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Death with Functioning Graft in Living Donor Kidney Transplantation: Analysis of Risk Factors

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Key Words
Death · Transplantation · Risk factors

Abstract
Background: Death with a functioning graft (DWF) has been reported as a major cause of graft loss after renal transplantation. It has been reported to occur in 9–30%. ***Methods:*** From March 1976 to January 2002, a total of 1,400 living donor renal transplants were performed in our center. Out of 257 reported deaths among our patients, 131 recipients died with functioning grafts after a mean period of 53.4 ± 53.2 months. ***Results:*** DWF patients account for 27% of all graft losses in our series. The mean age was 34.9 + 10.6 (range 8–62 years), 98 of them were male and 33 were female. The original kidney disease was GN in 9, PN in 24, PCK in 5 and nephrosclerosis in 8 patients. Acute rejection episodes were diagnosed in 84 patients (63.1). The post-transplant complications encountered were hypertension in 78 patients (59.5%), diabetes mellitus in 30 patients (22.9%), medical infections in 68 (51.5%), hepatic complications in 30 (22.9%) and malignancy in 17 patients (13%). The main causes of death in these patients were infections in 46 (35.6%), cardiovascular in 23 (17.6%), liver cell failure in 15 patients (11.4%) and malignancy in 8 (6.1%). The mean serum creatinine was 2 ± 0.6 mg/dl at last follow-up before death. ***Conclusion:*** We conclude that the relatively higher mortality in renal transplantation is, in part, due to co-morbid medical illness, pre-transplant dialysis treatment, and factors uniquely related to transplantation, including immunosuppression and other drug effects. DWF must be in consideration when calculating graft survival.

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Introduction

Although transplantation confers the highest survival benefit among all the different renal replacement therapies, renal allograft recipients still have a high mortality rate compared with age-matched population controls [1]. It has been reported that the mortality of recipients of first renal transplants was 14 times higher than the aged-matched population during the first year after transplantation, and was 4 times higher after this period. The relatively higher mortality in renal transplant recipients is in part due to co-morbid medical illness, pre-transplant dialysis treatment, and factors uniquely related to transplantation, including immunosuppression and other drug effects [2, 3].

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Death with graft function (DWF) has been reported to occur in 9–43% of patients [4–9], thus accounting for a substantial fraction if there is graft loss. The risk and causes of mortality may have changed over time because of the more recent advances in immunosuppressive protocols, improved surgical techniques and the availability of newer drugs for medical treatment of risk factors such as hypertension, diabetes mellitus and infection.

The purpose of our study was to describe the rate of DWF and the trends in the risk and causes of mortality at different post-transplant intervals in our live donor kidney transplant recipients.

Material and Methods

Patients

The records of all patients who had been transplanted in the Urology & Nephrology Center, Mansoura University, Egypt, from March 1976 to January 2002, were retrospectively reviewed. During this period, a total of 1,400 patients received renal allografts from live related donors.

Immunosuppression Protocols

All patients, before 1983, received azathioprine (2–3 mg/kg/day) and prednisolone (2 mg/kg/day), with subsequent tapering of the dose till 0.5 mg/kg/day after 1 month. After 1983, other protocols were evolved over time. Cyclosporine (CsA) was introduced with two main protocols: CsA (12 mg/kg/day) and prednisolone, or triple therapy CsA (10 mg/kg/day), prednisolone and azathioprine (1 mg/kg/day). The CsA dose was adjusted to keep CsA trough level between 200 and 400 ng/ml in the first 2 months and between 125 and 175 ng/ml thereafter. CsA trough level was first measured using radioimmunoassay kits (Sandoz, Basel, Switzerland), and then using monoclonal specific antibody (Abbott, USA). In the 1990s, tacrolimus (0.15 mg/kg twice daily) and/or mycophenolate mofetil 2 g/day were introduced as rescue therapy in some cases or to replace either CsA or azathioprine as a result of their side effects. The tacrolimus dose was adjusted to achieve a trough level between 5 and 10 ng/ml.

