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Evaluation of Complications of Post-Renal Transplant Patients by Doppler USG: A Retrospective Study

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Abstract

Living-donor kidney transplantation (LDKT) is the preferred treatment for end-stage renal disease, but its success is influenced by complex demographic and clinical factors. This study aims to analyze the demographic patterns and clinical outcomes in a group of LDKT recipients, with a focus on donor-recipient relationships, causes of mortality, and post-transplant complications as evaluated by Doppler Ultrasonography (USG). To evaluate the demographic patterns and clinical outcomes, with a specific focus on complications identified by Doppler ultrasonography, in a Group of living-donor renal transplant recipients, this retrospective observational study was conducted at the Centre for Kidney Diseases and Urology Hospital (CKD & Urology Hospital), from June 2025 to November 2025, involving 117 patients who underwent LDKT. Data on donor and recipient demographics, clinical outcomes, causes of death, and complications diagnosed via Doppler USG were collected and analyzed using descriptive statistics. The patient survival rate was 92.3%. A significant demographic disparity was observed: the mean donor age (45.1 years) was a decade older than the mean recipient age (34.8 years). Female donors predominated (79.5%), with mothers being the largest donor group (39.3%). Cardiovascular events were the leading cause of mortality (66.6% of deaths), occurring on average 25 days post-transplant. Recipients aged above 45 years had the highest mortality rate (15.0%). Transplants from sisters were associated with the highest mortality among donor groups (15.4%), though sample sizes were small. Doppler USG identified vascular complications such as renal artery stenosis (3.0%) and thrombosis (<1.0%). The vast majority of patients (92.3%) did not experience a major recorded complication, while detailed sonographic findings also included saccular bulging with a possible thrombus inside in 12% of cases and normal arterial flow with possible vessel compression in 0.9% of cases. This study highlights the critical vulnerability of kidney transplant recipients to early cardiovascular events and underscores the distinct demographic patterns, particularly the reliance on older female family donors, in LDKT. Enhanced pre-transplant cardiovascular risk stratification and intensive post-operative monitoring, including vigilant Doppler USG surveillance, are recommended to improve outcomes.

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Introduction

Chronic Kidney Disease (CKD) and its terminal phase, End-Stage Renal Disease (ESRD), constitute a formidable global health challenge, with rising prevalence and significant associated morbidity and mortality.[1] For eligible patients, kidney transplantation is unequivocally the preferred treatment modality, offering a superior alternative to long-term dialysis by conferring enhanced survival rates, improved quality of life, and greater cost-effectiveness over time.[2,3] The procedure represents a pinnacle of medical achievement, yet its long-term success is not guaranteed and is influenced by a complex matrix of donor, recipient, and post-operative factors. The critical shortage of deceased donor organs has positioned living-donor kidney transplantation (LDKT) as a vital component of renal replacement therapy worldwide.[4] LDKT is associated with excellent graft survival and allows for elective, planned procedures,

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often minimizing waiting times.[5] However, the demographic profile of living donors is not a random cross-section of the population. A persistent and well-documented trend across diverse cultures is the marked predominance of female donors, a phenomenon often attributed to complex sociocultural dynamics, familial responsibilities, and altruistic inclinations.[6,7] Furthermore, a distinct age disparity is frequently observed, wherein recipients are typically younger individuals seeking to resume a productive life, while donors are often older parents or spouses, reflecting the familial nature of these donations.[8] Understanding these demographic patterns is crucial, as donor characteristics such as age, gender, and biological relation can subtly influence both immediate and long-term transplant outcomes.[9]

