



Evaluation of complications in kidney transplant patients: late versus early ureteral stent removal. A single-center observational study.

Paola Andrea Toapanta Armas ^{ID 1}, German Patricio Trujillo Salazar ^{ID 1, 2}, Ramiro Ivan López Pulles ^{ID 1}.

1. Department of Postgraduate Studies, Faculty of Medical Sciences, Universidad Central del Ecuador.

2. Kidney Transplant Service, Carlos Andrade Marín Specialty Hospital, Ecuadorian Institute of Social Security, Quito, Ecuador.

Abstract

Received: December 17, 2024.

Accepted: February 26, 2025.

Published: February 27, 2025.

Edited by Dr. Franklin Mora Bravo.

How to cite:

Toapanta P, Trujillo G, López R. Evaluation of complications in patients with kidney transplantation: late removal versus early removal of ureteral stenting. A single-center observational study. REV SEN 2025; 13(1):54-62.

DOI: <http://doi.org/10.56867/110>

Sociedad Ecuatoriana de Nefrología, Diálisis y Trasplantes.

ISSN-L: 2953-6448



Copyright 2025, Paola Andrea Toapanta Armas, German Patricio Trujillo Salazar, Ramiro Ivan López Pulles. This article is distributed under the [Creative Commons CC BY-NC-SA 4.0 Attribution License](https://creativecommons.org/licenses/by-nc-sa/4.0/), which allows the use and redistribution of the article, citing the source and the original author for noncommercial purposes.

Introduction: Improvements in surgical techniques for kidney transplant management have prolonged graft survival, but urological complications leading to postoperative morbidity and impaired graft function are common. These complications are related to using urinary tract devices, such as ureteral stents. This study aimed to characterize the infectious and surgical urological complications associated with early or late ureteral stent removal.

Methods: This observational study was conducted at the Carlos Andrade Marín Specialty Hospital in Quito, Ecuador, from 2018 to 2022. Kidney transplant patients with a 6-month follow-up were included. The variables studied were age, sex, cause of kidney disease, residual urine output, type of kidney transplant donor, infectious complications, and surgical complications. The dependent variable was late versus early ureteral stent removal. Descriptive and inferential statistics were used.

Results: A total of 231 patients were enrolled in the study: 139 (60.17%) with late withdrawal and 92 with early withdrawal (39.82%). Fifty-seven percent of patients were men; the mean age was 45.6 ± 14.1 years. The cause of kidney disease was unknown in 41.9% of the patients, followed by hypertensive nephropathy (14.7%), glomerulopathy (12.5%), and diabetic nephropathy (7.7%); 32.9% maintained residual urine output, late withdrawal (independent ureteral stent and urinary catheter) was performed in 60.17%, and early withdrawal (ureteral stent attached to the urinary catheter) was performed in 39.82%. Urinary tract infection occurred in 47% of patients with late removal and 42% with early removal ($P > 0.05$). *E. coli* was isolated in 46.15% of the cases, *Klebsiella pneumoniae* was isolated in 10.73%, and the pathogen was not identified in 33.8%. The prevalence of surgical urological complications with late removal was 26%, and that with early removal was 7%.

Conclusion: Infectious urological complications were similar between early and late removal, but surgical complications were more prevalent with late removal.

Keywords:

Infectious urological complications, Surgical urological complications, Early removal, Late removal.

* Corresponding author

Email: Paola Andrea Toapanta Armas <andre_zoe@hotmail.com>

Address: Research Directorate of the Central University of Ecuador (UCE). Jerónimo Leyton and Gatto Sobral, Edificio Azul, behind the Hospital del Día. Quito, Ecuador. Tel [593] 022 904 796.



The 5-year survival rate of patients who receive a kidney transplant, regardless of whether the donor is living or deceased, is more than double that of patients on dialysis [1]. Improvements in surgical technique and pharmacological treatment have continuously prolonged allograft survival in recent years; however, urological complications are frequently observed, leading to both postoperative morbidity and gradual deterioration of allograft function. Urinary tract infection is the most common infection in the posttransplant period [2, 3].

Routine prophylactic stenting reduces the incidence of major urologic complications and is recommended based on currently available randomized controlled trials. Stents are associated with specific complications, and experienced surgeons may adopt a selective stent policy, as opposed to the universal stent, to minimize the potential morbidity of stents [4].

It is unclear whether early removal of ureteral stents after kidney transplantation is associated with an increased risk of major urological complications and may reduce the incidence of urinary tract infection (UTI) in immunosuppressed patients [5]. Given that both early and late withdrawals are performed in kidney transplant patients from this center and that withdrawal time is associated with infections and surgical complications, this study is proposed in light of the need to establish their prevalence and probable related factors.

