

Kidney graft functionality 1 year after kidney transplantation

Funcionalidad del injerto renal a 1 año del trasplante renal

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Abstract

Objective: To determine the evolution, associated factors and the outcomes of transplanted people one year after the evolution of a cohort in Mexico. **Method:** Kidney transplant cohort from 2013 to 2017 in Mexico. 1118 patients were analyzed. Five outcomes were studied: overall survival, kidney graft, patient survival, delayed function, and acute dysfunction. Kaplan-Meier was used for kidney graft survival. For risk, bivariate and multivariate analyzes were performed with a significant value of $p < 0.05$. **Results:** Of the 1118 kidney transplant patients, 57 (5.09%) had kidney graft loss, 52 (4.65%) died during the one-year follow-up; survival of the patient of 95.35% and of the graft 90.25%. **Conclusions:** The risk factors for the outcomes were transplantation from a deceased donor, recipient over 50 years of age and use of polyclonal agents. Infections and age are related to the death of the patient.

Keywords: Kidney transplant. Survival. Mortality. Delayed function.

Resumen

Objetivo: Determinar la funcionalidad del injerto renal a 1 año en una cohorte retrospectiva en México. **Método:** Cohorte de trasplante renal de 2013 a 2017 en México. Se analizaron 1118 pacientes. Se estudiaron cinco desenlaces: supervivencia global, supervivencia del injerto renal, supervivencia del paciente, función retardada y disfunción aguda. Para la supervivencia del injerto renal se usó Kaplan-Meier. Para el riesgo se realizó análisis bivariado y multivariado con valor significativo $p < 0.05$. **Resultados:** De los 1118 pacientes con trasplante renal, 57 (5.09%) tuvieron pérdida del injerto, 52 (4.65 %) fallecieron durante el año de seguimiento; la supervivencia del paciente fue del 95.35% y la supervivencia del injerto fue del 90.25%. **Conclusiones:** Los factores de riesgo para los desenlaces fueron trasplante de donante fallecido, receptor mayor de 50 años y uso de agentes policlonales. Las infecciones y la edad están relacionadas con la muerte del paciente.

Palabras clave: Trasplante renal. Supervivencia. Mortalidad. Función retardada.

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Introduction

Kidney transplant is considered the best therapeutic modality for patients with a terminal chronic renal disease¹. The advantages of a kidney transplant are resuming work activities and family life, a better quality of life, and a better cost-benefit ratio, compared to any dialysis modality²⁻⁵.

The kidney transplant is not free from disadvantages, and among them, the donor availability is one of the most important⁶. In case there are potential related living donors, the selection requires not only the immunological compatibility, but also the necessary tests that guarantee the donor's health⁶. In Mexico, after the creation of the National Transplant Center (CENATRA) and according to the records, there has been an increasing need of organs and tissues⁷. The process can extend when the population has unfavorable epidemiological characteristics, such as the high prevalence of obesity, diabetes or hypertension. Mexican population has one of the most elevated prevalence rates of these diseases in the world⁸⁻¹¹. A study from Amato et al.¹² showed that the population in Mexico with a chronic terminal renal disease had a prevalence of 1142 per million of inhabitants in the year 2005. It has also been established that, generally, chronic renal disease has a prevalence of 14.7% in all stages¹³.

When the patient requires a deceased donor, the permanence in the waiting list can be prolonged, as cultural, religious and legal factors make the donation rate low¹⁴. In Mexico, the deceased donor availability is low due to all of the reasons mentioned. The long wait increases patient mortality and may even exceed the mortality of those who are with chronic dialysis without the expectation of a kidney transplant⁷.

Monitoring of kidney transplant programs is useful in detecting opportunities to increase the number of procedures and improve the success rates¹⁵⁻¹⁸. Monitoring is particularly important in populations such as the Mexican, which has a high incidence of chronic terminal renal disease, often without a diagnosis. Such diagnosis absence leads to the development of chronic renal disease¹⁹⁻²¹, in addition to the low availability of donors, either living or cadaveric⁷.

The objective of this study is to know the rate of adverse outcomes, such as mortality, graft loss, delayed renal function, rejection, acute graft dysfunction and survival, as well as factors related to them.

