm, J. N. *et al*., 2020; Ling, Y. *et al*., 2020].

Markers of renal involvement: Proteinuria and hematuria are common manifestations of COVID-19, and these markers are common during the

***Corresponding Author:** Dr. Ali Riyad Hassan

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initial stages of the disease. Such abnormalities of the urine are linked with the severity of disease and have a higher likelihood of poor outcome, such as AKI development, subsequent renal replacement therapy, and in-hospital death. Proteinuria could indicate general dysfunction of the endothelium, damage of glomeruli, damage of tubules, or a mixture of any of these mechanisms. The hematuria may be a glomerular, tubular, or non-renal condition related to catheter trauma or urological malformations in hospital patients. Cohen *et al*. have shown through serial urine analysis of cohort studies that transient or persistent abnormalities of the urine may continue even after the acute stage of infection, implying that there may be persistent renal involvement or delayed recovery in certain patients [Kim, Y. I. *et al*., 2020; Song, J. Y. *et al*., 2020].

Pathways and pathogens to renal infection and damage. The pathways and the ways in which SARS-CoV-2 can impact the kidneys and the urinary tract are multifactorial and presumably synergistic [Cheng, Y. *et al*., 2020; Mumm, J. N. *et al*., 2020]. Viral attack to the renal tissue is possible due to the expression of the angiotensin-converting enzyme 2 (ACE2) receptor and transmembrane protease serine 2 (TMPRSS2) in the renal tubular epithelial cells and podocytes that mediate viral entry. Viral RNA and proteins have been shown in kidney tissues using autopsy studies and renal histopathology and have shown evidence of proximal tubule injury, podocytopathy, and interstitial inflammation [Manganotti, P. *et al*., 2023; Zachariou, A. *et al*., 2022; Selvi, I. *et al*., 2022]. Systemic hemodynamic instability, cytokine storm, and extensive inflammation, thrombotic microangiopathy, and rhabdomyolysis are all mechanisms that may lead to AKI or other urinary pathologies. Other causes are dehydration, nephrotoxic drugs (such as some antivirals, antibiotics, and anti-inflammatory agents) to treat COVID-19, and secondary infections. Multi-system inflammatory syndrome and various pathophysiological pathways may regulate renal involvement in a different manner between pediatric populations and adults. The comparative role of direct viral nephropathy and indirect injury has been the centre of current research, with certain studies finding considerable viral load in kidney tissues, and others highlighting systemic and hemodynamic factors of renal impairment [de Araújo, A. L. *et al*., 2021; Barry, M. J. *et al*., 1992].

Clinical spectrum: AKI to lower urinary tract. The urinary sign of COVID-19 involves both overt kidney injury and asymptomatic abnormalities that can only be detected through laboratory tests. The most clinically relevant renal presentation is AKI, whose definitions are commonly determined by the rise of serum creatinine or the fall of urine volume by KDIGO criteria. In most cohorts, AKI is linked to an older age, a prior history of CKD, hypertension, diabetes, cardiovascular disease, obesity, and other comorbid conditions that have an independent predisposing effect to renal dysfunction [Soler, R. *et al*., 2018; Coyne, K. S. *et al*., 2009]. The course of AKI in COVID-19 tends to be followed by the severity of the disease, with increased rates observed in individuals who need mechanical ventilation, vasopressor therapy, or have high levels of inflammatory biomarkers and coagulopathy. The post-AKI recovery can be either slow or fast; some patients recover to baseline renal function, and others have a partial or total functional loss, leading to CKD or long-term dialysis where Moreover, upper urinary tract and lower urinary tract symptoms (LUTS) have been reported in a few isolated cases, but are less frequent and are likely to be complicated by hospitalization issues like catheterization, urinary tract infection or underlying urological disease. The accumulation of effects of urinary tract involvement in COVID-19. When considering both transient and persistent abnormalities, this has implications on post-acute care and long-term surveillance of kidney health [Snaith, R. P. 2003; Herdman, M. *et al*., 2011].

Pediatric and vulnerable populations. In children, AKI is not uncommon, although the manifestations of COVID-19 on the kidney are less significant than in adults, especially in the context of multisystem inflammatory syndrome in children (MIS-C) and severe acute COVID-19. MIS-C may affect the kidneys by acute tubulointerstitial nephritis, AKI, and complications caused by hyponatremia, among other pathophysiological processes [Daryanto, B. *et al*., 2022]. The pediatric evidence confirms the necessity of treating renal functioning in all age groups during and after COVID-19, since early patterns of urinary abnormalities can be used to direct therapy and potentially enhance the results. The risk of AKI in the elderly and patients with underlying renal failure is increased, and polypharmacy makes the clinical situation more difficult, which puts them at risk the risk of nephrotoxic insults during the COVID-19 treatment.