Urinary devices and their permanence are related to infectious and surgical urological complications. Although, according to the recommendations for living donor kidney transplantation published in 2022 by the Spanish Society of Nephrology, the urinary catheter removal will be carried out after five to seven days [6], the timing of posttransplant removal of ureteral stents is controversial. It may affect the incidence of urinary tract infections [7]. These devices are used separately in the surgical act; however, no data describe the union of the ureteral stent to the bladder catheter; therefore, their simultaneous, early removal and impact on urological complications.

Because the Hospital de Especialidades Carlos Andrade Marín is a regional reference center for kidney transplantation, where urinary stents are removed both early and late, due to the collaboration of several surgical transplant teams, the objective of the study was to conduct an observational study and compare postoperative, infectious, and surgical urological complications.

Materials and methods

Study design

The present study is observational. The source is retrospective.

Stage

This study was carried out in the kidney transplant service of the Carlos Andrade Marín Specialty Hospital of the Ecuadorian Institute of

Social Security in Quito, Ecuador. The study period was from January 1, 2018, to December 31, 2022.

Participants

Patients of legal age who underwent renal transplantation from either a deceased donor or a related living donor were included, as well as patients who were followed for six months after kidney transplantation. Records were not excluded.

Variables

The variables studied included age, sex, cause of kidney disease, residual diuresis, type of kidney transplant donor, infectious complications, surgical complications, time of ureteral stent removal, and the postsurgical period. The dependent variable was the comparison between late removal and early removal of the ureteral stent.

Data sources/measurements

The source was indirect; an electronic form was filled out using data from the institutional medical records. In our research, we defined early removal as joining the ureteral stent to the bladder catheter (technique in Railroad, used in the Renal Transplantation Unit of the Carlos Andrade Marín Specialty Hospital). This involved the simultaneous removal of these two devices seven days after transplantation without requiring urological intervention with a cystoscope. We referred to late removal in cases where a bladder catheter was placed independently of the ureteral stent, with the latter being removed at 21 days post-transplantation, requiring a cystoscope. We refer to "early withdrawal" and "late withdrawal" in the wording for practical purposes. We considered urinary tract infections the presence of > 105 colony-forming units per milliliter (CFU/ml) in the urine culture or infectious characteristics with or without urinary symptoms. Preserving residual diuresis corresponds to diuresis greater than 100 ml/day.

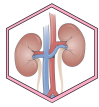
In addition, we defined an immediate complication as occurring up to the first 7 days after transplantation, early as occurring from 1 week to 3 months, and late as occurring within 3 months following transplantation.

Biases

Observation and selection bias were avoided by applying the participant selection criteria. To prevent possible interviewer, information, and memory biases, the principal investigator maintained the data at all times using a guide and records approved in the research protocol. Two researchers independently analyzed each record in duplicate, and the variables were recorded in the database once they reached an agreement verified.

Study size

The sample was probabilistic. The transplant rate in Ecuador is 10.8 transplants per million inhabitants annually. With a population of



17,980,000 in Ecuador for the year 2023, this projects a total of 899 transplants over 5 years. The expected frequency of transplants for the ABPM study referral center within the outpatient population is 25%, with a confidence limit of 5% and a confidence level of 95%, resulting in a sample size of 219 cases.

Quantitative variables

Descriptive statistics were employed. The results are presented as frequencies and percentages. Scale variables were not transformed into categorical variables.

Statistical analysis

The qualitative variables were analyzed using frequencies and percentages. The proportions were compared using the chi-square test. The statistical package employed was IBM Corp. (released from 2018) IBM SPSS Statistics for Windows, Version 26.0, Armonk, NY: IBM Corp.

Results

Participants

A total of 231 patients were included in the study: 139 (60.17%) experienced late withdrawal, while 92 had early withdrawal (39.82%).

Main characteristics of the study group

The characteristics of the study group are presented in [Table 1](#). The mean age of the population was 45.6 ± 14.1 years. The presence of residual diuresis was more common in the early withdrawal group (50% versus 21.3%) ([Table 1](#)). There were also more women in the early withdrawal group (54.34% versus 35.25%). There were no differences in the types of cadaveric donors compared to related living donors. In terms of etiology, there were more patients with diabetic nephropathy in the late withdrawal group (10.7%) than in the early withdrawal group (3.36%) ($P = 0.03$). In the early withdrawal group, the prevalence of women with systemic lupus erythematosus was higher at 10.8% versus 2.87% ($P = 0.01$).