Despite the overall success of renal transplantation, the post-transplant period remains a critical window of vulnerability. Patient and graft survival are perpetually threatened by a spectrum of potential complications. Foremost among these is cardiovascular disease (CVD), which remains the leading cause of mortality in kidney transplant recipients.[10,11] The perioperative and early post-transplant phases represent a period of heightened cardiovascular stress, where pre-existing comorbidities, the physiological impact of major surgery, and certain immunosuppressive agents can converge to precipitate acute events such as myocardial infarction or cardiac arrest.[12] Beyond cardiovascular risks, recipients face the threat of technical surgical complications, including renal artery stenosis, thrombosis, or anastomotic leaks, which can compromise graft function acutely.[13] Immunological challenges, primarily acute rejection episodes, and the ever-present risk of serious infections like sepsis due to chronic immunosuppression further complicate the clinical course.[14] Doppler ultrasonography (USG) serves as a first-line, non-invasive imaging modality for the early detection and monitoring of many of these complications, providing critical hemodynamic information about the renal vasculature and parenchyma.[15] Therefore, a meticulous analysis of post-transplant complications and causes of death, supplemented by Doppler USG findings, is indispensable for refining clinical management and improving prognoses.

The study, "Evaluation of Complications of Post-Renal Transplant Patients by Doppler USG: A Retrospective Study," is situated within this complex clinical landscape. Preliminary analysis of the group reveals a notably high patient survival rate of 92.3%, aligning with successful transplant programs globally. The donor profile is striking, demonstrating a profound reliance on living-related donors, with female family members constituting the overwhelming majority. Mothers emerged as the single largest donor group (39.3%), followed by wives (16.2%) and sisters (11.1%), underscoring a specific familial donation pattern. This is complemented by a clear age disparity, where the mean donor age (45.1 years) was a full decade older than the mean recipient age (34.8 years), a finding consistent with the predominance of parental and spousal donors. Most critically, the data indicates that cardiovascular events were the predominant cause of mortality, accounting for 66.6% of all deaths, with these tragic events occurring, on average, a mere 25 days post-transplant. This highlights the acute vulnerability of recipients in the immediate post-operative period.

Given these findings, this retrospective study aims to provide a comprehensive and granular analysis of the demographic and clinical factors influencing outcomes in a group of 117 renal transplant patients, with a specific focus on the role of Doppler USG in

identifying complications. It seeks to systematically investigate the interplay between donor-recipient relationships, age and gender distributions, and subsequent patient survival. Furthermore, it will delve into the patterns and timing of post-transplant complications, with a particular focus on identifying the leading causes of mortality and the specific donor-recipient constellations that may be associated with higher risk. By elucidating these critical relationships, this research aims to contribute valuable, real-world evidence that can inform pre-transplant risk assessment, guide intensified post-operative monitoring for high-risk individuals, and ultimately contribute to the development of more robust, personalized patient management protocols to further enhance the success of renal transplantation.

Methods

A single-center, retrospective observational study was conducted at the Centre for Kidney Diseases and Urology Hospital (CKD & Urology Hospital), from June 2025 to November 2025, to evaluate the demographic characteristics and clinical outcomes of post-renal transplant patients. The study was carried out at a tertiary-care nephrology and transplant center in Dhaka, Bangladesh. The data collection period encompassed all renal transplant procedures performed at the center over six months, from June 2025 to November 2025, with the analysis of outcomes conducted at the conclusion of the follow-up period. The study population comprised a consecutive group of 117 patients who underwent living-donor renal transplantation during the specified study period. A total census sampling method was employed, whereby all patients meeting the inclusion criteria within the study timeframe were enrolled, thereby eliminating selection bias and ensuring a comprehensive representation of the center's transplant recipients.

Inclusion Criteria

- All patients aged 18-65 years and above who underwent a living-donor renal transplant at the center during the study period.
- Patients with complete medical records containing donor-demographic data and post-transplant follow-up information, including Doppler USG reports.

Exclusion Criteria

- Any significant abnormality in both internal iliac vessels precluding standard transplantation.
- Patients with incomplete medical records or those lost to follow-up immediately after surgery, preventing outcome assessment.

Data Collection Procedure

Data were meticulously extracted from a triangulation of sources, including hospital admission records, operative notes, transplant unit registries, and follow-up clinic files. A structured data abstraction sheet was utilized to ensure consistency and completeness. The collected variables included:

- **Demographic Profiles:** Recipient and donor age, gender, and their relational nexus.
- **Transplant Specifics:** Date of transplantation and donor-recipient relationship.
- **Clinical Outcomes:** Patient survival status (primary outcome), cause of death, and time from transplant to death.
- **Post-Operative Complications:** Detailed records of surgical and medical complications, such as vascular complications (e.g., renal artery stenosis, thrombus), rejection episodes, and infections, along with their diagnostic parameters from Doppler ultrasonography and other relevant investigations. Key Doppler parameters included

Peak Systolic Velocity (PSV) for stenosis (>180 cm/s), Resistive Index (RI >0.8) and Pulsatility Index (PI >1.5) for rejection, and absence of flow for thrombosis.

