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Urinary Tract Infections in Kidney Transplant Patients Admitted to Hospital: A Real-Life Experience

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Abstract: Urinary tract infections in kidney transplant patients are a real challenge. We conducted a retrospective observational study, enrolling all kidney transplant patients hospitalized for urinary tract infection (UTI), with the objective to evaluate the epidemiology, clinical status, therapeutic management, and clinical outcome of kidney transplant patients hospitalized for urinary tract infection in a university hospital. From our real-life experience, infection with multidrug-resistant germs was confirmed as a risk factor for the severe evolution of the infection and at the same time the re-evaluation of immunosuppressive therapy could be an important therapeutic strategy in the course of infection. Prompt initiation of empiric antibiotic therapy upon initiation of microbiological investigations could potentially reduce the risk of severe infection progression.

Keywords: urinary tract infections; kidney transplant; MDR; SOT; empiric therapy

1. Introduction

Urinary tract infections are one of the main complications in patients who have received a kidney transplantation (1,2). In fact, it is estimated that 75% of kidney transplant recipients experience at least one episode of urinary tract infection (3,4), and about 27% experience recurring episodes (5). Moreover, urinary tract infections are a risk factor for unfavorable graft evolution, with a negative impact on kidney function over time (6-8). Additionally, in recent years, the complexity of urinary tract infections in the setting of kidney transplant patients has increased due to the frequent isolation of multidrug-resistant germs (MDRs) (9). More and more data are emerging regarding the increasing prevalence of ESBL (Extended Spectrum Beta-Lactamases) strains and carbapenem-resistant Enterobacteriaceae, not to mention the emerging finding of MBL(Metallo- Beta-Lactamase) - producing strains (10 - 13). In particular, the detection of Enterobacteriaceae (Escherichia coli and Klebsiella pneumoniae) ESBL is increasingly frequent in kidney transplant patients, with the consequent difficulty and probability of empiric therapy that is sometimes insufficient. In addition, cases of carbapenemic-resistant gram negatives are also increasing, resulting in the need for specific treatment choices. In addition, due to the selective pressure of different antibiotic therapies, this category of patients may experience colonization and the risk of consequent infections by metallo- β-lactamase-producing germs. In particular, although at the moment these are limited cases, cases of urinary tract infection by Enterobacteriaceae VIM (Verona Integron - Encoded Metallo – Beta - Lactamase) and NDM (New Delhi metallo – β - lactamase)-producing are beginning to be observed in kidney transplant recipients (10 – 13). Moreover, in addition to gram-negative microorganisms, an

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increasingly important role in urinary tract infections in kidney transplant patients is assumed by Enterococci, in particular by Enterococcus faecalis and especially by Enterococcus faecium. In fact, the latter often has a susceptibility profile with resistance to ampicillin, but above all more and more species of Enterococcus faecium with a R to vancomycin susceptibility profile are observed (VRE - Vancomycin Resistant Enterococcus). The role of these MDR mcroorganisms is becoming increasingly relevant in the context of urinary tract infections of kidney transplant patients, both from an epidemiological point of view and from the point of view of therapeutic management with increased risk of mortality and graft loss for the patient (9 – 13).

These awarenesses are fundamental prerogatives for the correct management of the infection and explain the importance of having to start a complete and timely diagnostic process in the face of a suspicion of urinary tract infection in the kidney transplant patient.

The objective of our study was to evaluate the epidemiology, clinical status, therapeutic management, and clinical outcome of kidney transplant patients hospitalized for urinary tract infection in a university hospital.