Main results

There were no significant differences in the incidence of infectious complications between the two groups. The prevalence of bacteria is presented in [Table 2](#). Surgical complications were lower in the early withdrawal group (7%) than in the late withdrawal ([Table 2](#)). Specifically, there were no differences in specific types of complications between the late- or early-withdrawal groups ([Table 3](#)).

With late withdrawal, urinary tract infection was reported immediately in 22% ($n = 14$), early in 46% ($n = 30$), and late in 32%. In contrast, early withdrawal was reported immediately in 41% ($n = 16$), early in 36% ($n = 14$), and late in 23% ($n = 10$) of patients. Patients who were withdrawn late presented with infectious complications, preserved residual diuresis in 23% ($n = 15$), and were anuric in 77% ($n = 50$), while those with early withdrawal preserved residual diuresis in 49% ($n = 19$) and were anuric in 51% ($n = 20$).

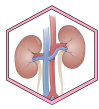
Table 1. Characteristics of the study group.

	With- drawal tardío n=139	Early with- drawal n = 92	P
Etiology			
Not affiliated	55 (39.5%)	42 (45.62%)	0.35
Hypertensive nephropathy	21 (15.1%)	13 (14.1%)	0.83
Glomerulopathy	22 (15.8%)	7 (7.6%)	0.06
Diabetic kidney disease	15 (10.7%)	3 (3.36%)	0.03
Systemic lupus erythematosus	4 (2.87%)	10 (10.8%)	0.01
Polycystic kidney disease	7 (5.0%)	2 (2.1%)	0.27
Congenital	4 (2.8%)	3 (3.2%)	0.86
Tubulointerstitial nephritis	5 (3.6%)	3 (3.2%)	0.89
Nonlithiasic obstructive	2 (1.4%)	2 (2.1%)	0.67
Nephrolithiasis	1 (0.7%)	2 (2.1%)	0.33
Preeclampsia	0 (0%)	2 (2.1%)	-
Vesicoureteral reflux	2 (1.43%)	0 (0%)	-
Vasculitis	0 (0%)	2 (2.1%)	-
Other	1 (0.7%)	1%	0.76
Residual diuresis, sex and type of donor			
Residual diuresis	30 (21.3%)	46 (50%)	0.006
Sex female	49 (35.25%)	50 (54.34%)	0.004
Cadaveric donor	126(90.6%)	85 (92.39%)	0.64

Table 2. Characteristics of the study group.

	With- drawal tardío n=139	Early with- drawal n = 92	P
Etiology			
Infectious complications	65 (47.0%)	39 (42.0%)	0.513
Surgical complications	36 (26.0%)	6 (7.0%)	0.001
Identified germ			
E coli multisensitive	16 (24.6%)	10 (25.64%)	0.90
E coli ESBL	14 (21.5%)	8 (20.51%)	0.97
<i>Klebsiella pneumoniae</i> multisensitive	4 (9.2%)	1 (2.56%)	0.68
<i>Klebsiella pneumoniae</i> ESBL	2 (4.6%)	1 (2.56%)	0.87
<i>Klebsiella pneumoniae</i> CRE	1 (1.53%)	1 (2.56%)	0.70
<i>Serratia marcescens</i> ESBL	1 (1.53%)	-	-
E cloacae complex ESBL	1 (1.53%)	-	-
<i>Enterococcus faecalis</i>	1 (1.53%)	-	-
<i>Proteus mirabilis</i> ESBL	1 (1.53%)	-	-
<i>Candida krusei</i>	1 (1.53%)	-	-
<i>Citrobacter freundii</i>	1 (1.53%)	-	-
Multisensitive <i>Staphylococcus capitis</i>	-	1 (2.56%)	-
<i>Staphylococcus epidermidis</i>	-	1 (2.56%)	-
<i>Lactobacillus</i> spp	-	1 (2.56%)	-
Unidentified	22 (33.8%)	15 (38.46%)	0.63
Sensitivity			
Sensitive	23 (53.5%)	14 (58.3%)	0.712
Resistant	20 (46.5%)	10 (41.6%)	0.712

Preservation of residual diuresis was significantly associated with the ureteral stent removal method and posttransplant infections ($P < 0.05$); thus, urinary tract infections were more frequent in anuric patients. In our sample, the prevalence of surgical urological



complications with late withdrawal was 26% ($n = 36$), whereas it was 7% ($n = 6$) with modified early withdrawal. The most common complication linked to late withdrawal was vesicoureteral reflux (38.8%, $n = 14$), followed by urinary fistula and urinoma (19.4%, $n = 7$) and stenosis (11.1%, $n = 4$). In contrast, with early withdrawal, no complication predominated. The relationships between these variables were not statistically significant ($P > 0.05$). Patients who experienced late withdrawal and presented with surgical complications maintained residual diuresis in 19% ($n = 7$) of cases. In comparison, those who experienced early withdrawal represented 33% ($n = 2$) of cases ($P = 0.44$), without a statistically significant association.

