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Original Research Article

Prevalence and Associated Risk Factors of Urinary Tract Infections among the Immunocompromised Patients Visiting a Microbiology Center in Srinagar, Kashmir

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Abstract:

Introduction: Immunocompromised hosts have more inclination towards developing infections, especially infections of the renal system. Morbidity in immunocompromised patients is considerably attributed to urinary tract infections, which when complicated fuel the mortality rate. In Kashmir, the magnitude of immune compromise-associated renal tract infections has increased in the past few years. The containment of these infections majorly depends upon the risk identification in the immunocompromised population. This research study is directed to assess the prevalence and associated risk factors of urinary tract infections in the immunocompromised subjects.

Methods: It was a cross-sectional and facility based study, screening 405 immunocompromised patients visiting the study center in Srinagar, Kashmir from April, 2021 to 31st March, 2022. Demographic data was collected through structured face-to-face interview. Standard microbiological testing protocol was followed to diagnose urinary tract infections. To evaluate the actual prevalence of urinary tract infection amid the heterogeneous immunocompromised patients, the study population were stratified into 6 categories. For risk assessment, univariate logistic regression was used to correlate the population characteristics with UTI positivity, with p-value<0.05 considered statistically significant. For the risk factors, adjusted and unadjusted odds ratios along with 95% confidence intervals were calculated.

Results: The general prevalence of urinary tract infections was found to be 34.81% with females accounting for 58.2% of the patients. Highest proportion of UTI positive patients (21.98%) were found between 31-40 years of age. Significantly raised occurrence of UTI (43.58%) was recorded among the diabetes mellitus category with AOR of 5.50 (p<0.001). The odds of acquiring UTI were notably higher in hyperglycemic women (adjusted odds ratio: 55.06). Interestingly we also observed that among the 141 UTI positive samples, 61 (43.26%) were positive for bacterial isolates whereas, 80 (56.73%) were positive for candida species.

Conclusion: Urinary tract infections were highly prevalent among the immunocompromised patients. Significant risk factors correlating with urinary tract infections were female gender, age, and hyperglycemic state. Assessment of risk factors predisposing the subjects with compromised immune system to UTIs along with standardized screening protocols can help in early identification of the vulnerable population and provide more effective management and prevention against urinary tract infections.

Keywords: Bacteriuria, Diabetes Mellitus, Immunocompromised, Post renal transplant, Post cancer chemotherapy, Prevalence, Risk factors, Urinary tract infection (UTI).

Introduction

Urinary tract infection with its wide range of etiology, is a highly prevalent infection, which causes mortality in 150 million global population every year. [1] Approximately 250 million population are diagnosed worldwide with urinary tract infections yearly, resulting in direct economic burden of about 6 billion dollars [2]. It is reported that more than 50% of the antimicrobial agents given to elderly patients with suspected urinary tract infection are unnecessary. [2] The estimated disease occurrence rate is 40% - 50% in women and 5% in men [3]. The commonest causative microorganisms of UTIs are E. coli, Klebsiella spp., Enterobacter spp., P. aeruginosa and Proteus mirabilis [4]. High rate of recurrence and antimicrobial resistance among the urinary

pathogens considerably increase the risk of urinary tract infections. Urinary tract infections are initiated with the entry of microorganisms in the urinary tract through the urethra which later start to multiply mainly inside the bladder. The renal system has a strong defense system in place which prevents the entry of such microbes, however these protective mechanisms fail due to the presence of various co-morbidities resulting in compromise of host immunity. UTIs are reported to be highly prevalent among patients with co-morbidities such as hypertension, diabetes mellitus, stroke, spinal cord dysfunction, chronic liver disease, arthritis, obesity, alcohol use disorder, immunocompromised states and few cancers, as well as conditions like pregnancy and recurrent catheterization. If not treated timely, UTIs can have serious consequences, such as renal scarring, hypertension and septic shock. Preeclampsia, decreased weight at birth, restrictions of fetal growth and malformation, neonatal UTI, premature labor, miscarriage, and increased incidence of death in the womb are reported by many studies in pregnant women [5].

