

# Urinary Tract Infection in Chronic Kidney Disease

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**Abstract:** *In a study of 120 CKD patients of nephrology unit in MGM Medical College, Aurangabad, a high incidence of urinary tract infection (U.T.I.) i.e. 35% was observed. E.coli was the predominating urinary pathogen. Presence of UTI is found to have associated with increased mortality in CKD patients indicating severe outcome in this study. However, the mortality is attributable only to the presence of UTI cannot be estimated due to presence of other confounding factors like diabetes mellitus and hemodialysis. Moreover, this study indicates the association of Diabetes, hemodialysis and advanced CKD stage as risk factors for U.T.I in CKD patients*

**Keywords:** UTI, CKD, Diabetes Mellitus, E.Coli, Hemodialysis

## 1. Introduction

Urinary tract infection is an infection of one or more structure in the urinary system. The urinary tract includes urethra, bladder, ureters, prostate and kidneys which is normally sterile and resistant to bacterial colonization. The body's defense mechanism against UTI includes complete emptying of the bladder during urination, urine acidity, the vesicoureteral valve, and various immunologic and mucosal barriers. In cases of renal failure, there is a change in the composition of urine with oliguria, anuria, albuminuria and haematuria. The resultant changes in pH, osmolality and urinary urea definitely have their own effects in urinary infection.<sup>5</sup> The urinary tract is the most common site of nosocomial infection<sup>1,2,3</sup> and most of these infections follow instrumentation of urinary tract, mainly urinary catheterization and is a subsequent cause of significant morbidity, sepsis and death<sup>4</sup>. Most frequently bacteria from the urethral meatus ascend to the bladder between the catheter and urethral surfaces. Alternatively, bacteria may ascend within the urinary drainage systems following contamination of the drainage bag or catheter tubing junction. The presence of bacteria in the bladder constitutes a potential reservoir for multi resistant bacteria.<sup>2,4</sup>

The risk of acquiring a urinary tract infection depends on the method and duration of catheterization, and the quality of catheter care.<sup>2,3</sup>

Intensive care units are a meeting point between the most severely ill patients receiving aggressive therapy and the most resistant pathogens which are selected by the use of broad spectrum antimicrobial therapy.<sup>5</sup>

Epidemiological study suggests that the 3 most commonly seen infectious complications in the CKD population are: urinary tract infection, pneumonia, and sepsis.<sup>1</sup> However, there are few studies of patients with CKD and UTI<sup>6</sup> and the incidence of UTIs in patients with CKD is unclear.<sup>7</sup>

## 2. Aims & Objectives

- 1) To study the incidence of urinary tract infections in chronic kidney disease patients
- 2) To know the microorganisms responsible for urinary tract infections in chronic kidney disease patients
- 3) To know whether presence of urinary tract infections influences the outcome in chronic kidney disease patients

## 3. Material and Methods

A total of 120 CKD patients above 18 year old attending nephrology unit were included where as patient having obstructive uropathies (urethral strictures, renal calculi) or patients with indwelling catheter or patients who were on antibiotic therapy prior to hospitalization or on immunosuppressive therapy were excluded. In this study U.T.I was defined as asymptomatic<sup>8</sup> or symptomatic bacteriuria<sup>9,11</sup> with isolation of at least one micro organism in urine culture. A clean catch urine sample-midstream was collected in a wide mouth, leak proof container with straps on lids. Urine samples were sent to laboratory within 2-3 hours of collection. In case of any delay, urine specimens were preserved by using boric acid as preservative or refrigeration at 2 - 4°C up to a span of 24 to 72 hours<sup>12,13</sup>

In the present study diagnosis of U.T.I was established either by

- a) Urine microscopy of clean catch urine in which presence of 10 or more white cells per cubic millimeter in a urine specimen, 3 or more white cells per high-power field of unspun urine<sup>8</sup> or leukocytes, leukocyte casts, and other cellular elements were observed directly under the microscope
- b) All specimens were inoculated on Mac Conkey agar plate and was incubated at 35°C overnight and specific organism was isolated by inoculating colony on blood agar plates. The antibiotic sensitivity was based on Kirby Bauer method of antibiotic susceptibility
- c) The ultrasound image shows a smaller kidney, thinning of the parenchyma and its hyperechogenicity (reflecting sclerosis and fibrosis) except in patients of diabetic

nephropathy in which both renal size and parenchymal thickness are preserved until end-stage renal failure.<sup>17</sup> Ultrasonogram can show evidence of pyelonephritis and cystitis as an additional clue for diagnosis of UTI and rule out obstructive uropathies

4. Results

Table 1: Incidence of UTI in CKD Patients:

UTI	No. of patients	Percentage
Positive	42	35.0
Negative	78	65.0
Total	120	100%

Out of 120 CKD patients, the total number of patients having urinary tract infection was 42. Hence, the incidence of UTI in CKD patients in this study was 35%.