Table 3. Characteristics of the study group

Surgical complication	With- drawal tardío $n=139$	Early with- drawal $n =$ 92	P
Vesicoureteral reflux	14 (10.1%)	2 (2.2%)	0.79
Urinary fistula	7 (5.0%)	-	-
Urinoma	7 (5.0%)	2 (2.2%)	0.44
Stenosis	4 (2.9%)	1 (1.1%)	0.80
Pyelocalyceal dilation	2 (1.4%)	-	-
Lithiasis	2 (1.4%)	1 (1.1%)	0.32

Discussion

Kidney transplantation is the optimal replacement treatment for kidney function. In comparison to dialysis, it has been reported to yield better results regarding quality of life, survival rates, profitability, and economic productivity [8-11].

Recent advances in surgical protocols, monitoring, and immunosuppression have significantly improved overall outcomes during the first year post-transplantation. However, long-term results have not been substantially changed [12].

Medical complications, common after kidney transplantation, especially in the early postoperative period, must be addressed promptly to implement aggressive treatment, as delays can result in loss of kidney function, increased medical care costs, or unexpected patient deaths [13].

In the present study, the mean age of the reported population was 45.6 ± 14.1 years. Similar data were reported in a Korean study that described the epidemiology, risk factors, and clinical impact of early posttransplant infection in elderly kidney transplant recipients. In addition, 3081 patients were included, where the age was 45.53 ± 9.88 years [8], as was the value of 49.8 ± 15.1 years reported in an Argentine study with 375 patients with infections in the first year after transplantation [14], which is also comparable with that cited in a survey in Bratislava (Slovakia), where the mean age of its population was 47.5 ± 12.6 years [15], and with Arabi, Z in Saudi Arabia, 43.4 ± 15.8 years [16].

This research revealed that most cases corresponded to men (57%). In the previous Korean study, 58.2% of the cases were men, whereas 41.8% were women [8]. In the Argentine survey, 60.5% of the cases were male [14]. In the Bratislava study, 66% of the cases

were men [15], and in a study reported in Saudi Arabia that included 553 records of transplant patients, 62.4% were men [17,18]. This trend toward the male sex is likely related to lifestyle and the increased prevalence of cardiometabolic diseases in men.

Concerning the etiology of end-stage kidney disease, unknown causes were the most prevalent (41.9%), followed by hypertension (14.7%), glomerulopathies (12.5%), and diabetic kidney disease (7.7%), data that match local reports [19-23].

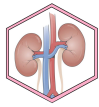
In this study, the prevalence of infectious urological complications with the surgical technique involving late removal of the ureteral stent was 47% ($n = 65$). In contrast, with early removal of the ureteral stent, it was 42% ($n = 39$), without a statistically significant association ($P = 0.513$).

Regarding urological surgical complications, the prevalence of late withdrawal in our sample was 26% ($n = 36$), with vesicoureteral reflux being the most common pathology (38.8%, $n = 14$). In contrast, the prevalence of early withdrawal was 7% ($n = 6$), with no specific pathology predominating, establishing a statistically significant association between these two variables ($P = 0.00185$, OR = 5). These results differ from those reported by Liu S, in a randomized, prospective, and double-blind trial that included 103 patients who underwent kidney transplantation from living donors and aimed to detect differences in urological complications between early removal of the ureteral stent (7 days) and routine removal of the ureteral stent at 4 weeks. Liu S reported that urinary tract infection occurred in 5.8% of patients in early removal compared to 29.4% of late removal patients, with $P = 0.002$ and an OR of 8.7 [7].

Regarding the difference in the incidence of urological complications reported in the present study, a Cochrane database review that included five randomized controlled studies (1125 patients, adults or children) mentioned above (Wilson, CH 2013) observed that the universal use of stents reduced the incidence of major urological complications, such as urinary leakage or fistula and ureteral stenosis, from 7-9% to 1.5%. Additionally, the incidence of UTI can be reduced in the early removal group (RR 0.49, 95% CI 0.30-0.81, $I^2 = 59\%$), but this was apparent only if a BI (permanent bladder) stent was used [1].

Wang conducted a meta-analysis involving seven studies with a total of 1277 patients, divided into two groups: early withdrawal at 2 weeks and late withdrawal at 3 weeks. The analysis revealed differences in the development of urinary tract infections, with a relative risk of 0.42 (95% CI, 0.26- 0.685; $P < 0.001$) favoring early withdrawal. However, concerning the incidence of major urological complications, no significant differences were found between early and late stent removal, with odds ratios at 2 and 3 weeks of 2.79 and 1.97, respectively ($P = 0.18$ and $P = 0.26$, respectively) [24].

