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Original Article

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Results of Renal Transplantation from the Very Elderly Deceased Donors: An Age-Based View

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ABSTRACT

Objective: Geriatric donors may be associated with worse allograft quality and less survival rates. We report the outcomes of allografts harvested from geriatric deceased donors and the survival rates of the recipients.
Methods: In this study, 284 deceased donors and their recipients were enrolled in the study. Donors and recipients were divided into 3 groups according to the World Health Organisation age classification: child (<18 years), adult (≥18 and <65 years), and geriatric (≥65 years). The geriatric group was divided into the elderly (≥65 and <75 years) and very elderly (≥75 years) groups. Short- and long-term survival of the allografts and recipients and factors might have an impact on those were investigated.
Results: 284 recipients were followed-up median of 55 months (0-143), in which 52 recipients died and the median allograft survival was 49 months (0-143). In the geriatric donor group, the average allograft survival rate was less compared to other age groups. However, the elderly donor and very elderly groups have a similar 1-, 3-, and 5-year allograft survival rate. One-year allograft survival rate was similar among all age groups, however, less at third and fifth years post-transplant, in the elderly and very elderly groups. One-, 3-, and 5-year recipient survival rates were similar among all age groups. However, in subgroup analysis, in the very elderly group, the 5-year recipient survival rate was the worst.
Conclusion: One-year allograft survival rates are similar among all age groups. However, allograft loss becomes apparent at 3- and 5-year post-transplant in geriatric donors. Short- and long-term outcomes of allografts from the elderly and very elderly deceased donors are similar. When considering a kidney allograft transplantation from geriatric donors, the inverse impacts of donors' age should be considered in matching donors and recipients. Nevertheless, clinicians should not hesitate to transplant an allograft from a very elderly deceased donor to a recipient candidate considering the worse outcomes of dialysis modalities.
Keywords: Deceased donors, kidney transplantation, survival

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INTRODUCTION

End-stage renal disease (ESRD) is a life-threatening health problem bearing various complications when not treated appropriately.[1] Renal transplantation (RTx) is the most favorable choice of treatment for the disease, however, lacking the sufficient number of organs to deliver to the patients is the major challenge in this regard.[2-4] In developed countries, organ pools are being supported by deceased donations in a higher portion.[5] In contrast, in Turkey, the majority of allografts are obtained from living-related donors and most of them are close relatives.[6]

Support of the deceased donor renal allograft donation to the organ pool is in limited numbers in Turkey. . So, there is a trend toward less ideal deceased donors in Turkey, as well as all around the world.[6] In this regard, a thorough evaluation is mandatory when an allograft from the deceased-originated is offered to a transplant

center from the national organ coordination center. There should be strict and rational mandatories to reject the allograft.

Many transplant centers hesitate to harvest an allograft from an elderly/very elderly deceased donors due to concerns of the low allograft quality and relatively less long-term graft survival expectancy. Especially, when a relatively younger recipient candidate is concerned the clinicians have even less willing to transplant the allograft from geriatric donors.[7]

Here, we present our outcomes of RTx from the deceased donations, in an age-based view.

MATERIALS AND METHODS

This single-center retrospective cohort study includes 284 deceased kidney allograft donors and their recipients between February 2009 and February 2019. Donors were divided into 3 groups according to the ages;

- Group 1 (child); < 18 years (25 recipients).
- Group 2 (adult); ≥ 18 and < 65 years (195 recipients).
- Group 3 (geriatric); ≥ 65 years (64 recipients).

Subsequently, the geriatric group was divided into 2 groups: the elderly (≥ 65 and < 75 years) (42 recipients) and the very elderly (≥ 75 years) (22 recipients).

With the aim of categorizing ages for children, adults, and elders, we investigated many studies and unfortunately, a uniform and generally accepted consensus was found lacking. Despite this, we tried to adhere to the report of the World Health Organization definition for aging and older individuals and the age grouping of previous studies.

Donors' demographic features and laboratory findings were noted. All donors were evaluated and matched to recipients according to the policy of national organ provision services. Allograft functions, allograft and patient survival, early mortality (mortality within post-transplant 3 months), delayed graft functions (DGF) (dialysis requirement within post-transplant 1 week), and primary graft nonfunction (PGF) were noted for each group. Factors that can influence allograft functions and survival (cytomegalovirus [CMV], polyoma BK-virus [BKV], acute kidney injury [AKI] of allograft at provision time, and acute rejection [AR] episodes) were also noted.