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MATERIAL AND METHOD

present a proposed cohort study in different hospitals in Iraq between January 2022 and December 2023 that aims at exploring the urinary tract involvement in 166 consecutive adult patients (aged ≥18 years) diagnosed with COVID-19 through RT-PCR confirmation of SARS-CoV-2 with nasopharyngeal swabs. Patients were recruited at the time of hospital admission or outpatient clinic presentation and were eligible to participate in the study regardless of the severity of their COVID-19 cases, with exclusion criteria that included patients with established end-stage renal disease or with a recent urologic surgery (within the next 6 months) and patients who had chronic indwelling catheters to reduce confounding. Baseline demographics, medical history, and comorbidities were collected by structured interviews and electronic health records, whereas urinary tract involvement was comprehensively measured by using a standardised protocol with the International Prostate Symptom Score (IPSS)-adapted lower urinary tract symptoms (LUTS) questionnaire that includes nocturia, frequency, urgency, and incontinence, which was administered within 24 hours of enrollment. The urine samples were analysed using automated urinalysis methods of dipstick identification of hematuria, proteinuria, leukocyturia, and pyuria, and then confirmed by using a microscope and urine culture on blood and MacConkey agar incubated at 37 °C to detect bacteriuria (>10 5 CFU/mL of bacteria is considered UTI confirmed). Severe cases were used to experience renal ultrasound images within 72 hours of assessing hydronephrosis, bladder wall thickening, or other disturbances as interpreted by board-certified radiologists who were not aware of clinical information. The use of severity stratification was based on the WHO COVID-19 Clinical Progression Scale, in which the patients were classified as mild, moderate, severe, and critical, according to oxygenation requirements and dysfunction of the organs. Statistical testing was done by use of SPSS version 27.0, where continuous variables were in terms of means and standard deviations or medians (interquartile ranges) and compared using independent t-tests or Mann-Whitney U tests; categorical data was presented as percentages and frequency, and was tested using chi-square or Fisher precise tests. The associations between urinary involvement with such outcomes as length of stay, ICU admission, and mortality were tested by the multivariate logistic regression by age, sex, diabetes, hypertension, and baseline eGFR (CKD-EPI formula), with p less than 0.05 as the value of significance and 95% confidence intervals reported.

RESULTS

Table 1: Assessment Demographics outcomes of Iraqi patients for 166

Characteristic	**n**	**%**
Age (mean ± SD)	166	58 ± 15
Male	92	55.4
Female	74	44.6
Hospitalized	112	67.5
Outpatient	54	32.5
Symptom	**n**	**%**
Nocturia	72	43.4
Frequency	58	34.9
Urgency	42	25.3
Incontinence	28	16.9
None	32	19.3
Urinalysis Abnormalities		
Finding	**n**	**%**
Hematuria	38	22.9
Proteinuria	52	31.3
Leukocyturia	40	24.1
Pyuria	22	13.3
Normal	68	41.0
Severity by Gender		
Severity	**Male (n=92)**	**Female (n=74)**

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Mild	28 (30.4%)	24 (32.4%)
Moderate	36 (39.1%)	28 (37.8%)
Severe	18 (19.6%)	12 (16.2%)
None	10 (10.9%)	10 (13.5%)

Table 2: Distribution pf patients according to UTI Confirmed Cases

Type	**n**	**%**
Community-acquired	12	7.2
Hospital-acquired	18	10.8
Asymptomatic bacteriuria	24	14.5
Total UTI	30	18.1

Table 3: Allocation of Comorbidities: Association of patients

Comorbidity	**Involved (n=112)**	**Non-Involved (n=54)**	**p-value**
Diabetes	32 (28.6%)	8 (14.8%)	0.04
Hypertension	44 (39.3%)	12 (22.2%)	0.02
CKD	18 (16.1%)	2 (3.7%)	0.01

Table4: Outcomes of patients according to Imaging Findings

Finding	**n**	**%**
Hydronephrosis	8	4.8
Bladder wall thickening	14	8.4
Normal	128	77.1
Abnormal	38	22.9

Table 5: knowledge finding based on Symptom Scores (IPSS-like)

Score Range	**n**	**Mean Score**
0-7 (Mild)	62	4.2
8-19 (Moderate)	68	12.5
20-35 (Severe)	36	24.1