Table 1. Baseline characteristics of the 1118 patients with kidney transplant

Variable	Median	IQR 25-75	Mean (SD)
Age (years)	29	24-40	33.25 (12.11)
Weight (kg)	63.3	54-72	63.76 (12.82)
Height (m)	1.63	1.56-1.69	1.62 (0.09)
Cr (mg/dL) 1 st month	1.14	0.92-1.43	1.42 (1.43)
UA (mg/dL) 1 st month	4.5	3.7-5.5	4.73 (1.53)
Hb (g/dL) 1 st month	11.9	10.6-13.2	11.87 (2.02)
Ca (mg/dL) 1 st month	9.4	9.0-9.9	9.38 (0.88)
P (mg/dL) 1 st month	2.6	1.9-3.5	2.8 (1.24)
PTH 1 st month	99.2	31.8-265.4	216.9 (303.09)
Variable	Number	Percentage	
Type of kidney transplant			
Living donor	803		71.8
Deceased donor	315		28.2
Gender			
Male	659		41.1
Female	459		58.9
Dichotomous by age			
Younger than 50 years	979		87.6
Older than 50 years	139		12.4

UA: uric acid; Ca: calcium; Cr: creatinine; SD: standard deviation; Hb: hemoglobin; P: phosphorus; PTH: parathormone; IQR: interquartile range.

Method

Design

A retrospective cohort of patients who received kidney transplants in two hospitals belonging to the network of the Mexican Social Security Institute in Mexico City, i.e. National Medical Center 21st Century (Centro Médico Nacional Siglo XXI) and National Medical Center La Raza Specialty Hospital (Hospital de Especialidades del Centro Médico Nacional La Raza), was studied.

Patients

Patients who received a kidney transplant in the period between January 1, 2013 and December 31, 2017 were considered. Those who had the clinical and biochemical data needed for analysis at baseline and during the 12-month follow-up were included. Patients with incomplete information or who had lost social security coverage were excluded.

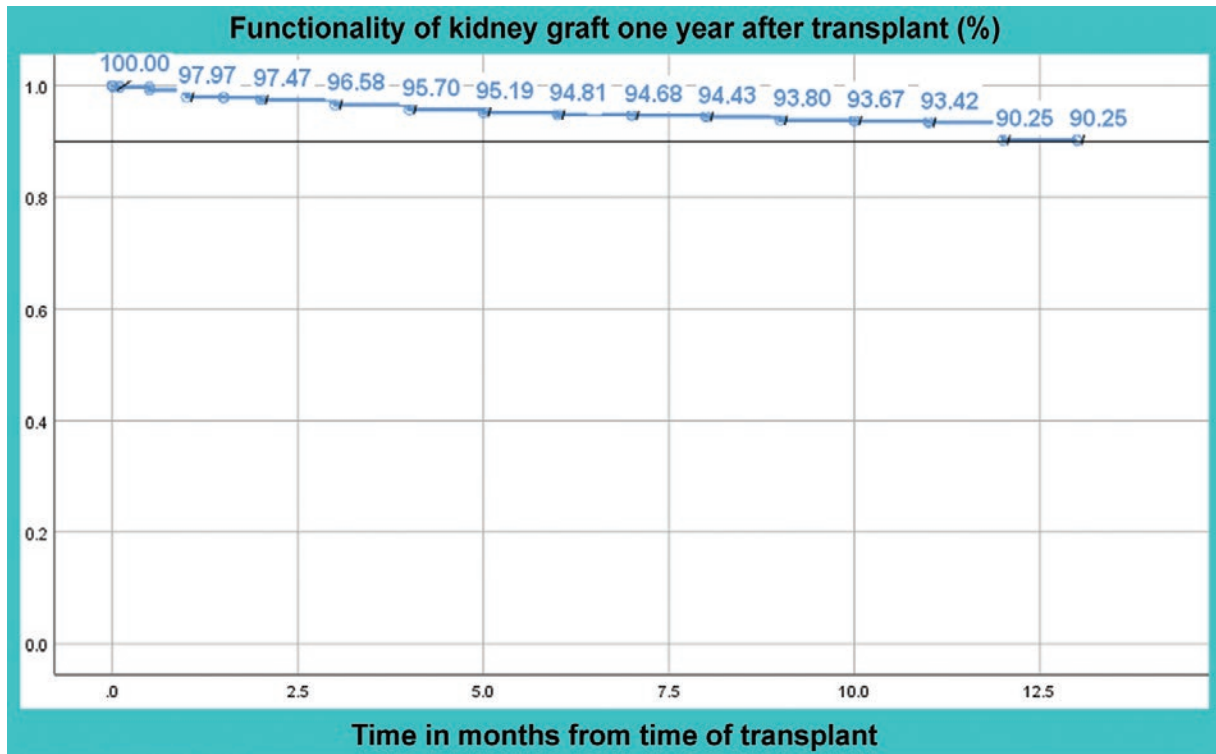


Figure 1. Functionality (survival) of the kidney graft after one-year progress.

Data recollection

Somatometric, demographic, clinical and comorbidity data were obtained from the records of each patient by specifically trained staff. All the information about variables related to transplantation was collected, i.e., the type of kidney transplant, induction scheme (which is related to the pre-transplant immunological risk, being of two types: low risk with basiliximab, a monoclonal agent, and high risk with thymoglobulin, a polyclonal agent) and primary immunosuppression, cold and warm ischemia times, and creatinine at discharge. Biochemical variables, as well as adverse events, hospitalizations and days of hospitalization, were recorded at months 1, 3, 6, 9 and 12 post-transplant.

