Rev Colomb Cir. 2022;37:214-25
https://doi.org/10.30944/20117582.1052

ORIGINAL ARTICLE

Long-term outcomes in kidney transplant patients with expanded criteria donors: 10-year experience

Desenlaces a largo plazo en pacientes trasplantados renales con donantes de criterios expandidos: experiencia de 10 años

David Espitia[1], Andrea García-López[2], Nasly Patino-Jaramillo[3], Fernando Giron-Luque[4]

1 MD, specialist in General Surgery, Universidad del Rosario, Bogota, Colombia.
2 MD, master in Clinical Epidemiology, Colombiana de Trasplantes, Bogota, Colombia.
3 MD, fellow of Molecular Research, Colombiana de Trasplantes, Bogota, Colombia.
4 MD, specialist in General Surgery and Trasplants, Colombiana de Trasplantes, Bogota, Colombia.

Honorific Mention in the ACC Member Category in the "José Félix Patiño Restrepo" National Surgery Research Contest, category of Medical Specialists, 47th National Surgical Week Congress "100 Leaders of World Surgery in Colombia", November 2021.

Abstract

Introduction. Kidney transplantation is the treatment of choice for chronic kidney disease. Due to the gap with donor availability, the use of expanded criteria is an option that seeks to improve the global donation rate. The objective of this study was to compare the survival of the graft and the transplanted patient with an expanded criteria donor versus the standard donor.

Methods. Retrospective cohort of 1002 kidney transplant patients where survival of the kidney graft and the recipient was determined at 10 years after transplantation. The survival of the kidney graft and the recipient were estimated by the Kaplan-Meier method. A Cox regression was performed by fitting the multivariate model.

Results. The analysis included 1002 recipients with 18.8% (n=189) corresponding to the use of an expanded criteria donor. The expanded criteria donor kidney transplant group had lower patient (48.1% versus 63.8%) and graft (63.3% versus 74.7%) survival compared to the donor kidney transplant group with standard criteria at 10 years post-transplant. The association of kidney transplantation with expanded criteria donor and death or loss of the kidney graft were not significant when the variables were adjusted in the multivariate model.

Conclusion. Kidney transplantation with an expanded criteria donor has a lower recipient and graft survival compared to the standard kidney transplant group. There were no statistically significant differences in expanded criteria donor kidney transplantation versus kidney graft loss or death.

Keywords: kidney transplant; donor selection; transplant donor site; tissue and organ procurement; graft rejection; graft survival.

Received: 08/15/2021 - Accepted: 11/14/2021 - Date of publication online: 02/03/2022
Corresponding author: Andrea García-López, Avenida carrera 30 # 47 A – 47, Colombiana de Trasplantes, Bogotá, D.C., Colombia. Phone number: +57 3005024618. Email: aegarcia@colombianadetrasplantes.com
Cite as: Espitia D, García-López A, Patino-Jaramillo N, Giron-Luque F. Desenlaces a largo plazo en pacientes trasplantados renales con donantes de criterios expandidos: experiencia de 10 años. Rev Colomb Cir. 2022;37:214-25. https://doi.org/10.30944/20117582.1052

Resumen

Introducción. El trasplante renal es el tratamiento de elección para la enfermedad renal crónica. Debido a la brecha con la disponibilidad de donantes, el uso de criterios expandidos es una opción que busca mejorar la tasa de donación mundial. El objetivo de este estudio fue comparar la sobrevida del injerto y del paciente trasplantado con donante de criterios expandidos versus el donante estándar.

Métodos. Cohorte retrospectiva de 1002 pacientes con trasplante renal donde se determinó la sobrevida del injerto renal y del receptor a 10 años después del trasplante. La sobrevida del injerto renal y el receptor fueron estimadas por el método de Kaplan-Meier. Una regresión de Cox fue realizada ajustando el modelo multivariado.
Resultados. El análisis incluyo 1002 receptores, con un 18,8 % (n=189) que correspondían al uso de donante de criterios expandidos. El grupo de trasplante renal con donante de criterios expandidos tuvo menor sobrevida del paciente (48,1 % versus 63,8 %) y del injerto (63,3 % versus 74,7 %) en comparación con el grupo de trasplante renal con donantes con criterios estándar a los 10 años después del trasplante. La asociación de trasplante renal con donante de criterios expandidos y muerte o pérdida del injerto renal no fueron significativas cuando se ajustaron las variables en el modelo multivariado.

Conclusión. El trasplante renal con donante de criterios expandidos tiene menor sobrevida del receptor y del injerto frente al grupo de trasplante renal con donante estándar. No hubo diferencias estadísticamente significativas en cuanto al trasplante renal con donante de criterios expandidos frente a la pérdida del injerto renal o muerte.

Palabras clave: trasplante de riñón; selección de donante; sitio donante de trasplante; obtención de tejidos y órganos; rechazo de injerto; supervivencia de injerto.

Introduction

Chronic kidney disease (CKD) is a progressive pathology that affects about 9% of the global population and is associated with multiple comorbidities, generating a high cost for health systems [1,2]. For 2019, a prevalence of 2.8% and an incidence of 3.5 cases per 1,000 inhabitants were estimated in Colombia, of which 11,053 were in stage 4 or 5 of the disease [3].

The optimal treatment for stage 4 and 5 CKD is kidney transplantation, offering better quality of life and longer survival [4,5], but this form of treatment is limited due to the limited availability of organs. The situation in Colombia is similar to that reported in other countries where the number of patients on the kidney transplant waiting list exceeds the number of donors [3]. Efforts to increase the pool of donors (living and deceased) are the current focus of transplant programs [6,7].