Bacterial infection is recognized as one of the critical complications in diabetic patients with high odds of acquiring infections as compared to the non-diabetic population [6]. The increased incidence of UTIs among the diabetic patients is considered to be due to poorly controlled diabetes, immune system compromise, and bladder dysfunction due to autonomic neuropathy [7]. Loss of 40% of the years of life has been reported in patients with diabetes which is again ascribed to conditions like carcinoma, infections, and neurodegenerative disorders [8].

High prevalence of UTI is observed among the cancer patients due to use of anticancer drugs which lead to long-term suppression of immune system, neutropenia, disruption of skin and destruction of epithelial tissues, and frequent use of antimicrobial agents resulting in alteration of gastrointestinal tract flora [9]. On the other hand, high prevalence of UTI in organ transplant recipients is reported due to the use of immunosuppressant drug regimens, extensive surgical procedures, in-dwelling urinary catheters and other environmental factors [10].

There is dearth of literature and research conducted in India to study the prevalence of UTI and its correlation with the immunocompromised patient characteristics. Whereas, the magnitude of immunocompromise-associated UTIs have increased nationwide as well as in the Kashmir region in the past few years. [11,12] To our knowledge this is the first comprehensive study planned to investigate the magnitude of urinary tract infections and correlate its association with various baseline features of immunocompromised patients in Srinagar, Kashmir.

Methods

Study design and setting

This was a random sample, facility based, cross sectional study. The study was conducted in the Department of Microbiology at 'Dr Qadqri's Hematology Centre and Clinical Laboratory', Srinagar, Kashmir, for a period of 1 year, from 1st April, 2021 to 31st March, 2022. The study center caters to the patient population of the Srinagar city in particular. Being one of the leading microbiology centers in the Kashmir valley and due to the overwhelmed tertiary healthcare facility in Kashmir region, most of the immunocompromised patients visit the center for routine follow-up. The principles of Declaration of Helsinki and ICH-GCP guidelines were followed during the study. As the study was conducted during COVID-19 pandemic period, COVID-19 preventive guidelines were followed strictly. Immunocompromised patients diagnosed with the following conditions; solid and blood malignancies, kidney transplant, diabetes mellitus, SLE and HIV; patients on immunosuppressant drugs and patients willing to provide informed written consent were included in the study. Children less than 10 years of age, pregnant females, history of prolonged catheterization (more than 2 days) or intake of antimicrobials within the past 2 weeks, patients hospitalized or unable to respond to the questions, and not consenting to participate in the study were excluded. Being a time based study, all patients attending the center for routine follow-up irrespective of the UTI symptoms, during the stated 1 year period were screened randomly for their eligibility in the study and urine specimens of patients were collected only after obtaining informed written consent.

Data collection

A face-to-face structured interview with the patient for collecting demographic and baseline data was conducted and information captured in a systematic case record form [13]. The structured interview was drafted in English, then translated to Kashmiri the local language for actual data collection and finally translated back to English to maintain data uniformity. The microbiological data to diagnose UTI was collected by the standard microbiological testing protocol followed in the study center. To assess the actual frequency of renal tract infection amid the heterogeneous immunocompromised patient population, the study participants were stratified into 6 categories; diabetes mellitus, post renal transplant, post cancer chemotherapy, diabetic mellitus and post renal transplant, diabetic mellitus and post cancer chemotherapy and others (SLE, ulcerative colitis, rheumatoid arthritis and

multiple sclerosis patients on immuno suppressant's).

Specimen processing

Urine specimen collection: Urine specimens were collected aseptically by standard mid-stream "clean-catch" method in sterile wide mouth leak proof bottles and processed within 2 hours after collection. All subjects were directed to wash the urethral area before urine collection to avoid contamination. The female subjects were also asked to hold the labia wide apart during urine collection.

Identification of uropathogen and diagnosis: Microscopical examination of urine specimens was done at low and high power to detect the epithelial cells, casts, crystals, pus cells, bacteria and yeast cells. A colony count of ≥10 5 CFU/ml was considered positive for UTI [14]. For classification of bacteria, gram staining of the specimen smears was carried out. Samples with colony count of ≥10 5 CFU/ml were sent for urine culture for further identification of the uropathogens and confirmation of diagnosis. Midstream urine samples were inoculated on HiCrome UTI agar without centrifugation for suspected bacterial infections [15] and incubated at 37°C aerobically for 24 hrs [16].

