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Original Research Article

Clinical study on infections with special reference to tubercular infection in post-kidney transplant recipients from Western India

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ABSTRACT

Background: Infections remain a major cause of morbidity and mortality following kidney transplantation. The spectrum of infectious complications differs between developing and developed countries, with tuberculosis (TB) continuing to pose a significant challenge in endemic regions such as India. Data on post-transplant infections from western India are limited. Objectives were to evaluate the spectrum of infections, with special reference to tuberculosis, among kidney transplant recipients and assess their impact on graft and patient outcomes.
Methods: This retrospective and prospective observational study was conducted at the department of nephrology, Goa Medical College, Goa, India. Sixty-two kidney transplant recipients transplanted between August 2018 and August 2025 were included. Demographic, transplant-related, infectious, tuberculosis-related, graft, and patient outcome data were analyzed. Risk factors for post-transplant tuberculosis were assessed using univariate analysis.
Results: Of 62 recipients, 48 (77.4%) developed at least one infectious episode, accounting for 84 infectious events. Urinary tract infection was the most common infection (32.1%), followed by lower respiratory tract infection (26.2%) and tuberculosis (10.7%). Tuberculosis occurred in 9 recipients (14.5%), with extrapulmonary disease predominating (55.6%). Two-thirds of cases developed within two years of transplantation. Low socioeconomic status (OR 18.67, p=0.002) and chronic allograft nephropathy (OR 4.74, p=0.04) were significantly associated with post-transplant tuberculosis. Chronic graft dysfunction occurred in 30.6% and overall mortality was 29%. Mortality among tuberculosis patients was 88.9%.
Conclusions: Infectious complications remain highly prevalent after kidney transplantation in western India. Tuberculosis continues to be associated with substantial graft dysfunction and mortality, highlighting the need for early diagnosis, vigilant surveillance, and prompt management.

Keywords: Graft dysfunction, Infection, Kidney transplantation, Mortality, Renal allograft, Tuberculosis

INTRODUCTION

Kidney transplantation is the preferred modality of renal replacement therapy for patients with end-stage kidney disease because it offers superior survival, improved quality of life, and better cost-effectiveness compared with long-term dialysis.[1] However, infectious complications remain a major cause of morbidity and mortality in kidney transplant recipients owing to chronic immunosuppression, exposure to opportunistic pathogens, and impaired host immune responses.[2,3]

The epidemiology of infections following kidney transplantation varies considerably across geographic regions. In developed countries, bacterial urinary tract infections, viral infections such as cytomegalovirus (CMV), and opportunistic fungal infections are common.[4,5] In contrast, tuberculosis continues to represent a significant infectious challenge in developing countries,

particularly India, where the background prevalence of Mycobacterium tuberculosis remains among the highest in the world.[6,7]

The incidence of post-transplant tuberculosis has been reported to be 20-70 times higher than that observed in the general population.[8] Furthermore, tuberculosis in transplant recipients frequently presents with atypical manifestations, extrapulmonary involvement, delayed diagnosis, graft dysfunction, and increased mortality.[9,10]

India continues to contribute a substantial proportion of the global tuberculosis burden, making kidney transplant recipients particularly vulnerable to active disease following transplantation.[11,12] The use of potent immunosuppressive agents, prolonged exposure to corticosteroids, and latent tuberculosis reactivation further increase this risk.[13]

Urinary tract infections remain the most common infectious complication after kidney transplantation and are associated with recurrent hospitalization, graft dysfunction, and increased healthcare utilization.[14-17] CMV infection has also emerged as an important opportunistic infection, contributing to indirect immunomodulatory effects and increasing susceptibility to secondary infections.[18,19]

Although several studies have described infectious complications among kidney transplant recipients, data from western India remain limited.[20,21] Understanding local epidemiological patterns is important for optimizing screening strategies, prophylactic measures, and post-transplant surveillance.

Therefore, this study was undertaken to evaluate the spectrum of infections among kidney transplant recipients at a tertiary care centre in western India, with special emphasis on tuberculosis and its impact on graft and patient outcomes.

METHODS

Study design and setting

It was a retrospective and prospective observational study. The study took place at Department of Nephrology, Goa Medical College, Goa.

Study population

All kidney transplant recipients attending nephrology outpatient and inpatient services during the study period.