Making use of cadaveric donors with expanded criteria (ECD) is one of the strategies used to bridge the gap between CKD patients requiring transplantation and the number of potential organ donors available [7]. Kidneys from expanded criteria donors may have lower long-term survival compared to those from standard criteria donors, but even so, ECD recipients have been widely shown in various publications to have much longer survival when compared to those dialysis patients on the waiting list [8-10].

Ojo et al, describe in their study that survival in these recipients increases by five years compared to those who have not received a transplant, while in recipients of standard criteria donors the increase in survival reaches 13 years. Survival varies according to the etiology of CKD and the patient's age group, with the greatest benefit found in patients with diabetic nephropathy (up to 5.6 more years of life) and patients with hypertensive nephropathy (up to 8.5 more years of life) [8]. Despite the above, these organs are discarded relatively frequently and many transplant centers prefer not to use them [11].

The objective of this study was to estimate the main long-term outcomes of kidney transplant patients with ECD compared to standard criteria in a cohort of patients transplanted by Colombiana de Trasplantes.

Methods

Analytical observational study of a historical cohort that included patients transplanted at Colombiana de Trasplantes, an entity that performs around 21% of these procedures in the country. The patients were operated between August 2008 and May 2019, in the cities of Bogota, Barranquilla and Rionegro. Data were collected from electronic medical records and included sociodemographic information, medical history, and clinical characteristics of the donor and recipient.

All patients older than 18 years, transplanted for the first time with kidneys from cadaveric donors, were evaluated; patients who had arterial or venous thrombosis were excluded. Recipients were followed until graft loss, death, or the end of follow-up 10 years after transplantation. All patients received induction therapy with alentuzumab®, basiliximab®, or antithymocyte immunoglobulin, according to immunological risk and transplant medical guidelines. The immunosuppression regimen consisted of calcineurin inhibitors and antimetabolites. The patients were closely monitored in the first four weeks after transplantation and then followed up with monthly visits to our center.

The main outcome was patient and graft survival. Death was defined as mortality from any cause recorded in the mortality template of the Colombiana de Trasplantes clinical history and was supplemented with information from national registries (National Registry of Civil Status). Graft loss was defined as permanent return to dialysis reported by the center. Patients were excluded from the study when they were transferred to another transplant center or lost to follow-up.

Two comparison groups were defined according to the presence or absence of expanded criteria in the donor. The presence of expanded criteria was defined as donors aged 60 years or older, or older than 50 years with at least two of the following conditions: history of arterial hypertension, serum creatinine > 1.5 mg/dl or cause of cardiovascular death. The other donors who did not meet these criteria were classified as the standard criteria group [12].

Bivariate descriptive statistics were used for continuous variables (mean with SD, mode with interquartile range) and categorical variables (frequencies and percentages) to characterize the patients according to the presence of expanded or standard criteria. For the comparison between the groups (expanded vs. standard criteria), the Chi^2 test was used for categorical variables and the Student's t-test or Mann Whitney for quantitative variables, as appropriate.

Overall survival was analyzed using the Kaplan Meier survival probability method. For this analysis, the event of interest was established as the survival of the patient and of the renal graft. Time to event corresponded to the time in years from the date of transplant to graft loss or exclusion. Median and standard error of the survival function with their respective 95% confidence interval were estimated. Survival functions were compared between categories of sociodemographic and clinical variables using the Log Rank test if the variable was categorical or a single-variable Cox regression for quantitative variables. Variables with values of $p<0.25$ were considered for multivariate analysis.

For multivariate analysis, survival curves were compared using the Log Rank test for categorical variables and the univariate Cox test for continuous variables. The variables that obtained a p-value <0.25 in the Log Rank test and Cox univariate test were selected to be included in the complete multivariate model of each outcome. From the complete multivariate model, the variables without statistical significance ($p<0.05$) were removed one by one, maintaining the main exposure variable (expanded criteria versus standard criteria) until the final model was obtained.

Results

During the study period, a total of 1621 patients were transplanted, of which 113 were pediatric, 452 were living donors, and 54 had graft thrombosis. After applying the selection criteria, a total of 1002 kidney transplant patients were included, 189 (18.8%) of them with kidneys from donors with expanded criteria. The majority were men (60.9%), the mean age was 45.9 ± 12.6 years, the age being higher in the ECD group.

In most patients, the cause of CKD was not identified, but of the known causes, diabetic etiology was the most frequent. Approximately 80% of the patients had a history of hypertension and 16% of diabetes mellitus; 44% were on hemodialysis therapy prior to transplantation. The mean time on dialysis was 35 months. The mean cold ischemia time was 18.3 hours. During follow-up, 34.3% of the patients presented acute cellular rejection and 2.1% presented humoral rejection. Table 1 describes in detail the sociodemographic and clinical characteristics of the study population according to the donor groups of expanded criteria versus standard criteria.

A total of 145 patients (14.4%) lost the graft during the study period. Overall graft survival estimated by the Kaplan Meier method was 91% in the first year, 81.4% in the fifth year, and 73.1% in the tenth year of follow-up. For the standard criteria group, graft survival was 92.1% in the first year, 83.2% in the fifth year, and 74.7% in the tenth year; while for the expanded criteria group it was 86.2%, 69.6% and 63.3%, respectively. Figure 1 shows overall graft survival and Figure 2 shows graft survival according to the expanded and standard criteria groups.