All patients received a standard immunosuppression protocol that consists of induction (rabbit anti-thymocyte globin [rATG]) and maintenance therapy (prednisolone + mycophenolate + calcineurine inhibitor). Two recipients received monoclonal IL-2 antagonist basiliximab instead of rATG, due to serious acute adverse reactions.

The estimated glomerular filtration rate (eGFR) was calculated by an online calculator on the basis of modification of diet on renal disease (MDRD 2009) formulation (www. mdrd.com).

AKI was defined on the serum creatinine changes which is determined by KDIGO 2012 AKI Guidelines. However, urine output did not consider for AKI.

Body mass index was calculated by the formula: weight (kg)/height $(m)^2$.

Ethical approval was obtained from the Istanbul Yeni Yuzyıl University Scientific Research Committee (IRB: 2020/06-477).

Statistical Analysis

Data were analyzed by using the Statistical Package for Social Sciences Version 15.0 (SPSS, Chicago, USA). Numeric variables were presented as mean ± standard deviation, and median (minimum and maximum). Categorical variables were compared by using the chi-square test. Parametric variables were compared among 3 groups, by using one-way analysis of variance. The Kruskal–Wallis test was used to determine whether the 3 groups differed for abnormally distributed variables. Then, the Mann–Whitney *U* test with Bonferroni correction was used to assess differences among the 3 groups. The elderly and very elderly groups were compared for parametric variables by using the independent sample *t* test and for non-parametric variables by using Mann–Whitney *U* test. Allograft and recipient survival rates were analyzed by Kaplan–Meier survival curves. Correlation analyses were performed by using Spearman and Pearson correlation analysis according to the type of variables. Cox-regression was used to demonstrate the impact of the potential factors on recipient and allograft survival. $P < .05$ was accepted as significant in a 95% CI.

RESULTS

A total of 284 kidney recipients (mean age 42.62 ± 14.16 years) and 284 deceased donors (mean age of 46.59 ± 20.37 years) were evaluated. Recipients were followed-up median 55 months (0-143 months), in which 52 recipients died in the follow-up period and 20 of that deaths occurred within post-transplant 3 months (early mortality rate 7%). The median allograft survival was 49 months (0-143 months). In this study, 46.5% of (132/284) donors had no AKI at the time of organ delivery. PGF was similar among 3 groups ($P = .58$) and in the very elderly group, 1 of 22 recipient had PGF. In the child group, DGF was the least compared to the other groups ($P = .001$). Fourteen of 21 recipients in the very elderly group had DGF (and 1 PGF event) and it was similar to other groups ($P > .05$), except child group; 68.2% versus 16% ($P = .002$). Duration of the renal replacement treatment was shortest in the child recipient group; approximately 32 months. Comparison of demographic, clinical, and laboratory parameters of donors and recipients, and allografts' functions were given in Table 1.

Recipient Survival

Average recipient survival duration and recipient 5-year cumulative survival are given in Table 1 and Figure 1. Recipients 1-, 3-, and 5-year cumulative survival rates were