Table 6: Final Outcomes by Involvement

Outcome	**Involved (n=112)**	**Non-Involved (n=54)**
Hospital LOS (days, mean)	12.4	7.2
ICU Admission	28 (25.0%)	4 (7.4%)
Mortality	12 (10.7%)	2 (3.7%)
Microorganisms in UTI		
Pathogen	**n**	**%**
E. coli	22	73.3
Klebsiella	4	13.3
Enterococcus	2	6.7
Others	2	6.7

DISCUSSION

The demographic variables reveal a mean age of 58 with a large standard deviation (15), and most of the sample is male (n=92; 55.4%). The ratio of the women is 44.6 (n=74). This age distribution is congruent with a population where LUTS (lower urinary tract symptoms) and UTIs are common, and in the latter case, tend to change with age in terms of continence, prostatic health in males, and mucosal/immune changes in elderly people. This predominance in males of this cohort could be evident in the pattern of referral, health-seeking behaviour, or underlying comorbidity profiles, which might be higher rates of prostatic obstruction, potentially leading to urinary retention and subsequent risk of secondary infection.

Regarding the healthcare setting, two out of three patients were admitted to a hospital (n=112; 67.5%), and only 32.5% were seen in an outpatient setting (n=54). The elevated rate of hospitalisation might represent a group with more severe symptoms or comorbidity burden, or a selection bias on inpatients with complicated UTIs or obstructive uropathies evaluated. On the other hand, it could be a way of indicating the local

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clinical practises of the health system in which patients with LUTS and possible UTIs are hospitalised to receive a diagnostic work-up or antibiotic stewardship. The implications of this distribution of patients in hospitals are on resource allocation and the need to have strong inpatient management principles to take into account not only infectious causes of urinary symptoms (eg, obstruction, stones, or neurogenic aetiology) but non-infectious ones as well.

The current symptoms include nocturia (43.4%), frequency (34.9%), urgency (25.3%), and incontinence (16.9%), with 19.3% reporting none of the problems. Overactive bladder, outlet obstruction by BPH, prostatitis, urinary stones, or diuretics appear to be a wide range of etiologies implicated in the cause of the prominence of nocturia and frequency, and can burden lower urinary tract symptomology significantly. Although of lower frequency than nocturia/frequency, urgency is also present in a quarter of patients, perhaps representing a combination of irritative LUTS to voiding symptoms of obstruction or infection.

Urinalysis results show that there is a combination of malfunctions: hematuria (22.9%), proteinuria (31.3%), leukocyturia (24.1%), pyuria (13.3%), and a significant percentage, which is considered normal (41.0%).

In the IPSS-like severity distribution, it is observed that mild disease is seen amongst males (n=92) and females (n=74), moderate disease is seen in 39.1 vs 37.8, severe disease is seen in 19.6 vs 16.2, and no symptoms is seen in 10.9 vs 13.5. The gender similarity is an indication that among the members of this cohort, the symptom burden and functional impairment is generally comparable between men and women, although the etiologies may vary (e.g., prostatic obstruction in men and gynecologic and urethral factors in women). There is no remarkable gender difference between severity, which highlights the importance of personalised evaluation and not assumptions premised on sex alone. It also indicates that the moderate-severe LUTS rates are significant in both sexes and could influence the quality of life and healthcare services.

a breakdown of UTI sources, 12 of community-acquired, 18 of hospital-acquired, 24 asymptomatic bacteriuria, and all 30 cases of Total UTI (18.1%). The designation of 30 cases as Total UTI is a little confusing when the number of cases is added as the number of cases of jaundice without symptoms (ABU); nevertheless, ABU can be regarded as a different phenomenon, not identical to the case of the symptomatic UTI. In this sample, 24 ABU cases make 14.5 percent of the sample, which is a high prevalence rate of asymptomatic bacteriuria. In clinical practise, there is a strong necessity to differentiate ABU and symptomatic UTI to prevent unnecessary use of antibiotics and antimicrobial resistance, especially in hospitalised or elderly individuals. The percentage of hospital-acquired UTIs (10.8) serves as an indicator of the risk of nosocomial infections. It can guide the practise of infection control and antibiotic management in a hospital environment.

Research on comorbidities in 112 involved vs 54 non-involved patients. There is diabetes (28.6 vs 14.8), p=0.04, hypertension (39.3 vs 22.2), p=0.02, and chronic kidney disease (CKD) (16.1 vs 3.7), p=0.01. The statistical significance of such associations demonstrates that comorbidity burden is greater among patients who have been involved (probably of urinary systems or infection-related involvement), and it indicates that metabolic and vascular comorbidities may add to the risk of being susceptible to infections, having a weakened host defences or more complicated presentation of disease [Plata, M. *et al*., 2019; Andersson, S. O. *et al*., 2004; Irwin, D. E. *et al*., 2009].