A total of 218 patients (21.7%) died during the study period. Of these, 158 had a functional graft at death. The overall survival of the patients estimated by the Kaplan Meier method was 86.7% in the first year, 72.8% in the fifth year, and 61% in the tenth year of follow-up. For the standard criteria group, patient survival was 88.8% in the first year, 76.1% in the fifth year, and 63.8% in the tenth year; while for the group with expanded criteria it was 77.9%, 53% and 48.1% for the first, fifth and tenth years, respectively. Figures 3 and 4 show overall and patient survival, and according to the expanded versus standard criteria groups, respectively.

For the multivariate analysis, the survival curves were compared for both graft loss and death, obtaining the results shown in Table 2. In a final model, it was found that the factors associated with graft loss were: "Mismatch" (increase of 10% for each number of "mismatch"; p=0.01); acute cellular rejection (2.4 times the risk of loss compared to those without cellular rejection; p=0.00); humoral rejection (2.0 times the risk of loss compared to those without humoral rejection; p=0.01); cold ischemia time greater than 14 hours (1.5 times the risk of loss compared to those with cold ischemia less than 14 hours; p=0.01), and hospital readmission (1.7 times the risk of loss compared to those with cold ischemia that did not require readmission). The presence of expanded criteria was not significant for graft loss in the multivariate analysis (p=0.178). The final model for graft loss is described in Table 3.

Regarding the factors associated with mortality, it was found that age (1.03 times the risk of death for each additional year; p=0.00); acute cellular rejection (1.5 times the risk of death compared to those without cellular rejection; p=0.00); cold ischemia time greater than 14 hours (1.4 times the risk of death compared to those who had cold ischemia less than 14 hours; p=0.02), and hospital readmission (1.5 times) were risk factors significant for death compared with those who did not require readmission. The presence of expanded criteria was not significant for mortality (p=0.086). The final model for mortality is described in Table 4.

Discussion

Due to the gap between the patients who need a kidney transplant and the available organs, transplant centers more frequently accept organs of suboptimal quality [13,14]. This alternative includes graft- and recipient-specific risks that must be considered individually [15,16], so alternative approaches to traditional donor selection, such as accepting ECD kidneys, have been proposed. Transplanted ECD kidneys have higher rates of delayed graft function, more episodes of acute rejection, and decreased graft function in the long term; however, ECD transplantation benefits a significant number of patients, improving their survival compared to those who remain on dialysis [9].

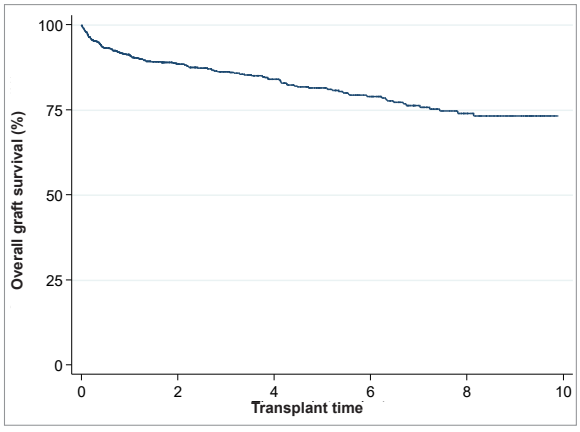
In our cohort, the main differences between the ECD groups and standard criteria donors

Table 1. Sociodemographic and clinical characteristics of the study population according to the donor groups of expanded criteria versus standard criteria.

Recipient characteristics	Cohort (n=1002)	Standard criteria (n=813)	Expanded criteria (n=189)	p-value
Sex (%)				0.075
Female	391 (39.0)	328 (40.3)	63 (33.3)	
Male	611 (60.9)	485 (59.6)	126 (66.6)	
Age (average, SD)	45.9 (12.6)	43.6 (12.2)	56.0 (8.7)	0.000
BMI (average, SD)	24.5 (4)	24.1 (4.0)	26.0 (3.8)	0.000
Location of residence (%)				0.029
Rural	38 (3.7)	36 (4.4)	2 (1.6)	
Urban	964 (96.2)	777 (95.7)	187 (98.4)	
Cause CKD (%)				0.000
Unknown	484 (48.3)	425 (52.2)	59 (31.2)	
Glomerular	144 (14.3)	121 (14.8)	23 (12.1)	
Arterial hipertension	129 (12.8)	100 (12.3)	29 (15.3)	
Diabetes mellitus	158 (15.7)	98 (12.0)	60 (31.7)	
Congenital	62 (6.1)	49 (6.0)	13 (6.8)	
Obstructive	25 (2.5)	20 (2.4)	5 (2.6)	
Support (%)				0.000
Strong	414 (41.3)	318 (39.1)	96 (50.7)	
Weak	352 (35.1)	279 (34.3)	73 (38.6)	
Unadequate	34 (3.3)	26 (3.2)	8 (4.2)	
Unknown	202 (20.1)	190 (23.3)	12 (6.3)	
Arterial hipertension (%)	796 (79.4)	626 (77.0)	170 (89.9)	0.000
Diabetes mellitus (%)	161 (16.0)	101 (12.4)	60 (31.7)	0.000
Type of dialysis (%)				0.000
Hemodialysis	449 (44.8)	350 (43.0)	99 (52.3)	
Peritoneal	283 (28.2)	223 (27.4)	60 (31.7)	
Predialysis	78 (7.7)	60 (7.3)	18 (9.5)	
Unknown	192 (19.1)	180 (22.1)	12 (6.3)	
Blood type (%)				0.831
O	577 (57.7)	472 (58.1)	105 (55.8)	
A	287 (28.7)	229 (28.2)	58 (30.8)	
B	91 (9.1)	73 (8.9)	18 (9.5)	
AB	45 (4.5)	38 (6.6)	7 (3.7)	
Time on dialysis, months (average, SD)	35.0 (31.1)	36.2 (38.2)	30.6 (32.3)	0.092
Missmatch (%)				0.000
0	14 (1.4)	13 (1.6)	1 (0.5)	
1	49 (4.9)	44 (5.4)	5 (2.6)	
2	165 (16.6)	150 (18.6)	15 (8.0)	
3	346 (34.8)	285 (35.3)	61 (32.6)	
4	239 (24.0)	183 (22.7)	56 (29.9)	
5	136 (13.7)	96 (11.9)	40 (31.3)	
6	44 (4.4)	35 (4.3)	9 (4.8)	
Type of induction (%)				0.000
Alemtuzumab	328 (32.7)	296 (36.4)	32 (16.9)	
Basiliximab	132 (13.1)	96 (11.8)	36 (19.0)	
Timoglobulina	489 (48.8)	370 (45.5)	119 (62.9)	
Other	53 (5.2)	51 (6.2)	2 (1.0)	
Cell rejection (%)	344 (34.3)	274 (33.7)	70 (37.0)	0.384
Humoral rejection (%)	21 (2.1)	17 (2.0)	4 (2.1)	0.982
Cold ischemia (media DE)	18.3 (14.3)	18.4 (15.6)	18.0 (6.6)	0.772
Hospital readmission (%)	580 (57.8)	448 (55.1)	132 (69.8)	0.000