Table 1. Comparisons of Demographic and Laboratory Features of Donor Groups

	Child; <18 Years, $n = 25$	Adult; ≥18 and ≤64 Years, $n = 195$	Geriatric, ≥65 Years, $n = 64$	*P*
Donor age, years	9.88 ± 5.77[a]	42.67 ± 13.17[b]	72.86 ± 5.86[c]	**.001**
Donor sex, male/female	17/8	121/74	30/34	.063
Donor BMI, kg/m^2	19.96 ± 3.64[a]	26.24 ± 3.83[b]	26.88 ± 4.53[b]	**.001**
Donor SCr_1, mg/dL	0.47 ± 0.24[a]	0.98 ± 0.49[b]	0.89 ± 0.29[b]	**.001**
Donor SCr_2 mg/dL	1.04 (0.16-5.72)	1.12 (0.33-7.47)	1.29 (0.50-8)	.735
Recipient age, year	21.24 ± 15.87[a]	44.38 ± 12.79[b]	45.59 ± 12.65[b]	**.001**
Recipient sex, male/female	10/15	117/78	35/29	.155
Recipient BMI, kg/m^2	18.15 ± 5.30[a]	24.08 ± 4.45[b]	23.51 ± 4.21[b]	**.001**
RRT duration, month	32 (1-360)[a]	126 (0-294)[b]	96 (5-230)[c]	**.001**
Cold ischemia time, h	13.55 ± 4.59	15.04 ± 4.78	15.06 ± 4.04	.270
Early mortality, yes/no	1/24 (4%)	16/179 (8.2%)	3/61 (4.7%)	.529
PGF, yes/no	0/25	6/189 (3.1%)	2/62 (3.1%)	.581
DGF, yes/no	4/21 (16%)[a]	102/93 (52.3%)[b]	40/23 (63.5%)[b]	**.001**
Average recipient survival, month	54 (2-133)	48 (0-143)	48 (0-136)	.632
Average allograft survival, month	51 (2-133)[a]	47 (0-143)[a]	35 (0-136)[b]	**.008**
Exitus, yes/no	4/21 (16%)	33/162 (16.9%)	15/49 (23.4%)	.487
Death-censored graft loss, yes/no	1/3	19/14	10/5	.325
Rejection episode(s), yes/no (Bx proven)	4/21(16%)	52/143 (26.7%)	15/49 (23.4%)	.481
BKV, positiviy (BKV DNA in the blood), yes/no	3/21	32/143	13/43	.507
No BKV history	21	143	43	
>10^4 copies/mL	2	4	2	.455
<10^4 copies/mL	1	20	7	
Bx proven BKVAN	0	8	4	
CMV, positivity (CMV DNA in blood), yes/no	11/13	53/122	25/31	.078
No CMV history	13	122	31	
Viremia	11	47	23	.135
CMV disease	0	6	2	
AKI, yes/no	19/6 (76%)[a]	93/102 (47.7%)[b]	40/24 (62.5%)[b]	**.007**

BMI, body mass index; SCr1, serum creatinine at admission; SCr2, terminal serum creatinine; RRT, renal replacement treatment; PGF, primary graft nonfunction; DGF, delayed graft function; Bx, biopsy; BKV, polyoma B-K virus; BKVAN, polyoma B-K virus-associated nephropathy; CMV, cytomegalovirus; AKI, acute kidney injury.
Each different superscript letter indicates the difference between groups at the 0.05 level. For instance, in each line, the same superscript means there is no difference between them. Every line is independent of the under and above columns.

similar among 3 groups ($P = .332$, $P = .225$, and $P = .230$, respectively) (Figure 1). However, subgroup analysis revealed that 5-year recipient survival rate was shorter in the very elderly group (63.6%), compared to the elderly group (90.5%) ($P = .012$) (Figure 2). In the very elderly group, 1- and 3-year recipient survivals were similar to the child and adult groups ($P = .302$ and $P = .074$, respectively), however, 5-year survival rate was less ($P = .020$ and $P = .031$, respectively). Death rates were similar among 3 groups ($P = .487$) (Table 1), however, subgroup analysis demonstrated that the mortaliy rate in the very elderly group was considerably higher compared to the elderly group ($P = .003$) (Table 3). There was a strong inverse correlation between recipient age and recipient survival rate ($P = .001$ and $r^2 = -0.19$). The recipient survival rate decreased with increasing age (Table 2). Death-censored allograft loss was also similar among all groups ($P = .32$) (Table 1). Recipient age was the only and the strongest predictive factor for the 1-, 3-, and 5-year recipient survival, $P = .001$ and $r^2 = -0.65$,

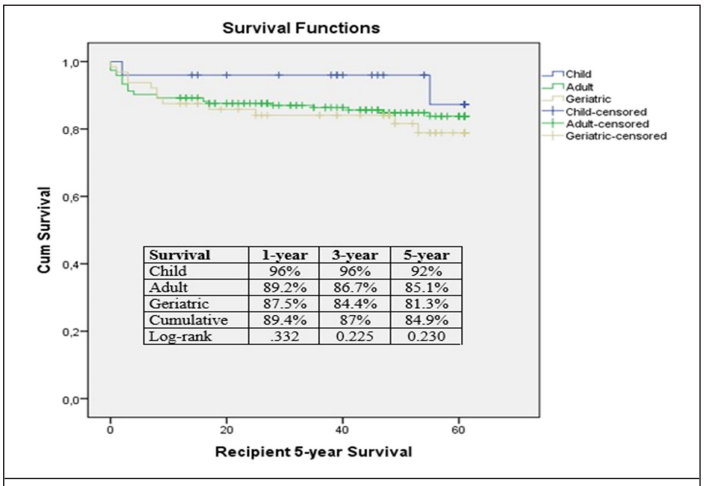

Figure 1. Recipient 5-year recipient survival rates.