Arabi, Z evaluated the impact of the timing of stent removal on the incidence of UTIs in kidney transplant recipients in a retrospective study conducted in Saudi Arabia, which included a total of 279 recipients: 114 in the early withdrawal group (< 3 weeks) and 165 in the late withdrawal group (> 3 weeks). A total of 17.5% of the patients experienced UTIs during early removal, whereas 32.7% had UTIs



during late removal. The early removal of the stent was associated with a statistically significant reduction in the incidence of stent-related UTIs ($P = 0.009$), without increasing the incidence of urological complications (early 0.36%, late 2.4%, $P = 0.272$ [25]. In addition, when the odds ratio of stent-related UTIs around the time of stent removal was compared, it was observed that stent removal before 21 days post-transplantation decreased the number of stent-related UTIs (OR: 0.403). Additionally, removing the stent before 14 days can further reduce the risk of UTI (OR: 0.311). The incidence of urological complications after kidney transplantation was low and did not significantly differ between the two groups (early $n = 1$, late $n = 5$) ($P = 0.272$) [25].

Cai, J et al. conducted a meta-analysis involving 568 kidney transplant patients from 5 randomized controlled studies. They reported that among the 261 patients with early withdrawal, 16.09% ($n = 42$) had UTIs, while in the group of 307 patients with late withdrawal, 34.85% ($n = 107$) experienced this infectious complication, with $P < 0.01$. Early withdrawal was defined as ≤ 7 days, and late withdrawal was defined as ≥ 14 days. In the same study, 4.98% ($n = 13$) of early-withdrawal patients and 2.61% ($n = 8$) of late-withdrawal patients showed MUCs (ureteral stenosis, obstruction, or leakage), with no statistically significant difference ($P > 0.05$). The researchers concluded that early removal can significantly reduce the incidence of UTIs but does not increase the incidence of surgical urological complications [25].

Regarding the preservation of residual diuresis, in the late withdrawal group that presented with infectious complications, 77% were anuric, and 51% were anuric during early withdrawal, showing a statistically significant association ($P = 0.006$). In contrast, for surgical complications, 81% and 67% of the patients in the late withdrawal group were anuric, which was not statistically significant ($P = 0.44$).

In the aforementioned retrospective study, Arabi Z, evaluated urinary tract infections in the first 6 months after kidney transplantation in a population of 279 patients, of whom the preservation of residual diuresis was determined in 171. A total of 23.7% ($n = 23$) were anuric ($P = 0.805$), so the authors concluded that the residual urine volume before transplantation was not associated with a higher incidence of UTIs [26].

The present study has weaknesses due to its observational nature and the limited number of cases. The patients included in the present study were adults under 50 years of age who were candidates for kidney transplantation. The proportion of patients from various Ecuadorian ethnicities in the general sample was 40%, which included Afro-Ecuadorians and indigenous peoples of the Sierra. Sixty percent of the population is considered mestizo or Hispanic. A large proportion of patients with unknown or unspecified etiology were included, and 15% of the patients were diabetic.

Conclusions

Infectious urological complications are similar to both early and late withdrawal; however, surgical complications are more prevalent with late withdrawal.

Abbreviations

ESBL: Extended-spectrum beta lactamase.

UTI: urinary tract infection.

Supplementary information

The supplementary materials have not been declared.

Acknowledgments

Does not apply.

Authors' contributions

Paola Andrea Toapanta Armas: Conceptualization, methodology, research, Writing - original draft.

German Patricio Trujillo Salazar: Conceptualization, Data curation, Project management, Supervision, validation, visualization, Writing - review and edition.

Ramiro Iván López Pulles: Formal analysis, Acquisition of funds, Methodology. All the authors read and approved the final version of the manuscript.

Financing

The authors self-financed the study. The patient's insurance company assumed the costs of hospitalization and transplant surgeries.

Availability of data or materials

Does not apply.

Declarations

Ethics committee approval and consent to participate

The study was approved by the Ethics Committee for Research in Human Beings (CEISH) of San Francisco de Quito University with the registration number CE047-2023-CEISH-USFQ in Quito on September 11, 2023.

Consent for publication

Patient-specific photographs, radiographs, and CT scans are not needed.

Conflicts of interest

The authors declare that they have no conflicts of interest.

Author information

Paola Andrea Toapanta Armas: Doctor from the Central University of Ecuador (Quito, 2013). Specialist in Nephrology from the Central University of Ecuador (Quito, 2023).