The specimens were further sub-cultured on MacConkey agar media. Presence of 100,000 colony-forming units (CFU) per millilitre in the urine culture was reported as UTI positive [17]. Standard identification procedures were followed for gram-negative bacteria with a subculture on chromatic differential medium (Liofilchem, Italy) and use of Analytical Profile Index (API) [18]. The gram-positive isolates were identified based on the phenotypic parameters like growth on mannitol salt agar (Oxoid, UK), chromatic agar, colony morphology, and gram staining, which was followed by microscopic analysis and specific biochemical test.

For identification and examination of morphologic characteristics of important yeast species, germ tube test, corn meal agar and HiChrome^{TM} Candida Differential Agar culture were used [19].

Operational definition

A patient was considered positive for UTI on presence of more than 100,000 CFU of bacteria per milliliter after culture of an appropriately collected sample. The presence of more than two bacterial species was considered as contamination [17].

Statistical analysis: Patient demographic characteristics and clinical data (immunocompromised category) were analysed by using descriptive statistics. Statistical analysis was done using SPSS- 20 program (SPSS Inc, Chicago, IL, USA). Univariate logistic regression was used to assess the significance of each factor level with respect to UTI positivity. Multivariate binary logistic regression analysis was employed to overcome the impact of confounding factors associated with UTI. For the risk factors, adjusted and unadjusted odds ratios with 95% confidence intervals were calculated. p-value was <0.05 was taken as statistically significant.

Results

A total of 405 immunocompromised patients visiting the study facility were screened during the stipulated period and the overall prevalence of UTI was found to be 34.81% (141). Table 1 reflects the sociodemographic and baseline characteristics of the immunocompromised study participants. The mean age of the subjects was 33.09 ± 23.73 years. The highest proportion of the immunocompromised patients (77/405; 19.01%) was in 41-50 years of age group. Female gender accounted for 55.06% and males 44.93% of the immunocompromised study population.

Patients of diabetes mellitus category comprised of 38.51% of the study population, whereas the overall diabetic patient population (including the hyperglycemic hosts with other immunocompromised condition) made up 48.39% of the participants. From table 2, it can be appreciated that amongst the 141 samples testing positive for UTI, females accounted for 58.15% (82/141) of the patients with UTI as compared to 41.84% (59/141) of males. Once again the highest proportion of UTI positive patients (29/141; 20.57%) was found in the 51-60 years of age group. It can be inferred from the results of table 3 and figure 1 that majority (68/141; 43.58%) of UTI positive patients were from diabetes mellitus category with highest female (47/156; 69.11%) population. Of the 141 UTI positive samples, 61 (43.26%) tested positive for bacterial isolates whereas, 80 (56.73%) tested positive for candida species as documented in table 4. Table 4 also reveals a positive statistical association of gram negative UTI among the post renal transplant patients (p=0.014).

The results also reflected high odds of acquiring UTI (68/156; 43.58%) among the diabetes mellitus category with AOR of 5.50 (p<0.001), as depicted in table 5. The odds of acquiring UTI were also high in female immunocompromised patients (55.06%) with AOR of 1.48.

Table 1: Socio-demographic and baseline characteristics of immunocompromised patient population (n=405)

Demographic & baseline characteristics		Total N (%)
Age	18-20	26 (6.42)
	21-30	57 (14.07)
	31-40	71 (17.53)
	41-50	77 (19.01)
	51-60	63 (15.56)
	61-70	60 (14.81)
	>70	51 (12.59)
Gender	Male	182 (44.93)
	Female	223 (55.06)
Immunocompromised category	Diabetes mellitus	156 (38.51)
	Post renal transplant	132 (32.59)
	Post cancer chemotherapy	59 (14.56)
	Diabetic mellitus and post renal transplant	39 (09.62)
	Diabetic mellitus and post cancer chemotherapy	1 (0.24)
	Others	18 (04.44)

Table 2: Age and gender specific distribution of UTI among the immunocompromised patients (n=405)

