Twelve-Month Pancreas Graft Function Significantly Influences Survival Following Simultaneous Pancreas-Kidney Transplantation

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Background and objectives: Simultaneous pancreas-kidney transplantation (SPK) is regarded as the treatment of choice for type 1 diabetes (T1DM) and kidney dysfunction, despite the morbidity associated with pancreas transplantation. These morbidities often influence selection of SPK *versus* living-donor kidney alone (LD KA) transplant. This study quantifies the impact of pancreas graft function on outcomes following SPK.

Design, setting, participants, & measurements: Using the SRTR database, SPK wait-listed patients transplanted from 1997 to 2005 were evaluated and segregated as: (*1*) SPK recipients with functioning pancreas graft 12 mo posttransplant (SPK, P+); (*2*) SPK recipients with loss of pancreas graft function within 12 mo posttransplant (SPK, P-); (*3*) recipients of deceased donor (DD) KA; (*4*) recipients of LD KA. The study compared patient and kidney graft survival to 84 mo posttransplant.

Results: Patient survival for SPK, P+ was significantly better than the LD KA; SPK, P-; and DD KA cohorts (88.6% *versus* 80.0%, 73.9% and 64.8%, respectively [$P < 0.001$]), a finding confirmed by multivariate analysis and not influenced by pancreas-after-kidney transplantation (PAK) rates and outcomes. Unadjusted graft survival was also highest in the SPK, P+ cohort (72.0% *versus* 63.6%, 59.8%, 49.7%, $P = 0.015$ *versus* LD KA).

Conclusions: SPK recipients with functioning pancreas grafts have superior survival compared with LD KA and DD KA, including in the setting of PAK. Early pancreas graft failure results in kidney and patient survival rates similar to KA. These data help further clarify the decision-making of SPK *versus* KA transplant options for patients and providers.

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Transplant options for the patient with type 1 diabetes (T1DM) and severe renal dysfunction include simultaneous pancreas-kidney transplantation (SPK), living donor kidney transplant alone (LD KA), or deceased donor kidney transplant alone (DD KA). The selection of one option over another is generally dependent on the patient's candidacy for pancreas transplant and the availability of a living donor. While it is generally accepted that SPK or LD KA is superior to DD KA for these patients, questions continue to arise regarding the relative benefit of SPK over LD KA. This, in turn, creates challenges to the clinician in advising which option may be best suited for an individual patient. For a patient who may have a potential living donor, one must balance the potential benefits of euglycemia provided by SPK *versus* the waiting time accrual and the risks of a larger surgery that are inherent to SPK.

SPK has been proposed to be the treatment of choice for patients with T1DM and severe renal dysfunction, due to potential reductions in microvascular and macrovascular complications, an improved quality of life, and prolonged kidney graft and patient survival (1–8). However, pancreas transplantation is not without risk. Compared with patients receiving DD KA, patients who receive an SPK have increased peri-operative mortality, higher rates of technical graft failure, re-laparotomy rates, and increased infection rates (9–11) contributing to an approximately 15% 1-yr pancreas graft loss rate in SPK (12). Because of the increased risk of pancreas transplantation, an important question to consider for patients with potential living donors is what the "cost" of a failed pancreas transplant would be in terms of kidney graft and patient survival if SPK was selected over LD KA.

This question becomes more ambiguous when the possibility of a pancreas-after-kidney transplant (PAK) is considered for patients with living donors. Database and single-center analyses indicate that SPK provides superior patient survival compared with DD KA, but may be equivalent to living donor KA (LD KA) (13,14). However, questions remain regarding the "added benefit" of PAK. Venstrom *et al.* demonstrated that in the setting of preserved renal function, pancreas transplant following kidney transplant (PAK) did not improve patient survival at 4 yr, with an increased relative risk of death of 42% following PAK compared with those receiving a kidney transplant alone (KA)(15). To date, no direct comparison of SPK recipients *versus* LD KA/ PAK recipients has been reported.

Given the lack of a concerted study to assist in evaluating the hazards of pancreas graft loss when advising patients regard-

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ing an SPK *versus* LD KA transplant, the authors sought to quantify the impact of early pancreas graft loss on kidney graft and patient survival following SPK. The potential impact of PAK transplant for KA recipients to determine if a later pancreas transplant was comparable to a successful SPK in recipients with type 1 diabetes also was assessed.