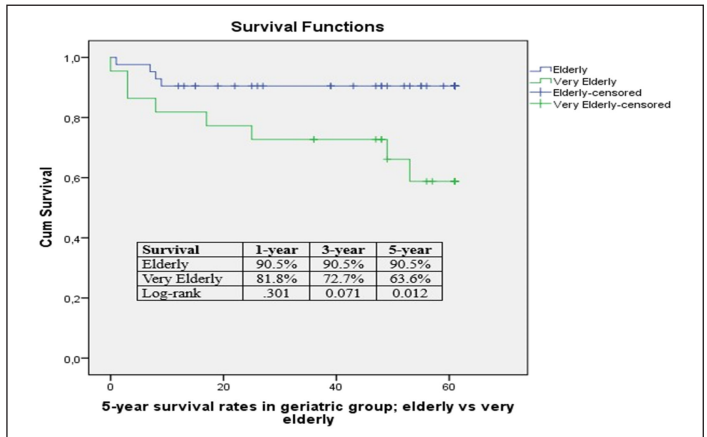

Figure 2. Recipient 5-year survival rates in geriatric group; elderly vs very elderly.

$P = .001$ and $r^2 = -0.67$, and $P = .001$ and $r^2 = -0.88$, respectively. One-year eGFR was not associated with the recipient long-term survival ($P = .30$ and $r^2 = 0.001$).

Allograft Survival

Average allograft survival rate and recipient 5-year cumulative allograft survival rates are given in Table 1 and Figure 3. In the child group, the average allograft survival rate was significantly higher than the geriatric group (Table 1). Kaplan–Meier survival curves indicate 1-year allograft survival is similar among 3 groups ($P = .065$) (Figure 3). Allograft survival rate was lower at the third and fifth years post-transplant in the geriatric donor group compared to the child and adult groups (geriatric vs. the child and adult groups; $P = .008$, and $P = .014$ for 3-year allograft survival and $P = .012$, and $P = .005$ for 5-year allograft survival, respectively) (Figure 3). In the very elderly group, 1-year allograft survival rate was similar to all other age groups ($P = .091$). The elderly and very elderly groups have

Table 2. Impact of the Factors on Recipient and Allograft Survival Rates (Univariate Analysis; Cox-Reggression)

	Recipient Survival			Allograft survival		
	P value with 95% CI and odds ratio					
	1-year	3-year	5-year	1-year	3-year	5-year
Donor age, year	0.991 (0.978-1.023) 1.000	0.602 (0.985-1.027) 1.006	0.761 (0.978-1.01) 0.997	**0.023** (1.004-1.053) 1.028	**0.001** (1.015-1.061) 1.038	**0.003** (1.009-1.047) 1.028
Recipient age, year	**0.034** (1.004-1.091) 1.046	**0.006** (1.016-1.100) 1.057	**0.008** (1.013-1.089) 1.050	0.313 (0.945-1.019) 0.981	0.465 (0.952-1.023) 0.987	0.542 (0.961-1.021) 0.991
RRT duration, month	0.562(0.996-1.008) 1.002	0.791 (0.995-1.007) 1.001	0.810 (0.995-1.006) 1.001	0.716 (0.995-1.008) 1.001	0.983 (0.993-1.006) 1.000	0.353 (0.992-1.003) 0.997
Donor BMI, kg/m^2	0.937 (0.910-1.109) 1.004	0.790 (0.924-1.108) 1.012	0.95 (0.914-1.008) 0.997	0.914 (0.901-1.097) 0.994	0.627 (0.888-1.074) 0.997	0.201 (0.886-1.032) 0.945
Recipient BMI, kg/m^2	0.885 (0.891-1.104) 0.992	0.498 (0.871-1.069) 0.965	0.38 5(0.870-1.055) 0.958	0.277 (0.955-1.174) 1.059	0.519 (0.935-1.144) 1.034	0.626 (0.938-1.114) 1.022
CMV positivity	0.482 (0.432-5.910) 1.598	0.420 (0.271-1.742) 0.687	0.09 (0.219-1.127) 0.497	0.822 (0.287-2.690) 0.879	0.765 (0.336-2.235) 0.866	0.257 (0.295-1.378) 0.637
BKV positivity	0.212 (0.141-1.561) 0.469	0.273 (0.201-1.582) 0.564	0.274 (0.235-1.513) 0.596	0.741 (0.284-5.788) 1.282	0.866 (0.322-3.845) 1.112	0.82 (0.337-2.375) 0.895
Acute rejection	0.601 (0.097-1.050) 0.318	0.188 (0.230-1.324) 0.55	0.305 (0.311-1.444) 0.670	0.940 (0.413-2.287) 0.972	0.657 (0.566-2.456) 1.179	0.198 (1.125-3.836) 2.077