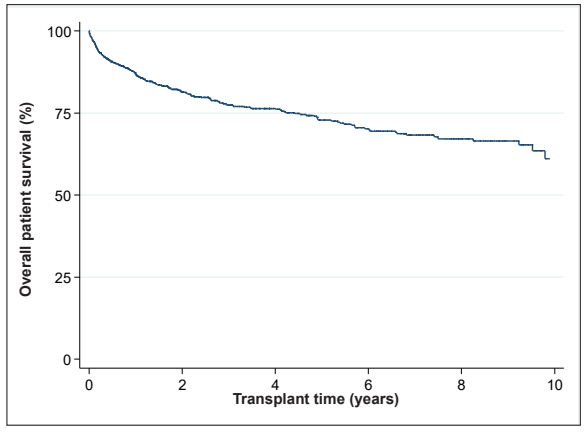
SD: standard deviation; BMI: body mass index; CKD: chronic kidney disease.

Source: authors



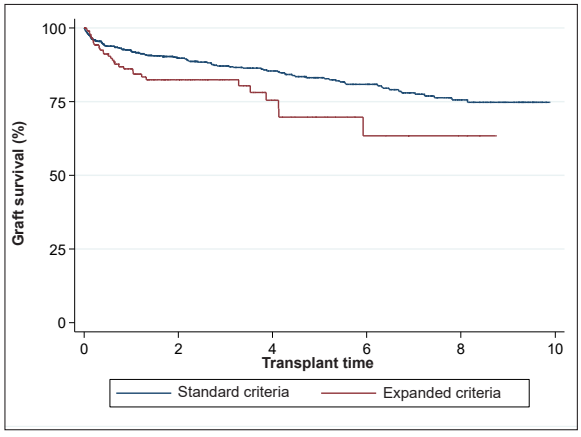
Source: authors

Figure 1. Overall graft survival in patients transplanted from cadaveric donors.



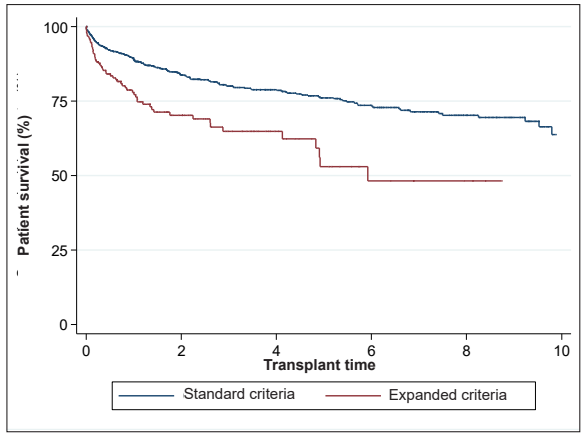
Source: authors

Figure 3. Overall patient survival in kidney transplant recipients from cadaveric donors.



Source: authors

Figure 2. Graft survival according to expanded criteria sets versus standard criteria.



Source: authors

Figure 4. Patient survival in renal transplant recipients according to the groups of expanded criteria versus standard criteria.

Table 2. Characteristics of cadaveric donor kidney transplant patients according to the outcomes of graft loss and death.