Materials and Methods

Standard Analysis Files (SAF) were utilized and supplied by the Scientific Registry of Transplant Recipients (SRTR) to perform a retrospective database analysis of all patients on the SPK wait-list who were transplanted January 1997 through December 2005. Surviving recipients with kidney graft function at 12 mo posttransplant were separated into four groups: (*1*) SPK recipients with functioning pancreas graft at 12 mo posttransplant (SPK, P+); (*2*) SPK recipients with loss of pancreas graft function within 12 mo posttransplant (SPK, P-); (*3*) recipients of deceased donor (DD) KA; (*4*) recipients of living donor (LD) KA. Exclusion criteria included death or kidney graft loss before 12 mo posttransplant or follow-up less than 12 mo at the time of analysis. Figure 1 shows the distribution of the recipients that were analyzed for this study. Of 9630 patients transplanted from the SPK wait-list from January 1997 to December 2005, 7952 were SPK, 1062 were LD KA, and 616 were DD KA. Eighty-six percent, 85% and 84% of SPK, LD KA, and DD KA, respectively, survived to 12 mo with functioning kidney grafts. At 12 mo, 6486 SPKs with functioning kidney and pancreas grafts (SPK, P+), 371 SPKs with kidney function but nonfunctioning pancreas grafts (SPK, P-), 520 DD KA, and 904 LD KA were available for analysis (Figure 1).

Primary end points were patient survival and kidney allograft survival, followed to 84 mo. For patient survival, patients were followed until death or kidney graft loss. For unadjusted graft survival, patient death was included as graft loss regardless of the functional status of the kidney graft at the time of death.

Statistical analysis of baseline characteristics included the Wilcoxon rank sum test for comparison of continuous variables and the Chi-square test for association for comparison of categorical variables. Survival analysis was performed using the Kaplan-Meier (product-limit) estimator of survival and the log-rank test to compare survival curves. Univariate analysis and subsequent multivariate analysis using Cox regression was performed to control for variables shown to contribute to the primary end points.

Results

Baseline characteristics of the four groups are shown in Table 1. Significant differences between SPK and KA recipient cohorts were present despite limiting the analysis to SPK wait-listed candidates. Notably, wait-list time, pretransplant dialysis time, peak PRA, 0HLA mismatch, and prior kidney transplant were all higher in the DD KA cohort, while the rates of PAK and the era of transplant were more prevalent, and acute rejection less prevalent in the LD KA cohort compared with SPK recipients.

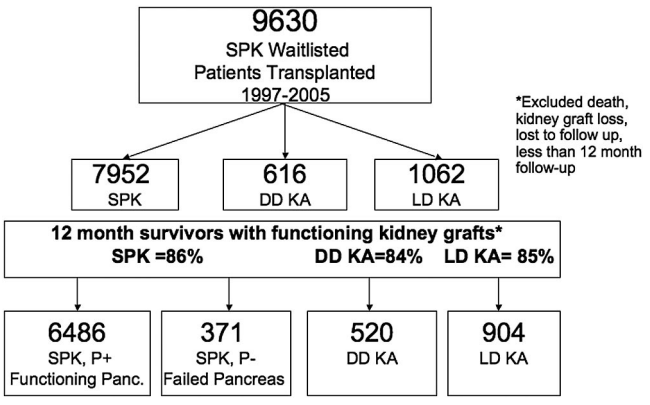

Figure 1. Conceptual model.

Figure 2 shows 12-mo a) patient and b) kidney graft survival for SPK, LD KA and DD KA before separation into study arms (Figure 1). Patient survival for SPK, LD KA, and DD KA was 95.9%, 97.2%, 95.6% (LD KA *versus* SPK, $P = 0.04$ and LD KA *versus* DD KA, $P = 0.1$). Kidney graft survival was 92.0%, 94.8%, and 90.3%, respectively (LD KA *versus* SPK, $P = 0.001$, LD KA *versus* DD KA $P < 0.001$). As Figure 2 demonstrates, initial 12-mo graft and patient survival was significantly higher following LD KA than SPK.