2. Materials and Methods

We conducted a retrospective observational study, enrolling all kidney transplant patients hospitalized for urinary tract infection (UTI) at the A.O.U. Federico II in Naples from January to December 2023. In particular, we enrolled all kidney transplant patients hospitalized for urinary tract infection naïve to antibiotic therapy before admission to the hospital and before the start of diagnostic-microbiological investigations. Patients receiving secondary prophylaxis for urinary tract infection were excluded. All enrolled patients met the diagnosis of urinary tract infection, according to the guidelines of the Infectious Diseases Society of America (IDSA). UTIs are defined as the presence of bacteriuria with signs of infection that may manifest with mild symptoms as inflammation of the lower urinary tract or acute graft pyelonephritis (AGPN) (14-16).

All patients underwent urine testing and urine culture before starting antibiotic therapy. Blood cultures were obtained prior to antibiotic administration in case of body temperature ≥ 37.3°C or chills. After these diagnostic procedures, empiric antibiotic therapy with piperacillin/tazobactam, at a dose adjusted according to each patient's baseline renal function, was initiated. This empiric therapy was continued until the identification of the causative organism, at which point targeted antibiotic therapy was established. Clinical recovery was defined as clinical-laboratory response with resolution of the clinical symptoms present at the time of hospitalization and with normal CRP (C reactive protein).

Moreover, we assessed the rate of severe evolution of the infection during hospitalization and prolonged hospitalization. Severe evolution of the infection during hospitalization was defined as patients who developed sepsis during hospitalization, defining this condition based on the SOFA score criteria. In particular, it meant a patient with an increase in SOFA score with a value ≥ 2 compared to baseline (17). Prolonged hospitalization was defined as the need for the patient to remain hospitalized for more than 14 days. MDR (Multi-Drug Resistance) was defined as antimicrobial resistance shown by a species of microorganism to at least one antimicrobial drug in three or more antimicrobial categories (18).

We considered the previous events as dependent variables and the following (defined a priori) as independent variables: age > 60 years, presence of comorbidities (obesity, type 2 diabetes mellitus, cardiovascular disease), type of immunosuppression (triple vs dual immunosuppressive therapy), history of bacterial colonization of the urinary tract, history of recent episodes of UTI (in the last six months), MDR germ infection or colonization in the last 6 months, use of empiric therapy, appropriate empiric therapy, in relation to the timing between the onset of urinary symptoms and hospitalization (with a threshold of 3 days), and in relation to the timing between hospitalization and the start of empiric antibiotic therapy (with a threshold of 2 days).

Data are presented as mean and SD or median and interquartile range (IQR), in case of Gaussian or non-Gaussian distribution, respectively. For correlation analysis, Pearson or Spearman tests were used for data distributed in Gaussian or non - Gaussian fashion, respectively. Continuous variables

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were compared by Student's t-test or Mann - Whitney U - Test, as parametric or non-parametric test, respectively. The p - value for statistical significance was set at < 0.05 for all tests. A logistic regression model was employed to evaluate risk factors for severe infection progression and clinical recovery.

With respect to the ethical issues, the study was conducted in accordance with ethical principles originating from the Declaration of Helsinki and good clinical practice. The authors confirm that the ethical policies of the journal have been observed.

3. Results

In the year 2023, about 700 kidney transplant patients were in follow-up at the A.O.U. Federico II in Naples. Of these, approximately 200 required hospitalization for infections, and 52 received a diagnosis of UTI. Among the 52 cases, only 31 were antibiotic-naïve at the time of urine culture, making them eligible for our study.

Table 1 presents the characteristics of the enrolled patients, while Table 2 provides details on the characteristics of the identified urinary tract infections, including the corresponding microbiological etiological agents, treatments, and clinical outcomes.

Table 1. Characteristics of enrolled patients.