Study period and sample size

The study period was from August 2018 to August 2025. Sixty-two kidney transplant recipients were included in the study.

Inclusion criteria

Patients with end-stage kidney disease who underwent kidney transplantation.

Exclusion criteria

Patients unwilling to participate were excluded.

Data collection

Demographic characteristics, transplant details, donor characteristics, immunosuppressive therapy, infectious episodes, microbiological investigations, tuberculosis characteristics, graft outcomes, and patient survival were recorded.

Statistical analysis

Data were analyzed using SPSS version 23. Continuous variables were expressed as mean±standard deviation and categorical variables as frequencies and percentages. Chi-square test and Student's t-test were used. A p value <0.05 was considered statistically significant.

RESULTS

The mean age at transplantation was 43.1±12.7 years (range: 17-76 years), with the majority of patients falling within the 30-49 years age group (56.4%). There is a marked male predominance of 83.9% (52 males) and 16.1% (10 females), representing a male-to-female ratio of 5.2:1. The study showed more patients underwent living donor transplantation at 75.8% (n=47), with deceased donor transplants comprising 24.2% (n=15).

Table 1: Baseline characteristics of kidney transplant recipients (n=62).

Variables	Value N (%)
Mean age (years)	43.1±12.7
Male sex	52 (83.9)
Female sex	10 (16.1)
Living donor transplant	47 (75.8)
Deceased donor transplant	15 (24.2)
Hypertension	59 (95.2)
Diabetes mellitus	14 (22.6)
Post-transplant diabetes mellitus	7 (11.3)
Ischemic heart disease	5 (8.1)
Chronic interstitial nephritis	22 (35.5)
Chronic glomerulonephritis	18 (29.0)
IgA nephropathy	4 (6.5)
ADPKD	2 (3.2)
Other native kidney diseases	16 (25.8)

In this study hypertension was the most prevalent comorbidity, present in 95.2% of patients. Diabetes mellitus was seen in 22.6%, while post-transplant diabetes

mellitus (PTDM) occurred in 11.3% of the cohort. Ischemic heart disease was present in 8.1%. Chronic interstitial nephritis was found to be the leading cause of end-stage kidney disease at 36% (n=22), followed by chronic glomerulonephritis at 29% (n=18). The remaining cases include IgA nephropathy 6%(n=4), ADPKD 3% (n=2) and others comprising 26% of the cohort.

Table 2: Spectrum of infectious complications.

Infections	Number	Percentage
Urinary tract infection	27	32.1
Lower respiratory tract infection	22	26.2
Tuberculosis	9	10.7
COVID-19 pneumonia	7	8.3
Acute gastroenteritis	6	7.1
CMV infection	4	4.8
Fungal meningitis	3	3.6
Herpes simplex infection	2	2.4
Oropharyngeal candidiasis	2	2.4
Pyogenic meningitis	1	1.2
Hepatitis B infection	1	1.2
Hepatitis C infection	1	1.2

77.4% of patients (n=48/62) developed at least one infection during post-transplant period. Among the 84 infectious episodes observed, urinary tract infections were the most common, accounting for 32.1% of all infections, followed by lower respiratory tract infections (26.2%). Tuberculosis contributed to 10.7% of cases, while COVID-19 pneumonia constituted 8.3%. Acute gastroenteritis (7.1%), fungal meningitis (3.6%), CMV infection (4.76%), and oropharyngeal candidiasis (2.4%) were less frequent. Herpes simplex infection (2.4%), pyogenic meningitis (1.2%), hepatitis C infection (1.2%), and hepatitis B infection (1.2%) represented remaining infectious complications in this cohort.

Table 3: Microbiological profile of urinary tract infections.

Variables	Value (%)
Total TB cases	9
Prevalence	14.5%
Pulmonary TB	4 (44.4)
Extra pulmonary TB	5 (55.6)
Abdominal TB	2 (40)
Genitourinary TB	2 (40)
CNS TB	1 (20)

Among the patients with microbiologically confirmed urinary tract infections, *Escherichia coli* was the predominant pathogen, accounting for 50% of cases. *Klebsiella* species was the second most common (23.9%), followed by *Proteus mirabilis* and *Pseudomonas* (each 8.7%). Less frequent isolates included Acinetobacter, *Enterococcus*, and non-albicans *Candida*, each contributing to approximately 2.2% of cases.