Figures 3a, b, and c represent censored 84-mo Kaplan-Meier patient, unadjusted kidney graft, and death censored kidney graft survival in 12-mo survivors with kidney graft function. Patient survival (Figure 3a) was highest in the SPK, P+ group (88.6%) compared with LD KA (80.0%, $P < 0.001$). Loss of pancreas graft function within 12 mo of transplantation (SPK, P-) resulted in significantly worse patient survival compared with SPK, P+ (73.9%, $P < 0.001$), while DD KA recipients had the lowest patient survival (64.8% $P < 0.001$ *versus* SPK, P+). Unadjusted kidney graft survival (Figure 3b) again was highest in the SPK, P+ group compared with the remaining groups, but when kidney graft survival was censored for death with a functioning graft (Figure 3c), it was apparent that the differences noted between the groups could be entirely ascribed to differences in patient death. Table 2 demonstrates the between group log-rank comparisons and shows that the improved unadjusted kidney graft and patient survival seen in the SPK, P+ compared with the LD KA, SPK, P- and DD KA groups was statistically significant. For those SPK recipients who lost their pancreas graft within 12 mo posttransplant (SPK, P-), there was no statistically significant difference in either kidney graft or patient survival compared with LD KA or DD KA recipients.

To identify factors contributing to these unadjusted findings, univariate analysis was performed for risk factors influencing graft and patient survival (Table 3). Risk factors significantly increasing risk of kidney graft loss included donor age, donor race, donor BMI, cause of donor death, recipient age, recipient race, pretransplant dialysis >24 mo, delayed graft function, era of transplant before 2001, and acute rejection. Factors significantly increasing the risk of patient death included donor race, recipient age, pretransplant dialysis >24 mo, delayed graft function, era of transplant before 2001, and zero HLA mismatch. We then performed a multivariate regression analysis controlling for the recipient and transplant factors, not including donor factors due to the inherent differences that exist between living donors and deceased donors and including PAK in the multivariate analysis given its strong correlation with LD KA status and potential for co-segregation (Table 4). Loss of the pancreas graft within the first 12 mo posttransplant conferred a 64% increased risk of kidney graft failure and 2.66-fold increased risk of patient death compared with SPK

Table 1. Baseline characteristics

	Group 1 (SPK, P+)	Group 2 (SPK, P-)	Group 3 DD KA	Group 4 LD KA
Deceased Donor Factors:				
Age (year)[b]	29.8	32.6	35.8	NA
BMI[b]	23.9	24.6	25.8	NA
Race %[a]	–	–	–	NA
White	73.6	75.1	82.2	–
Black	12.7	2.7	6.1	–
Hispanic	11.6	10.7	9.7	–
Other	2.0	2.7	2.0	–
Gender (% male)	66.9	67.3	65.5	NA
Death %[b]	–	–	–	NA
Head Trauma	68.8	59.6	51.9	–
CVA	20.6	31.2	30.7	–
Other	10.7	9.2	17.4	–
Recipient Factors:				
Age (year)[b]	39.9	39.5	42.5	40.3
BMI[b]	24.6	25.1	26.0	25.0
Race:[a]				
White	79.7	82.6	83.3	83.3
Black	11.9	10.2	10.4	8.3
Hispanic	6.9	5.3	5.2	6.6
Other	1.5	1.9	1.1	1.9
Gender (% male)[b]	60.1	52.8	58.3	54.3
Wait-list Days[b]	344.8	351.8	562.1	251.8
Dialysis Pretransplant[b]				
None	21.7	22.0	16.5	31.1
%≤6 months	9.6	9.0	7.4	18.1
%>6 ≤ 12 months	13.4	13.1	10.6	20.7
%>12 ≤ 24 months	26.5	25.9	18.6	18.7
%>24 months	28.9	30.0	46.8	11.4
Peak PRA %[b]	8.1	8.3	19.5	9.3
Previous Kidney Tx %[b]	6.5	4.8	10.9	6.6
Subsequent Pancreas Transplant% (PAK)[b]	2.7	32.1	33.9	53.7
Transplant Factors:				
Zero HLA Mismatch %[b]	3.6	2.9	31.3	13.4
CIT[b]				
%≤12 h	43.4	40.7	23.3	97.0
%>12 ≤ 24 h	51.4	50.0	56.0	1.5
%>24 ≤ 36 h	4.9	9.0	19.2	0.9
%>36 h	0.2	0.3	1.5	0.7
DGF %[b]	6.5	16.3	21.2	3.8
Acute Rejection %[b]	18.8	17.7	7.0	3.2
Era of Transplant:	53.4	48.5	82.3	81.1
% (2001-2005 *versus* 1997-2000)[b]				

[a]$P < 0.05$; [b]$P < 0.001$.

recipients with preserved pancreas graft function. Similarly, LD KA and DD KA both had >50% increased risk of graft loss and a twofold higher risk of death compared with SPK, P+ when controlling for known recipient and transplant differences that impact patient and graft survival.