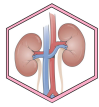
E-mail: andre_zoe@hotmail.com

ORCID <https://orcid.org/0009-0004-9659-9042>

German Patricio Trujillo Salazar: Doctor of Medicine and Surgery from the Central University of Ecuador (Quito, 2004). Specialist in Nephrology from the Catholic University of Córdoba (Argentina, 2013). Attending Physician of the Renal Transplant Service of the Carlos Andrade Marín Specialty Hospital of the Ecuadorian Institute of Social Security in Quito, Ecuador.

E-mail: german.trujillo@iess.gob.ec

ORCID <https://orcid.org/0009-0006-3077-4463>



Ramiro Iván López Pulles: Doctor of Medicine and Surgery from the Central University of Ecuador (Quito, 2004). Specialist in Basic Biomedical Sciences from the Central University of Ecuador (Quito, 2004). Higher Diploma of the Fourth Level in Local Development and Health by the Private Technical University of Loja (Loja, 2005). Specialist in Management and Strategic Health Planning from the Private Technical University of Loja (Loja, 2006).

E-mail: ramirolopezp@gmail.com

ORCID <https://orcid.org/0000-0002-5216-9241>

CV: [Curriculo](#)

References

- Thompson ER, Hosgood SA, Nicholson ML, Wilson CH. Early versus late ureteric stent removal after kidney transplantation. *Cochrane Database Syst Rev*. 2018 Jan 29;1(1):CD011455. doi: [10.1002/14651858.CD011455.pub2](https://doi.org/10.1002/14651858.CD011455.pub2). PMID: 29376218; PMCID: PMC6491073.
- Khedr L, Teama N, El Sharkawy M. Infections in the first year of living related kidney transplantation in a young transplant cohort. *BMC Nephrol*. 2023 Nov 7;24(1):328. doi: [10.1186/s12882-023-03379-9](https://doi.org/10.1186/s12882-023-03379-9). PMID: 37936062; PMCID: PMC10631087.
- Abril J, Sánchez J. Características de la enfermedad renal crónica en el Ecuador desde el año 2009 hasta el año 2012. [Tesis de grado]. Universidad de Cuenca. dspace/38543037c8e
- Choate HR, Mihalko LA, Choate BT. Urologic complications in renal transplants. *Transl Androl Urol*. 2019 Apr;8(2):141-147. doi: [10.21037/tau.2018.11.13](https://doi.org/10.21037/tau.2018.11.13). PMID: 31080774; PMCID: PMC6503228.
- Patterson LG, Tingle SJ, Rix DA, Manas DM, Wilson CH. Routine intraoperative ureteric stenting for kidney transplant recipients. *Cochrane Database Syst Rev*. 2024 Jul 9;7(7):CD004925. doi: [10.1002/14651858.CD004925.pub4](https://doi.org/10.1002/14651858.CD004925.pub4). PMID: 38979749; PMCID: PMC11232101.
- Frutos MÁ, Crespo M, Valentín MO, Alonso-Melgar Á, Alonso J, Fernández C, García-Erauizkin G, González E, González-Rinne AM, Guirado L, Gutiérrez-Dalmau A, Huguet J, Moral JLLD, Musquera M, Paredes D, Redondo D, Revuelta I, Hofstadt CJV, Alcaraz A, Alonso-Hernández Á, Alonso M, Bernabeu P, Bernal G, Breda A, Cabello M, Caro-Oleas JL, Cid J, Diekmann F, Espinosa L, Facundo C, García M, Gil-Vernet S, Lozano M, Mahillo B, Martínez MJ, Miranda B, Oppenheimer F, Palou E, Pérez-Saez MJ, Peri L, Rodríguez O, Santiago C, Taberner G, Hernández D, Domínguez-Gil B, Pascual J. Recommendations for living donor kidney transplantation. *Nefrología (Engl Ed)*. 2022 Dec;42 Suppl 2:5-132. doi: [10.1016/j.nefro.2022.07.001](https://doi.org/10.1016/j.nefro.2022.07.001). Epub 2022 Jul 29. PMID: 36503720.
- Liu S, Luo G, Sun B, Lu J, Zu Q, Yang S, Zhang X, Dong J. Early Removal of Double-J Stents Decreases Urinary Tract Infections in Living Donor Renal Transplantation: A Prospective, Randomized Clinical Trial. *Transplant Proc*. 2017 Mar;49(2):297-302. doi: [10.1016/j.transproceed.2016.12.007](https://doi.org/10.1016/j.transproceed.2016.12.007). PMID: 28219588.
- Kim JS, Jeong KH, Lee DW, Lee SY, Lee SH, Yang J, Ahn C, Hwang HS; Korean Organ Transplantation Registry Study Group. Epidemiology, risk factors, and clinical impact of early posttransplant infection in older kidney transplant recipients: the Korean organ transplantation registry study. *BMC Geriatr*. 2020 Dec 2;20(1):519. doi: [10.1186/s12877-020-01859-3](https://doi.org/10.1186/s12877-020-01859-3). PMID: 33267808; PMCID: PMC7709316.
- Mudiayi D, Shojai S, Okpechi I, Christie EA, Wen K, Kamaleldin M, Elsadig Osman M, Lunney M, Prasad B, Osman MA, Ye F, Khan M, Htay H, Caskey F, Jindal KK, Klarenback S, Jha V, Rondeau E, Turan Kazancioglu R, Ossareh S, Jager KJ, Kovesdy CP, O'Connell PJ, Muller E, Olanrewaju T, Gill JS, Tonelli M, Harris DC, Levin A, Johnson DW, Bello AK. Global Estimates of Capacity for Kidney Transplantation in World Countries and Regions. *Transplantation*. 2022 Jun 1;106(6):1113-1122. doi: [10.1097/TP.0000000000003943](https://doi.org/10.1097/TP.0000000000003943). Epub 2022 Sep 7. PMID: [34495014](https://pubmed.ncbi.nlm.nih.gov/34495014/); PMCID: PMC9128615.
- Abramyan S, Hanlon M. Kidney Transplantation. 2023 Jan 2. In: StatPearls [Internet]. Treasure Island (FL): StatPearls Publishing; 2025 Jan-. PMID: [33620832](https://pubmed.ncbi.nlm.nih.gov/33620832/).
- Jethwani P. Overview of Renal Transplantation for Primary Care Physicians: Workup, Complications, and Management. *Med Clin North Am*. 2023 Jul;107(4):707-716. doi: [10.1016/j.mcna.2023.03.008](https://doi.org/10.1016/j.mcna.2023.03.008). Epub 2023 Apr 14. PMID: 37258008.
- Thongprayoon C, Hansrivijit P, Leeaphorn N, Acharya P, Torres-Ortiz A, Kaewput W, Kovvuru K, Kanduri SR, Bathini T, Cheungpasitporn W. Recent Advances and Clinical Outcomes of Kidney Transplantation. *J Clin Med*.