Age range	Positive UTI N (%)			Negative UTI N (%)		
	Male	Female	Total	Male	Female	Total
18-20	2 (3.39)	2 (2.44)	4 (2.84)	15 (12.2)	7 (4.96)	22 (8.33)
21-30	10 (16.95)	9 (10.98)	19 (13.48)	13 (10.57)	25 (17.73)	38 (14.39)
31-40	15 (25.42)	13 (15.85)	28 (19.86)	17 (13.82)	26 (18.44)	43 (16.29)
41-50	6 (10.17)	21 (25.61)	27 (19.15)	22 (17.89)	28 (19.86)	50 (18.94)
51-60	11 (18.64)	18 (21.95)	29 (20.57)	26 (21.14)	8 (5.67)	34 (12.88)
61-70	11 (18.64)	16 (19.51)	27 (19.15)	14 (11.38)	19 (13.48)	33 (12.5)
>70	4 (6.78)	3 (3.66)	7 (4.96)	16 (13.01)	28 (19.86)	44 (16.67)
Total	59 (100)	82 (100)	141 (100)	123 (100)	141 (100)	264 (100)

Table 3: Immunocompromised category and gender specific distribution of UTI (n=405)

Immunocompromised category	Positive UTI N (%)			Negative UTI N (%)		
	Male	Female	Total	Male	Female	Total
Diabetes mellitus (n=156)	21 (30.88)	47(69.11)	68 (43.58)	40 (45.45)	48 (54.54)	88 (56.41)
Post renal transplant (n=132)	32 (60.37)	21 (39.62)	53 (40.15)	49 (62.02)	30 (37.97)	79 (59.84)
Post cancer chemotherapy (n=59)	3 (42.85)	4 (57.14)	7 (11.87)	20 (38.46)	32 (61.53)	52 (88.13)
Diabetic mellitus and post renal transplant (n=39)	2 (22.22)	7 (77.77)	9 (23.07)	8 (26.66)	22 (73.33)	30 (76.92)
Diabetic mellitus and post cancer chemotherapy (n=1)	0 (0)	1 (100)	1 (100)	0 (0)	0 (0)	0
Others (18)	1 (33.33)	2 (66.66)	3 (16.66)	6 (40)	9 (60)	15 (83.33)
Total	59 (41.84)	82 (58.15)	141 (34.81)	123 (46.59)	141 (53.40)	264 (65.18)