RRT, renap replacement treatment; BMI, body mass index; CMV, cytomegalovirus; BKV, polyoma B-K virus; CMV positivity, any CMV DNA presence in blood samples at the follow-up course; BKV positivity, any Polyoma BKV DNA presence in blood samples at the follow-up period.

Table 3. Comparison of the Elderly and Very Elderly Donors in Geriatric Group.

	Elderly (≥65 and <75 Years), *N* = 42	Very Elderly (≥75 Years), *N* = 22	*P*
Donor sex, male/female	19/23	11/11	.792
Donor age, year	69.26 ± 2.78	79.73 ± 3.57	**.001**
Donor BMI, kg/m^2	27.24 ± 4.47	26.20 ± 4.67[b]	.395
Recipient age, year	41.71 ± 11.92	53.77 ± 9.45	**.001**
Recipient BMI, kg/m^2	23.68 ± 4.79	23.51 ± 2.69	.710
RRT duration, month	96 (5-230)	104 (112-124)	.563
Donor SCr_1, mg/dL	0.93 ± 0.31[b]	0.82 ± 0.26[b]	.139
Donor SCr_2, mg/dL	1.42 ± 0.76	1.64 ± 1.39	.444
Cold ischemia time, h	14.87 ± 4.45	15.08 ± 3.66	.975
Early mortality, yes/no	1/41	2/20	.635
PGF, yes/no	1/41	1/21	.582
DGF, yes/no	16/2	14/7	.570
Average recipient survival, month	53 (1-136)	49 (0-135)	.497
Average allograft survival, month	33 (0-136)	35 (0-136)	.232
Exitus, yes/no	5/37 (11.9%)	10/12 (45.5%)	**.003**
Death-censored allograft loss, yes/no	4/1	6/4	.608
Rejection (Bx proven), yes/no	8/34	7/15	.252
AKI, yes/no	23/19 (54.8%)	17/5 (77.3%)	.072

similar overall allograft survival rate (*P* = .839, *P* = .292, *P* = .144, respectively, for 1-, 3-, and 5-year allograft survivals) (Figure 4). Allograft survival rate was inversely correlated to donors' and recipients' ages (*P* = .001 and *P* = .001, $r^2 = -0.18$ and $r^2 = -0.19$,

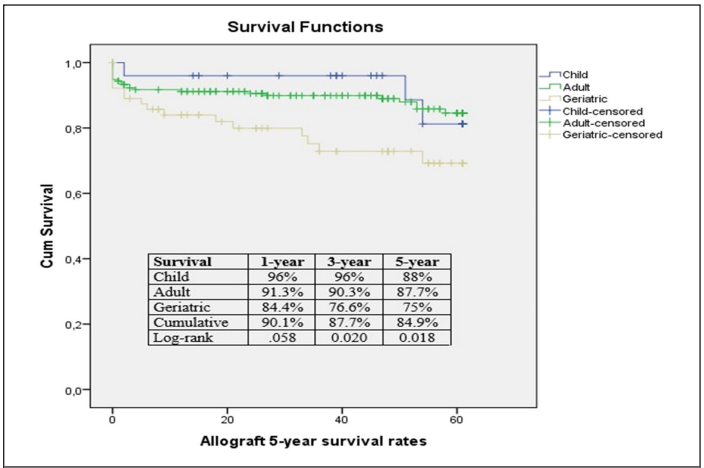

Figure 3. Comparison of the 5-year allograft survival rates.