Of particular interest is the CKD discovery: CKD may contribute to UTIs through immune dysfunction, stagnation of the urinary stream, and structural defects, and UTIs may worsen the course of CKD. The results on diabetes and hypertension are in line with the established risk factors of lower urinary tract symptoms and infections, such as vascular and neuropathic diseases, glycemic abnormalities, and homeostatic inflammation pathways. These findings highlight the importance of careful monitoring of comorbidities to minimise the morbidity of UTI and to guide the use of antibiotics due to the possible renal functional factors [Legrand, M. *et al*., 2022; Coyne, K. S. *et al*., 2009].

The imaging results reveal that most of them have normal imaging (77.1%), and 22.9% show abnormalities, which include hydronephrosis (4.8%) and bladder wall thickening (8.4%). The absence of structural obstruction problems in most cases or severe anatomical issues is not typical in this group of patients, as indicated by normal imaging [Gomes, C. M. *et al*., 2020]. Nonetheless, hydronephrosis in some patients is a clinical

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indication pointing to clinically significant obstruction or reflux and requires intervention. The increase in bladder wall thickness can be an indicator of long-term inflammation, detrusor overactivity, or other pathologies, which is congruent with the symptom load. The categorical severity data is consistent with the mean scores, and it showed that there is a significant burden of symptoms in a sizeable proportion of patients. The moderate and severe mean scores underscore the fact that urinary symptoms have a big role to play in the daily activities and quality of life of most of the patients. The findings can also be used to prognosticate and may inform the decision-making on pharmacologic treatments (alpha-blockers, antimuscarinics, or combination therapy) or lifestyle changes [Subramanian, A. *et al*., 2022; Tristão, L. S. *et al*., 2023].

Infection type distribution and antimicrobial stewardship issues: A large proportion of the subjects has asymptomatic bacteriuria, which does not usually need antibiotic treatment except in particular situations (e.g., during pregnancy, scheduled urologic surgery). It is important to differentiate ABU and symptomatic UTI to prevent unnecessary treatment and to limit the prevalence of antimicrobial resistance. The identified pattern of UTIs (community-acquired, hospital-acquired, and ABU) demonstrates the necessity of specialised stewardship initiatives in the community and hospital context. Infection control is also relevant in hospitalised patients in order to minimise the transmission of nosocomial and resistant organisms.

Microbiology profile assists in the decision of empiric therapy: the E. coli prevalence is observed in the pathogen spectrum, and Klebsiella and Enterococcus play significant roles. The common Gramme-negative pathogens should be included in the empirical regimens, and local patterns of resistance should be taken into account in the development of protocols. Enterococcus, however, being less common, can lead to a review of ampicillin-sulbactam or other such coverage in specific patient groups (eg, urosepsis with a risk of enterococcal infection). Frequent changes of local antibiograms and use of patient susceptibility are essential components of effective intervention. Resource and severity implications: The more adverse outcomes of the “involved group in terms of the length of stay, ICU admission, and mortality is an indicator that the status of involvement ought to be identified early to enable effective triage, allocation of resources, and aggressiveness of therapy. The information supports the use of standard assessment instruments during the presentation to distinguish the patients who may be prone to complications so that care, imaging, and antibiotic control can be escalated in time.

Gender factors in the severity of the symptoms: In spite of the fact that there were no differences in the distribution of moderate, mild, and severe levels of symptoms between males and females, etiological distinctions between the genders must be taken into account during the diagnostic workups.

Multidimensional data of demographics, symptoms, urinalysis, imaging, comorbidity, microbiology, and outcomes.

Huge sample size to allow investigation of comorbidity burden and clinical outcomes.

ABU data should be included, as it will allow us to understand the range of bacteriuria in this population better.

By stratification of results by participation, actionable information on risk stratification and intensity of management is availed.

CONCLUSION

The dataset provides a complex picture of urinary symptoms and infections in a group of Iraqi patients, revealing a large number of patients suffering from moderate to severe LUTS, a high proportion of patients with no symptoms but bacteriuria, and a comorbidity burden having a significant negative impact on the clinical outcome. Imaging studies indicate that the majority of patients do not have any major structural pathology, but a few do show hydronephrosis or bladder wall thickening, which indicates that there might be obstructive or inflammatory processes that need to be treated with specific management. The connection between comorbidities (diabetes, hypertension, CKD) and poor outcomes is a clear indicator of the necessity for comprehensive care that will include addressing urologic, infectious, and systemic health issues. The knowledge gained from this study can be used to set up clinical pathways, guide antibiotic usage, and plan future research that targets the reduction of morbidity and the optimization of care for patients with urinary tract symptoms and infections in similar situations.

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