All acute rejection episodes were documented by histopathological examination and treated by methylprednisolone pulses of 500 mg/day for 5 days. Steroid-resistant rejection was treated by antibody therapy; antithymocyte globulin (ATG) or orthoclone (OKT3).

Follow-Up Data

Patient survival data were collected. Patients were considered to have died with a functioning graft if death was not preceded by return to dialysis or transplant nephrectomy. Cause-of-death data were obtained and for the purpose of analysis, the codes for cause of death were broken down into nine categories: cardiovascular death, stroke, infection/sepsis, malignant neoplasm, hepatic complications, accident, miscellaneous, others and unknown. The recipient's and donor's age and sex, donor-recipient relationship, degree of HLA matching, pre-transplant hypertension, original kidney disease, primary immunosuppression, episodes of acute rejection, presence of post-transplant complications as hypertension, diabetes mellitus, infections, hepatic, malignant were analyzed as risk factors affecting patient survival. The uni- and multivariate analyses for risk factors were done. All patients who died with a functioning graft were compared with patients who died with failed grafts as well as patients who have functioning grafts.

Statistical Analysis

Statistical analysis was carried out using an IBM-compatible computer SPSS/PC for Windows Version 10 (SPSS Inc., Chicago, Ill., USA). For univariate analysis, Student's t test and the χ^2 test were used. Multivariate analysis was carried out using Cox logistic regression. Differences were compared using the log-rank test. Kaplan-Meier graft and patient survival curves stratified by era were done for DWF patients. A value of $p < 0.05$ was considered significant.

Results

Between March 1976 and January 2002, a total of 1,349 patients received 1,400 live donor renal allografts. Figures 1 and 2 show the Kaplan-Meier curves for graft and patient survival stratified by era of transplantation (1970s, 1980s, 1990s and 2000s, respectively). The 5-year graft survival rate increased over decades from 48% in the 1970s, to 73% in the 1980s to 78% in the 1990s with non-significant differences ($p = 0.07$), while the 5-year patient survival increased significantly from 48% to 82–90% in the same period of time. During this period, 515 grafts were lost (36.8%). The total number of patients who died after renal transplantation during the follow-up period was 257 (19%). Among these patients, 131 died with a functioning graft (51%), which constitutes the material of this study. The median time from transplantation to death with function was 37 months (mean 53.4 ± 53.2, range 1–203). The most recent mean serum creatinine prior to death was 2.0 ± 0.6 mg/dl and was <2.0 mg/dl in 69.4% of patients, reflecting good renal allograft function.

Table 1 shows the baseline characteristics of renal transplant recipients who died with a functioning graft. From the table we found that patients of increasing age at the time of transplantation have a higher mortality rate than younger recipients ($p = 0.00$). Other recipients' factors such as sex, primary causes of end-stage renal disease (ESRD) and pre-transplant dialysis show no statistical significance.

During the post-transplantation course, data from table 2 show that DWF patients were more prone to acute rejection episodes. There was also noticeable increase in post-transplant morbidity complications. However, the mean serum creatinine was comparable in both groups at different time periods after transplantation.