It was then determined if the addition of a PAK provided a benefit to those patients receiving KA (LD or DD) or to SPK recipients who suffered early loss of the pancreas (Table 5). While numerically those patients that underwent subsequent PAK had higher graft and patient survival rates in each subset, this only reached statistical significance for kidney graft survival in the LD KA cohort. Furthermore, patient survival (but

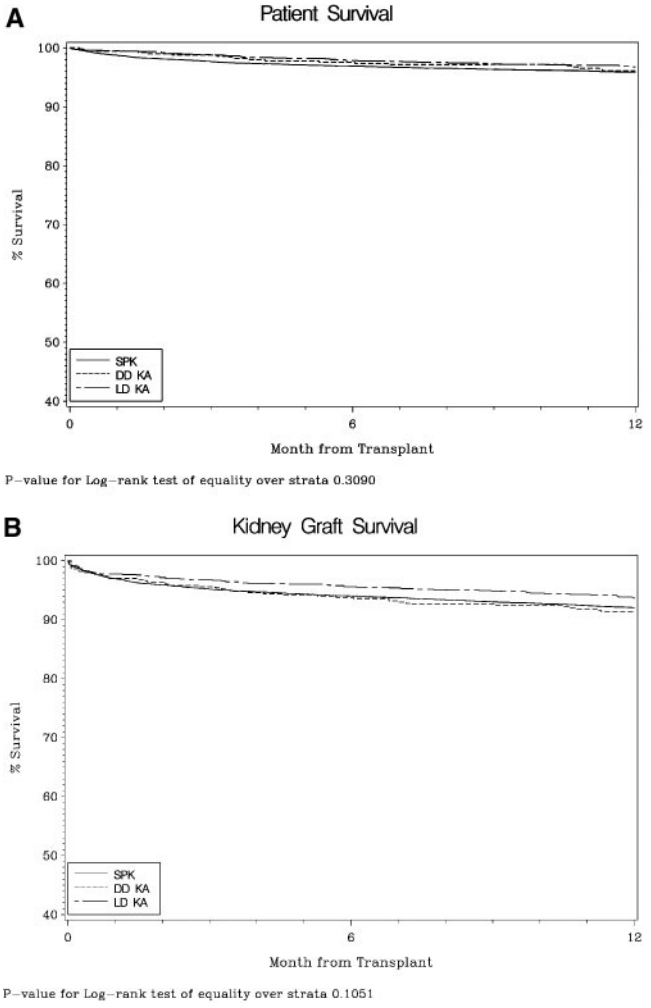

Figure 2. Patient and kidney graft survival to 12 mo in patients following simultaneous pancreas-kidney transplantation (SPK), living-donor kidney alone (LD KA), or recipients of deceased donor (DD KA). *Figure 2a*: Kaplan-Meier 12-mo patient survival. SPK = 95.9%, DD KA = 95.6%, LD KA = 97.2% ($P = 0.04$ *versus* SPK, $P = 0.10$ *versus* DD KA). *Figure 2b*: Kaplan-Meier 12-mo kidney graft survival. SPK = 92.0%, DD KA = 90.3%, LD KA = 94.8% ($P = 0.001$ *versus* SPK, $P < 0.001$ *versus* DD KA).

not kidney graft survival) remained statistically higher for the SPK,P+ group compared with all other subsets, indicating that while PAK offered a nominal improvement in outcomes, this did not overcome the survival advantages of a successful SPK.

