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Graft and Patient-Associated Outcomes for Deceased Donor Kidney Transplant as a Re-Transplant: A Ten-Year Experience from a Tertiary Care Center

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Abstract

Aims: The high prevalence of End-Stage Renal Disease (ESRD) has led to a shortage of donor kidneys especially for patients who have failed first kidney transplant. However, Deceased Donor Kidney Transplant (DDKT) as a Re-transplant can be a likely option for these individuals. This study aims to evaluate the graft and patient-associated outcomes for DDKT performed as re-transplant over ten years at a tertiary care center. Methods: A retrospective analysis was conducted involving patients (n = 21) who underwent DDKT as a re-transplant between 1st June 2014 and 31st December 2023, with a follow-up till 31st December 2024. Follow-up periods ranged from 12 to 126 months. The demographic and clinical data regarding the recipient, deceased donor, intraoperative course and immunosuppressives as induction and maintenance, were collected and clinical outcomes including renal function, graft rejection, graft failure and all-cause mortality were analyzed. Relevant statistical formulas were implemented on the results to assess their significance and to formulate a conclusion. Results: We noted graft rejection, graft failure, and all-cause mortality in 14.2%, 8.53%, and 14.2% patients respectively. The mean serum creatinine at 5-year follow-up was 103.8 ± 37. Mean anastomosis time and cold ischemia time were 43.7 minutes and 12.9 hours respectively. 81% (n = 17) of the deceased donors were from Standard Donor Criteria (SDC). 19% (n = 4) of patients had DGF. The association of recipient age, gender, comorbidities, donor age, SDC vs Extended Donor Criteria (EDC), and cold ischemia time with studied outcomes was not statistically significant. Conclusion: We

observed a relatively low incidence of graft rejections and graft failure in our patients. The findings suggest that with appropriate management, re-transplantation as DDKT can provide satisfactory graft and patient outcomes. Further studies with larger sample sizes and longer follow-up periods are recommended to validate these results and improve patient care strategies.

Keywords

Deceased Donor Kidney Transplant, Re-Transplant, Graft Rejection, Graft Survival, Standard Donor Criteria, Extended Donor Criteria

1. Introduction

End-Stage Renal Disease (ESRD) represents a significant public health challenge worldwide, contributing to considerable morbidity and mortality rates. The global prevalence of ESRD continues to rise in parallel with increasing rates of diabetes mellitus, hypertension, and aging populations [1]. Renal Replacement Therapy (RRT) is vital for patients with ESRD, with kidney transplantation emerging as the preferred treatment modality due to its association with improved survival rates, enhanced quality of life and reduced healthcare costs compared to long-term dialysis [2]-[6].

While Living DONOR kidney Transplantation (LDKT) offers optimal graft survival and patient outcomes [7], it remains inaccessible to many due to limitations in donor availability, medical contraindications among potential donors, and sociocultural or psychological barriers [8]. This donor shortfall has intensified the demand for Deceased Donor Kidney Transplantation (DDKT), which plays a crucial role in bridging the gap between organ supply and the growing transplant waiting list. DDKT not only expands transplant opportunities but also provides an essential avenue for patients with no suitable living donors [9], particularly in regions with a high prevalence of ESRD.

Patients with failed primary kidney grafts, especially those who previously received living-related donor kidneys, represent a unique and clinically challenging cohort. These individuals frequently face immunological sensitization, vascular complications and deteriorating health, making subsequent transplantation more complex [10]. For such candidates, DDKT as a re-transplant offers renewed hope for long-term renal function and survival, though data on its outcomes remain limited and variable across centers.

The challenges associated with DDKT as a kidney re-transplant are multifaceted. These patients often have heightened immunological risk due to sensitization from prior transplantation, more complex surgical histories and greater comorbidity burdens. The decision to proceed with a re-transplant—especially after the loss of a graft from a living related donor, often perceived as the best initial option—brings significant emotional and clinical weight for patients and providers alike. Importantly, recent international studies demonstrate that with careful

patient selection and optimized immunosuppression protocols, outcomes for second DDKT can approach those of primary transplants, offering renewed hope for long-term renal function and patient survival [10]-[12]. Therefore, documenting and understanding successful outcomes in this setting is not only vital for guiding clinical management but also provides optimism for patients facing the daunting prospect of a re-transplant, reinforcing the value of DDKT as a lifesaving intervention.