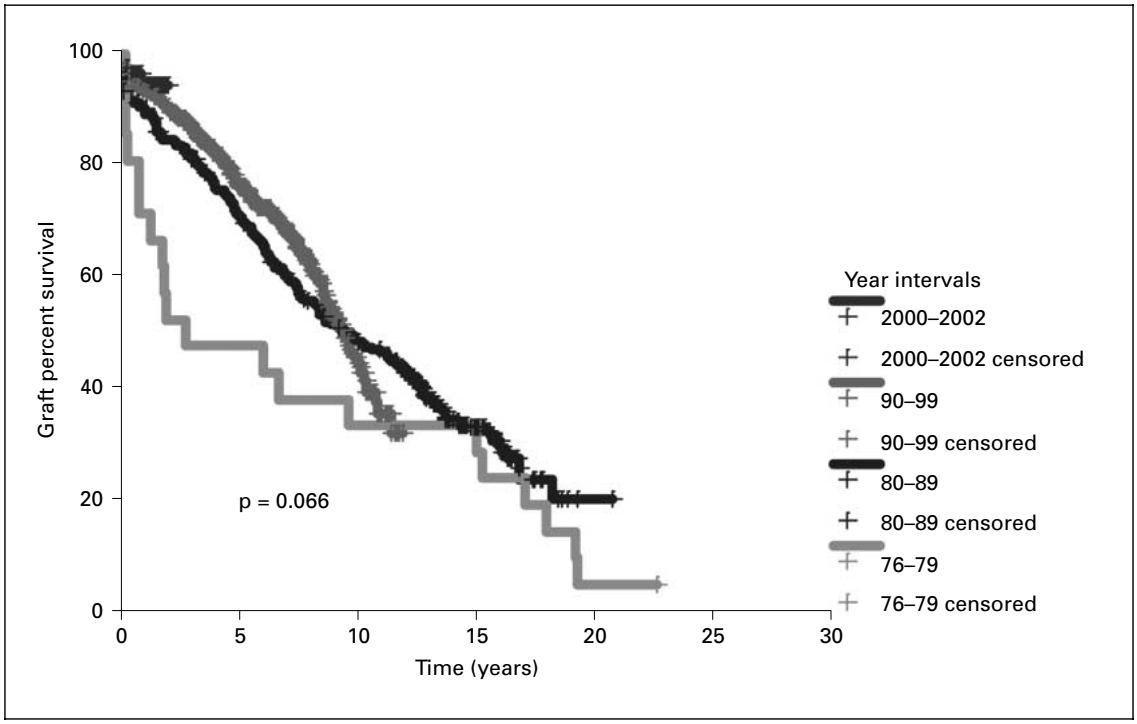

Fig. 1. Actuarial graft survival according to decades.

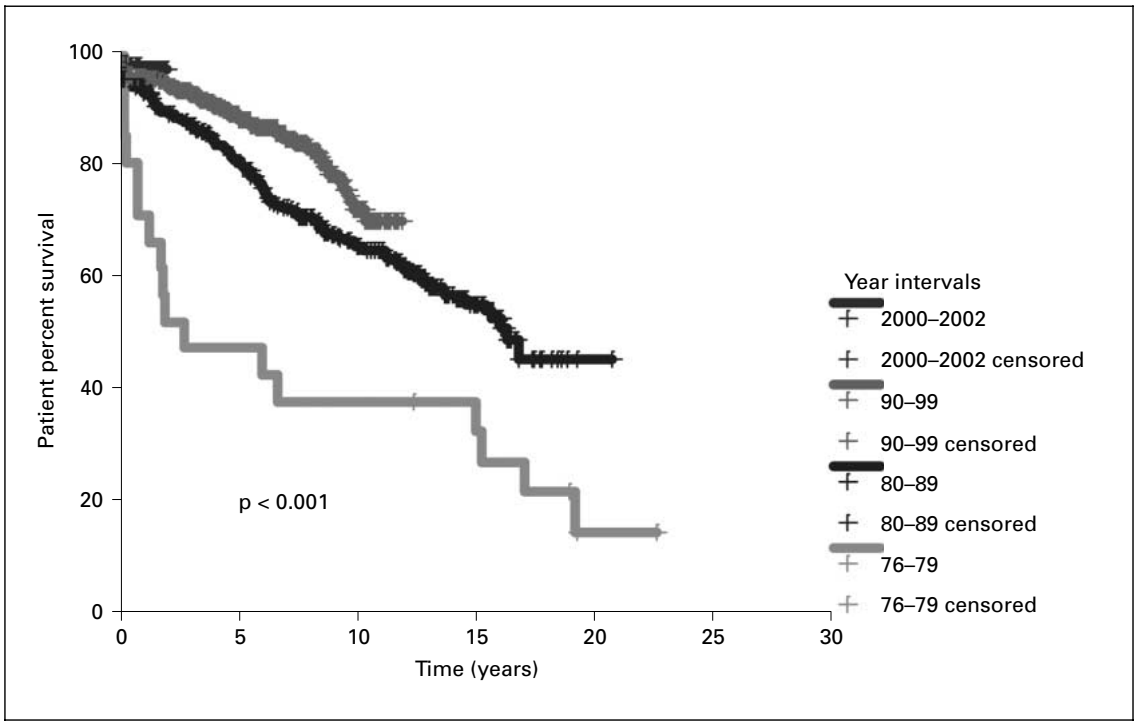

Fig. 2. Actuarial patient survival according to decades.