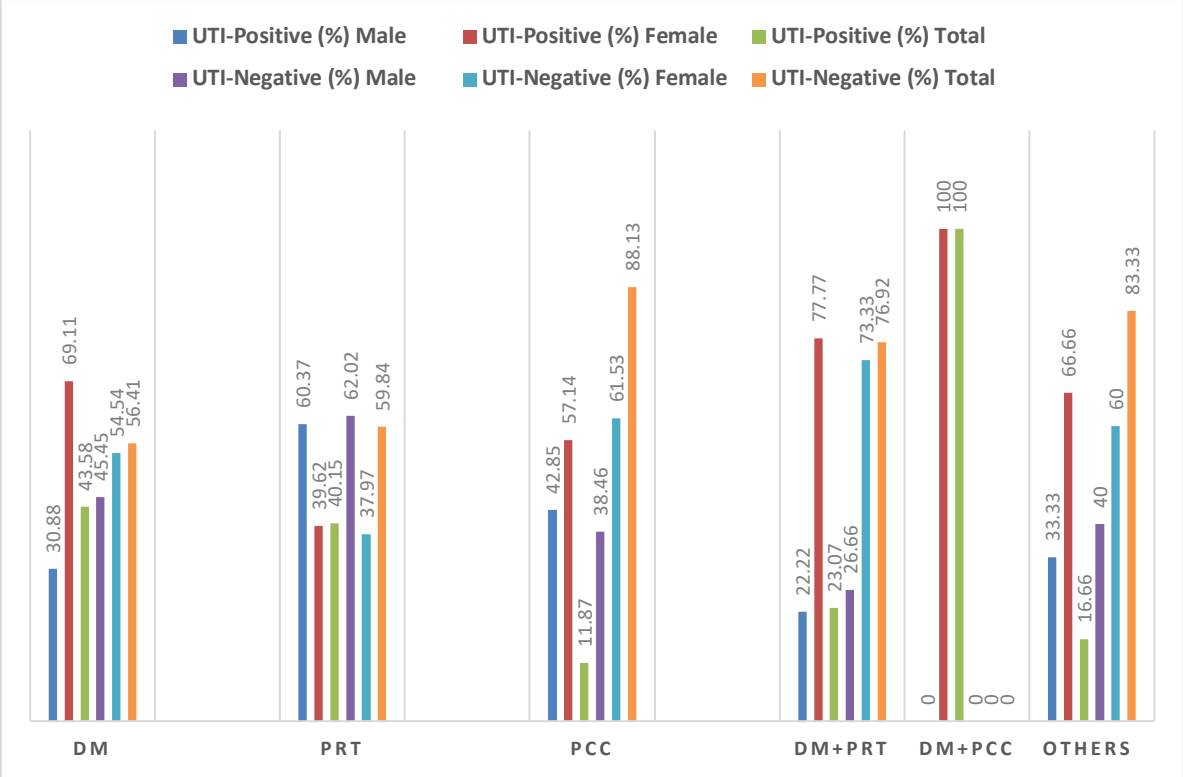

Figure 1: Immunocompromised category and gender specific prevalence of UTI. (n=405)

Table 4: Correlation of immunocompromised category with gender and microbiological classification of UTI positive patients (n141)

Immunocompromised category	Bacterial UTI N (%)						Fungal UTI N (%)			
	Gram +		Gram –		Total	p-value (gram positive vs negative)			Total	p-value (bacterial vs fungal)
	M	F	M	F			M	F		
Diabetes mellitus (n=68)	2	4	5	17	28 (41.17)	0.002***	14	26	40 (58.82)	0.146
Post renal transplant (n=53)	0	6	11	8	25 (47.16)	0.009***	21	7	28 (52.83)	0.680
Post cancer chemotherapy (n=7)	1	1	0	0	2 (28.57)	0.157	2	3	5 (71.42)	0.257
Diabetic mellitus and post renal transplant (n=9)	1	0	1	2	4 (44.44)	0.317	0	5	5 (55.55)	0.739
Diabetic mellitus and post cancer chemotherapy (n=1)	0	0	0	1	1 (100)	0.3.16	0	0	0 (0)	0.317
Others (n=3)	0	0	0	1	1 (33.3)	0.316	1	1	2 (66.6)	0.564
Total	4 (26.66)	11 (73.33)	17 (36.95)	29 (63.04)	61 (43.26)		38 (47.50)	42 (52.50)	80 (56.73)	
	15 (24.59)		46 (75.40)							

***, highly significant difference (P< 0.01);**, significant difference (p <0.05):*, significant difference (p <0.10).

Table 5: Factors associated with prevalence of UTI among immunocompromised patient population (n=405)

Demographic & baseline characteristics	Total N (%)	UTI Positive N (%)	UTI Negative N (%)	COR	COR 95% CI		P-value	AOR	AOR 95% CI		P-value
					Lower Limit	Upper Limit			Lower Limit	Upper Limit	
Age											
18-20	26 (6.42)	4 (2.84)	22 (8.33)	**1.143**	.302	4.325	**.844**	**2.738**	.650	11.524	**.170**
21-30	57 (14.07)	19 (13.48)	38 (14.39)	**3.143**	1.192	8.284	**.021**	**3.169**	1.168	8.599	**.024**
31-40	71 (17.53)	28 (19.86)	43 (16.29)	**4.093**	1.617	10.361	**.003**	**4.575**	1.756	11.917	**.002**
41-50	77 (19.01)	27 (19.15)	50 (18.94)	**3.394**	1.346	8.558	**.010**	**3.443**	1.321	8.977	**.011**
51-60	63 (15.56)	29 (20.57)	34 (12.88)	**5.361**	2.097	13.710	**<0.001**	**5.574**	2.103	14.771	**.001**
61-70	60 (14.81)	27 (19.15)	33 (12.5)	**5.143**	1.997	13.244	**.001**	**4.743**	1.778	12.653	**.002**
>70	51 (12.59)	7 (4.96)	44 (16.67)	Reference							
Gender											
Female	223 (55.06)	82 (36.77)	141 (63.22)	**1.212**	.802	1.832	**.360**	**1.480**	.932	2.350	**.097**
Male	182 (44.9)	59 (32.41)	123 (67.58)	Reference							
Immuno-compromised category											
Diabetes mellitus	156 (38.51)	68 (43.58)	88 (56.41)	**5.740**	2.453	13.433	**<0.001**	**5.500**	2.202	13.740	**<0.001**
Post renal transplant	132 (32.59)	53 (40.15)	79 (59.8)	**4.984**	2.104	11.806	**<0.001**	**5.202**	2.069	13.081	**<0.001**
Post cancer chemotherapy	59 (14.56)	7 (11.8)	52 (88.13)	Reference							
Diabetic mellitus and post renal transplant	39 (9.62)	9 (23.07)	30 (76.92)	**2.229**	.753	6.596	**.148**	**1.867**	.593	5.874	**0.286**
Diabetic mellitus and post cancer chemotherapy	1 (0.02)	1 (100)	0 (0)	**81.714***	9.109	733.011	**<.001***	**73.23***	3.431	687.21	**0.001***
Others	18 (4.44)	3 (16.66)	15 (83.3)	**1.486**	.342	6.458	**.597**	**2.253**	.486	10.450	**0.299**