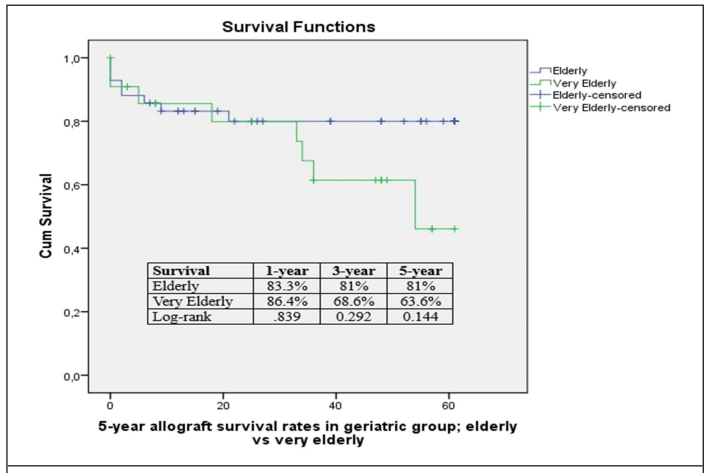

Figure 4. Allograft survival rates in geriatric group; elderly vs very elderly.

respectively). Recipients' and donors' body mass index had no correlation with overall allograft survival (*P* = .27 and *P* = .53, $r^2 = 0.037$ and $r^2 = -0.085$, respectively) in Table 2.

Allograft Functions

The child group had the best 1-, 3-, and 5-year allograft functions (Table 4). Geriatric group had the worst allograft functions (*P* = .001) compared to the child and adult groups for 1-, 3-, and 5-year eGFR (Table 4). Donor age was the only strongest factor on 1-, 3-, and 5-year allograft functions (*P* = .001 and $r^2 = -0.54$, *P* = .001 and $r^2 = -0.58$, and *P* = .001 and $r^2 = 0.55$, respectively). Recipients' and donors' BMI had no correlation with 1-year eGFR (*P* = .12, *P* = .16, $r^2 = -0.13$ and $r^2 = -0.09$, respectively). Serum creatinine level at the admission time to the hospital (is the first determined serum creatinine levels in the hospital) was negatively correlated to 1-, 3-, and 5-year eGFR (*P* = .006 and $r^2 = -0.29$, *P* = .015 and $r^2 = -0.26$, *P* = .045 and $r^2 = -0.21$). Nevertheless, at the time of allograft harvesting, the terminal creatinine levels which almost had increased in all groups compared to the admission serum creatinine, had no correlation to the allograft functions (*P* = .70, *P* = .64, and *P* = .96, respectively).

Contributory Factors

AR episodes, CMV, and BKV positivities were similar between all groups (*P* = .481, *P* = .07, and *P* = .507, respectively), which all

Table 4. One-, 3-, and 5-years Allograft Functions

	Child, *n* = 25	Adult, *n* = 194	Geriatric, *n* = 41	*P*
1-year eGFR, mL/min	95.00 ± 28.30[a]	70.01 ± 24.57[b]	44.79 ± 19.81[c]	.001
3-year eGFR, mL/min	96.70 ± 31.60[a]	66.32 ± 25.31[b]	46.03 ± 16.82[b]	.001
5-year eGFR, mL/min	98.25 ± 36.25[a]	68.58 ± 25.46[b]	46.61 ± 12.65[c]	.001

Each different superscript letter indicates the difference between groups at the 0.05 level. Every column is independent of the under and above columns.