Table 1. Baseline characteristics of renal transplant recipients according to vital status

Characteristic	Died with functioning graft (n = 131)	Alive with functioning graft (n = 885)	p value
Recipient factors			
Age, years	34.9 ± 10.6	29.2 ± 10.2	0.00
Male gender	74.4%	74.6%	0.5
Primary cause of ESRD			
Glomerulonephritis	7.6	11	
Pyelonephritis	18.3	18.4	
Nephrosclerosis	6.1	2.4	
Amyloidosis	3.8	1.8	0.2
PCK	3.8	2.4	
Other, unknown	60.4	64.0	
Prior renal transplant	3.8	4.1	0.9
Pre-transplant dialysis (yes)	92.4%	93.1%	0.7
Donor factors			
Age, years	34.1 ± 9.8	35.3 ± 9.9	0.3
Gender (male:female)	51.1:48.9	48.2:51.8	0.2

Table 2. Characteristics of post-transplantation course according to vital status

Characteristic	Died with functioning graft (n = 131)	Alive with functioning graft (n = 885)	p value
ATN	8.6	3.5	0.03
Acute rejection episodes (yes)	64.1	45.4	0.00
Total dose of steroids (g)			
After 3 months	7.2 ± 3.2	5.7 ± 2.9	0.002
Post-transplant complications			
Hypertension	59.5	74.8	0.00
Diabetes mellitus	22.9	11.4	0.00
Infection	51.5	19.3	0.00
Hepatic	22.9	5.6	0.00
Malignant	13.0	1.5	0.00
Mean serum creatinine, mg/dl			
At 1 month	1.3 ± 0.4	1.3 ± 0.4	0.9
At 3 months	1.5 ± 0.6	1.4 ± 0.5	0.06
At 12 months	1.5 ± 0.5	1.4 ± 0.6	0.4
At last follow-up	2.0 ± 0.6	1.6 ± 0.8	0.1

Table 3. Pattern of causes of graft loss (in %) in kidney transplants, 1976–2002

	1970s (n = 21)	1980s (n = 384)	1990s (n = 812)	2000s (n = 180)
Total number of graft losses	95	59.1	27.5	2.8
Death with functioning graft	38.1	26.4	27.2	20
Immunological cause	61.9	73.6	69.2	80
Recurrence	–	–	1.9	–
Other causes	–	–	1.9	–

Table 3 shows the pattern of graft loss in kidney transplants over decades. Of the grafts transplanted in 1976s, only 1 (4.8%) is currently functioning versus nearly 40% of those transplanted in the 1980s, 75.5% of those transplanted in the 1990s and 97.2% in the 2000s. The causes of graft loss have changed over time. In the 1970s, 38% were due to DWF; by the 1980s the figure was only 26.4% with only a marginal increase in the 1990s (27.2%). Graft loss due to an immunological reason was the major cause of graft failure over all decades.

The causes of DWF over decades were summarized in table 4. Infection and sepsis was the leading cause of DWF over all decades, with a decreasing level after the era of the 1970s from 37.5 to 28.8% and 28.1% in the 1980s and 1990s, respectively. Cardiovascular complications were the second leading cause of DWF with an increasing incidence over decades (12.5, 16.9 and 17.2%, respectively). The incidence of death from hepatic cell failure had dropped in the 1980s from 12.5 to 6.0% but rose again in the 1990s to 12.5%. Miscellaneous causes of death included hemorrhage from the upper gastrointestinal tract or other sites, pancreatitis, pulmonary embolism and accidents. The cause of DWT was unknown in more than 12.5% of deaths.