Statistics

Data are presented as average and standard deviation (SD) for continuous variables, or as frequencies or medians and interquartile ranges (IQR) for nominal or free distribution variables. For survival analyses Kaplan-Meier curves were used, and the risk factor

analysis was performed with logistic regression, bivariate and multivariate. The statistical significance was established at $p < 0.05$. The statistical package SPSSw v25 was used for the analysis.

Results

1118 patients from the two units of kidney transplant were included. The most relevant demographic, clinical and biochemical data are shown in Table 1. It should be noted that it was a cohort of young patients, mostly men, and where living donors were the most frequent. Baseline creatinine was 1.14 mg/dl (IQR: 0.92-1.43). There was an important number of patients with anemia (hemoglobin 11.9 g/dl; IQR: 10.6-13.2). Polyclonal agents were used in 404 patients (315 from deceased donors and 89 from living donors, with high reactive panel or donor-specific antibodies present).

During the 12 months of follow-up, out of the 1118 patients, there were 52 deaths, 57 had graft losses, 64 had delayed graft function, 103 had acute graft dysfunction unrelated to rejection, and 122 had rejection, either of a humoral, cellular or mixed type. At the 1-year follow-up, in the cohort of 1118 patients, 1066 (95.35%)

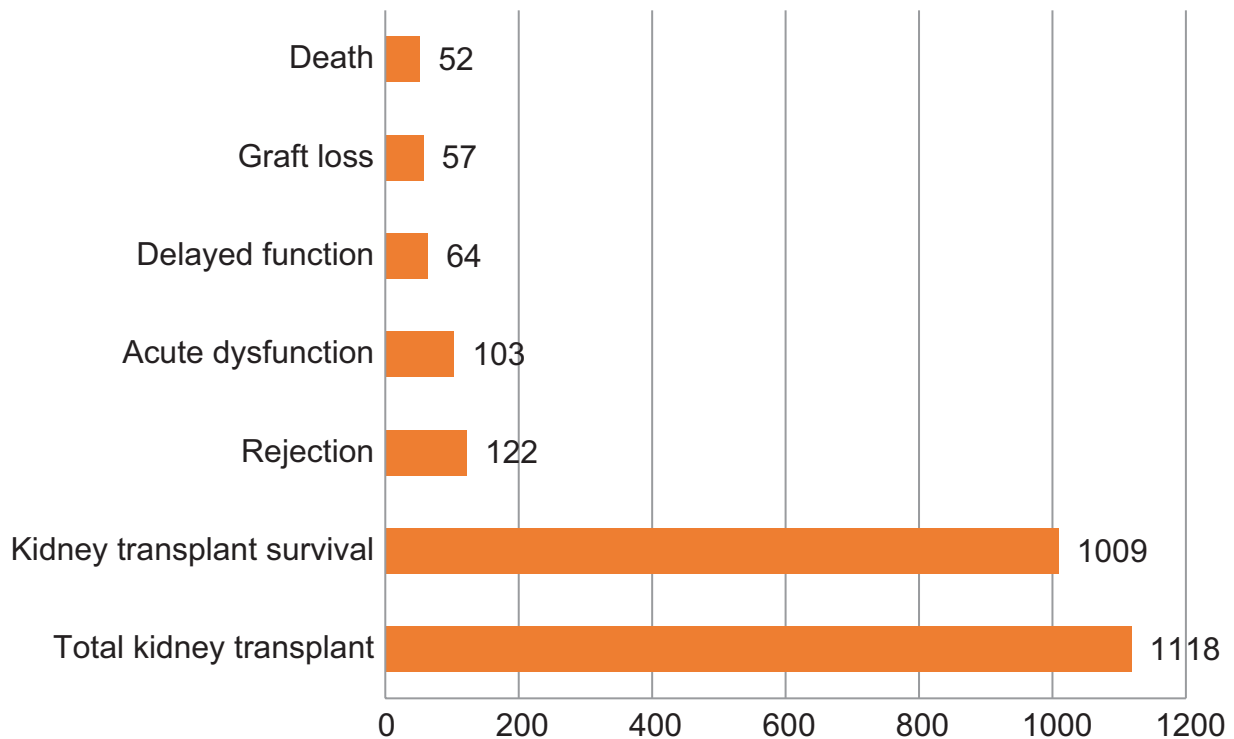


Figure 2. Number of patients due to important clinical outcomes after one-year progress.

survived and the kidney graft functionality was good in 1009, excluding the patients who died and those who had kidney graft loss and switched to another modality of renal replacement therapy, such as peritoneal dialysis or hemodialysis (90.25%) (Figs. 1 and 2).