- 2020 Apr 22;9(4):1193. doi: [10.3390/jcm9041193](https://doi.org/10.3390/jcm9041193). PMID: 32331309; PMCID: PMC7230851.
13. Baig ZF, Siddiqui UA, Mahmood A, Sabir H, Tareen TB. Medical Complications Of Renal Transplant - 2 Years' Experience At Armed Forces Institute Of Urology. *J Ayub Med Coll Abbottabad*. 2018 Jul-Sep;30(3):345-350. PMID: [30465363](https://pubmed.ncbi.nlm.nih.gov/30465363/).
 14. Saad EJ, Fernández P, Cardozo Azua AE, Ellena V, Diz C, Giordano G, Borgogno P, Nuñez S, Sarmantano D, Guzman A, Schwarz F, Naser S, Flores MF, Alaye ML, Caeiro JP, De la Fuente J. Infections in the first year after renal transplant. *Medicina (B Aires)*. 2020;80(6):611-621. English. PMID: [33254105](https://pubmed.ncbi.nlm.nih.gov/33254105/).
 15. Vnucak M, Granak K, Beliancinova M, Miklusica J, Dedinska I. Age and sex disparity in infectious complications after kidney transplantation. *Bratisl Lek Listy*. 2022;123(7):463-469. doi: [10.4149/BLL.2022.074](https://doi.org/10.4149/BLL.2022.074). PMID: 35907050.
 16. Arabi Z, Al Thiab K, Altheaby A, Tawhari M, Aboalsamh G, Almarastani M, Kashkoush S, Shaheen MF, Altamimi A, Alnajjar L, Alhussein R, Almuhteb R, Alqahtani B, Alotaibi R, Alqahtani M, Ghazwani Y, O'Hali W, Saad KB. The Impact of Timing of Stent Removal on the Incidence of UTI, Recurrence, Symptomatology, Resistance, and Hospitalization in Renal Transplant Recipients. *J Transplant*. 2021 Jul 2;2021:3428260. doi: [10.1155/2021/3428260](https://doi.org/10.1155/2021/3428260). PMID: 34306740; PMCID: PMC8272658.
 17. Al Tamimi AR, Alotaibi WS, Aljohani RM, Aldharman SS, Alharbi NM, Khair HS. The Impact of Urinary Tract Infections in Kidney Transplant Recipients: A Six-Year Single-Center Experience. *Cureus*. 2023 Aug 31;15(8):e44458. doi: [10.7759/cureus.44458](https://doi.org/10.7759/cureus.44458). PMID: 37791170; PMCID: PMC10544306.
 18. Neto HM, Tedesco Silva Junior H, Pestana JM, Foresto RD, Aguiar WF. Urological Complications Associated With Pyeloureterostomy Without Ipsilateral Nephrectomy in Renal Transplant Recipients. *Transpl Int*. 2022 Jan 18;35:10213. doi: [10.3389/ti.2021.10213](https://doi.org/10.3389/ti.2021.10213). PMID: 35185371; PMCID: PMC8842274.
 19. Rivera-González SC, Pérez-Grovas H, Madero M, Mora-Bravo F, Saavedra N, López-Rodríguez J, Lerma C. Identification of impeding factors for dry weight achievement in end-stage renal disease after appropriate kidney graft function. *Artif Organs*. 2014 Feb;38(2):113-20. doi: [10.1111/aor.12133](https://doi.org/10.1111/aor.12133). Epub 2013 Jul 25. PMID: 23889479.