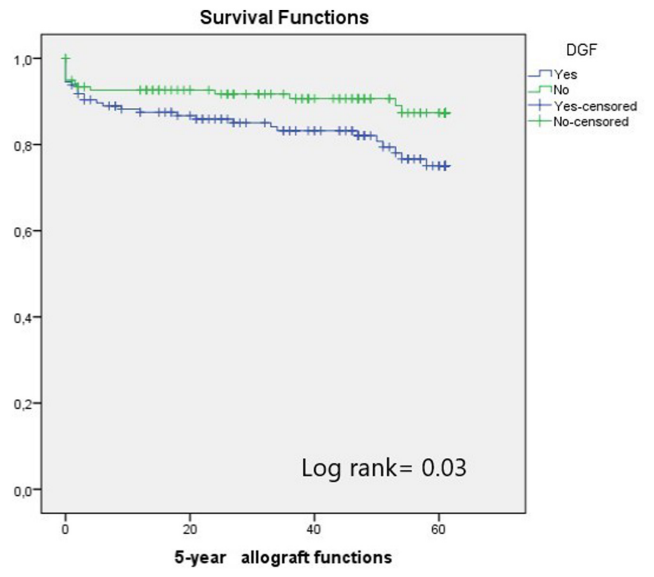

Figure 5. Impact of DGF on allograft survivals.

traditionally have some potential adverse impacts on allograft functions. DGF was significantly less common in the child donor group compared to other groups ($P = .001$) (Table 1). The survival curve revealed that DGF had no impact on 1- and 3-year allograft survival ($P = .172$ and $P = .083$, respectively), however, 5-year allograft function was lower in DGF group ($P = .035$) (Figure 5). On the other hand, in the very elderly group, a higher incidence of DGF had associated with poor allograft functions compared to the child and adult groups ($P = .032$, $P = .001$, and $P = .001$, respectively, for 1-, 3-, and 5-year allograft survival). AKI prevalence was 53.5% in donors and 12.7% of donors had AKI stage 3. AKI had no impact on short and long-term allograft survivals.

DISCUSSION

End-stage renal disease is a life-threatening health problem and the most favorable renal replacement therapy is still RTx. Deceased kidney allograft donation is the desired allograft harvesting type compared to living-related donation. By aging the population, the average donation age will increase further. So it is reasonable to be in concern when accepting an allograft from a very elderly deceased donor. In our study, we revealed that 1 –year survival rate of allografts from the very elderly donors (≥75 years) was similar to allografts from all other age groups, besides 3 and 5-years allograft survival rates were also similar to the elderly group (≥ 65 and <75 years). However, in the population of the elderly and very elderly groups, the survival of allografts was getting worse from the 3rd year after transplantation.

To do transplant an allograft from geriatric deceased donors has been a more controversial issue, in the transplantation era. Since all populations around the world are getting older, as well as donors and recipients, the outcomes of allografts from very elderly deceased donors need to be clarified. It is a well-described topic that RTx provides the best survival rates and good health-related quality of life with the lowest cost in the long-term compared to other renal replacement therapies.[8,9] But this common view is controversial in considering the older recipients and donors (also, donors >60 years are accepted as donors with expanded criteria donor [ECD]). Saidi et al. reported that ECD (mean age; 61.2 years) is associated with a significantly higher incidence of DGF, longer time to reach serum creatinine below 3 mg/dL, a longer length of stay in the hospital, and more readmissions compared to standard criteria donors (36.1 years). The early allograft survival rate was comparable among all age groups but after a mean 50-month, follow-up allograft survival was significantly less in ECD group.[7] In two other studies; the authors suggest that transplantation of kidneys from “old” donors into “young” recipients should be avoided, and these kidneys should be given to age-matched recipients.[10,11] In contrast, given the high mortality of >75 years hemodialysis patients (a 5-year survival rate is as low as 12.5% for dialysis patients and 29% for those on the waiting list),[10] a recent study revealed less mortality rate in the kidney allograft recipients who were >75 years, compared the HD patients at a similar age.[12] In our study, in recipients who received an allograft from a geriatric deceased donor 1, 3, and 5 years recipient survival was not inferior compared to other age groups. However when the geriatric group was divided into the elderly and very elderly groups; in the very elderly group 5-year recipients’ survival rate was less, 63.6% versus 90.5%, $P = .01$. In contrast, 1-, 3-, and 5-year allograft survival rates were similar between the elderly and very elderly groups ($P = .83$, $P = .29$, and $P = .14$, respectively). Those outcomes are superior to dialysis modalities in considering the United States Renal Data System (USRDS) report. USRDS reports reveal the survival rate for patients on hemodialysis (HD) is 57% at 3 years after the onset of ESRD and 68% for patients receiving peritoneal dialysis (PD). Five-year survival rates for patients receiving HD and PD are 42% and 52%, respectively (overall outcomes for all ages).[13,14] Allograft functions (eGFR) at 1-, 3-, and 5-year were best in the child and worst in the elderly groups, which was closely related to donor age and indirectly to the allograft quality. Considering all, allograft from the very elderly individuals might provide some benefits on patient survival when matched to at a relatively similar age patient on maintenance dialysis.