Of the entire population, the median age was 29 years old (IQR: 24-40), 803 transplants (71.8%) were from a living donor and 315 (28.2%) from a deceased donor, and the distribution by gender was 659 men (58.9%) and 459 women (41.1%) (Fig. 2).

In relation to the five outcomes, the results were:

- The delayed function of the kidney graft occurred in 64 cases, of which 13 (20.31%) were from a living donor and 51 (79.69%) from a deceased donor, mainly associated with long periods of cold ischemia and expanded criteria donors.
- Acute graft dysfunction, not associated with rejection, occurred in 103 patients at some point during the 12 months progress; four of these patients had already had delayed graft function. Of the patients with acute graft dysfunction, 10 suffered graft loss, one of them died and 92 still have functional graft. Some observed characteristics in this group of patients were more from deceased donors, men and body mass index > 25 kg/m².

- Rejection occurred in 122 patients; two of them even had two rejection events. Out of these 122 patients with rejection, 13 had already had delayed graft function, 34 had kidney graft loss and 3 presented deaths associated with said rejection event as they were of humoral type. Finally, 85 out of the 122 patients maintained a functional graft at 12 months. Patients with use of polyclonal induction due to high immunological risk.
- Kidney graft loss was observed in 57 patients in the surveillance time of 12 months, and it was related to the conditions of the graft, in 34 patients with rejection, in 13 with delayed graft function and in 10 with acute graft dysfunction. Only one patient died. Five of these patients had a series of multiple events, starting with delayed graft function and then without an established order: acute dysfunction, rejection and, finally, graft loss. The case of death was humoral rejection unrelated to human leukocyte antigen, with graft loss, and pneumonia and death some days later.
- Death occurred in 52 patients, 3 of them had previously had delayed graft function, 3 had humoral type rejection and 1 had acute graft dysfunction. Nonetheless, what was more related to

Table 2. Characteristics a month after the kidney transplant, dichotomized

Variable	Men (659) Median (IQR 25-75)	Women (459) Median (IQR 25-75)	p*
Age (years)	30 (24-41)	31 (25-41)	0.474
Weight (kg)	68 (60.5-75.5)	55 (49-63)	0.001
Height (m)	1.67 (1.62-1.71)	1.55 (1.50-1.60)	0.001
Cr (mg/dL) 1 st month	1.30 (1.10-1.57)	0.97 (0.80-1.16)	0.001
UA (mg/dL) 1 st month	4.8 (4.0-5.7)	4.2 (3.4-5.1)	0.001
Hb (g/dL) 1 st month	12.2 (10.7-13.6)	11.4 (10.3-12.6)	0.483
Ca (mg/dL) 1 st month	9.5 (9.0-10.0)	9.4 (9.0-9.9)	0.429
P (mg/dL) 1 st month	2.5 (1.8-3.5)	2.8 (2.1-3.5)	0.153
PTH (pg/mL) 1 st month	92 (61.35-238.32)	138 (25.9-277.4)	0.441
	Living donor (803)	Deceased donor (315)	p*
Age (years)	28 (23.25-36.00)	37 (29-48)	0.001
Weight (kg)	62 (53-71)	65 (55-74)	0.619
Height (m)	1.64 (1.56-1.70)	1.62 (1.55-1.68)	0.249
Cr (mg/dL) 1 st month	1.1 (0.90-1.33)	1.30 (1.05-1.78)	0.001
UA (mg/dL) 1 st month	4.4 (3.7-5.2)	5.0 (4.0-6.3)	0.005
Hb (g/dL) 1 st month	12.1 (10.0-13.5)	10.9 (9.2-12.4)	0.001
Ca (mg/dL) 1 st month	9.5 (9-10)	9.2 (8.5-9.8)	0.001
P (mg/dL) 1 st month	2.8 (2.0-3.5)	2.4 (1.7-3.2)	0.023
PTH (pg/mL) 1 st month	85.7 (31.25-203.20)	124 (66.49-522.30)	0.441
	< 50 years old (979)	≥ 50 years old (139)	p*
Weight (kg)	62 (53-71.5)	67 (59.75-75.00)	0.137
Height (m)	1.63 (1.55-1.69)	1.62 (1.56-1.68)	0.353
Cr (mg/dL) 1 st month	1.13 (0.92-1.40)	1.14 (0.90-1.51)	0.378
UA (mg/dL) 1 st month	4.59 (3.8-5.5)	4.3 (2.56-5.6)	0.011
Hb (g/dL) 1 st month	11.9 (10.6-13.3)	11.3 (9.9-13.0)	0.087
Ca (mg/dL) 1 st month	9.5 (9-10)	9.3 (8.6-9.7)	0.013
P (mg/dL) 1 st month	2.7 (1.9-3.5)	2.5 (1.75-3.50)	0.316
PTH (pg/mL) 1 st month	103.10 (30.75-274.40)	115 (85.5-419.9)	0.439

UA: uric acid; Ca: calcium; Cr: creatinine; SD: standard deviation; Hb: hemoglobin;

P: phosphorus; PTH: parathormone; IQR: interquartile range.