Recipient characteristics	Graft loss (n= 145)	p-value	Death (n=218)	p-value
Sex (%)		0.55		0.03*
Female	55 (37.9)		72 (33.0)	
Male	90 (62.0)		146 (66.9)	
Age (average, SD)	44.8 (0.3)	0.62	50.6 (0.7)	0.00
BMI (average, SD)	24.6 (0.3)	0.23*	25.1 (0.2)	0.00
Location of residence (%)		0.66		0.77
Rural	7 (4.8)		10 (4.5)	
Urban	138 (95.1)		208 (95.4)	

Recipient characteristics	Graft loss (n= 145)	p-value	Death (n=218)	p-value
Cause CKD (%)		0.55		0.00*
Unknown	64 (44.1)		109 (50.0)	
Glomerular	26 (17.9)		18 (8.2)	
Arterial hipertension	19 (13.1)		32 (14.6)	
Diabetes mellitus	23 (15.8)		49 (22.4)	
Congenital	10 (6.9)		6 (2.7)	
Obstructive	3 (2.0)		4 (1.8)	
Support (%)		0.00*		0.45
Strong	55 (37.9)		90 (41.2)	
Weak	53 (36.5)		59 (27.0)	
Unadequate	9 (6.2)		4 (1.8)	
Unknown	28 (19.3)		65 (29.8)	
Arterial hipertension (%)	104 (71.7)	0.02*	169 (77.5)	0.54
Diabetes mellitus (%)	23 (15.8)	0.80	50 (22.9)	0.01*
Type of dialysis (%)		0.05*		0.04*
Hemodialysis	76 (52.4)		94 (43.1)	
Peritoneal	30 (20.6)		49 (22.4)	
Predialysis	9 (6.2)		10 (4.5)	
Unknown	30 (20.6)		65 (29.8)	
Blood type (%)		0.93		0.17*
O	88 (60.6)		121 (55.7)	
A	38 (26.1)		57 (26.2)	
B	13 (8.9)		25 (11.5)	
AB	6 (4.1)		14 (6.4)	
Time on dialysis, months (average, SD)	35.3 (3,7)	0.86	37.6 (2.9)	
Missmatch (%)		0.24*		0,68
0	1 (0.7)		1 (0.4)	
1	4 (2.8)		9 (4.1)	
2	21 (14.7)		42 (19.4)	
3	47 (33.1)		72 (33.3)	
4	39 (24.4)		56 (25.9)	
5	23 (16.2)		29 (13.4)	
6	7 (4.9)		7 (3.2)	
Type of induction (%)		0.91		0.47
Alemtuzumab	62 (42.7)		98 (44.9)	
Basiliximab	21 (14.4)		30 (13.7)	
Timoglobulina	53 (36.5)		73 (33.4)	
Other	9 (6.2)		17 (7.8)	
Cell rejection (%)	91 (62.7)	0.00*	103 (47.2)	0.00*
Humoral rejection (%)	10 (6.9)	0.00*	7 (3.2)	0.19
Cold ischemia (media DE)	20.7 (19.1)	0.05*	20.6 (22.4)	0.03*
Hospital readmission (%)	109 (75.1)	0.00*	156 (71.5)	0.00*
Expanded criteria (%)	32 (22.0)	0.00*	56 (25.6)	0.00*

SD: standard deviation; BMI: body mass index; CKD: chronic kidney disease.
*Variables <0,25 in the univariate Log Rank or Cox test.

Source: authors

Table 3. Multivariate model with associated factors for graft loss in patients transplanted from cadaveric donors.

Variable	HR	p-value	95% CI
Mismatch	1.1	0.019	1.02-1.36
Acute rejection	2.4	0.000	1.74-3.53
Humoral rejection	2.0	0.033	1.06-3.98
Cold ischemia time >14 hours	1.5	0.020	1.07-2.01
Hospital readmission	1.7	0.004	1.20-2.60
Expanded criteria	1.3	0.178	0.87-2.01

HR: Hazard Ratio; CI: confidence interval.

Source: authors

were due to the fact that the ECD group was older, more frequently hypertensive or diabetic, and the patients presented hospital readmissions. The results obtained show that, like most published studies, the outcomes in ECD recipients are inferior in terms of graft and patient survival [11,17]. Although the survival of both the graft and the ECD recipients was lower, the great age difference between both groups and the implicit probability of presenting unfavorable events in the elderly group should be considered.

By applying the multivariate analysis we were able to determine that the differences found in graft and patient survival were not statistically significant and, on the contrary, other important factors associated with each of these outcomes were found.

The national literature on renal transplantation with expanded criteria is limited. In 2019, García et al published an observational descriptive study in which the main objective was to characterize transplant patients with expanded criteria donors, and renal function at the first and third year after transplant. The study concluded that transplant patients with expanded criteria donors have adequate renal graft function at three years, with graft and patient survival of 88.9% and 80% at one year and three years, respectively [18]. This figure is higher than that found in our findings; however, it should be noted that the sample size in this last mentioned study is small and only included 18 patients who received a transplant from ECD.

In our analysis, acute cellular rejection, cold ischemia time, and hospital readmissions were significant risk factors for both graft loss and mortality, as previously reported in the literature [11,19–22]. Other factors associated with graft loss were the number of HLA mismatches and humoral rejection, results that have also been reported in other studies [23-27].

The identification of risk factors for long-term graft loss has been provided by several studies; however, there is great variability in the data collection, the methods used and the variability of the predictors included [28], some the most described are: chronic dysfunction [19,29–32], decreased renal function [31,33–35], death with functional graft [19,29], glomerulonephritis [19], donor age [30], hypertension [30], diabetes [30,36], type of immunosuppression [30], delayed graft function [30], recipient age [33], race [33], albumin [33], and proteinuria [30,31-36].

This study found that advanced age had a negative impact on patient survival, a finding that is consistent with several published studies that report that younger age groups have less mortality compared to groups older than 60-65 years [37-41], but that in the long term the survival of the transplanted patient is significantly better compared to those who remain on the waiting list [41-44].