 20. Strohaecker J, Aschke V, Koenigsrainer A, Nadalin S, Bachmann R. Urinary Tract Infections in Kidney Transplant Recipients-Is There a Need for Antibiotic Stewardship? *J Clin Med*. 2021 Dec 31;11(1):226. doi: [10.3390/jcm11010226](https://doi.org/10.3390/jcm11010226). PMID: 35011966; PMCID: PMC8745876.
 21. Moein M, Garn RM, Settineri J, Saidi R. Urinary Tract Infection 1 Year After Kidney Transplant: Effect on Kidney Transplant Outcomes. *Exp Clin Transplant*. 2023 Jul;21(7):556-561. doi: [10.6002/ect.2023.0057](https://doi.org/10.6002/ect.2023.0057). PMID: 37584535.
 22. Plage H, Pielka P, Liefeldt L, Budde K, Ebbing J, Sugünes N, Miller K, Cash H, Bichmann A, Sattler A, Kotsch K, Friedersdorff F. Extended Criteria Donors in Living Kidney Transplantation Including Donor Age, Smoking, Hypertension and BMI. *Ther Clin Risk Manag*. 2020 Aug 24;16:787-793. doi: [10.2147/TCRM.S256962](https://doi.org/10.2147/TCRM.S256962). PMID: 32922016; PMCID: PMC7455534.
 23. Patel P, Rebollo-Mesa I, Ryan E, Sinha MD, Marks SD, Banga N, Macdougall IC, Webb MC, Koffman G, Olsburgh J. Prophylactic Ureteric Stents in Renal Transplant Recipients: A Multicenter Randomized Controlled Trial of Early Versus Late Removal. *Am J Transplant*. 2017 Aug;17(8):2129-2138. doi: [10.1111/ajt.14223](https://doi.org/10.1111/ajt.14223). Epub 2017 Mar 17. PMID: 28188678.
 24. Wang Y, Yang Y, Zhang H, Wang Y. Early Removal of Ureteral Stent After Kidney Transplant Could Decrease Incidence of Urinary Tract Infection: A Systematic Review and Meta-Analysis. *Exp Clin Transplant*. 2022 Jan;20(1):28-34. doi: [10.6002/ect.2021.0183](https://doi.org/10.6002/ect.2021.0183). PMID: 35060446.
 25. Cai JF, Wang W, Hao W, Sun ZJ, Su LL, Li X, Zheng X, Zhang XD. Meta-analysis of Early Versus Late Ureteric Stent Removal After Kidney Transplantation. *Transplant Proc*. 2018 Dec;50(10):3411-3415. doi: [10.1016/j.transproceed.2018.08.033](https://doi.org/10.1016/j.transproceed.2018.08.033). Epub 2018 Sep 7. PMID: 30577214.
 26. Arabi Z, Al Thiab K, Altheaby A, Aboalsamh G, Kashkoush S, Almarastani M, Shaheen MF, Altamimi A, O'hali W, Bin Saad K, Alnajjar L, Alhussein R, Almuhteb R, Alqahtani B, Alotaibi R, Alqahtani M, Tawhari M. Urinary Tract Infections in the First 6 Months after Renal



Transplantation. Int J Nephrol. 2021 Nov
15;2021:3033276. doi: [10.1155/2021/3033276](https://doi.org/10.1155/2021/3033276). PMID:
34820141; PMCID: PMC8608522.

DOI: Digital Object Identifier. **PMID:** PubMed Identifier.

Editor's Note

REV SENs remain neutral concerning jurisdictional claims on published maps and institutional affiliations.