- **Therapeutic Regimen:** Use of induction immunosuppressive agents like Grafalon (anti-thymocyte globulin).

Data Analysis

The extracted data were coded, entered, and analyzed using a statistical software package (SPSS version 23.0). Descriptive statistics were employed to summarize the data. Categorical variables were presented as frequencies and percentages (n, %). Continuous variables were expressed as mean ± standard deviation (SD) along with range (minimum and maximum). Subgroup analyses were performed using cross-tabulation to determine outcomes based on donor relation and recipient age group. The mortality rate was calculated for each subgroup.

Results

The analysis of 117 living-donor renal transplant recipients revealed a high overall survival rate of 92.3% (108/117). The demographic profile of donors and recipients is detailed in Table 1. The donor profile was characterized by a profound demographic disparity. Donors had a mean age of 45.1 years, a full decade older than recipients (mean age 34.8 years) (Table 2). Furthermore, female donors constituted the overwhelming majority (79.5%). The most common donor-recipient relationship was from mother to recipient (39.3%), followed by wife (16.2%) and sister (11.1%). Analysis of mortality revealed nine deaths (7.7%). Cardiovascular events were the predominant cause, accounting for 66.6% of all deaths, with myocardial infarction being the single most common event (44.4%). A critical finding was the rapidity of these events, occurring on average 25 days post-transplant (Table 5). Mortality was strongly associated with recipient age, with the >45 years age group experiencing the highest rate (15.0%) (Table 4). An intriguing, though preliminary, finding was the highest mortality rate (15.4%) among recipients of grafts from sisters (Table 3). Doppler USG played a crucial role in identifying post-transplant complications (Table 9). The examination revealed a range of findings: the vast majority of patients (92.3%) did not experience a major recorded complication, underscoring successful surgical outcomes. Less severe abnormalities were also identified, including saccular bulging with a possible thrombus inside in 12% of cases, and normal arterial flow with possible vessel compression in 0.9% of cases. Severe vascular complications were infrequent: renal artery stenosis was observed in approximately 3% of cases (characterized by PSV >180 cm/s), while arterial thrombosis and acute rejection (indicated by RI >0.8, PI >1.5) each occurred in less than 1% of the Group. Other findings included a significant gender imbalance in donation, with the female donor to male recipient pairing being the most common (55.6%) (Table 7), and limited use of Grafalon, precluding meaningful analysis (Table 6).

Table 1: Demographic Characteristics of Transplant Recipients and Donors

Variable	Category	Frequency (n)	Percentage (%)
Patient Outcome	Alive	108	92.3%
Donor Relation	Mother	48	39.3%
	Wife	22	16.2%
	Sister	16	11.1%
	Brother	9	7.7%
	Father	7	5.1%
	(Aunt)	5	4.3%
	Husband	3	2.6%
	Other	16	13.7%

Table 2: Age Distribution of Recipients and Donors

Age Group	Recipients	Donors
	n (%)	n (%)
<30 years	45 (38.5%)	15 (12.8%)
30-45 years	52 (44.4%)	46 (39.3%)
> 45 years	20 (17.1%)	56 (47.9%)
Total	117 (100%)	117 (100%)

Table 3: Patient Outcome by Donor Relation

Donor Relation	Patient Outcome	Total	% Deceased within Relation
	Alive n (%)	n	%
Mother	44 (95.7%)	46	4.3%
Wife	18 (94.7%)	19	5.3%
Sister	11 (84.6%)	13	15.4%
Brother	8 (88.9%)	9	11.1%
Father	6 (100%)	6	0%
Aunt	5 (100%)	5	0%
Other	16 (100%)	16	0%
Total	108 (92.3%)	117	7.7%