Strengths and limitations

The strength of this study is the large number of patients included in the cohort, taking into account that according to the 2018 National Institute of Health annual report [45], the Colombiana de Tras-

Table 4. Multivariate model with associated factors for mortality in patients transplanted from cadaveric donors.

Variable	HR	p-value	95% CI
Age	1.03	0.000	1.02-1.04
Acute rejection	1.5	0.001	1.19-2.06
Cold ischemia time >14 hours	1.4	0.018	1.06-1.94
Hospital readmission	1.5	0.007	1.12-2.04
Expanded criteria	1.3	0.086	0.95-1.86

HR: Hazard Ratio; CI: confidence interval.

Source: authors

plantes group has the largest volume of kidney transplants in the country (without discriminating type of donor). This study presents the largest sample size known in the country regarding the evaluation of renal graft survival using expanded criteria.

The available literature on the evaluation of donor kidney graft survival with expanded criteria in Colombia is limited, so this study is of great importance in contributing to a better understanding of the problem at the local level, by linking sociodemographic and clinical data with the outcomes of morbidity and mortality in cadaveric donor kidney transplantation and especially transplantation with ECD.

This study was carried out with a single kidney transplant program, which represents a limitation to have a general overview at the national level, since there are other transplant centers that use ECD, without having reports in the literature that support the use or not of this type of donors in the other groups of the country. The variable of delayed graft function was not included in the analysis since this information was not available in the database; however, we know that it is a variable that has an impact on morbidity and mortality associated with kidney transplantation with a cadaveric donor with expanded criteria.

Given the different immunosuppression combination throughout the follow-up cohort and the different changes in its follow-up, this variable was excluded from the analysis, so the impact it has on the study population is unknown.

Conclusions

Patients who received a kidney transplant from donors with expanded criteria had lower graft survival and higher mortality than those who received a graft with standard criteria, but this difference was not statistically significant when adjusted for the other covariates.

The results, inferior to the recipients of donors with standard criteria, do not mean a lack of therapeutic benefit, on the contrary, kidney transplantation from donors with expanded criteria constitutes a valid alternative to excessive times to those on the waiting list.

Akcnowledgment

To Dr. Néstor Pedraza for his valuable contributions in the final review of this article.

Compliance with ethical standards

Informed consent: This study was approved by the Ethics Committee of Colombiana de Transplantes and is considered a minimal risk research according to Resolution 008430 of 1993 of the Colombian Ministry of Health.

Conflict of interest: none declared by the authors.

Funding: study supported by Colombiana de Trasplantes, Bogota, Colombia.

Author's contributions:

Conception and design of the study: David Espitia-Palacios, Andrea García-López, Nasly Patino-Jaramillo, Fernando Girón-Luque.

Data acquisition: David Espitia-Palacios, Andrea García-López, Nasly Patino-Jaramillo, Fernando Girón-Luque.

Data analysis and interpretation: David Espitia-Palacios, Andrea García-López, Nasly Patino-Jaramillo, Fernando Girón-Luque.

Drafting the manuscript: David Espitia-Palacios, Andrea García-López, Nasly Patino-Jaramillo, Fernando Girón-Luque.

Critical review: David Espitia-Palacios, Andrea García-López, Nasly Patino-Jaramillo, Fernando Girón-Luque.