Table 2: Gender wise distribution of UTI in CKD patients

Gender	UTI				Total		Chi-square test	P-value
	Positive		Negative		No	%		
	No	%	No	%				
Male	18	42.9	38	48.7	56	40.0	0.337	P=0.539 NS
Female	24	57.1	40	51.3	64	60.0		
Total	42	100	78	100	120	100		

Out of 120 CKD patients in this study, 56 (40%) were males and 64 (60%) were females. Among the 42 CKD patients having UTI, 18 (42.9%) were males and 24 (57.1%) were females. Among the 78 CKD patients not having UTI, 38 (48.7%) were males and 40 (51.3%) were females. The difference between the two groups was not statistically significant in this study.

Table 3: Age-Group wise distribution of UTI in CKD Patients:

Age-Group	UTI				Total		Chi-square test	P-value
	Positive		Negative		No	%		
	No	%	No	%				
19-30	03	7.1	06	7.7	06	5.0	6.68	P=0.246 NS
31-40	04	9.5	11	14.1	15	12.5		
41-50	05	11.9	20	25.6	27	22.5		
51-60	10	23.8	17	21.8	27	22.5		
61-70	16	38.1	22	28.2	38	31.7		
>70	04	9.5	02	2.6	07	5.8		
Total	42	100	78	100	120	100		

Out of 120 CKD patients, 38 (31.7%) were from age group 61-70 years followed by 27 (22.5%) each from age group 41-50 and 51-60 years. Among the 42 CKD patients having UTI, majority were from age group 61 – 70 years i.e. 16 (38.1%) followed by 51 – 60 years i.e. 10 (23.8%). Among the 78 CKD patients without UTI, majority were from age group 61 – 70 years i.e. 22 (28.2%) followed by 20 (25.6%) from 41-50 year age group.

Table 4: Association of Diabetics Mellitus with UTI in CKD Patients:

Diabetic status	UTI				Total		Chi-square test	P-value
	Positive		Negative		No	%		
	No	%	No	%				
Diabetic	26	61.9	34	43.6	60	50.0	3.69	P=0.041 S
Non diabetic	16	38.1	44	56.4	60	50.0		
Total	42	100	78	100	120	100		

Out of 120 CKD patients in this study, 60 (50%) were diabetic and 60 (50%) were non diabetic. Among the 42 CKD patients with UTI, 26 (61.9%) were diabetic and 16 (38.1%) were non diabetic. Among the 78 CKD patients not having UTI, 34 (43.6%) were diabetic and 44 (56.4%) were non diabetic. The statistical difference between two groups was significant indicating association between diabetes mellitus and UTI in CKD patients.

Table 5: CKD stage wise distribution of UTI:

CKD stage	UTI				Total		Chi-square test	P-value
	Positive		Negative		No	%		
	No	%	No	%				
G1	00	00	00	00	00	00	9.38	P=0.002 S
G2	03	7.1	07	8.9	10	8.3		
G3A	04	9.5	20	25.6	24	20.0		
G3B	06	14.3	20	25.6	26	21.7		
G4	10	23.8	14	17.9	24	20.0		
G5	19	45.3	17	21.8	36	30.0		
Total	42	100	78	100	120	100		

Out of 120 CKD patients, majority belonged to stage G5 i.e. 36 (30%). Among the 42 CKD patients having UTI, majority belonged to stage G5 i.e. 19 (45.3%) followed by G4 i.e. 10 (23.8%). Among the 78 CKD patients without UTI, majority belonged to CKD stage G3a and G3b with each being 20 (25.6%) of patients. The statistical difference between the two groups was significant indicating association of severity of CKD stage and UTI in this study.