*Chi-square test.

deaths were infectious processes, in the following order: 17 patients had atypical pneumonia, 6 bacterial pneumonia, 4 septic shock related to pneumonia, 3 abdominal sepsis, 3 sepsis, 1 pneumonia due to *Pseudomonas*, 1 pneumonia with lung choriocarcinoma, 1 acute myocardial infarction, 1 pneumonia with severe urinary tract infection, 1 pancreatitis, 1 septic shock with influenza, 1 abdominal abscess; 1 patient died at home 2 weeks after the transplant without having determined the cause of death, and 8 more with an unclear cause with systemic inflammatory response without identified infectious process, without rejection.

In Tables 2 and 3, the 1009 patients with functional graft at 12 months are classified as per three conditions: gender (male and female), type of donor (living or cadaveric) and age (< 50 years old and > 50 years old). The distribution of the functional grafts was: 590 men (659 received transplant, corresponding to 89.52% of men with functional graft) and 419 women (459 initial grafts for this item, 91.28% for this gender). As regards the type of donor, of those who remained with functional graft at 12 months, 755 were from a living donor (803 had been operated, 94.02% of all functional from living donors per year) and 254 were from deceased donors (315 were recipients of deceased donor transplant, 80.63%). Finally, in relation to age, 882 under 50 years old (979 operated, 90.09%) and 127 over 50 years old at the time of transplantation (139 were the recipients of transplant, 91.36%) were functional (Table 2).

The distribution by gender, type of transplant and age for each of the outcomes is shown in Table 3.

As for age, of the patients who had functional graft, compared to those who died or returned to renal replacement therapy (kidney graft loss), it was observed that patients who died had a mean age of 44.24 years (SD: 14.11), compared to the mean of the patients with graft loss of 33.63 years (SD: 13.68), contrasting with patients with functional graft by 12 months, 33.25 years (SD: 12.11) (Fig. 3).

Five main outcomes were studied (Table 4): mortality, kidney graft loss, delayed graft function, acute kidney graft dysfunction and survival. These outcomes were combined with nine factors: deceased donor, recipient > 50 years of age at the time of the kidney transplantation, female gender, body mass index > 25 kg/m², left ventricular ejection fraction (LVEF) < 50%, diastolic dysfunction of some degree prior to the kidney transplant and induction with polyclonal agent (due to

Table 3. Risk factors related to the outcomes of the kidney transplant

Variable	Total (1118)	Deaths (52)	p*	Graft loss (57)	p*
Gender			0.083		0.233
Men	659 (58.95)	32 (61.53)		37 (64.91)	
Women	459 (41.05)	20 (38.47)		20 (35.09)	
Type of donor			0.001		0.567
Living	803 (71.82)	17 (32.69)		26 (45.61)	
Deceased	315 (28.18)	35 (67.31)		31 (54.39)	
Age			0.508		0.218
< 50 years old	979 (87.56)	44 (84.61)		53 (92.98)	
≥ 50 years old	139 (12.44)	8 (15.39)		4 (7.02)	
Variable		Delayed function (64)	p*	Functional graft (1009)	p*
Gender			0.573		0.001
Men	803 (71.82)	44 (68.75)		755 (74.82)	
Women	315 (28.18)	20 (31.25)		254 (25.18)	
Type of donor			0.001		0.330
Living	659 (58.94)	13 (20.31)		590 (58.47)	
Deceased	459 (41.06)	51 (79.69)		419 (41.53)	
Age			0.053		0.635
< 50 years old	979 (87.56)	61 (95.31)		882 (87.41)	
≥ 50 years old	139 (12.44)	3 (4.69)		127 (12.59)	

*Chi-square test.

immunological risk indication). Bivariate analysis was performed in the first part of each table and multivariate in the lower section of each corresponding table.

The results were the following:

- For mortality, statistically significant associated risk factors in the bivariate analysis were deceased donor and > 50 years of age, which continued to be significant in multivariate analysis.
- For the outcome of graft loss, none of the factors was related to risk or protection.
- The delayed function had significance for risk in the bivariate analysis in the case of deceased donor, > 50 years of age, body mass index > 25 kg/m² and induction with polyclonal agent.
- Acute graft dysfunction over the course of the 12-month follow-up showed two significant factors in the bivariate analysis: a protective factor, which was female gender and was maintained in the multivariate analysis, and one factor of risk, only in the bivariate analysis, which was induction with a polyclonal agent.
- Lastly, survival showed deceased donor, recipient older than 50 years at the time of transplantation, and induction with polyclonal agent as risk factors, with only the first two factors maintaining statistical significance.