Table 4: Clinical characteristics of post-transplant tuberculosis (n=9).

Variables	Value (%)
Total TB cases	9
Prevalence	14.5%
Pulmonary TB	4 (44.4)
Extra pulmonary TB	5 (55.6)
Abdominal TB	2 (40)
Genitourinary TB	2 (40)
CNS TB	1 (20)

In this study tuberculosis was found in 9 cases with a prevalence of 14.5%. Extra pulmonary tuberculosis was predominant affecting 5 patients (56%) and pulmonary tuberculosis in 4 patients (44%). Of the extra pulmonary Tuberculosis patient's abdominal tuberculosis and genitourinary tuberculosis were seen in 40% each (n=2) and CNS tuberculosis seen in 20% patients (n=1).

Table 5: Timing of TB after transplantation.

Time after transplant	N
<2 months	1
2-6 months	1
6-12 months	1
1-2 years	3
2-3 years	2
>5 years	1

Three patients (n=3, 33%) were detected tuberculosis within 1 year post kidney transplant and another 3 patients were detected between 1-2 years. Two patients (n=2, 22%) were detected between 2-3 years. And one patient was diagnosed with tuberculosis 18 years after transplant.

Table 6: Risk factors associated with post-transplant tuberculosis.

Risk FACTORS	OR (95% CI)	P value
Age >50 years	0.57 (0.11-2.88)	0.55
Male sex	1.45 (0.17-12.7)	0.72
Low socioeconomic status	18.67 (2.75-126)	0.002
Diabetes mellitus	0.80 (0.15-4.18)	1.00
Post-transplant diabetes mellitus	2.83 (0.47-16.9)	0.27
CMV infection	2.08 (0.33-19.7)	0.40
Chronic allograft nephropathy	4.74 (1.22-18.3)	0.04
Fungal infection	5.11 (0.76-34.4)	0.10

On univariate analysis, low socioeconomic status and chronic allograft nephropathy were found to be significantly associated with the development of post-

transplant TB. Recipients with low socioeconomic status had a markedly higher risk of acquiring TB (OR 18.67, 95% CI 2.75-126; p=0.002). Similarly, the presence of chronic allograft nephropathy was also associated with increased odds of developing post-transplant TB (OR 4.74, 95% CI 1.22-18.3; p=0.04). Other variables age >50 years, male sex, diabetes mellitus, post-transplant diabetes, CMV infection and fungal infection are present in TB patients but did not show a statistically significant association with TB in this cohort, although some factors such as fungal infections (OR 5.11; p=0.10) and CMV infection (OR 2.08; p=0.40) demonstrated a trend toward higher risk but did not reach statistical significance, likely due to small event numbers.

Table 7: Graft outcomes.

Outcome	N (%)
Normal graft function	32 (51.6)
Chronic graft dysfunction	19 (30.6)
Acute graft dysfunction	9 (14.5)
Graft failure requiring dialysis	6 (9.6)

Assessment of graft function among the kidney allograft recipients revealed that normal graft function was maintained in 32 patients (51.6%). Chronic graft dysfunction was seen in 19 patients (30.6%), while acute graft dysfunction occurred in 9 patients (14.5%). Dialysis was re-initiated in 6 patients (9.6%).

Table 8: Patient survival.

Outcome	N (%)
Alive	44 (71.0)
Expired	18 (29.0)

Of kidney allograft recipients included in the study,44 patients (71.0%) were alive at last follow-up, while 18 patients (29.0%) had expired.

Table 9: Causes of death.

Cause	N (%)
LRTI with sepsis	8 (44.4)
Tuberculosis	5 (27.8)
UTI with sepsis	3 (16.7)
Fungal meningitis	2 (11.1)

Among the kidney allograft recipients 18 patients (29.0%) died during the follow-up period. The leading cause of death was pneumonia with sepsis, accounting for 8 patients (44.4% of deaths). Tuberculosis was responsible for 5 deaths (27.8%), while urinary tract infection (UTI) with sepsis contributed to 3 deaths (16.7%). Fungal meningitis was documented in 2 patients (11.1%). However, causal overlap was seen in few patients.

Out of 9 patients who developed TB, 8 patients expired, with mortality rate of 89%. All patients were found to have hypertension (100%). 2 patients (22.2%) had diabetes mellitus. Post-transplant diabetes was documented in 2 patients (22.2% each). Among patients who developed chronic graft dysfunction, tuberculosis was seen in 5 patients (55.6%).