Age (median, IQR)		56 (37-72)
Gender		
	M	16 (52%)
	F	15 (48%)
Comorbidities:		
	Hypertension	27 (87%)
	Obesity	15 (48%)
	Type II diabetes mellitus	4 (13%)
	Cardiovascular disease	2 (6%)
	Hypothyroidism	2 (6%)
	COPD	1 (3%)
Type of transplant		
	Kidney transplant	30 (97%)
	Kidney - pancreas transplant	1 (3%)
Indication for the transplant		
	Chronic Renal Failure	13 (42%)
	ADPKD	8 (27%)
	Systemic Lupus Erythematosus	3 (10%)
	IgA nephropathy	2 (6%)
	VUR	2 (6%)
	Hypertensive nephropathy	2 (6%)
	Diabetic nephropathy	1 (3%)
Induction Immunosuppressive therapy		
	Basiliximab + Methylprednisolone	31 (100%)
Immunosuppressive therapy at diagnosis		
	Tacrolimus – Mycophenolate -Steroids	16 (52%)
	Tacrolimus – Everolimus - Steroids	3 (10%)
	Cyclosporine – Mycophenolate - Steroids	1 (3%)
	Cyclosporine – Everolimus - Steroids	1 (3%)
	Tacrolimus - Steroids	6 (20%)
	Cyclosporine - Steroids	4 (12%)
Time from transplant (months), mean (IQR)		49 (2 - 312)
	TOE	T1
WBC (cell/μL; median, IQR)	14,220 (4,380 - 21,740)	9,885 (3,760 - 15,920)
PLT (cell/μL; median, IQR)	379,000 (68,000 - 512,000)	274,000 (83,000-492,000)

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Creatinine (mg/dl; median, IQR)	2.2 (1.5 - 4.7)	1.9 (1.4 - 3.5)
Bilirubin (mg/dl; median, IQR)	1.4 (0.9 - 2.9)	1.1 (0.7 - 2.3)
CRP (mg/L; median, IQR)	55 (9 - 130)	29 (4 - 68)

IQR: InterQuartile Range, COPD: Chronic Obstructive Pulmonary Disease, ADPKD: Autosomal Dominant Polycystic Kidney Disease, VUR: Vesicoureteral Reflux, TOE: time of enrolment, T1: time of 4 days post - therapy, PLT: Platelets, CRP: C - Reactive Protein.

In particular, a median age (IQR - Inter Quartile Range, median) of 56 (37-72) was observed, with 52% of enrolled patients being male. The majority of enrolled patients had a history of hypertension (87%) and obesity (48%). All patients were kidney transplant recipients (97%), except for one kidney transplant pancreas transplant recipient (3%). Regarding immunosuppressive therapy, the majority of enrolled patients practiced immunosuppressive therapy with Tacrolimus - Mycophenolate - Steroids (52%), while 20% practiced immunosuppressive therapy with Tacrolimus – Steroids. 12% of enrolled patients were on immunosuppressive therapy with Cyclosporine - Steroids, while 10% were on immunosuppressive therapy with Tacrolimus – Everolimus - Steroids. Solid organ transplant patients had a median (IQR) of time since transplantation in months of 49 (2 – 312).

Table 2. Characteristics of Urinary Tract Infections (UTIs).