COR: crude odds ratio; CI: confidence interval; AOR: adjusted odds ratio, *; very low sample size

Discussion

The observations made in this study disclose an overall 34.81% (141/405) prevalence of urinary tract infections in the immunocompromised study subjects (table 3). Among the 6 major immunocompromised categories of study population, highest prevalence of 43.58% was observed in the diabetic patients. However, the prevalence of UTI was reduced to 39.79% when all hyperglycaemic patients with other immunocompromised conditions (post renal transplant and post cancer chemotherapy) were also taken into account (table 3). Our results regarding the prevalence of UTI in diabetic subjects was comparable to the observations of studies from Malaysia (40.2%) [20], Kuwait (35%) [21] and Jammu & Kashmir (43.10%) [12].

In contrast, the magnitude of urinary tract infection reported was lower in studies from South Ethiopia (33.9%) [13], Romania (12%) [22] South India (13.6%) [23], Nigeria (15.5%) [24] and Northeast Ethiopia (22.3%) [25]. whereas, the results were higher as compared to our UTI prevalence in a study from Nepal (54.7%) [26]. The statistically significant association of hyperglycemia with UTI could be due to immune dysfunction in hyperglycemic patients, comprising of impaired polymorphonuclear leukocyte function such as abnormal leukocyte adherence, phagocytosis and chemotaxsis; altered anti-bacterial activity of the antioxidant system [27]; and neuropathic complications like bladder dysfunction. Increased glucose concentration in the urine of diabetic subjects could also have served as a culture medium for uropathogens.

Our results depict 40.15% prevalence of urinary tract infections (table 3) in post kidney transplanted patient category with an overall 36.25% prevalence in all patients of post renal transplant including other immunocompromised conditions (diabetes mellitus). A broad range of 7-80% of urinary tract infection prevalence has been documented in renal transplant recipients depending on the diagnostic criteria of UTIs used [28, 29]. In a recent Turkish study by Velloglu et. al., the UTI incidence reported was 20.5% in the initial year after kidney transplant, which is considered the high risk period [30]. A increased incidence of 65% was reported from a study carried out in Kashmir [11]. UTIs in

post-renal transplant hosts are highly significant as they are considered the major cause of acute graft dysfunction. Further increased morbidity and hospitalization rates are associated with urinary tract infections in post kidney transplant subjects. Factors demonstrating significant correlation with precipitation, frequency and severity of urinary tract infections in post renal transplant hosts are, urethral catheterization to safeguard the surgical anastomosis during the initial week after transplantation; surgical and immunologic trauma; and immunosuppressive therapy [31].