Table 4. Predominant causes of death, by decades, in patients (%) who died with a functioning graft

Causes	1970s	1980s	1990s
Cardiovascular	12.5	16.9	17.2
Infection	37.5	28.8	28.1
Hepatic	12.5	6.8	12.5
Cerebrovascular	12.5	10.2	7.8
Malignancy	–	8.5	4.7
Others	12.5	11.9	7.8
Unknown	12.5	16.9	20.3

Table 5. Characteristics of patients who died with a functioning graft according to the time of death

Characteristic	Patient died <12 months	Patient died >12 months	p value
Recipient age, years	35.5 ± 11.2	34.1 ± 10	0.5
Recipient sex (male)	75%	74.7%	1.0
Pre-transplant hypertension	59.1	56.3	0.9
Preemptive transplantation	9	8	1.0
Re-transplantation	4.5	3.4	1.0
Acute rejection episodes	70.4	60.9	0.5
Post-transplant complications (early)			
Hypertension	47.7	65.5	0.05
Diabetes mellitus	20.5	4.6	0.04
Infection	36.4	6.9	0.00
Hepatic	15.9	11.5	0.5
Malignant	4.5	17.2	0.00
Viral infections	9.1	1.1	0.02
Cause of death			
Cardiovascular	20.5	13.7	
Infection/sepsis	36.4	19.5	
Hepatic	13.6	9.2	0.01
Cerebrovascular	6.8	10.3	
Malignant	–	8	
Others	18.2	15.2	

Table 6. Characteristics of patients who died with a functioning graft vs. patients who died with failed grafts

	Death with functioning graft (n = 131)	Death with failed graft (n = 126)	p value
Age at transplantation, years			
<10	3.8	2.8	
10–20	6.1	19.0	
21–30	26.0	27.8	0.03
31–40	36.6	32.5	
41–50	22.9	16.7	
>50	4.6	1.6	
Patients with acute rejection			
No	35.9	21.4	
Once	42.7	22.4	0.000
Twice	17.6	23.8	
Three or more	3.8	21.4	
Post-transplant hepatitis	22.9	11.9	0.03
Change of blood pressure after transplantation			
Normotensive-normotensive	30.4	14.3	
Hypertensive-normotensive	11.4	9.1	0.001
Normotensive-hypertensive	31.6	64.9	
Hypertensive-hypertensive	26.6	11.7	
Cause of death			
Cardiovascular	18.3	33.3	
Infection/sepsis	35.9	18.3	
Hepatic cell failure	11.5	7.9	0.04
Cerebrovascular	9.2	1.6	
Tumor	6.1	4.0	
Unknown	8.4	33.3	

Our data show that 4 (3.1%) of our DWF patients were HBsAg-positive before transplantation and all of them were in the 1980s. Three had experienced clinical and biochemical chronic hepatitis 3–5 years after transplantation and finally died of liver cell failure. Hepatitis C virus (HCV) infection was diagnosed in 80 (61.1%) patients before transplantation (diagnosis made by ELISA-2 and/or PCR) – 18 of them were in the late 1980s and the remaining patients were in the 1990s and 2000s. All patients had normal liver function tests for at least 3 months before transplantation and interferon therapy was used in 10 patients before transplantation for seroconversion (80% success rate). After transplantation, 17 patients (21.3%) experienced biochemical evidence of acute hepatitis which was transient in 15, while it is followed by chronic increase in liver enzymes in 2 patients who died later on. In 10 patients there was chronic increase in liver enzymes after an average period of 3–7 years after transplantation and finally they died of liver cell failure. In all patients the treatment modalities were mostly conservative in the form of withholding of azathioprine and supportive treatment for the liver. None of our patients were considered for the liver transplantation program since it only just started in our country 1–2 years ago. Our results demonstrated that more than one third of our DWF patients had schistosomal infection before transplantation. All these patients received antischistosomal treatment before transplantation. Only 1 patient died due to severe bleeding from esophageal varicose veins.