Discussion

The results of this study help clarify the risks and benefits of SPK *versus* KA (both LD KA and DD KA) when discussing these treatment options with patients. First, consistent with prior reports (13,15,16), an increased rate of death and graft loss of approximately 2% to 3%, when comparing SPK to LD KA within the first 12 mo following transplant, was shown. Second, for the first time it was demonstrated that for patients who survive the first year after transplant with a functioning kidney, SPK recipients with a functional pancreas enjoy a survival advantage when compared with LD KA. Third, for SPK survi-

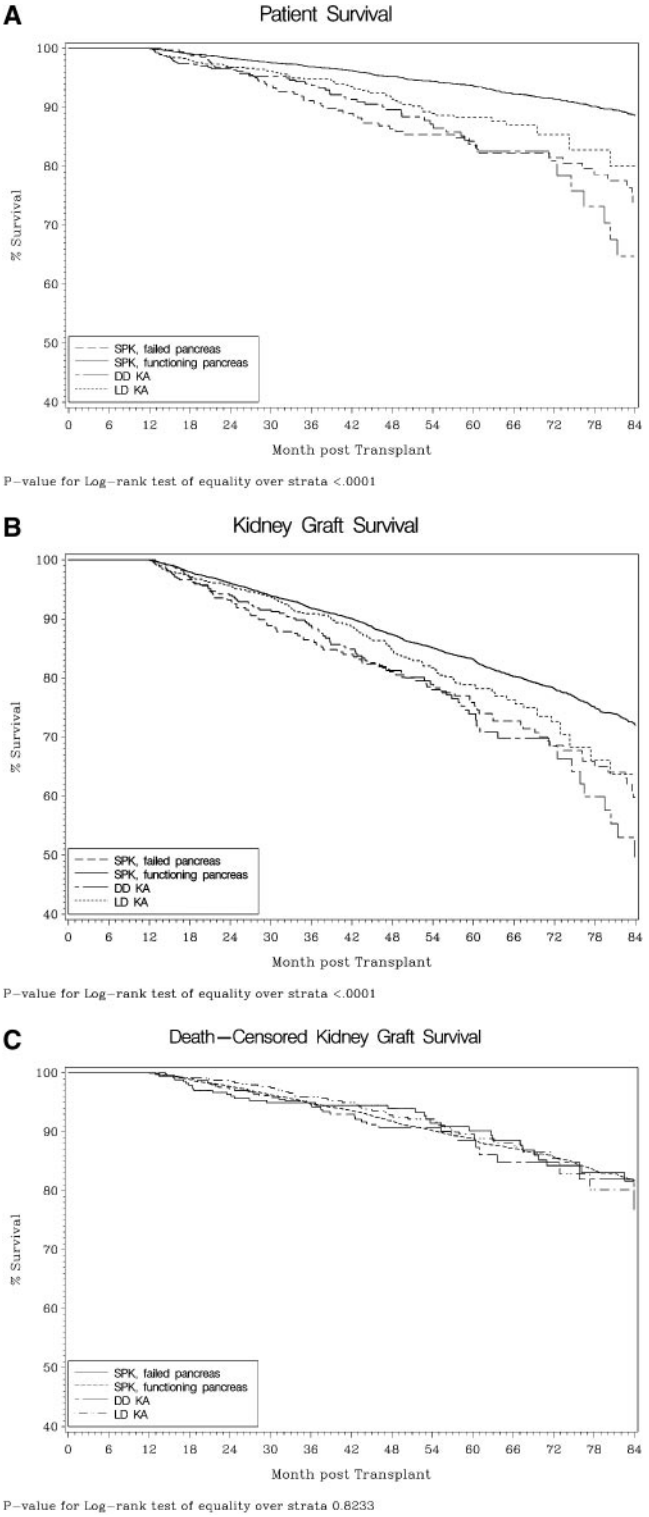

Figure 3. Patient, and Kidney Graft Survival to 84 mo (unadjusted and death-censored graft survival) in patients surviving 12 mo with kidney function. *Figure 3a*: Kaplan-Meier 84-mo patient survival. SPK, P+ = 88.6%,[a] LD KA = 80.0%, SPK,P- = 73.9%, DD KA = 64.8% ([a]$P < 0.001$ *versus* each group individually and collectively). *Figure 3b*: Kaplan-Meier 84-mo unadjusted kidney graft survival. SPK, P+ = 72.0%,[a] LD KA = 63.6%, SPK,P- = 59.8%, DD KA = 49.7% ([a]$P < 0.001$ *versus* SPK,P- and DD KA, $P = 0.015$ *versus* LD KA). *Figure 3c*: Kaplan-Meier 84-mo death-censored kidney graft survival (p = ns for all groups/comparisons).