Discussion

The data obtained in our study are very varied as there were five outcomes taken into account (delayed graft function, acute dysfunction, rejection, kidney graft survival and survival of the patient) and seven potential influential factors. Factors already proven were excluded, such as donor age and post-transplant proteinuria, among others²². Induction with a polyclonal agent was the greatest risk factor for mortality outcomes (odds ratio [OR]: 3.18; 95% confidence interval [95%CI]: 1.54-6.53), followed by delayed function (OR: 1.99; 95%CI: 1.02-3.68), acute dysfunction (OR: 1.72; 95%CI: 1.05-2.79) and transplant survival (OR: 1.91; 95%CI: 1.18- 3.08). One must be careful with the interpretation of these results, since they are patients with high immunological risk (sensitized, highly sensitized, deceased, etc.). However, this makes us think that they will also be patients more susceptible to presenting infections (proven complication that affects the graft function, systemic diseases and associated loss, especially by Cytomegalovirus, herpes zoster virus, Epstein-Barr virus, polyomavirus, etc.)^{23,24} and rejection, which require immediate post-transplant prophylaxis, with closer immunological and clinical surveillance due to the results obtained in this study, similar to those of other studies conducted in Mexico²⁵.

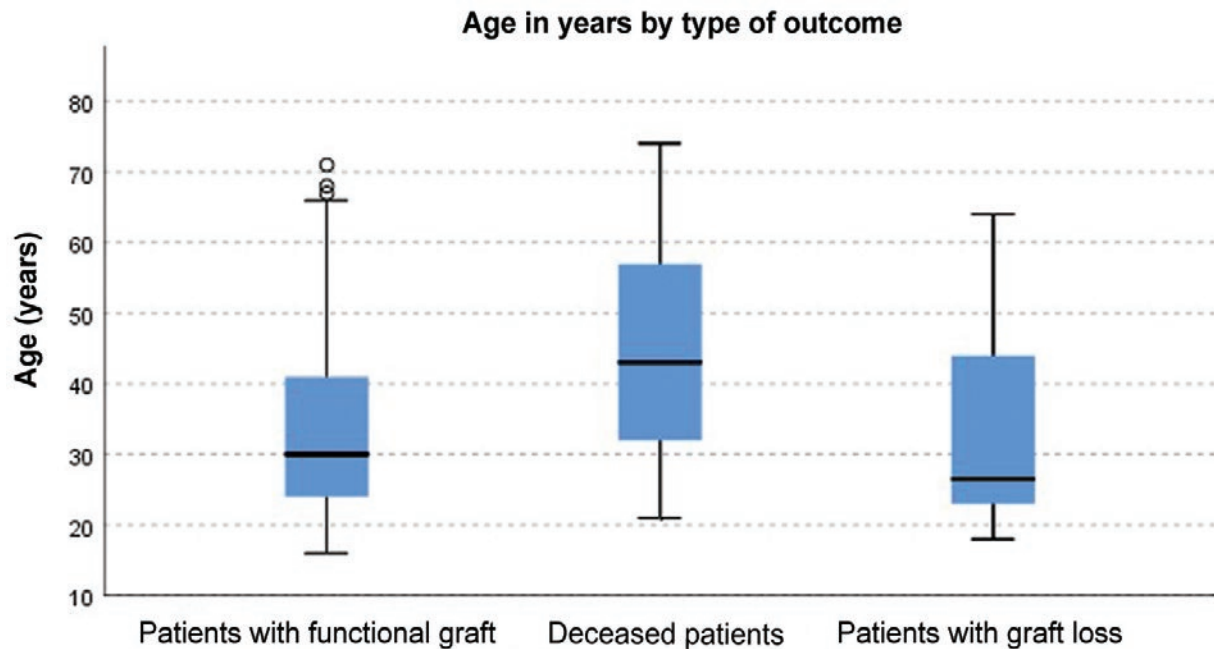


Figure 3. Age difference between the groups of patients with functional graft, deceased and with graft loss. With a difference by Kruskal-Wallis test between the groups ($p = 0.001$).

Mortality was mostly related to infections associated with sepsis, and survival of the kidney graft maintained a link with delayed graft function, acute dysfunction and rejection. This data shows some contrast with that of other studies which link graft survival and mortality with delayed function; in our study, conversely, delayed function was only related to kidney graft survival²⁶. The graft dysfunction was more related with the deceased donor during the first year and there was a strong correlation with a better quality of the transplanted kidney based on the kidney donor profile index (KDPI)²⁷. There are very conclusive records in other countries; for example, in the United States of America there is a database where survival and, therefore, mortality are recorded²⁸. In the case of survival for those with a living donor, there are figures of 98.8% after 12 months from the transplant, contrasting with our cohort, in which survival with this type of donor is 97.43% (17 out of the 659 recipients with a living donor died at 12 months). Similarly, survival in the case of a deceased donor after 12 months is 93.8%, compared to 92.38% in our patients (35 deaths out of 459 patients receiving a deceased donor transplant)²⁸.