Geriatric-aged patients face many problems in regard to RTx. Increased risks associated with surgical procedures and immunosuppression, giving priority to younger candidates (an informal approach) are barriers to the provision of the advantage of RTx to older individuals. An age-based approach could be a key point, in providing an allograft to recipient candidates, given the shorter survival of allograft from the very older deceased donors. This approach will also provide many older ESRD patients to receive proper allografts. Meanwhile, the

more age difference between the very elderly donors (approximately 80 years) and their matched relatively young recipients (approximately 54 years) will be some critics of our results. However, transplantations from the very elderly deceased donors provided a 63.6% recipient and 63.6% allograft survival rate, which means a dialysis-free life, at a 5-year follow-up. Age-based regression analyses revealed the donor age was closely related to allograft survival while recipient age was further related to recipients' survival. Factors that might impact the short and long-term allograft functions such as CMV, BKV, and AR episodes were similar among all groups and had no impact on long-term allograft survival. Additionally, renal replacement treatment duration and donor BMI had no impact on short- and long-term allograft and recipient survivals, in our cohort.

Obesity of donors has been found a discard cause, according to the United Kingdom and the United States of America organ donation reports.[15,16] Obesity is on the increase and constitutes one of the biggest public health burdens across the world. In regards to RTX, facing an obese donor or, at least, one with a higher BMI will be a more common event in the near future and even today in the developed countries it is realized. Previous studies have shown contradictory results. Data from the UK suggest donor BMI is associated with DGF, however, has no impact on short- and long-term allograft survival rate.[17] One can think that larger allografts received from donors with higher BMI might have better allograft functions, especially when transplanted in smaller-sized recipients. However, a recent study reported exactly the opposite outcomes, which demonstrated an association between mortality and larger allografts.[18] In our study, we demonstrated that donors' and recipients' BMI has no impact on long-term allograft survival.

The incidence of DGF is on the rise due to the increasing use of older donors. DGF has several impacts on short- and long-term allograft functions.[19] USRDS data indicates 31% of recipients require at least one dialysis session post-transplant. Two other recent study demonstrated the incidence of DGF 30.8% in deceased donors and 55.1 in deceased donors after cardiac death.[20,21] DGF has been found associated with worse short- and long-term allograft survivals and functions.[22] In our study the prevalence of DGF was 51.4% and 1- and 3-year allograft survival rates were similar to recipients without DGF, however, 5 years allograft survival rate was worse compared to recipients without DGF. Serum creatinine of the donors' which was first determined at the hospital had a significant negative correlation to 1-year eGFR levels. It might be an indirect reflection of the allograft function which differs from AKI.

In the child group, recipient and allograft survival rates were the longest due to a reflection of generally longer life expectancy of disease-free child population and provision of an allograft from a young donor.

We suggest keeping some key points in mind, according to our and previous studies' outcomes: (i) suggest an allograft from a very elderly donor to a recipient candidate, in an age-matched fashion, (ii) avoid suggesting an older donor-related allograft to a child or young adult, (iii) if there is a mandatory (lack of adequate vascular access, highly sensitized patient, otherwise no available recipient candidates) to give an older allograft to a young recipient candidate, check the allograft quality by biopsy, if severe sclerosis, tubular atrophy, and vascular changes are described think about the double allograft transplantation.[23,24]

In conclusion, harvesting an allograft from the elderly and even from the very elderly donors provides superior patient survival rates compared to dialysis modality. However, the expected allograft survival rate could be inferior to relatively younger donors. In an age-based modality, all recipients on the waiting list might receive the advantages of the RTx.

Limitation of the study: Immunosuppression regimens which were adjusted according to recipients clinical aspect (CMV, BKV, and serious urinary tract or other systemic infections, AR episodes, a few numbers of protocol treatment of consisting mammalian Target of Rapamycin (mTOR) inhibitors, drug-associated adverse reactions) were not analyzed and that might be the major limitation of the study.

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Informed Consent: Written informed consent was obtained from all participants who participated in this study.

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