Recognizing this gap, our study aims to review the graft and patient-associated outcomes of DDKT performed as a re-transplant over a ten-year period at a tertiary care center. By evaluating clinical parameters, graft survival, metabolic complications, and patient mortality, this analysis seeks to inform clinical practice and optimize management strategies for this high-risk, underserved population.

This study aims to evaluate the graft and patient-associated outcomes for DDKT performed as re-transplants over ten years follow-up at a tertiary care center.

2. Materials and Methods

2.1. Study Design and Population

A retrospective analysis was conducted involving adult patients (n = 21) who underwent DDKT as a second or third kidney re-transplant between 1st June 2014 and 31st December 2023, with a follow-up till 31st December 2024. Follow-up periods ranged from 12 to 126 months. The study got Institutional Review Board (IRB) approval from the hospital's Research Ethics Committee (IRB number 2020-48). Each patient's file was deidentified and issued a study code to facilitate data collection and electronic data entry. Only the primary investigator and actively associated members of the study team had access to the patients' personal identifiers.

2.2. Data Collection

Using the Statistical Package for the Social Sciences software and an MS Excel sheet, we extracted relevant data from the medical records of patients who underwent DDKT as a second or third kidney re-transplantation at our center during the specified time period. The demographic and clinical data regarding the recipient, deceased donor, intraoperative course and immunosuppressive medication as induction and maintenance, were collected and clinical outcomes including graft rejection, graft failure, all-cause mortality and serum creatinine at different time intervals were noted and analyzed.

Standard Donor Criteria (SCD):

These are the **baseline requirements** for deceased kidney donors to be under SDC:

- **Age:** Younger than 60 years.
- **Cause of death:** Typically Brain Death (DBD) or Cardiac Death (DCD) with stable circulation.
- **Medical history:** No history of chronic hypertension, diabetes, or other sys-

temic diseases that could impair kidney function.

- **Renal function:** Normal serum creatinine and no significant structural abnormalities in the kidneys.
- **Other exclusions:** No active infections, malignancies (except some localized cancers), or transmissible diseases.

Expanded Criteria Donors (ECD):

These are donors who fall outside the standard criteria but are still considered acceptable due to organ shortage:

- **Age ≥ 60 years**, OR.
- **Age 50 - 59 years** with at least **two of the following risk factors**:
  - History of hypertension.
  - Terminal serum creatinine > 1.5 mg/dL.
  - Death due to cerebrovascular accident (stroke).
- May include donors with mild chronic kidney disease, controlled diabetes, or other comorbidities.

Graft loss was defined as re-transplantation, dialysis or death with a functional graft. Graft rejection was defined as histologically obvious rejection based on BANFF criteria confirmed by an ultrasound-guided transplant kidney biopsy. Infections were identified using recorded positive blood and urine cultures, serology and PCR.

2.3. Recipient Selection Criteria

Deceased kidney recipient list is organized according to criteria including vascular access malfunction leading to multiaccess failure, years on hemodialysis, sensitization status of the patients on renal replacement therapy, graft failure due to surgical complications post living related kidney donation, non-availability of living related donor, duration of time on waiting list and fitness for undergoing surgery. These factors are cumulatively considered and patients are assigned to the deceased kidney transplant waiting list. On receipt of a deceased kidney offer, patients on waiting list of the same blood group as deceased donors are considered. A virtual cross-match is run according to available patient data and patients with negative virtual cross-match are considered for a deceased kidney offer. At the time of kidney transplant, actual flow cross-match is done with deceased donor and patient blood samples and results are conveyed to the primary team. Acceptable cold ischemia time is standardized to be less than 24 hours in our center.

2.4. Histological Assessment

We performed a renal biopsy on each post-kidney transplant patient who had no improvement in serum creatinine in the absence of known surgical problems within the first two weeks following the transplant. In follow-ups, every patient with a serum creatinine increase of more than 27 umol/l in the absence of dehydration, a high Tacrolimus level, bladder outflow blockage or active infections underwent an ultrasound-guided transplant kidney biopsy. Additionally, biopsies were con-

ducted in patients with new-onset proteinuria and hematuria.

HLA typing was performed using Sequence Specific Oligonucleotide (SSO) and Next Generation Sequencing (NGS). The flow cross-match was performed using the flow cytometry method.