Deceased donor transplant is another of the greatest impact factors on the studied outcomes, with an OR for mortality of 4.26 (95%CI: 2.10-8.63; $p = 0.001$), for

delayed graft function of 8.62 (95%CI: 4.08-18.21; $p = 0.001$) and for survival of 2.67 (95%CI: 1.66-4.30; $p = 0.001$), with a tendency to risk without statistical significance for kidney graft loss and acute dysfunction in both bivariate and multivariate analysis. There are some survival and mortality studies with similar results^{15,19}. Nevertheless, these studies express their final data in frequencies and percentage, with smaller populations than the one we studied, with 164 and 184 patients compared to the 1118 transplanted from ours^{19,29}. Our study did not analyze other factors strongly related with the deceased donor, such as cold ischemia or having extended or expanded criteria for death. In this case, there are studies that clearly discuss the relationship between a longer cold ischemia time and delayed graft function, and of the extended criteria for death in the case of the deceased donor³⁰.

The age of the kidney transplant recipient has also been studied. In our study, being over 50 years old at the time of kidney transplantation was, statistically, a risk for mortality, with an OR of 4.16 (95%CI: 2.07-8.37; $p = 0.001$), as well as for delayed function and survival, in addition to presenting a tendency to the risk of kidney graft loss, without the result being significant. Age has been much studied in the recipient and the donor, with an increased risk if this is over 65 years old: hazard ratio (HR): 2.59, 95%CI: 1.12-6.00,

Table 4. Factor analysis for each of the outcomes in kidney transplant after 1 year

Variable/outcome	OR	95%CI	p	OR	95%CI	p
	Bivariate analysis			Multivariate analysis		
Mortality						
Deceased donor	4.26	2.10-8.63	0.001	2.34	1.00-5.47	0.050
Age > 50 years old	4.16	2.07-8.37	0.001	4.01	1.85-8.71	0.001
Female	0.94	0.45-1.78	0.904	1.06	0.52-2.15	0.859
BMI > 25	1.17	0.60-2.27	0.645	1.26	0.61-2.57	0.525
Hb < 12 g/dl	0.79	0.40-1.53	0.490	0.89	0.43-1.83	0.760
Previous use of EPO	0.81	0.41-1.63	0.568	0.64	0.29-1.39	0.263
LVEF < 50%	1.09	0.37-3.17	0.866	1.12	0.33-3.74	0.851
Diastolic dysfunction	1.18	0.59-2.33	0.631	1.21	0.56-2.62	0.616
Polyclonal induction	3.18	1.54-6.53	0.002	2.05	0.86-4.88	0.104
Delayed graft function						
Deceased donor	8.62	4.08-18.21	0.001	13.85	5.21-36.76	0.001
Age > 50 years old	2.40	1.19-4.80	0.013	1.08	0.47-2.44	0.851
Female	0.65	0.34-1.25	0.207	0.69	0.35-1.36	0.289
BMI > 25	2.40	1.30-4.45	0.005	1.90	0.98-3.67	0.055
Hb < 12 g/dl	0.66	0.36-1.21	0.180	0.70	0.36-1.36	0.294
Previous use of EPO	0.67	0.35-1.28	0.232	0.66	0.32-1.35	0.259
LVEF < 50%	1.41	0.58-3.45	0.445	2.26	0.77-6.61	0.135
Diastolic dysfunction	1.06	0.56-2.00	0.841	1.28	0.61-2.70	0.507
Polyclonal induction	1.99	1.02-3.68	0.028	2.36	1.02-5.46	0.044
Acute graft dysfunction						
Deceased donor	1.55	0.95-2.52	0.078	1.18	0.63-2.24	0.593
Age > 50 years old	0.63	0.28-1.41	0.265	0.64	0.27-1.49	0.643
Female	0.57	0.33-0.97	0.040	0.49	0.28-0.84	0.010
BMI > 25	0.82	0.50-1.36	0.463	0.74	0.44-1.25	0.268
Hb < 12 g/dl	0.91	0.56-1.47	0.703	0.74	0.44-1.24	0.260
Previous use of EPO	0.43	0.24-0.75	0.003	0.37	0.20-0.68	0.001
LVEF < 50%	0.79	0.33-1.88	0.595	0.61	0.23-1.59	0.315
Diastolic dysfunction	1.00	0.60-1.66	0.990	1.02	0.58-1.79	0.920
Polyclonal induction	1.72	1.05-2.79	0.028	1.57	0.84-2.91	0.151
Acute graft dysfunction						
Deceased donor	2.67	1.66-4.30	0.001	2.00	1.09-3.67	0.025
Age > 50 years old	3.06	1.79-5.24	0.001	3.17	1.75-5.73	0.001
Female	0.83	0.51-1.36	0.479	0.84	0.50-1.39	0.511
BMI > 25	0.97	0.59-1.57	0.901	0.73	0.43-1.22	0.232
Hb < 12 g/dl	1.21	0.75-1.95	0.430	1.26	0.75-2.13	0.373
Previous use of EPO	0.66	0.41-1.10	0.112	0.63	0.36-1.10	0.111
LVEF < 50%	1.33	0.68-2.83	0.360	1.27	0.56-2.87	0.552
Diastolic dysfunction	1.33	0.82-2.16	0.237	1.26	0.73-2.17	0.401
Polyclonal induction	1.91	1.18-3.08	0.008	1.36	0.74-2.48	0.309