Overall, DWF accounted for 27.2% of all graft losses, with the proportion increasing from 9.2% during the first month post-transplant to 22.9% between post-transplant months 2 and 12, and then 29.8% during months 13 through 60 and 35.1% after 61 months. Almost half (50%) of DWF occurring within 30 days after transplantation was due to infection and cardiovascular disease (25% in each of them). Infection was the first leading cause of DWF, reaching the highest level of 43.3% during the 2- to 12-month intervals; with a trend to be marginally decreased to 26.6 and 23.9% during the subsequent intervals. Cardiovascular disease was the second leading cause of DWF, with slightly marginal differences during all intervals after 1 month (15.4, 17.9 and 13%, respectively). The post-transplant malignancy accounted for a total of 6.1% of DWF with 87.5% of them after 5 years post-transplant. There were 15 deaths from liver cell failure and 10 deaths due to cerebrovascular causes, almost all of these cases were after the first month post-transplant (86.7 and 90%, respectively). There were only 2 reported deaths due to accidents and no mortality from suicide in our series.

Table 7. Factors associated to death with functioning graft in renal transplant recipients

Variable	p value
Univariate analysis	
Recipient age at transplantation	0.115
Recipient gender	0.380
Donor age	0.315
Donor gender	0.214
Pre-transplant hypertension	0.712
Pre-transplant schistosomal infection	0.549
HLA class I and II (0–6 mismatches)	0.571
Transplant received	0.972
Primary plane of immunosuppression	0.079
Early acute rejections	0.979
Total steroid doses at 3 months	0.997
Post-transplant hypertension	0.979
Post-transplant diabetes mellitus	0.098
Post-transplant infection	*0.000*
Post-transplant malignancy	*0.005*
Urological complications	0.343
Multivariate analysis	
Post-transplant infection	*0.001*

Table 5 shows the characteristics of patients before 1 year and those who died after 1 year. There was no statistically significant difference ($p > 0.05$) regarding recipient age, sex, pre-transplant hypertension and dialysis, and number of transplants. Although the number of patients who experienced acute rejection episodes was not statistically significant between the groups ($p = 0.5$), the patients who died before 1 year needed further adjuvant immunosuppressive therapy (prophylactic induction therapy with ATG and orthoclone for resistant rejection). Patients who died before 1 year had a higher rate of post-transplant complications as diabetes mellitus, medical infections, hepatic and malignancy ($p < 0.05$). The incidence of post-transplant hypertension was statistically significant ($p = 0.05$) in patients who died after 1 year. The cause of death was statistically significantly different between the groups. Infection is the first leading cause of death before and after 1 year of transplantation (36.4 and 19.5%, respectively).

To assess the characteristics of DWF patients, we compared them with patients who died with failed graft in table 6. DWF patients were in a significantly higher age group than patients who died with failed grafts ($p = 0.03$). Patients who died with failed graft had a higher rate of acute rejection episodes ($p = 0.00$), receiving more steroid doses ($p = 0.003$), and experienced a statistically signifi-

cant post-transplant hypertension (p = 0.007). Infection and sepsis was the leading cause of death in patients with a functioning graft (35.9%), while cardiovascular causes attributed to 33.3% of patient deaths in the group who died with failed graft which may be attributed to a higher incidence of post-transplant hypertension in this group of patients.

Uni- and multivariate Cox logistic regression analysis was used to identify risk factors predisposing to DWF (table 7). Post-transplant medical infection was found to be the only significant risk factor for DWF, by multivariate analysis (p = 0.001).

Discussion

The study highlights the importance of DWF relative to other competing risks of graft loss. Almost one quarter (25.4%) of all graft losses in our series was due to death with function, and the effect of DWF on graft loss was gradually more pronounced with longer time since transplantation. This finding supports the strong case previously made by others [6, 7], that graft survival analyses should consider death with function for better interpretation.

The pattern of causes of graft loss has changed over time among kidney transplant recipients [6]. DWF was demonstrated to be a major cause of graft loss in many series [4, 8, 9] and became the predominant cause of graft loss in the 1990s [11, 12]. In our series, there was an overall continued improvement in graft survival over the years with a similar trend in the DWF patient. Many centers, including ours, still hesitate to accept older patients for renal transplantation on account of their shorter life expectancy. This may explain the decreasing level of DWF patients in our series, due to the policy of avoidance of older and sicker patients in our transplantation program.