2.5. Transplant Phase

All transplant recipients received a consistent immunosuppressive regimen in accordance with our center's practice. Thymoglobulin was provided intravenously for induction at a total dose of 4.5 to 7 mg/kg to all 21 patients, with the first dose given intraoperatively at 1.5 mg/kg. Mycophenolate mofetil was started on day 0, while tacrolimus (FK) was started on days 3 to 5 after the kidney transplant, once serum creatinine levels had dropped to 50% of pre-transplant values. Methylprednisolone was administered in doses of 250 mg IV on day 0, 125 mg on day 1, and then 1 mg per kilogram on day two, with a taper of 5 mg every day until a daily dose of 20 mg was reached. Later, it was lowered by 5 mg per week until reaching a maintenance dose of 5 mg per day.

Tacrolimus trough levels were maintained at 8.5 - 10 ng/mL for the first three months, then steadily decreased to 7.5 - 8.5 ng/mL by six months, 6 - 7.5 ng/mL by the end of a year, and finally between 4 - 6 ng/mL. The target level was slightly higher for patients who experienced graft rejection. When tacrolimus toxicity was detected, the dose was lowered and everolimus was introduced instead. When tacrolimus was coupled with everolimus, the target levels were 3.5 - 4.5 ng/mL and 4.5 - 5.5 ng/mL, respectively. For most patients, MMF was administered twice day at a dose of 1000 mg. This was reduced to 750 mg twice daily if the patient's BSA was less than 1.3 m^2.

The surgical anastomosis time varied between 35 and 105 minutes, according to the surgical anatomy of donor-recipient vessels.

All rejections were biopsy-confirmed and treated with 500 mg IV methylprednisolone daily for three days. Following ABMR, plasmapheresis with IVIg administration was carried out either daily or on alternate days. Following TCMR, patients were treated with 500 mg IV methylprednisolone daily for three days, with steroid tapering based on clinical response. Thymoglobulin was considered for patients with BANFF categorization 2a or higher.

Cytomegalovirus (CMV) prophylaxis was given to all high-risk patients. All D+/R+ patients were given valganciclovir, 450 mg daily for 90 days to prevent CMV infection; D+/R- patients were given the same prophylaxis for six months.

Co-trimoxazole 80 mg oral daily is recommended as a Pneumocystis Pneumonia (PCP) prophylaxis for 6 - 9 months. Valganciclovir and co-trimoxazole were started once GFR exceeded 30 ml/min/1.73m^2 BSA.

3. Results

The study includes data from 21 recipients and 21 donors. The recipients have a mean age of 41.00 years (SD = 13.03), with 38.1% being male. The mean BMI for

recipients is 24.79 (SD = 5.80). Among the recipients, 9.5% have undergone a preemptive renal transplant, and 19.0% use a different RRT modality. The average duration of RRT is 5.26 years (SD = 5.50). Additionally, 33.3% of recipients have diabetes mellitus (DM), and 85.7% have Hypertension (HTN).

For the donor group, the mean age is 37.48 years (SD = 10.44), and 85.7% are male. Among donors, 14.3% have DM and 14.3% have HTN. The mean baseline creatinine level is 156.00 (SD = 104.81). In terms of surgical decisions, 81.0% of cases involve SDC. Acute Kidney Injury (AKI) is present in 57.1% of donors, and 42.9% have an infection requiring antibiotics (Table 1).

Table 1. Recipient & donor characteristics.

Recipient Characteristics		**Donor Characteristics**	
n	21	n	21
Age (mean (SD))	41.00 (13.03)	Age (mean (SD))	37.48 (10.44)
Gender Male (%)	8 (38.1)	Gender = Male (%)	18 (85.7)
BMI (mean (SD))	24.79 (5.80)	DM = Yes (%)	3 (14.3)
Preemptive Renal Transplant = Yes (%)	2 (9.5)	HTN = Yes (%)	3 (14.3)
RRT Modality = Other (%)	4 (19.0)	Donor baseline creatinine (mean (SD))	156.00 (104.81)
Years of RRT (mean (SD))	5.26 (5.50)	SDC VS EDC = SDC (%)	17 (81.0)
DM Recipient = Yes (%)	7 (33.3)	Donor AKI = Yes (%)	12 (57.1)
HTN Recipient = Yes (%)	18 (85.7)	Donor infection (on antibiotics) = Yes (%)	9 (42.9)

The analysis reveals trends in recipient and donor characteristics, with key findings indicating higher prevalence rates of HTN in recipients and a substantial percentage of donors with AKI.

Table 2. Preoperative factors.