Urinary Tract Infections (UTIs)	cUTIs	*22 (71%)*		
	cUTIs and bacteraemia	*5 (16%)*		
	Urosepsis	*4 (13%)*		
Microbiological agents isolated*			***Targeted antibiotic therapy***	
	*Escherichia coli ESBL***	*10 (32%)*	*Meropenem*	*6 (19%)*
			Ertapenem	*4 (13%)*
	*Klebsiella pneumoniae ESBL***	*6 (19%)*	*Meropenem*	*4 (13%)*
			Ertapenem	*2 (6%)*
	Pseudomonas aeruginosa MDR	*4 (13%)*	*Meropenem*	*4 (13%)*
	Klebsiella pneumoniae no - ESBL	*2 (7%)*	*Piperacillin / Tazobactam*	*2 (7%)*
	Enterococcus faecium VRE	*2 (7%)*	*Daptomycin*	*2 (7%)*
	Enterococcus faecium Ampi - S	*2 (7%)*	*Piperacillin / Tazobactam*	*1 (3%)*
			Amoxicillin / clavulanate	*1 (3%)*
	Klebsiella pneumoniae CRE	*1 (3%)*	*Ceftazidime / avibactam*	*1 (3%)*
	Escherichia coli no - ESBL	*1 (3%)*	*Piperacillin / Tazobactam*	*1 (3%)*
	Pseudomonas aeruginosa no - MDR	*1 (3%)*	*Ciprofloxacin*	*1 (3%)*
	Proteus mirabilis ESBL	*1 (3%)*	*Meropenem*	*1 (3%)*
	Citrobacter farmeri ESBL	*1(3%)*	*Meropenem*	*1 (3%)*
Overall targeted antibiotic therapy	*Meropenem*	*15 (48%)*		
	Ertapenem	*7 (23%)*		
	Piperacillin / Tazobactam	*4 (13%)*		
	Daptomycin	*2 (7%)*		
	Ciprofloxacin	*1 (3%)*		
	Amoxicillin / clavulanate	*1 (3%)*		
	Ceftazidime / avibactam	*1 (3%)*		
Duration of targeted therapy in days (median, IQR)		*14 (7-18)*		
Length of stay in days (median, IQR)		*15 (8-20)*		
Outcome	*Alive*	*31 (100%)*		

cUTIs: complicated Urinary Tract Infections, ESBL: Extended - Spectrum β - Lactamase, MDR: MultiDrug Resistance, VRE: Vancomycin - Resistant Enterococci, Ampi - S: ampicillin - Sensitive, CRE: Carbapenem -

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Resistant Enterobacterales, IQR: InterQuartile Range. * isolated from urine culture, ** also isolated from blood cultures (3 Escherichia coli ESBL, 2 Klebsiella pneumoniae ESBL).

It is noteworthy that of the 31 patients enrolled, 26 (84%) had a history of urinary tract colonization in the post-transplant period, while 22 (71%) had experienced at least one past episode of urinary tract infection in the post-transplant period. Among these patients, 15 (68%) had their last episode more than six months earlier, while 7 (32%) had experienced the last episode of urinary tract infection within the last six months. We observed a prevalence of urinary tract infections of about 15%, with approximately 64% being due to MDR germs.

In particular, a higher prevalence of Enterobacteriacaee ESBL was observed, in particular Escherichia coli ESBL was observed in 32% of cases and Klebsiella pneumoniae ESBL in 19%. Several cases of Pseudomonas aeruginosa MDR (13%), Klebsiella pneumoniae no - ESBL (7%), Enterococcus faecium VRE (7%) and Enterococcus faecium Ampi - S (7%) were observed. Less frequently were cases of Klebsiella pneumoniae CRE (3%), Escherichia coli no - ESBL (3%), Pseudomonas aeruginosa no - MDR (3%), Proteus mirabilis ESBL (3%) and Citrobacter farmers ESBL (3%).

Among the enrolled patients, 16% had bacteremia, while 13% experienced sepsis; however, none developed septic shock (Table 2).

The median time interval in days between the onset of urinary tract infection-related symptoms and hospitalization was approximately 2 days (IQR, 1 - 4), while the median time interval in days between the onset of urinary tract infection-related symptoms and the initiation of empiric antibiotic therapy was 3 days (IQR, 1 - 4).

Regarding targeted antibiotic therapy, the majority practiced targeted antibiotic therapy with carbapenemic, in particular 48% of patients practiced empirical antibiotic therapy with Meropenem, while 23% practiced antibiotic therapy with Ertapenem. Only 13% practiced targeted antibiotic therapy with Piperacillin/Tazobactam, while 7% practiced targeted antibiotic therapy with Daptomycin. While Ciprofloxacin, Amoxicillin / clavulanate, Ceftazidime / avibactam were used in 3% of targeted antibiotic therapy, respectively. There was a median (IQR) duration in days of targeted antibiotic therapy of 14 (7 - 18), while a median (IQR) duration in days of hospitalization was observed of 15 (8 – 20)

No patients died during the study period.