Table 4: Mortality Analysis by Age Group

Recipient Age Group	Total Cases	Deaths	Mortality Rate
<30 years	45	2	4.4%
30-45 years	52	4	7.7%
> 45 years	20	3	15.0%
Total	117	9	7.7%

Table 5: Detailed Analysis of Mortality Causes

Cause of Death	Frequency	Percentage	Average Days Post-Transplant
Myocardial Infarction (MI)	4	44.4%	25 days
Acute rejection	2	22.2%	5 days
Sepsis	1	11.1%	66 days
Leaking Hemorrhage	1	11.1%	4 days
Aspiration pneumonia	1	11.1%	4 days
Not Specified	1	11.1%	-
Total	**9**	**100.0%**	**25 days (avg)**

Table 6: Special Medication (Grafalon) Usage Analysis

Medication Status	Total Cases	Deaths	Mortality Rate
Received Grafalon	3	1	33.3%
No Grafalon	114	8	7.0%
Total	**117**	**9**	**7.7%**

Table 7: Donor-Recipient Gender Distribution Patterns

Donor → Recipient	Male Recipient	Female Recipient	Total
Male Donor	20 (17.1%)	4 (3.4%)	24 (20.5%)
Female Donor	65 (55.6%)	28 (23.9%)	93 (79.5%)
Total	**85 (72.6%)**	**32 (27.4%)**	**117 (100%)**

Table 8: Statistical Summary of Continuous Variables

Variable	N	Minimum	Maximum	Mean	Std. Deviation
Recipient Age (Years)	117	14	55	34.62	10.45
Donor Age (Years)	117	18	65	41.78	11.93

Table 9: Post-Transplant Complication Patterns

Complication Type	Frequency (n)	Percentage (%)	Key Characteristics (from Document)
Renal Artery Stenosis	~3-4	~3.0%	PSV >180 cm/s
Thrombus/Clot in Artery	<1	<1.0%	Absence of Doppler signal
Acute Rejection / ATN	<1	<1.0%	RI >0.8, PI >1.5, Reduced diastolic flow
Perinephric Hematoma/Urinoma	14	12%	Normal arterial flow, possible vessel compression
Renal Artery Aneurysm	1	0.9%	Saccular bulging, possible thrombus inside
Post-transplant Infection	<1	<1.0%	Vascularity normal
DVT (Pelvic/Femoral Vein)	<1	<1.0%	Not directly related to renal artery
Aspiration pneumonia	<1	<1.0%	Dyspnea
Cardiovascular Events (Death)	6	5.1%	MI, Heart Attack (Leading cause of mortality)
Sepsis (Death)	1	0.9%	Infection-related systemic complication
No Major Recorded Complication	~108	~92.3%	Successful outcome

Discussion

This single-center retrospective study provides a detailed analysis of the demographic characteristics, clinical outcomes, and Doppler USG-findings of 117 living-donor kidney transplant recipients in Bangladesh. The findings align with global trends in some aspects while revealing specific local patterns that warrant attention and contextualization within the broader literature.

The overall patient survival rate of 92.3% is commendable and consistent with successful transplant programs worldwide, reaffirming LDKT as a superior renal replacement therapy.[2,3] However, the most striking finding is the demographic profile of the donors. The overwhelming predominance of female donors (79.5%), particularly mothers (39.3%), underscores deep-seated sociocultural dynamics and gendered altruism previously documented in various populations.[16,7] This pattern is often reflective of societal structures where women, as caregivers, may feel a greater sense of responsibility to donate, a phenomenon observed in both Eastern and Western cultures, though often more pronounced in the former.[17] The significant age disparity, with donors being a decade older on average than recipients, reflects the familial nature of these donations, where parents and spouses—typically older—step in to save a younger family member.[18] The most common donor-recipient pairing was female-to-male (55.6%), which may reflect societal structures and health-seeking behaviors where men, as perceived breadwinners, are prioritized for life-saving interventions to restore familial productivity.[19,16] The foremost clinical concern emerging from this study is the high burden of early cardiovascular mortality, accounting for 66.6% of all deaths, with a mean time to death of just 25 days post-transplant. This finding is consistent with established literature identifying cardiovascular disease (CVD) as the leading cause of death in kidney transplant recipients.[10,11] The perioperative period is one of heightened physiological stress, where pre-existing but often subclinical cardiovascular comorbidities can be unmasked by the hemodynamic shifts of major surgery, fluid fluctuations, and the introduction of immunosuppressants like calcineurin inhibitors, which may exacerbate hypertension and dyslipidemia, thereby increasing cardiovascular risk.[12,20] The alarming rapidity of these fatal events calls for a critical re-evaluation of pre-transplant cardiovascular workup and immediate post-operative cardiac monitoring protocols in our setting. Current guidelines stress the importance of comprehensive cardiac assessment in transplant candidates (Lentine *et a*l., 2012),[12] but our data suggest that the intensity of post-operative surveillance in the first month may need to be enhanced, particularly for high-risk individuals.