Variable	**N = 12**
Cold ischemia time hours (mean (SD))	12.90 (4.81)
Anastomosis time minutes (mean (SD))	43.76 (7.80)
Intraoperative hypotension = Yes (%)	9 (42.9)
HD in first 7 days = Yes (%)	4 (19.0)

The analysis of preoperative factors (Table 2) reveals that the mean cold ischemia time was 12.90 hours (SD = 4.81) and the mean anastomosis time was 43.76 minutes (SD = 7.80). Intraoperative hypotension occurred in 42.9% of the cases. Additionally, 19.0% of patients required Hemodialysis (HD) within the first 7 days post-operation. These results highlight the critical preoperative conditions encountered during the study.

Table 3. Longitudinal analysis of creatinine and (tacrolimus) FK levels in recipients.

Variable	Mean (SD)
Creatinine Recipient 1 Month	117.25 (41.04)
Creatinine Recipient 6 Months	107.11 (34.46)
Creatinine Recipient 1 Year	107.17 (28.71)
Creatinine Recipient 2 Years	102.57 (24.42)
Creatinine Recipient 5 Years	104.00 (45.07)
Creatinine Recipient Last follow-up (1 yr – 9 yrs)	103.81(37.23)
FK Level 7 Days	7.20 (3.12)
FK Level 1 Month	10.61 (3.80)
FK Level 6 Months	7.76 (1.13)
FK Level 1 Year	6.89 (1.14)
FK Level 2 Years	6.15 (1.86)
FK Level 5 Years	6.45 (1.30)

The mean creatinine levels decrease from 117.25 μmol/L (SD = 41.04) at 1 month to 104.00 μmol/L (SD = 45.07) at 5 years (Table 3). The mean creatinine at last follow-up with minimum follow-up of one year and maximum follow-up of plus 10 years was 103.81 umol/l (SD = 37.23). FK levels show an initial increase, peaking at 1 month with a mean of 10.61 ng/mL (SD = 3.80), then stabilizing over time to 6.45 ng/mL (SD = 1.30) at 5 years. The data suggest a trend of stabilization in both creatinine and FK levels in recipients over the observed period.

Table 4. Factors associated with graft loss.

Variable	No (n = 19)	Yes (n = 2)	Total (n = 21)	p-value
Total n (%)	19 (90.5)	2 (9.5)	21	
Age (Recipient) Mean (SD)	42.1 (13.3)	31.0 (0.0)	41.0 (13.0)	0.264
RRT Modality—HD	15 (78.9)	2 (100.0)	17 (81.0)	1.000
RRT Modality—Other	4 (21.1)	0 (0.0)	4 (19.0)	
Years of RRT Mean (SD)	4.5 (5.1)	12.0 (5.7)	5.3 (5.5)	0.066
Donor DM—No	17 (89.5)	1 (50.0)	18 (85.7)	0.271
Donor DM—Yes	2 (10.5)	1 (50.0)	3 (14.3)	
HTN Recipient—No	3 (15.8)	0 (0.0)	3 (14.3)	1.000
HTN Recipient—Yes	16 (84.2)	2 (100.0)	18 (85.7)	
Donor Age Mean (SD)	37.4 (10.9)	38.5 (4.9)	37.5 (10.4)	0.888
SDC VS EDC—EDC	4 (21.1)	0 (0.0)	4 (19.0)	1.000
SDC VS EDC—SDC	15 (78.9)	2 (100.0)	17 (81.0)	
Donor AKI—No	8 (42.1)	1 (50.0)	9 (42.9)	1.000

Continued

Donor AKI—Yes	11 (57.9)	1 (50.0)	12 (57.1)	
Cold ischemia time hours Mean (SD)	12.9 (5.0)	13.0 (2.8)	12.9 (4.8)	0.977
Anastomosis time minutes Mean (SD)	43.3 (8.0)	48.5 (2.1)	43.8 (7.8)	0.380
Intraoperative hypotension—No	12 (63.2)	0 (0.0)	12 (57.1)	0.171
Intraoperative hypotension—Yes	7 (36.8)	2 (100.0)	9 (42.9)	
HD in first 7 days—No	17 (89.5)	0 (0.0)	17 (81.0)	0.029
HD in first 7 days—Yes	2 (10.5)	2 (100.0)	4 (19.0)	

Table 4 examines factors associated with graft loss in our study population, among whom 9.5% experienced graft loss. The mean age of recipients without graft loss is 42.1 years, compared to 31.0 years in those with graft loss, though this difference is not statistically significant (p = 0.264).