The hazard of mortality from infection and sepsis was most pronounced in our series, and was nearly twofold higher than cardiovascular disease, though there was a trend in decreasing frequency of deaths due to infection and marginal increase in deaths due to cardiovascular disease during the different eras. Many other published studies in the literature, consisting mainly of earlier series, have reported infection as the leading cause of death in a mix of transplant recipients with and without graft function [7, 10, 17]. Cardiovascular death is the most frequent cause in transplant patients in most published series [4, 5]. The increased cardiovascular mortality probably reflects an acceptance of older and sicker population of patients in the transplantation program in recent years.

The infection rate in our study group (35.6%) was higher than that published in other series as USRDS (18%) and ERA-EDTA Registry (15%), but lower than the Leiden group (46%). The prevalence of infection in transplant patients usually varies from country to country. There are many factors which may interact to determine the risk of infection as the state of immunosuppression, post-operative care and patient's epidemiologic exposure. Further, poorer socioeconomic conditions and lower standards of hygiene contributed to higher infectious complications in the developing countries. Our results show that infection was more likely in the patients who died in the first year and most of them were due to pneumonia and closely related to intensity of immunosuppression and use of adjuvant therapy as ATG or OKT3. In 2000, Pelletier et al. [17] demonstrated that post-transplantation infections which occur during the admission for transplantation have markedly increased mortality. Tuberculosis pneumonia was documented in 1 patient. The overall incidence of tuberculosis in our transplant population is 3.8%.

Patients aged ≥ 40 years at the time of transplantation had a higher relative risk of mortality with a functioning graft with no higher relative risk of mortality in the first year following transplantation. This is partly in contrast with previous studies, reporting higher mortality ratio for older patients in the first year after transplantation [18, 19]. We found by uni- and multivariate analysis no further increase in the risk of DWF in the highest age category, which is in conflict with what has been previously published in the literature where there is a consensus that age is the most significant factor influencing patient survival [3, 5, 8], and maybe due to the policy is not to accept patients >60 years for transplantation. However, in other studies, higher mortality rates were found in patients aged >60 years at transplantation [19].

The underlying disease responsible for end-stage renal failure did not affect the risk of mortality with function, by multivariate analysis, in our series. Many studies found that ESRD caused by diabetes mellitus was the most important determinant of death with function [4, 5, 7], and the excess risk of death in these patients can be explained, primarily, by significantly higher mortality rates from both cardiovascular disease and stroke. Patients with diabetes mellitus pre-transplantation are not accepted for transplantation in our center.

Hepatotoxicity is a major problem after transplantation in our series. The interplay between high schistoso-

mal infection among our transplant population [13–16] and HCV infection may be the contributing factor. The prevalence of HCV infection in our patients on hemodialysis is high, reaching 60% [13]. The development of fulminating hepatitis in our renal transplant patients is an ominous sign and implies imminent death.

In line with other studies [5, 7], an increased risk of mortality was associated with established risk factors for graft survival such as acute rejection and acute tubular necrosis. In some cases, this concordance of risk factors for mortality and graft survival suggests a direct mechanistic relationship.

The issue of consideration of DWF patients who actually had a good kidney function or whether their death was related to or hastened by impaired graft function was raised by West et al. [20]. In line with other studies [9, 13], we found that mean serum creatinine was <2 mg/dl at 1 month, 1 year and at the time of death for the vast majority of these patients. This finding may support the argument that kidney recipients who died with functioning grafts should be considered separately when analyzing graft outcome.

Conclusion

The survival of patients with functioning renal transplants is high and has markedly improved in recent years. Cause-specific mortality varies substantially depending on the post-transplant era interval. Infection supersedes cardiovascular causes at all times during follow-up of our transplant population. Our findings demonstrate that kidney recipients who die with a functioning graft had good renal function; this is an additional support for presenting graft survival results both with and without death-censored data. Lastly, more efforts should be paid for addressing the health issues encountered by the transplant populations.