In univariate analysis for the risk of severe evolution of the infection, we found that triple immunosuppressive therapy (OR: 1.8, 95% CI: 1.2 – 1.9, p-value: 0.048), infection caused by MDR germs (OR: 1.5, 95% CI: 1.1 – 1.8, p-value: 0.044), and initiation of empiric antibiotic therapy more than two days after hospitalization (OR: 1.5, 95% CI: 1.1 – 1.7, p-value: 0.047) were significant risk factors (Table 3). While obesity BMI > 30Kg / m^2 (OR: 1.6, 95% CI: 0.9 – 1.9, p-value: 0.082), appropriate empiric therapy (OR: 0.9, 95% CI: 0.7 – 1.1, p-value: 0.084) and the timing between onset of symptoms and hospitalization (> 3 days) (OR: 1.3, 95% CI: 0.9 – 1.8, p-value: 0.093) showed a trend as potential risk factors severe evolution of the infection (Table 3). Instead, age > 60 (OR: 1.1, 95% CI: 0.6 – 1.4, p-value: 0.126), male sex (OR: 1.3, 95% CI: 0.7 – 1.6, p-value: 0.235), cardiovascular disease (OR: 1.3, 95% CI: 0.7 – 1.5, p-value: 0.164), diabetes mellitus (OR: 1.5, 95% CI: 0.7 – 1.7, p-value: 0.143), history of bacterial colonization (OR: 1.3, 95% CI: 0.8 – 1.5, p-value: 0.174) and UTIs in the last six months (OR: 1.1, 95% CI: 0.6 – 1.3, p-value: 0.133) were not found to be risk factors for a severe evolution of the infection (Table 3).

Table 3. Univariate analysis for severe evolution of infection.

	OR	**95% CI**	***p-value***
Age > 60	1.1	0.6 - 1.4	0.126
Male sex	1.3	0.7 - 1.6	0.235
Comorbidity			
Obesity BMI > 30Kg / m^2	1.6	0.9 - 1.9	*0.082*
Cardiovascular disease	1.3	0.7 - 1.5	0.164
Diabetes mellitus	1.5	0.7 - 1.7	0.143

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Triple vs dual immunosuppressive therapy	1.8	1.2 - 1.9	*0.048*
History of bacterial colonization	1.3	0.8 - 1.5	0.174
UTIs in the last six months	1.1	0.6 - 1.3	0.133
MDR microorganism infection	1.5	1.1 - 1.8	*0.044*
Appropriate empiric therapy	0.9	0.7 - 1.1	*0.084*
Timing between onset of symptoms and hospitalization (> 3 days)	1.3	0.9 - 1.8	*0.093*
Timing of empiric therapy initiation from hospitalization (>2 days)	1.5	1.1 - 1.7	*0.047*

On univariate analysis for the risk of prolonged hospitalization, infection with MDR germs (OR: 1.7, 95% CI: 1.1 – 1.9, p-value: 0.047) and a delay of more than two days in the start of empiric therapy (OR: 1.6, 95% CI: 1.1 – 1.7, p-value: 0.042) emerged as risk factors, while targeted therapy was found to be a protective factor (OR: 0.8, 95% CI: 0.7 – 0.9, p-value: 0.048) (Table 4). While age > 60 years (OR: 1.4, 95% CI: 0.9 – 1.7, p-value: 0.091), appropriate empiric therapy (OR: 0.9, 95% CI: 0.7 – 1.1, p-value: 0.077) and the timing between onset of symptoms and hospitalization (> 3 days) (OR: 1.5, 95% CI: 0.9 – 1.6, p-value: 0.085) showed a trend as potential risk factors for prolonged hospital stay (Table 4). Instead, male sex (OR: 1.2, 95% CI: 0.7 – 1.6, p-value: 0.322), obesity BMI > 30 Kg / m^2 (OR: 1.6, 95% CI: 0.9 – 1.8, p-value: 0.186), cardiovascular disease (OR: 1.3, 95% CI: 0.8 – 1.5, p-value: 0.238), diabetes mellitus (OR: 1.4, 95% CI: 0.6 – 1.8, p-value: 0.215), triple vs dual immunosuppressive therapy (OR: 1.7, 95% CI: 0.9 – 1.9, p-value: 0-110), history of bacterial colonization (OR: 1.3, 95% CI: 0.7 – 1.4, p-value: 0.154) and UTIs in the last six months (OR: 1.4, 95% CI: 0.8 – 1.5, p-value: 0.123) were not found to be risk factors for the risk of prolonged hospitalization (Table 4).