References

1. Bikbov B, Purcell CA, Levey AS, Smith M, Abdoli A, Abebe M., et al. Global, regional, and national burden of chronic kidney disease, 1990–2017: a systematic analysis for the Global Burden of Disease Study 2017. Lancet. 2020;395:709–33. https://doi.org/10.1016/S0140-6736(20)30045-3
2. Acuña L, Sánchez P, Soler LA, Alvis LF. Enfermedad renal en Colombia: prioridad para la gestión de riesgo. Rev Panam Salud Publica/Pan Am J Public Healt. 2016;40:16–22.
3. Cuenta de Alto Costo Colombia. Situación de la enfermedad renal crónica, la hipertensión arterial y la diabetes mellitus en Colombia, 2019. Cuenta Alto Costo. 2019;1(2322–6323):293.
4. Evans RW, Manninen DL, Garrison LPJ, Hart G, Blagg C, Gutman R., et al. The quality of life of patients with end-stage renal disease. N Engl J Med. 1985;312:553–9. https://doi.org/10.1056/NEJM198502283120905
5. Rosselli D, Rueda J-D, Diaz C. Cost-effectiveness of kidney transplantation compared with chronic dialysis in end-stage renal disease. Saudi J Kidney Dis Transplant. 2015;26:733. https://doi.org/10.4103/1319-2442.160175
6. Mandal AK, Kalligonis AN, Ratner LE. Expanded criteria donors: attempts to increase the renal transplant donor pool. Adv Ren Replace Ther. 2000;7:117–30. https://doi.org/10.1053/rr.2000.6113
7. Cohen B, Smits JM, Haase B, Persijn G, Vanrenterghem Y, Frei U. Expanding the donor pool to increase renal transplantation. Nephrol Dial Transplant. 2005;20:34–41. https://doi.org/10.1093/ndt/gfh506
8. Ojo AO, Hanson JA, Meier-Kriesche H-U, Okechukwu Ch, Wolfe R, Leichtman A. et al. Survival in recipients of marginal cadaveric donor kidneys compared with other recipients and wait-listed transplant candidates. J Am Soc Nephrol. 2001;12:589–97. https://doi.org/10.1681/ASN.V123589
9. Dedinská I, Palkoci B, Vojtko M, Osinová D, Lajiaková M. Experiences with expanded criteria donors: 10-year analysis of the martin, slovakia transplant center. Exp Clin Transplant. 2019;17:6–10.
10. De Rosa P, Muscogiuri G, Sarno G. Expanded criteria donors in kidney transplantation: the role of older donors in a setting of older recipients. Lim W, Vos R, Veroux M, Nardo B, eds. ISRN Transplant. 2013;301025. https://doi.org/10.5402/2013/301025
11. Valjalo R, Reynolds E, Herrera P, Espinoza A, Gonzalez F. Resultados a largo plazo en trasplante renal de donantes con criterios expandidos. Rev méd Chile. 2016;144:22–9. https://doi.org/10.4067/S0034-98872016000100004
12. Rao PS, Ojo A. The alphabet soup of kidney transplantation: SCD, DCD, ECD--Fundamentals for the practicing nephrologist. Clin J Am Soc Nephrol. 2009;4:1827–31. https://doi.org/10.2215/CJN.02270409
13. Shaheen FAM, Kurpad R, Shaheen MF, Al Sayyari A. Ways to overcome organ shortage: increasing donor pool by accepting suboptimal kidney donors. Exp Clin Transplant Off J Middle East Soc Organ Transplant. 2020;18(Suppl1):16–8. https://doi.org/10.6002/ect.TOND-TDTD2019.L21
14. Niño-Murcia A, Pinto Ramírez JL, Niño-Torres L. Organ transplantation in Colombia. Transplantation. 2018;102:1779–82. https://doi.org/10.1097/TP.0000000000002409
15. Ramos E, Aoun S, Harmon WE. Expanding the donor pool: effect on graft outcome. J Am Soc Nephrol. 2002;13:2590–9. https://doi.org/10.1097/01.ASN.0000033462.66353.F5
16. Schütte-Nütgen K, Finke M, Ehlert S, Thölking G, Pavenstädt H, Suwelack B., et al. Expanding the donor pool in kidney transplantation: Should organs with acute kidney injury be accepted? A retrospective study. PLoS One. 2019;14:1–14. https://doi.org/10.1371/journal.pone.0213608
17. Pascual J, Zamora J, Pirsch JD. A systematic review of kidney transplantation from expanded criteria donors. Am J Kidney Dis. 2008;52:553–86. https://doi.org/10.1053/j.ajkd.2008.06.005
18. García-Padilla PK, Vargas-Brochero MJ, Hurtado-Uriarte M, González-González CA, Rodríguez-Sánchez MP. Patiño JA., et al. Caracterización de trasplantados renales con donantes de criterios expandidos. Acta Médica Colombiana. 2019;44:22-6. https://doi.org/10.36104/amc.2019.1185
19. Tanabe K, Takahashi K, Toma H. Causes of long-term graft failure in renal transplantation. World J Urol. 1996;14:230–5. https://doi.org/10.1007/BF00182072
20. Bicalho PR, Requião-Moura LR, Arruda ÉF, Chinen R, Mello L, Bertocchi AP., et al. Long-term outcomes among kidney transplant recipients and after graft failure: a single-center cohort study in brazil. Minor T, ed. Biomed Res Int. 2019;7105084. https://doi.org/10.1155/2019/7105084