The type of Renal Replacement Therapy (RRT) modality shows no significant association with graft loss, as both groups predominantly used Hemodialysis (HD). However, the mean duration of RRT is longer in the graft loss group (12.0 years) compared to those without graft loss (4.5 years), approaching significance (p = 0.066).

Donor characteristics such as Diabetes Mellitus (DM) and Acute Kidney Injury (AKI) do not show a significant relationship with graft loss. However, all recipients with graft loss had donors with Hypertension (HTN), though this was not statistically significant (p = 1.000).

Cold ischemia time and anastomosis time are similar between groups, indicating no significant impact on graft loss. However, intraoperative hypotension is more frequent in the graft loss group (100% vs. 36.8%), although not statistically significant (p = 0.171).

A significant finding is that all patients with graft loss required hemodialysis within the first 7 days post-operation, contrasting with only 10.5% in the non-graft loss group (p = 0.029), suggesting early post-operative dialysis is associated with graft loss.

Table 5. Factors associated with graft rejection.

Variable	No (n = 18)	Yes (n = 3)	Total (n = 21)	p-value
Total N (%)	18 (85.7)	3 (14.3)	21	
Age (Recipient) Mean (SD)	39.7 (11.9)	48.7 (19.6)	41.0 (13.0)	0.282
RRT Modality—HD	15 (83.3)	2 (66.7)	17 (81.0)	0.489
RRT Modality—Other	3 (16.7)	1 (33.3)	4 (19.0)	
Years of RRT Mean (SD)	5.2 (5.8)	5.5 (0.7)	5.3 (5.5)	0.951
Donor DM—No	16 (88.9)	2 (66.7)	18 (85.7)	0.386
Donor DM—Yes	2 (11.1)	1 (33.3)	3 (14.3)	
HTN Recipient—No	3 (16.7)	0 (0.0)	3 (14.3)	1.000

Continued

HTN Recipient—Yes	15 (83.3)	3 (100.0)	18 (85.7)	
Donor Age Mean (SD)	37.8 (10.7)	35.7 (10.7)	37.5 (10.4)	0.755
SDC VS EDC—EDC	4 (22.2)	0 (0.0)	4 (19.0)	1.000
SDC VS EDC—SDC	14 (77.8)	3 (100.0)	17 (81.0)	
Donor AKI—No	9 (50.0)	0 (0.0)	9 (42.9)	0.229
Donor AKI—Yes	9 (50.0)	3 (100.0)	12 (57.1)	
Cold ischemia time hours Mean (SD)	13.0 (5.0)	12.3 (4.0)	12.9 (4.8)	0.830
Anastomosis time minutes Mean (SD)	44.2 (7.8)	41.0 (9.2)	43.8 (7.8)	0.521
Intraoperative hypotension—No	9 (50.0)	3 (100.0)	12 (57.1)	0.229
Intraoperative hypotension—Yes	9 (50.0)	0 (0.0)	9 (42.9)	
HD in first 7 days—No	14 (77.8)	3 (100.0)	17 (81.0)	1.000
HD in first 7 days—Yes	4 (22.2)	0 (0.0)	4 (19.0)	

Table 5 explores the factors associated with graft rejection in a cohort of 21 patients, where 14.3% experienced graft rejection. The mean age of recipients experiencing rejection is higher (48.7 years) compared to those without rejection (39.7 years), though not statistically significant ($p = 0.282$).

The modality of Renal Replacement Therapy (RRT) does not show a significant association with graft rejection, with the majority using Hemodialysis (HD). The mean years on RRT are similar between groups ($p = 0.951$).

Donor characteristics such as Diabetes Mellitus (DM) and Acute Kidney Injury (AKI) do not significantly impact graft rejection, although all cases of rejection occurred in recipients with donors who had AKI ($p = 0.229$). Hypertension (HTN) is present in all recipients with graft rejection, but not significantly associated ($p = 1.000$).

Cold ischemia time and anastomosis time minutes are similar between groups, indicating no significant impact on graft rejection. Intraoperative hypotension is more frequent in the non-rejection group (50.0%), though not significant ($p = 0.229$).

The initial need for hemodialysis within the first 7 days post-operation does not differ significantly between groups ($p = 1.000$), suggesting it is not a predictor of graft rejection in this cohort.