We recorded a prevalence of 11.86% of UTI among the cancer patients post chemotherapy (table 3). However studies from other regions have demonstrated bacteriuria ranging from 6% in a hospital in Ethiopia [32] to as high as 72% in a hospital in Egypt [33], among the cancer patients post chemotherapy. Our observations are in line with the results of studies conducted in Texas (15%) [34] and Japan (15%) [35]. However, the prevalence of UTI reported by a Swedish study (5%) [36] is lower, whereas the prevalence reported by an Indian study (34.7%) [37] is higher than our findings. Shrestha et.al. (Nepal) and Tigabu et al. (Ethiopia) in their recent studies have also reported increased frequency of asymptomatic bacteriuria at 24% and 23.3% respectively, in patients with cancer [38,39]. The results of various studies have demonstrated that patients with increasing age, solid tumors (compared to hematological tumors) and surgical management are at higher risk of UTI [40]. It is well documented that patients with carcinoma have greater risk of acquiring urinary tract infections due to the use of anticancer drugs resulting in neutropenia due to acute as well as chronic suppression of immune system [39]. Cancer chemotherapy supposed to kill the cancer cells multiplying uncontrollably, also suppress the human immune system, thus rendering the patient vulnerable to infections [41].

The variation in the frequency of urinary tract infections within the various immunocompromised categories as reported across the globe is attributed to the differences in socio-demographic characteristics; quality of sampling and diagnostic techniques; and community social practices, such as standards of personal hygiene.

In this study, the gender based prevalence of urinary tract infections was 36.77% (82/223) among the female and 32.41% (59/182) among the male immuno compromised population (table 3 and figure 1). Further correlating the prevalence of urinary tract infections with gender, we identified that urinary tract infection was more commonly observed among women in all immunocompromised categories except the post cancer chemotherapy category.

A record high prevalence of UTI was noted in females of diabetes mellitus category and post renal transplant category at 49.47% and 41.17% respectively, as reflected in figure 1. Whereas, the prevalence of UTI in men for the same two categories was 34.42% and 39.50% respectively. Most of the studies have reported significantly higher prevalence of UTI among diabetic females, such as studies conducted in Southwest Ethiopia [13,42] and Malaysia [20] South India [23] Nigeria [24] as well Jammu & Kashmir [12]. Our results for post renal transplant patients also confirm the findings of many studies which have reported higher incidence of UTI among the female renal transplant recipients [28, 43]. Various factors predisposing women to increased risk of UTI are the anatomical and reproductive physiological factors, such as short urethra with closer proximity to anorectal region where pathogens colonize easily, [44] lack of bacteriostatic prostatic secretions, and sexual intercourse; as well as post-menopausal changes in normal flora and pH of vagina which facilitate the bacterial growth [45]. However, there are few studies that have not observed any gender based difference in prevalence of urinary tract infections [46,47]. There are also studies conducted in general population as well as kidney transplant patients which support these findings [48,49]. Urinary outflow obstruction due to enlarged prostate, prostatitis, and inadequate response to antibiotics due to long uro-epithelial tissue in males compared to females are the possible factors which explain these findings. It is noteworthy that we observed a relatively increased prevalence of UTI among males (13.04%) in comparison to women (11.11%), in the post cancer chemotherapy category. However, these results are in contrast to the study conducted by Tigabu et al., who reported higher symptomless bacteriuria in women (64.3%) than in males (35.7%) during the post cancer chemotherapy period [39].

The highest prevalence of UTI in the immunocompromised patients as a function of age was observed in 51-60 and 61-70 years of age group at 46.87% and 46.77% respectively (table 2). The high prevalence of UTI matched the high distribution of immunocompromised patients in these two elderly age groups, which may in turn correspond to high prevalence of comorbidities seen with increasing age. It is also reported that UTIs are 4.8 times more likely in diabetics with comorbidities than without comorbidities, which means that the presence of comorbidities facilitates and reflects progression of illness. [42,24]

On microbiological examination, fungal species (candida) were identified in 80 (56.73%) and bacterial isolates in 61 (43.26%) out of 141 samples testing positive for UTI (table 4). Interestingly, we observed higher prevalence of