21. Debout A, Foucher Y, Trébern-Launay K, Legendre C, Kreis H, Mourad G., et al. Each additional hour of cold ischemia time significantly increases the risk of graft failure and mortality following renal transplantation. Kidney Int. 2015;87:343–9. https://doi.org/10.1038/ki.2014.304
22. King EA, Bowring MG, Massie AB, Kucirka L, McAdams-DeMarco M, Al-Ammary F.,et al. Mortality and graft loss attributable to readmission after kidney transplantation: immediate and long-term risk. transplantation. 2017;101:2520–6. https://doi.org/10.1097/TP.0000000000001609
23. Foroutan F, Friesen EL, Clark KE, Motaghi S, Zyla R, Lee Y., et al. Risk factors for 1-year graft loss after kidney transplantation: systematic review and meta-analysis. Clin J Am Soc Nephrol. 2019;14:1642–50. https://doi.org/10.2215/CJN.05560519
24. Lim WH, Gray NA, Chadban SJ, Pilmore H, Wong G. Graft and patient outcomes of zero-human leucocyte-antigen-mismatched deceased and live donor kidney transplant recipients. Transpl Int Off J Eur Soc Organ Transplant. 2015;28:610–8. https://doi.org/10.1111/tri.12542
25. Shi X, Lv J, Han W, Zhong X, Xie X, Su B., et al. What is the impact of human leukocyte antigen mismatching on graft survival and mortality in renal transplantation? A meta-analysis of 23 cohort studies involving 486,608 recipients. BMC Nephrol. 2018;19:116. https://doi.org/10.1186/s12882-018-0908-3
26. Sun Q, Yang Y. Late and chronic antibody-mediated rejection: main barrier to long term graft survival. Clin Dev Immunol. 2013;859761. https://doi.org/10.1155/2013/859761
27. Teo RZC, Wong G, Russ GR, Lim WH. Cell-mediated and humoral acute vascular rejection and graft loss: A registry study. Nephrology. 2016;21:147–55. https://doi.org/10.1111/nep.12577
28. KaborÉ R, Haller MC, Harambat J, Heinze G, LeffondrÉ K. Risk prediction models for graft failure in kidney transplantation: A systematic review. Nephrol Dial Transplant. 2017;32:ii68–ii76. https://doi.org/10.1093/ndt/gfw405
29. Morales JM, Marcén R, Del Castillo D, Andres A, González-Molina M, Oppenheimer F., et al. Risk factors for graft loss and mortality after renal transplantation according to recipient age: A prospective multicentre study. Nephrol Dial Transplant. 2012;27-Suppl4:39-46. https://doi.org/10.1093/ndt/gfs544
30. Khalkhali HR, Ghafari A, Hajizadeh E, Kazemnejad A. Risk factors of long-term graft loss in renal transplant recipients with chronic allograft dysfunction. Exp Clin Transplant Off J Middle East Soc Organ Transplant. 2010;8:277–82.
31. Fellström B, Holdaas H, Jardine AG, Gudrun N, Grönhagen-Riska C, Madsen S., et al. Risk factors for reaching renal endpoints in the Assessment of Lescol in Renal Transplantation (ALERT) trial. Transplantation. 2005;79:205–12. https://doi.org/10.1097/01.TP.0000147338.34323.12
32. Meier-Kriesche HU, Ojo AO, Hanson JA, Cibrik DM, Punch JD, Leichtman AB., et al. Increased impact of acute rejection on chronic allograft failure in recent era. Transplantation. 2000;70:1098–1100. https://doi.org/10.1097/00007890-200010150-00018
33. Shabir S, Halimi JM, Cherukuri A, Ball S, Ferro Ch, Lipkin G., et al. Predicting 5-year risk of kidney transplant failure: A prediction instrument using data available at 1 year posttransplantation. Am J Kidney Dis. 2014;63:643–51. https://doi.org/10.1053/j.ajkd.2013.10.059
34. Hariharan S, McBride MA, Cherikh WS, Tolleris CB, Bresnahan BA, Johnson CP. Post-transplant renal function in the first year predicts long-term kidney transplant survival. Kidney Int. 2002;62:311–18. https://doi.org/10.1046/j.1523-1755.2002.00424.x
35. Salvadori M, Rosati A, Bock A, Chapman J, Dussol B, Bertrand F., et al. Estimated one-year glomerular filtration rate is the best predictor of long-term graft function following renal transplant. Transplantation. 2006;81:202–6. https://doi.org/10.1097/01.tp.0000188135.04259.2e
36. Cole EH, Johnston O, Rose CL, Gill JS. Impact of acute rejection and new-onset diabetes on long-term transplant graft and patient survival. Clin J Am Soc Nephrol. 2008;3:814–21. https://doi.org/10.2215/CJN.04681107
37. Fabrizii V, Winkelmayer WC, Klauser R, Kletzmayr J, Säemann M, Steininger R., et al. Patient and graft survival in older kidney transplant recipients: does age matter? J Am Soc Nephrol. 2004;15:1052–60. https://doi.org/10.1097/01.ASN.0000120370.35927.40
38. Mohamed Ali AA, Abraham G, Khanna P, Reddy Y, Mehrota A, Mathew M., et al. Renal transplantation in the elderly: South Indian experience. Int Urol Nephrol. 2011;43:265–71. https://doi.org/10.1007/s11255-010-9887-4
39. Abeling T, Scheffner I, Karch A, Broecker V, Koch A, Haller H., et al. Risk factors for death in kidney transplant patients: analysis from a large protocol biopsy registry. Nephrol Dial Transplant. 2018;34:1171–81. https://doi.org/10.1093/ndt/gfy131
40. Gerbase-DeLima M, de Marco R, Monteiro F, Tedesco-Silva H, Medina-Pestana JO, Mine KL. Impact of combinations of donor and recipient ages and other factors on kidney graft outcomes. Front Immunol. 2020;11:1–9. https://doi.org/10.3389/fimmu.2020.00954
41. Rao PS, Merion RM, Ashby VB, Port FK, Wolfe RA, Kayler LK. Renal transplantation in elderly patients older than 70 years of age: Results from the scientific registry of transplant recipients. Transplantation. 2007;83:1069–74. https://doi.org/10.1097/01.tp.0000259621.56861.31

42. Schold J, Srinivas TR, Sehgal AR, Meier-Kriesche H-U. Half of kidney transplant candidates who are older than 60 years now placed on the waiting list will die before receiving a deceased-donor transplant. Clin J Am Soc Nephrol. 2009;4:1239–45. https://doi.org/10.2215/CJN.01280209

43. Schold JD, Srinivas TR, Kayler LK, Meier-Kriesche HU. The overlapping risk profile between dialysis patients listed and not listed for renal transplantation. Am J Transplant Off J Am Soc Transplant Am Soc Transpl Surg. 2008;8:58–68. https://doi.org/10.1111/j.1600-6143.2007.02020.x

44. Hernández D, Alonso-Titos J, Armas-Padrón AM, Ruiz-Esteban P, Cabello M, López V., et al. Mortality in elderly waiting-list patients versus age-matched kidney transplant recipients: where is the risk? Kidney Blood Press Res. 2018;43:256–75. https://doi.org/10.1159/000487684

45. Instituto Nacional de Salud. Red de donación y trasplantes. Informe anual red de donación y trasplantes 2018:104. (05-08-2021) https://www.ins.gov.co/Direcciones/RedesSaludPublica/DonacionOrganosYTejidos/Estadisticas/Informe-Anual-Red-Donacion-Trasplantes-2018.pdf