Table 6. Factors associated with mortality in patients.

Variable	No (n = 19)	Yes (n = 2)	Total (n = 21)	p-value
Total N (%)	19 (90.5)	2 (9.5)	21	
Age (Recipient) Mean (SD)	42.6 (12.6)	26.0 (7.1)	41.0 (13.0)	0.087
RRT Modality—HD	15 (78.9)	2 (100.0)	17 (81.0)	1.000
RRT Modality—Other	4 (21.1)	0 (0.0)	4 (19.0)	
Years of RRT Mean (SD)	4.9 (5.1)	8.5 (10.6)	5.3 (5.5)	0.395

Continued

Donor DM—No	17 (89.5)	1 (50.0)	18 (85.7)	0.271
Donor DM—Yes	2 (10.5)	1 (50.0)	3 (14.3)	
HTN Recipient—No	3 (15.8)	0 (0.0)	3 (14.3)	1.000
HTN Recipient—Yes	16 (84.2)	2 (100.0)	18 (85.7)	
Donor Age Mean (SD)	36.5 (10.4)	47.0 (7.1)	37.5 (10.4)	0.181
SDC VS EDC—EDC	3 (15.8)	1 (50.0)	4 (19.0)	0.352
SDC VS EDC—SDC	16 (84.2)	1 (50.0)	17 (81.0)	
Donor AKI—No	9 (47.4)	0 (0.0)	9 (42.9)	0.486
Donor AKI—Yes	10 (52.6)	2 (100.0)	12 (57.1)	
Cold ischemia time hours Mean (SD)	12.9 (5.0)	12.5 (2.1)	12.9 (4.8)	0.904
Anastomosis time minutes Mean (SD)	43.4 (8.1)	47.5 (3.5)	43.8 (7.8)	0.490
Intraoperative hypotension—No	11 (57.9)	1 (50.0)	12 (57.1)	1.000
Intraoperative hypotension—Yes	8 (42.1)	1 (50.0)	9 (42.9)	
HD in first 7 days—No	16 (84.2)	1 (50.0)	17 (81.0)	0.352
HD in first 7 days—Yes	3 (15.8)	1 (50.0)	4 (19.0)	

Table 6 analyzes factors associated with mortality among 21 patients, with 9.5% experiencing mortality. The mean age of recipients who died is younger (26.0 years) compared to those who survived (42.6 years), with a p-value of 0.087, indicating a trend without statistical significance.

Renal Replacement Therapy (RRT) modality shows no significant association with mortality, as all deceased patients were on Hemodialysis (HD). The average duration of RRT is longer in patients who died (8.5 years) than those who survived (4.9 years), although this is not statistically significant ($p = 0.395$).

Donor characteristics such as Diabetes Mellitus (DM) and Acute Kidney Injury (AKI) do not show a significant impact on mortality, though all deceased patients had donors with AKI. Hypertension (HTN) in recipients is not significantly associated with mortality ($p = 1.000$). Cold ischemia and anastomosis times are similar between groups, with no significant differences. Intraoperative hypotension and early post-operative dialysis within the first 7 days also do not show significant associations with mortality, with p-values of 1.000 and 0.352, respectively. Overall, the analysis suggests no single factor shows a statistically significant association with mortality, though trends in younger recipient age and longer RRT duration warrant further investigation.

4. Discussion

This ten-year retrospective analysis evaluated the outcomes of Deceased Donor Kidney Transplantation (DDKT) as a second or third re-transplant in a clinically complex cohort. Our findings demonstrate relatively favorable patient and graft survival, with low rates of rejection and acceptable metabolic complication rates,

even among recipients with substantial comorbidities and a history of prior graft failure. Notably, the incidence of Delayed Graft Function (DGF), early post-transplant dialysis and metabolic complications such as Post-Transplant Diabetes Mellitus (PTDM) and Post-Transplant Hypertension (PTHTN) was consistent with, or even favorable compared to existing literature on high-risk transplant populations. The study's significance lies in its focus on a population—recipients with previous graft failure, often from living related donors—for whom optimal management strategies and outcome expectations remain insufficiently defined.