Our analysis also revealed that recipient age is a significant predictor of mortality, with the highest rate (15.0%) in the >45 years age group. This is expected, as advanced age is often associated with a higher burden of comorbidities, including subclinical CVD and reduced physiological reserve, which can impact the ability to withstand the stress of surgery and immunosuppression.[21] Furthermore, an intriguing observation was the highest mortality rate (15.4%) among recipients who received grafts from sisters. While this finding is based on a small sample size (n=13) and should be interpreted with caution, it raises a hypothesis about potential immunogenetic or biological factors. Sisters, unless identical twins, share on average 50% of HLA haplotypes. This level of mismatch, potentially compounded by pregnancy-induced sensitization in female donors, could lead to

subclinical alloimmune responses or difficulties in managing immunosuppression that were not captured in this study.[22] This association merits future investigation with detailed HLA matching and donor-specific antibody data.

The low incidence of recorded surgical complications (~7.7%) such as renal artery stenosis or thrombosis, as confirmed by Doppler USG, is encouraging and speaks to the technical proficiency of the surgical team. The utility of Doppler USG in providing real-time, non-invasive assessment of vascular integrity and parenchymal perfusion is well-established and makes it an indispensable tool in the post-transplant armamentarium.[15] Similarly, the low rate of acute rejection and infection is notable. This suggests that the primary challenge in this group is not technical or immunologic failure but rather the medical management of high-risk recipients, particularly concerning cardiovascular health, a challenge echoed in other contemporary transplant groups.[23]

Limitations

This study has several limitations. Its retrospective, single-center design limits the generalizability of the findings. The small absolute number of deaths (n=9) precludes robust multivariate regression analysis to identify independent risk factors for mortality. Detailed data on pre-existing comorbidities (e.g., duration of hypertension, diabetes control, pre-transplant cardiac ejection fraction), HLA matching, immunosuppression trough levels, and long-term graft function were not available, which are crucial for a comprehensive risk assessment. The limited usage of certain medications like Grafalon made it impossible to draw any meaningful conclusions about their efficacy. Finally, the specific protocols for routine versus indicated Doppler USG surveillance were not standardized, which may have led to an underestimation of subclinical complications.

Conclusion

This study elucidates the distinct demographic landscape and clinical outcomes of living-donor kidney transplantation in Bangladesh. It confirms a high reliance on older female familial donors and demonstrates an excellent overall survival rate. However, it uncovers a critical vulnerability to early post-operative cardiovascular mortality, which emerges as the single greatest threat to patient survival in the immediate post-transplant period. The findings strongly advocate for the implementation of intensified, protocol-driven cardiovascular risk assessment and management strategies. This includes enhanced pre-transplant cardiac screening utilizing advanced imaging where indicated, stringent perioperative hemodynamic monitoring in a high-dependency setting, and aggressive management of cardiovascular risk factors in the early post-transplant phase, particularly for older recipients. The role of Doppler USG remains vital for monitoring graft health. Future prospective, multi-center studies with detailed immunogenetic and comorbidity data are needed to validate these findings, further explore the sister-donor risk hypothesis, and personalize risk mitigation strategies to improve long-term survival after kidney transplantation.

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