Table 2. 84 Month Between-Group Log-Rank Comparisons

12 Month Survivors	84 Month Unadjusted Graft Survival %	*P* value *versus* 1[a] *versus* 4[b]	84 Month Patient Survival %	*P* value *versus* 1[a] *versus* 4[b]
1) SPK, P+	72.0	—	88.6	—
2) SPK, P-	59.8	<0.001[a] NS[b]	73.9	<0.001[a] NS[b]
3) DD KA	49.7	<0.001[a] 0.063[b]	64.8	<0.001[a] 0.085[b]
4) LD KA	63.6	0.015[a]	80.0	<0.001[a]

SPK, P+, pancreas-kidney transplantation recipients with functioning pancreas graft function within 12 mo posttransplant; SPK, P-, recipients with loss of pancreas graft function within 12 mo posttransplant; LD KA, living-donor kidney alone; DD KA, deceased donor kidney alone.

Table 3. Univariate Analysis of Risk Factors for Graft and Patient Survival

	HR Graft loss (95% CI)	HR Death (95% CI)
Deceased Donor Factors		
Age:		
≥35 *versus* <35	1.27 (1.12–1.44)[b]	1.07 (0.88–1.31)
≥50 *versus* <35	1.45 (1.09–1.92)[a]	0.79 (0.45–1.38)
Race:		
AA *versus* White	1.40 (1.21–1.63)[b]	1.52 (1.21–1.91)[b]
Other *versus* White	0.99 (0.84–1.17)	1.09 (0.84–1.40)
BMI:		
>25–30 *versus* 20–25	1.13 (1.00–1.28)[a]	1.54 (0.96–1.39)
>30 *versus* 20–25	1.03 (0.84–1.27)	1.08 (0.79–1.48)
Gender: Male	0.95 (0.85–1.06)	1.11 (0.93–1.32)
Death:		
CVA *versus* Head Trauma	1.23 (1.09–1.40)[a]	1.16 (0.96–1.41)
Other *versus* Head Trauma	1.32 (1.11–1.58)[a]	1.25 (0.96–1.63)
Recipient/Transplant Factors:		
Age:		
≥35 *versus* <35	0.77 (0.69–0.87)[b]	1.21 (1.00–1.47)[a]
≥50 *versus* <35	1.00 (0.85–1.18)	2.13 (1.67–2.71)[b]
Race: AA *versus* White	1.52 (1.31–1.76)[b]	1.14 (0.89–1.45)
Other *versus* White	0.96 (0.78–1.78)	0.74 (0.52–1.04)
Previous Kidney Transplant	1.22 (0.98–1.51)	1.23 (0.89–1.70)
Subsequent Pancreas Transplant (PAK)	0.96 (0.81–1.15)	1.23 (0.96–1.59)
Peak PRA >0	1.02 (0.92–1.13)	1.23 (0.89–1.70)
Pre-Transplant Dialysis:		
<12m *versus* None	1.15 (0.99–1.34)	1.11 (0.88–1.40)
>12–24m *versus* None	1.17 (1.01–1.36)[a]	1.14 (0.90–1.43)
>24m *versus* None	1.41 (1.22–1.63)[b]	1.49 (1.20–1.86)[b]
CIT		
12–23 h *versus* <12 h	0.97 (0.86–1.10)	0.90 (0.75–1.07)
24 ≤ 36 h *versus* <12 h	1.15 (0.91–1.44)	1.23 (0.88–1.71)
Zero HLA Mismatch	1.09 (0.88–1.34)	1.50 (1.34–1.98)[a]
Delayed Graft Function	1.72 (1.45–2.03)[b]	1.77 (1.38–2.28)[b]
Acute Rejection	1.22 (1.08–1.37)[a]	0.89 (0.74–1.09)
Era of Transplant: 2001–2005 *versus* 1997–2000	0.79 (0.70–0.89)[b]	0.60 (0.50–0.73)[b]

[a]$P < 0.05$; [b]$P < 0.001$.