Table 6: Association of Hemodialysis with UTI in CKD Patients:

Hemo-dialysis status	UTI				Total		Chi-square test	P-value
	Positive		Negative		No	%		
	No	%	No	%				
HD	29	69.0	31	39.7	60	50.0	9.38	P=0.002 S
Non HD	13	31.0	47	61.3	60	50.0		
Total	42	100	78	100	120	100		

Out of 120 CKD patients, 60 (50%) were on maintenance hemodialysis and 60 (50%) were managed conservatively. Among the 42 CKD patients having UTI, 29 (69%) were on maintenance hemodialysis and 13 (31%) were on conservative treatment. Among the 78 CKD patients without UTI, 31 (39.7%) were on hemodialysis and 47 (61.3%) were being managed conservatively. The statistical difference between two groups was significant indicating association between hemodialysis and UTI in CKD patients.

Table 7: Microorganisms isolated in UTI in CKD Patients:

Microorganisms isolated	UTI Positive	
	No	%
E.coli	24	57.1
S.aureus	06	14.3
Klebsiella spp.	08	19.1
Proteus spp.	03	7.1
Candida spp.	03	7.1
Acinetobacter spp.	1	2.4
Cons	03	7.1

The most common microorganism isolated from 120 CKD patients having UTI was E.coli in 24 (57.1%) patients followed by Klebsiella spp. in 8 (19.1%) patients. Other microorganisms were S.aureus in 6 (14.3%), Proteus spp. in

3 (7.1%), Coagulase negative staphylococci in 3 (7.1%), *Candida* spp. in 3 (7.1%) and *Acinetobacter* spp. in 1 (2.4%) patients in this study.

**Table 9: Deaths in UTI with CKD Patients:**

Death status	UTI				Total		Chi-square test	P-value
	Positive		Negative		No	%		
	No	%	No	%				
Dead	14	33.3	10	12.8	24	20.0	7.18	P=0.007 S
Alive	28	66.7	68	87.2	96	80.0		
Total	42	100	78	100	120	100		

Out of 120 CKD patients, 24 (20%) succumbed to death and 96 (80%) were salvaged. Among 42 CKD patients having UTI, 14 (33.3%) patients succumbed to death and 28 (66.7%) were salvaged. Among the 78 CKD patients without UTI, 10 (12.8) succumbed to death while 68 (87.2%) were salvaged. The statistical difference between the two groups is significant indicating association between severity of outcome and UTI in CKD patients.

## 5. Discussion

- 1) Incidence of UTI in CKD patients in this study was 35%. In a study conducted by Jadhav SK, et al., high incidence of urinary tract infection i.e. 57.5%, was observed in CKD patients.<sup>5</sup> This difference might be because of Exclusion of obstructive uropathies and catheterized patients in our study. In a cross sectional study conducted by Falah S Manhal, et al., the frequency of UTI in renal failure patients undergoing hemodialysis was found to be 37.5%.<sup>18</sup>
- 2) Among the 42 CKD patients having UTI, 18 (42.9%) were males and 24 (57.1%) were females. Among the 78 CKD patients not having UTI, 38 (48.7%) were males and 40 (51.3%) were females. The difference between the two groups was not statistically significant in this study. Similar results were observed in a study conducted by Chih-Yen HSIAO, et al. where, 52.2% were females and 47.8% were males out of all CKD patients with lower UTI.<sup>19</sup>
- 3) Among the 42 CKD patients having UTI, majority were from age group 61–70 years i.e. 16 (38.1%) followed by 51–60 years i.e. 10 (23.8%). Among the 78 CKD patients without UTI, majority were from age group 61 – 70 years i.e. 22 (28.2%). The statistical difference between the two groups was not significant in this study. Similar results were observed in a study conducted by Chih-Yen HSIAO et al. where, average ages of the upper and lower UTI patients with CKD were  $59.21 \pm 16.54$  and  $71.18 \pm 14.77$  years.<sup>19</sup> In a study by Zhang et al., they found a high prevalence (17.4%) of CKD among older adults 50 to 74 years from 9806 participants.<sup>20</sup> Another study done by Gauba C, et al., showed high incidence of urinary tract infections in CKD patients with older age group.<sup>21</sup>
- 4) Among the 42 CKD patients with UTI, 26 (61.9%) were diabetic and 16 (38.1%) were non diabetic. Among the 78 CKD patients not having UTI, 34 (43.6%) were diabetic and 44 (56.4%) were non diabetic. The statistical difference between two groups was significant indicating association between diabetes mellitus and UTI in this study. In a study conducted by Chih-Yen HSIAO et al., it was observed that 36.9% patients with lower UTI were

found to have diabetes mellitus.<sup>19</sup> The difference might be attributable to the large number of diabetics in our study and high prevalence of diabetes mellitus in India.