Comparison with international studies highlights that our observed graft and patient survival rates align well with global reports on second kidney transplantation using deceased donor organs. For instance, a study by Gumber *et al.* [10] reported a five-year graft survival of approximately 80% in second deceased donor transplants, closely mirroring our outcomes. Likewise, Miles *et al.* [13] and Yahyazadeh *et al.* [14] have shown that, despite increased immunological risk and surgical complexity, second DDKT recipients can achieve long-term graft function and survival rates comparable to primary transplant recipients, especially when careful patient selection and optimized perioperative management are employed. Additional analyses underscore the pivotal role of standardized immunosuppression protocols and meticulous perioperative care in reducing rejection and improving outcomes in sensitized or high-risk recipients. Reports by Girerd *et al.* [11] and Franco *et al.* [12] emphasize that individualized immunosuppression and vigilant post-transplant monitoring significantly contribute to improved graft longevity and recipient survival. Furthermore, a systematic review by Tonelli *et al.* [3] supports the assertion that transplantation, even for repeat recipients, confers better survival and quality of life compared to remaining on dialysis, underscoring the value of pursuing DDKT when living donor options are exhausted. Recent population-based studies from Europe and North America further reinforce these findings. For example, Sandal *et al.* [15] analyzed a large US cohort and found that second and third kidney transplants from deceased donors remain associated with substantial survival benefits, despite slightly higher rates of early complications. Similarly, a Norwegian registry-based study by Heldal *et al.* [16] concluded that there was no difference in outcomes in elderly recipients of DDKT as first or second transplant. Access to repeat transplantation, including DDKT, is critical for maximizing the lifetime benefit of renal replacement therapy and outcomes continue to improve with advancements in immunological risk stratification and organ allocation policies. A broader literature review reveals a growing consensus that DDKT is an effective and often necessary intervention for patients with failed previous grafts, particularly in health systems with limited living donor availability or where sociocultural factors impede living donation. The observed stability in renal function and manageable rates of complications reinforce the notion that DDKT can and should be offered to suitable candidates, even as a repeat procedure, provided that individualized perioperative care and immunological risk management are rigorously applied.

5. Limitations

Despite valuable insights, our study has limitations. The small sample size (n = 21) does not stop us from gaining an insight into studied outcomes and their potential association with clinical, immunological and demographic factors but restricts the statistical power to detect significant associations. We did not have the opportunity to perform protocol biopsies due to a lack of consent from the patient which might underdiagnose subclinical graft rejection. Being a single-center study, results may not be generalizable to diverse populations with varying immunosuppressive practices. Finally, retrospective data collection introduces potential selection bias and accuracy issues in data collection. There is also a concern about missing out important clinical events due to possible follow-up of patient for clinical diagnosis or treatment outside our institution.

6. Conclusion

Our study provides encouraging evidence supporting the use of deceased donor kidney transplantation as a second or third transplant in patients with prior graft failure. With meticulous perioperative management and standardized immunosuppression, favorable patient and graft survival can be achieved, even in this high-risk group. Our findings support the expansion of DDKT programs to address the donor organ gap and offer renewed hope to patients who have exhausted primary transplantation options. Further large-scale, prospective studies are warranted to confirm these findings, refine recipient selection, and optimize clinical protocols for this challenging but increasingly prevalent clinical scenario.

Author's Contributions

Dr. Bilal contributed to the study design. Dr. Bilal, Dr Lujain, Dr Saima and Dr Wahaj were involved in the writing of article. Data analysis was done by Dr Nadeem and Ms Lama Hefni. Dr Bushra, Dr Bilal and Dr Lujain contributed to the organization of the MS Excel sheet. Dr Wahaj and Dr Saima Faisal were responsible for proof reading, formatting and editing the article according to publication guidelines. Dr Wael Habhab and Dr Najla oversaw work supervision and coordination. Dr Bilal is the corresponding author.

Ethical Considerations

This retrospective study was conducted in accordance with the ethical standards of the KFSHRC Institutional Review Board and adhered to the principles outlined in the Declaration of Helsinki (as revised in 2013). The study protocol was reviewed and approved by the ethics committee.

Consent to Participate

Given the retrospective nature of the study and the use of de-identified data from ESRD patients, the requirement for informed consent was waived by the IRB.

Consent for Publication

All patient details have been anonymized to ensure confidentiality in accordance with ethical guidelines and the Declaration of Helsinki.

Data Availability

All the available data is mentioned in the primary manuscript or the supporting material.

Writing Assistance and Third-Party Submissions

We utilized Paper Pal services for grammatical correction and editing before submission.

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Conflicts of Interest

The authors declared no potential conflicts of interest with respect to the research, authorship, and/or publication of this article.

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