Table 4. Univariate analysis for prolonged hospital stay.

	OR	**95% CI**	***p-value***
Age > 60	1.4	0.9 - 1.7	*0.091*
Male sex	1.2	0.7 - 1.6	0.322
Comorbidity			
Obesity BMI > 30 Kg / m^2	1.6	0.9 - 1.8	0.186
Cardiovascular disease	1.3	0.8 - 1.5	0.238
Diabetes mellitus	1.4	0.6 - 1.8	0.215
Triple vs dual immunosuppressive therapy	1.7	0.9 - 1.9	0.110
History of bacterial colonization	1.3	0.7 - 1.4	0.154
UTIs in the last six months	1.4	0.8 - 1.5	0.123
MDR microorganism infection	1.7	1.1 - 1.9	*0.047*
Appropriate empiric therapy	0.9	0.7 - 1.1	*0.077*
Timing between onset of symptoms and hospitalization (> 3 days)	1.5	0.9 - 1.6	*0.085*
Timing of empiric therapy initiation from hospitalization (> 2 days)	1.6	1.1 - 1.7	*0.042*

On multivariate analysis for the risk of severe infection progression, infection due to MDR strain (OR: 1.7, 95% CI: 1.2 – 1.8, p-value: 0.043), triple immunosuppressive therapy (OR: 1.6, 95% CI: 1.1 – 1.7, p-value: 0.046), and initiation of empiric antibiotic therapy more than two days after hospitalization (OR: 1.3, 95% CI: 1.1 - 1.6, p-value: 0.047) were found to be independent risk factors for deterioration (Table 5). While obesity BMI > 30Kg / m^2 (OR: 1.4, 95% CI: 0.9 – 1.6, p-value: 0.093), appropriate empiric therapy (OR: 0.9, 95% CI: 0.7 – 1.1, p-value: 0.083) and the timing between onset of symptoms and hospitalization (> 3 days) (OR: 1.5, 95% CI: 0.9 – 1.7, p-value: 0.092) showed a trend as potential risk factors for severe evolution of the infection (Table 5). Instead, age > 60 years (OR: 1.3, 95% CI: 0.7 – 1.5, p-value: 0.158), male sex (OR: 1.2, 95% CI: 0.8 – 1.3, p-value: 0.231), cardiovascular disease (OR: 1.3, 95% CI: 0.7 – 1.4, p-value: 0.334), diabetes mellitus (OR: 1.5, 95% CI: 0.7 – 1.8, p-value: 0.245), history of bacterial colonization (OR: 1.3, 95% CI: 0.8 – 1.5, p-value: 0.187) and UTIs in

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the last six months (OR: 1.4, 95% CI: 0.7 – 1.8, p-value: 0.132) were not found to be risk factors for a severe evolution of the infection.

Table 5. Multivariate regression analysis for severe evolution of infection.