fungal UTI as compared to bacterial UTI, in all immunocompromised patient categories. Highest prevalence of fungal UTI was recorded at 58.82% (40/68) in the diabetes mellitus category, with 50.94% (27/53) in post renal transplant category of patients, however, no statistical significance was observed. Furthermore, data of bacterial isolates based on their gram staining revealed that the prevalence of gram negative bacteria was 3 times that of gram positive bacteria (15:46 samples). Thus, from among the 61 bacterial isolates, 46 (75.40%) were identified to be gram negative and 15 (24.59%) were gram positive. Statistically significant increased prevalence of gram negative bacteria (19/25) was noted in renal transplant category of patients (p=0.014). The overview of gender distribution reflected the dominance of females in both fungal and bacterial UTI, across all immunocompromised categories, with an exception of post renal transplant category, wherein fungal UTI and gram negative bacterial UTI was more prevalent among the males (table 4). Contrary to our results, a Japanese study reported bacteriuria in 15% urine specimens of cancer patients [35]. While, the prevalence of gram-negative bacterial UTI was 17.2% among the cancer patients in Egypt [50].

We also evaluated various demographic parameters for their association with UTI in patients with compromised immune system (table 5). It was observed that all age groups, except for 18-20 years, were significantly associated with UTI. Highest association with crude odds ratio of 5.36 and adjusted odds ratio of 5.57 and highly significant p-value of <0.001 was observed for patients of 51-60 age group (table 5). We reported higher odds of urinary tract infection in females with adjusted odds ratio of 1.48, however the result was not statistically significant. Walelgn et.al. have reported significantly higher odds of acquiring urinary tract infections in diabetic women (adjusted odds ratio: 2.46) and diabetic patients with any associated chronic disease (adjusted odds ratio: 4.87) [25]. Our results reflected higher odds of urine culture positivity among the diabetes mellitus category (AOR; 5.50) followed by post renal transplant category (AOR, 5.20) which was found to be statistically significant in both the categories (p<0.001). Factors such as age, female gender, long duration of urinary catheter and presence of urologic complications, are few documented risk factors for urinary tract infection in any patient group [30].

However, in a study conducted in cancer patients, no statistically significant risk factors were reported for asymptomatic bacteriuria (P > 0.05) [39]. Research studies have revealed that susceptibility of various categories of immunocompromised patients, to a specific infection does not depend on a single factor, rather the concept of 'triple state of immunosuppression', has been postulated. The concept proposes a complex interaction of several critical factors; such as the main disease characteristics, the dose and duration of the prescribed immunosuppressive therapy; technical factors including the presence of granulocytopenia and the integrity of the mucosal skin barrier at the beginning of the infection; metabolic factors such as hyperglycemia, uremia and protein-calorie malnutrition; and the immunomodulatory effects of viruses such as cytomegalovirus, Epstein-Barr virus, hepatitis viruses and HIV [51]. Hence, it is recommended that patients with these risk factors should be screened regularly for asymptomatic UTI.

Limitation of the study

The first and foremost limitation of this study was that the study was conducted during the COVID-19 pandemic period, hence we were unable to generalize our findings. Second, the qualitative component of the assessment variables which would explain the study findings better, was not included due to paucity of resources. Third, we were able to only comment on limited patient characteristics and their correlation with the uropathogens isolated, as lot of data was missing on certain variables that significantly predict the bacterial growth in urine specimens, such as demographic features, presence of symptoms, stage of carcinoma and use of antimicrobial agents before the specimen collection for culture [52]. The reason for paucity of resources and the missing data could be COVID-19 related over-burdened healthcare system or lack of standardized guidelines for UTI screening among immunocompromised patients.

Conclusion

The findings of our study reflected a high magnitude of UTI among immunocompromised patients especially the diabetic population. The study suggested that gender, duration of diabetes and presence of any comorbidity were independent risk factors for UTIs among immunocompromised patients. Most of our observations were comparable with the prior studies conducted in India. Identification of these risk factors predisposing the immunocompromised patients to UTIs can help in early detection and management of the vulnerable population. We suggest that the healthcare facility should develope standard guidelines for systematic UTI screening and use standardized protocol for requesting urine cultures and antibiotic susceptibility testing among the immunocompromised patients visiting for routine checkup. We strongly propose that each tertiary health center catering to immunocompromised patients should draft their own antibiograms on

regular basis which is critical for promoting targeted antibiotic treatment. The results of our study are expected to serve as baseline data for designing large multi-center prospective studies for UTI risk identification among the local immunocompromised population.

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All authors have read and approved the final article.

Availability of data and materials

The datasets used and/or analyzed during the current study are available from the corresponding author upon reasonable request.

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