EPO: erythropoietin; LVEF: left ventricular ejection fraction; Hb: hemoglobin; 95%CI: 95% confidence interval; BMI: body mass index; OR: odds ratio.

and HR: 5.65, 95%CI: 2.31-13.79, respectively³¹. Risk has also been shown with different age cohorts.

The female gender has statistically shown to be protector for acute delayed graft dysfunction (OR: 0.57; 95%CI: 0.33-0.97), without presenting statistical significance for the other five items. Gender plays a role in incidence and progression of conditions and kidney transplant behavior, especially by modifying the pharmacokinetics and the pharmacodynamics of immunosuppressants. However, there are not many studies that allow to determine the true impact on this aspect³². Carrero et al.³³ establish that the female

gender is mostly affected by chronic terminal kidney disease compared to men, but the involvement of gender is not clearly defined in the context of kidney transplant.

In the case of the overweight factor there is controversy, as some studies mention it as a risk and others have found that it is not. There is no consensus on the effects of obesity in patients before and after kidney transplantation. Studies related to obesity that have had different points of view on the subject reveal the need for more research³⁴. In our study, overweight before kidney transplantation showed a statistical

significance in clinical outcomes solely for delayed graft function, with an OR of 2.4 (95%CI: 1.30-4.45; $p = 0.005$). On the subject of obesity, there are studies that state the need to improve the approach for the proper management of candidates and recipients with some degree of excess of weight³⁵.

Finally, the only two factors that did not show a statistical significance were the dichotomization by LVEF in less and more than 50%, as well as the diastolic dysfunction detected within the kidney transplant protocol. Nevertheless, there was a tendency of risk in both regarding kidney graft loss and survival. This is partly explained by the complexity of the cardiovascular system, since there are proatherogenic protective effects that are compensated by a deleterious effect of the immunosuppressant drugs to the endothelium. Today, the immunological effect with the inclusion of donor-specific antibodies, and their direct endothelial damage to the allograft and the systemic damage is also relevant. This leads to the search for markers that guide a better individualization of immunosuppressants that do not modify the cardiac and endothelial condition³⁶.

Conclusions

This is one of the largest retrospective studies in Mexico, with 1118 kidney transplants studied and monitored over 12 months for five outcomes: mortality, kidney graft loss, delayed graft function, acute dysfunction and survival. It has been found significance for three risk factors for these outcomes: receiving the transplant from a deceased donor, age of recipient > 50 years old and use of polyclonal agent in induction, which is more associated with high immunological risk. Survival after 12 months was 90.25% (1009 living patients with functional graft), mortality 4.65% (52 patients), graft loss 5.09% (57 patients returned to peritoneal dialysis or hemodialysis), delayed graft function 5.72% (64 patients) and there were 103 patients (9.21%) with acute graft dysfunction and recovery throughout the 12-month follow-up; lastly, 122 patients (10.91%) presented rejection.

In relation to graft survival, it was observed that the loss of it had a marked progression in patients who presented functional initial failures, acute dysfunction or rejection. Conversely, regarding patient survival (mortality), a direct relationship with sepsis was observed, especially due to the great number of patients with pneumonia (30 cases out of 52 who died, 57.69%),

and abdominal and cardiovascular infectious problems as well.

The female gender was found as protection against acute graft dysfunction, without having an impact on the other four outcomes. Overweight influenced as a risk factor for delayed graft function. The LVEF < 50% and diastolic dysfunction factors did not statistically impact any outcome; however, a tendency to be of risk for graft loss and acute dysfunction was observed.

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Conflicts of interest

All the authors declare that they have no conflicts of interest.

Ethical disclosures

Protection of people and animals. The authors declare that no experiments have been made on human beings or animals for this research.

Data confidentiality. The authors declare that they have followed the protocols of their work center regarding the publication of patient data.

Right to privacy and informed consent. The authors declare that no patient data appears in this article.

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