	OR	95% CI	*p-value*
Age > 60	1.3	0.7 - 1.5	0.158
Male sex	1.2	0.8 - 1.3	0.231
Comorbidity			
Obesity BMI >30Kg/m²	1.4	0.9 - 1.6	*0.093*
Cardiovascular disease	1.3	0.7 - 1.4	0.334
Diabetes mellitus	1.5	0.7 - 1.8	0.245
Triple vs dual immunosuppressive therapy	1.6	1.1 - 1.7	*0.046*
History of bacterial colonization	1.3	0.8 - 1.5	0.187
UTIs in the last six months	1.4	0.7 - 1.8	0.132
MDR microorganism infection	1.7	1.2 - 1.8	*0.043*
Appropriate empiric therapy	0.9	0.7 - 1.1	*0.083*
Timing between onset of symptoms and hospitalization (> 3 days)	1.5	0.9 - 1.7	*0.092*
Timing of empiric therapy initiation from hospitalization (>2 days)	1.3	1.1 - 1.6	*0.047*

4. Discussion

Our study highlights the significant challenge posed by urinary tract infections in kidney transplant patients. In fact, the majority of patients (71%) in our study had experienced at least one episode of urinary tract infection in their medical history, and almost all (84%) had a history of urinary tract colonization.

Our data are comparable to what has been reported in the literature (19 - 21). Although we observed a similar prevalence of urinary tract infections (15% vs. 15 – 25%), our study showed a higher prevalence of MDR germ infections compared to other studies (64% vs. 15 - 40%) (19 - 22). The predominant role of Enterobacteriaceae in microbial etiology was confirmed, along with a similar prevalence of Enterobacteriaceae ESBL and an increasing number of MDR germs in our case (23).

The higher rate of MDR germs in our cohort compared to studies in the literature could be attributed to differences in study periods and geographical locations.

Interestingly, our study indicates that triple immunosuppressive therapy, infection caused by MDR germs, and a delay of more than two days from hospitalization to the initiation of empiric antibiotic therapy were significant risk factors for severe infection progression.

Regarding triple immunosuppressive therapy, our findings corroborate several studies that have highlighted its association with an increased risk of severe infections (24,25). For instance, Chuang P et al. demonstrated that triple immunosuppressive therapy, particularly in combination with azathioprine or mycophenolate, increased the risk of severe urinary tract infections (24). Similarly, Wu SW et al. showed that triple immunosuppressive therapy increased the risk of urosepsis (26). These findings underscore the importance of regularly reassessing and potentially reducing immunosuppressive therapy to mitigate infection risk.

Similarly, our study confirmed previous work showing that infection with MDR germs had an adverse impact on infection progression (27).

Another noteworthy finding was that a delay of more than two days in initiating empiric antibiotic therapy from hospitalization was a risk factor for severe infection progression, irrespective of whether appropriate empiric antibiotic therapy was initiated. This suggests the importance of promptly initiating empiric antibiotic therapy once microbiological investigations have commenced. In our case, the choice of initiating empirical therapy with piperacillin/tazobactam pending microbiological results was a prudent decision.

While obesity is a known potential risk factor for severe infection progression (28), we could not demonstrate a significant role for obesity in our study, possibly due to the small sample size.

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However, our study did highlight the significance of early hospitalization within three days of symptom onset to prevent severe infection progression.

Regarding prolonged hospitalization, infection with MDR germs and a delay of more than two days in initiating appropriate antibiotic therapy after hospitalization were identified as risk factors.

While our study provides valuable insights, we acknowledge its limitations, including the small sample size, lack of a control group, and retrospective, monocentric nature.

5. Conclusions

Our real-life experience underscores the ongoing challenge posed by urinary tract infections in kidney transplant patients. The escalating issue of antimicrobial resistance significantly impacts the management and outcome of infections in solid organ transplant recipients (SOTs). Additionally, the role of immunosuppressive therapy requires careful consideration, as timely therapeutic re-evaluation may mitigate infection risk.

Of particular interest is the approach to initiating antibiotic therapy empirically. Prompt initiation of empiric antibiotic therapy upon initiation of microbiological investigations could potentially reduce the risk of severe infection progression. These findings merit further exploration through additional studies and clinical trials.

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