References

1 Arend SM, Mallat MJ, Westendorp R, van der Woude FJ, van Es LA: Patient survival after renal transplantation: More than 25 years' follow-up. Nephrol Dial Transplant 1997;12: 1672–1679.
2 Arrazola L, Sozen H, Humar A, Ukins M, Papalois, AJ, Matas AJ: Death with function: The next major hurdle. Transplant Proc 2000; 32:1832.
3 Briggs ID: Causes of death after renal transplantation. Nephrol Dial Transplant 2001;16: 1545–1549.
4 Denny RR, Sumrani N, Miles AMV, Dibenedetto A, Distant DA, Hong JH, Markell M, Friedman EA, Sommer BG: Survival on hemodialysis versus renal transplantation following primary renal allograft failure. Transplant Proc 1997;29:3602–3604.
5 Ekstrand A: Kidney transplantation with and without prior dialysis therapy in diabetic patients with end-stage renal failure. Scand J Urol Nephrol 1993;27:83–87.
6 Hariharan S, Johnson CP, Breshnahan BA: improved graft survival after renal transplantation in the United States 1988–1996. N Engl J Med 2000;342:605–612.
7 Hill MN, Grossman RA, Feldman HI, Hwravitz S, Dafooe DC: Changes in the causes of death after renal transplantation, 1966–1987. Am J Kidney Dis 1991;27:512–518.
8 Hirata M, Cho YW, Cecka JM, Terasaki PI: Patient death after renal transplantation. An analysis of its role in graft outcome. Transplantation 1996;61:1479–1483.
9 Howard RJ, Reed AI, Hemming AW, Van der Werf WJ, Patton, PR, Ptaff, WW, Srinivas TR, Scarnik JC: Graft loss and death: Changing causes after kidney transplantation. Transplant Proc 2001;33:3416.
10 Kim MS, Kim SI, Moon JI, Kim YS Pork K: Functional graft survival: The significance of patient death with a functioning graft. Transplant Proc 1998;30:3099–3100.
11 Kim YS, Oh CK, Park K: Causes of early or late patient death after living donor renal transplantation. Transplant Proc 1994;26:2019–2020.
12 Lindholm A, Albrechtsen D, Frodin L, Tufveson G, Persson NH, Lundgren G: Ischemic heart disease – Major cause of death and graft loss after renal transplantation in Scandinavia. Transplantation 1995;60:451–457.
13 Mahmoud IM, Sobh MA, Amer GM, El-Chenawy FA, Gazarren SH, El-Sherif A, El-Sawy E, Ghoneim MA: A prospective study of hepatitis C viremea in renal allograft recipients. Am J Nephrol 1999;19:576–585.
14 Mahmoud KM, Sobh MA, EL-Agroudy AE, Mostafa FE, EL-Baz M, Shokeir AA, Ghoneim MA: Impact of schistosomiasis on patient and graft outcome after renal transplantation: 10 years follow-up. Nephrol Dial Transplant 2001;16:2214–2221.
15 Matas AJ, Gillingham KJ, Sutherland, DER: Half-life and risk factors for kidney transplant outcome. Importance of death with function. Transplantation 1993;55:757–761.
16 Ojo AO, Hanson JA, Wolfe RA, Leichtman AB, Agodoa LY, Port FK: Long-term survival in renal transplant recipients with graft function. Kidney Int 2000;57:307–313.
17 Pelletier SJ, Crabtree TD, Gleason TG, Raymound DP, Oh Ck, Pruett TL, Sawyer RG: Characteristics of infectious complications associated with mortality after solid organ transplantation. Clin Transplant 2000;14:401–408.
18 Perez RV, Matas AJ, Gillingham KJ: Lessons learned and future hopes: Three thousand renal transplants at the University of Minnesota; in Terasaki PI, Cecka JM (eds): Clinical Transplants 1990. Los Angeles, UCLA Press, 1990, pp 217–231.
19 Schauelle P, Lorenz D, Trede M, Von der Woude FJ: Impact of cadaveric transplantation on survival in end-stage renal failure: Evidence for reduced mortality risk compared with hemodialysis during long-term follow-up. J Am Soc Nephrol 1998;9:2135- 2141.
20 West M, Sutherland DER, Matas AJ: Kidney transplant recipients who die with functioning grafts: Serum creatinine level and cause of death. Transplantation 1996;62:1029–1030.