- 5) Among the 42 CKD patients having UTI, majority belonged to stage G5 i.e. 19 (45.3%) followed by G4 i.e. 10 (23.8%). Among the 78 CKD patients without UTI, majority belonged to CKD stage G3a and G3b with each being 20 (25.6%) of patients. The statistical difference between the two groups was significant indicating association of severity of CKD stage and UTI in this study. A different study conducted by Gauba C et al. observed high incidence of UTI in patients with advanced CKD stage and low urine flow rates.<sup>21</sup> In a study conducted by Chih-Yen HSIAO et al. it was observed that patients belonging to CKD stage G4 and G5 were 13.4% and 8% respectively.<sup>19</sup> The difference might be due to geographic and genetic differences in Turkish and Indian population and large number CKD patients enrolled in our study belonged to CKD stage G4 & G5. Also all catheterized patients are excluded from our study.
- 6) Among the 42 CKD patients having UTI, 29 (69%) were on maintenance hemodialysis and 13 (31%) were on conservative treatment. Among the 78 CKD patients without UTI, 31(39.7%) were on hemodialysis and 47 (61.3%) were being managed conservatively. The statistical difference between two groups was significant indicating association between hemodialysis and UTI in this study. In a different study conducted by Jadhav SK, et al., out of 73 CKD patients undergoing hemodialysis 42 had UTI i.e. (57.5%).<sup>5</sup> In a study conducted by Falah S.Manhal et al., 37.5% of the CKD patients on maintenance hemodialysis had UTI.<sup>18</sup> The difference might be attributable to large number of ESRD patients requiring hemodialysis enrolled in our study.
- 7) The most common microorganism isolated from CKD patients having UTI was *E.coli* in 24 (57.1%) patients followed by *Klebsiella* spp. in 8 (19.1%) patients. Other microorganisms were *S.aureus* in 6 (14.3%), *Proteus* spp. in 3 (7.1%), Coagulase negative staphylococci in 3 (7.1%), *Candida* spp. in 3 (7.1%) and *Acinetobacter* spp. in 1 (2.4%) patients in this study. In a study conducted by FalahS. Manhal et al., (15%) patients had been infected with *E. coli*, (12.5%) patients with *Klebsiella* spp., and (2.5%) with *Acinetobacter*,  $\alpha$ -hemolytic *Streptococci*, coagulase negative *Staphylococci*, and *Proteus* spp.<sup>18</sup> In a study done by HSIAO et al., Microorganisms isolated in upper and lower UTI were, *E.coli* (58.9% & 51.2%), *Proteus* (8.2% & 3%), *Klebsiella* (4.1% & 7.9%), *Enterococcus* (0% & 5.9%), *Pseudomonas* (2.7% & 6.9%) and *staphylococcus* (0% and 0.5%) respectively.<sup>19</sup> The minor difference may be attributable to exclusion of catheterized patients and obstructive uropathies in our study.
- 8) Among 42 CKD patients having UTI, 14 (33.3%) patients succumbed to death and 28 (66.7%) were salvaged. Among the 78 CKD patients without UTI, 10 (12.8) succumbed to death while 68 (87.2%) were salvaged. The statistical difference between the two groups is significant indicating association between severity of outcome and UTI in this study. A study done by Reinhard Funfstuck et al. observed that an acute infection can influence the course of a pre-existing renal

disease and enhance the development of renal failure in cases of existing damage of renal parenchyma or anatomical alteration of the urinary tract.<sup>22</sup>

## 6. Conclusion

This study was conducted on 120 CKD patients attending OPD and/or casualty of nephrology unit in MGM Medical College & Hospital, Aurangabad.

Incidence of urinary tract infection in chronic kidney disease patients is 35%.

E.coli was the most common microorganism isolated from urine cultures.

Presence of UTI is found to have associated with increased mortality in CKD patients indicating severe outcomes in this study. However, whether the mortality is attributable only to the presence of UTI cannot be estimated due to presence of other confounding factors such as diabetes mellitus and hemodialysis.

Moreover, this study indicates the association of Diabetes mellitus, hemodialysis and advanced CKD stage as risk factors for urinary tract infections in CKD patients.

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