Table 10: Outcomes of patients with tuberculosis.

Variables	N (%)
Alive	1 (11.1)
Expired	8 (88.9)
Chronic graft dysfunction among TB patients	5 (55.6)
Hypertension	9 (100)
Diabetes mellitus	2 (22.2)
Post-transplant diabetes mellitus	2 (22.2)

DISCUSSION

The present study evaluated infectious complications among kidney transplant recipients from a tertiary care centre in Western India and demonstrated that infections remain a major determinant of post-transplant morbidity and mortality.

The overall infection rate in the present study was 77.4%, highlighting the substantial infectious burden among kidney transplant recipients. Similar high infection rates have been reported in Indian studies owing to environmental exposure, endemic infections, and prolonged immunosuppression.[20,21]

Urinary tract infection emerged as the most frequent infectious complication, accounting for 32.1% of all infectious episodes. *Escherichia coli* was the predominant pathogen, followed by *Klebsiella* species. These findings are consistent with previous transplant literature identifying urinary tract infections as the commonest bacterial infection after kidney transplantation.[14-17]

Tuberculosis was identified in 14.5% of recipients, which remains substantially higher than rates reported in Western countries.[9,10] Extrapulmonary disease predominated, reflecting the altered immune response in transplant recipients. The predominance of abdominal and genitourinary tuberculosis further emphasizes the need for a high index of suspicion when evaluating unexplained constitutional symptoms in transplant recipients.[6,7]

An important finding of this study was the exceptionally high mortality among recipients who developed tuberculosis. Nearly 89% of affected patients died during follow-up. Previous Indian studies have also reported tuberculosis-associated mortality rates significantly higher than those observed in the general population, although the mortality observed in our cohort was considerably greater.[7,8]

Low socioeconomic status emerged as the strongest predictor of post-transplant tuberculosis, while chronic allograft nephropathy was also significantly associated with disease development. These findings suggest that both environmental exposure and chronic immune dysregulation contribute to tuberculosis risk. Similar observations have been reported in previous transplant studies from tuberculosis-endemic regions.[7,9]

Chronic graft dysfunction was observed in nearly one-third of recipients. Furthermore, tuberculosis was present in over one-fourth of patients with chronic graft dysfunction, supporting a possible association between chronic infection and adverse graft outcomes. Previous studies have shown that infectious complications adversely affect both graft survival and long-term patient outcomes.[22]

CMV infection was observed in a smaller proportion of recipients; however, its occurrence remains clinically relevant because CMV has been shown to increase susceptibility to secondary opportunistic infections and allograft dysfunction.[18,19]

Overall mortality was 29%, with lower respiratory tract infection-associated sepsis representing the leading cause of death. These findings emphasize the continued importance of infection prevention, early diagnosis, and prompt treatment in kidney transplant recipients. Respiratory infections continue to account for a substantial proportion of infection-related deaths in transplant populations worldwide.[23]

The findings of this study reinforce the importance of comprehensive infection surveillance programs, tuberculosis screening strategies, vaccination, antimicrobial prophylaxis, and early intervention in kidney transplant recipients living in high tuberculosis burden settings.[11,24,25]

This study has certain limitations that should be considered while interpreting the findings. Being a single-center study conducted at a tertiary care referral hospital, the results may not be fully generalizable to other transplant populations. The relatively small sample size may have limited the statistical power to detect additional risk factors associated with post-transplant infections and tuberculosis. Furthermore, the ambispective study design included both retrospective and prospective data collection, which may have introduced information bias due to incomplete documentation in some retrospective records. Owing to the limited number of tuberculosis events, multivariate analysis could not be performed to identify independent predictors of post-transplant tuberculosis. Despite these limitations, the study provides valuable insights into the epidemiology of infectious complications and the burden of tuberculosis among kidney transplant recipients from Western India, a region where published data remain scarce.

CONCLUSION

Infectious complications remain highly prevalent among kidney transplant recipients in western India. Urinary tract infection and lower respiratory tract infection constitute the predominant infectious burden. Tuberculosis continues to represent a major opportunistic infection and is associated with significant graft dysfunction and exceptionally high mortality. Enhanced screening, vigilant surveillance, and timely management of infectious complications are essential to improve patient and graft outcomes.

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