Table 4. Multivariate Analysis of Risk Factors for Graft and Patient Survival[a]

	HR Graft Loss (95% CI)	HR Death (95% CI)
SPK, P+	1.0	1.0
SPK, P-	1.64 (1.31–2.05)[b]	2.66 (1.98–3.57)[b]
DD KA	1.63 (1.28–2.06)[b]	2.05 (1.48–2.83)[b]
LD KA	1.51 (1.22–1.88)[b]	1.98 (1.47–2.67)[b]

[a]Included significant variables in stepwise backward regression: Recipient age, recipient race, pretransplant dialysis time, delayed graft function, acute rejection, 0HLA mismatch, PAK status, transplant era (>2000).
[b]$P < 0.001$ for all comparisons

Table 5. Five-YearActuarial Patient and Kidney Graft Survival Rates in Patients Surviving with Kidney Function at One Year: Influence of PAK

12-Month Survivors	n	Unadjusted Kidney Graft Survival (%)	Patient Survival (%)
SPK, P-	252	72.4	81.8
SPK, P- (PAK)	119	81.2	87.6
LD KA	419	75.9	85.6
LD KA (PAK)	485	83.0[c]	89.6
DD KA	344	69.1	80.2
DD KA (PAK)	176	76.0	87.2
SPK, P+	6486	83.1[b]	93.6[ab]

[a]$P = 0.03$ *versus* DD KA (PAK), $P = 0.005$ *versus* LD KA (PAK), $P = 0.02$ *versus* SPK,P- (PAK), $P < 0.0001$ *versus* all non-PAK groups.
[b]$P = 0.0001$ *versus* SPK, P-, LD KA, and DD KA.
[c]$P = 0.006$ *versus* LD KA.
No other significant differences between groups, PAK *versus* no PAK.

vors who lose function of the pancreas graft within the first year, it was shown than the survival advantage of this treatment option is eliminated and has outcomes parallel to those achieved with DD KA outcomes. Fourth, the study demonstrates that KA recipients who subsequently undergo PAK benefit nominally from the additional surgery, but still do not achieve similar survival as those with a functioning SPK.

Registry data demonstrates that for the period 1999 to 2004, the one-year pancreas survival rate for SPK recipients was approximately 85% (12), a success rate that has improved over time (17,18). Given these data in combination with the results of this study, one could estimate that approximately 80% of SPK recipients overall would be expected to enjoy better patient survival compared with LD KA, while 20% of SPK recipients would fare slightly worse than LD KA. These survival differences persist even in the setting of subsequent PAK. For patients and providers who are considering the options of LD KA *versus* SPK, these results can be summarized as follows: there is an increased perioperative risk of death and kidney graft loss with SPK *versus* LD KA of approximately 2% to 3%, plus an additional chance that the pancreas will fail within the first year (approximately 15% to 20%), which then influences outcomes. In the approximately 80% of patients who survive with a functional kidney and pancreas, patient survival of SPK recipients is superior, while in the remainder who suffer pancreas graft loss, the outcomes following SPK are nominally worse than LD KA.

There are a number of potential reasons for improved patient survival with a functional SPK. While it is clear that intensive glucose control results in reduction in both microvascular and macrovascular complications in T1DM, (19,20), the impact of pancreas transplantation on complications of diabetes, including nephropathy, retinopathy, and neuropathy, is more subtle (1,7,8). One potential explanation is that stabilization of diabetes control may lead to a reduction in cardiac events, a hypothesis supported by others (21–25). However, since 5-yr pancreas graft survival following SPK is only 71% (12), explanations other than euglycemia must be considered to account for the improved outcomes. Inherent differences in donor, recipient and transplant characteristics between SPK and KA cohorts (Table 1) might be expected to favor the SPK group regardless of beta cell function. When controlling for these differences in regression analysis, SPK,P-; LD KA; and DD KA all performed poorly when compared with SPK,P+ (Table 4), consistent with findings in some (26), but not all (27), studies. The inconsistency in the literature suggests that it is difficult to fully control for these baseline differences. Analysis was limited to patients listed for SPK in an effort to minimize these inherent differences, both measured and unmeasured.

A number of potential explanations for the worse outcomes of the SPK, P- group should also be considered. One could hypothesize that donor quality was different in those with failed *versus* surviving pancreas grafts. From available baseline characteristics, only donor death by cerebrovascular accident incidence and recipient delayed graft function rates (defined by dialysis within the first week) were different in those with pancreas graft loss compared with those without pancreas graft loss. Given these differences, it is possible that unaccounted-for donor factors may have contributed to pancreas loss in the SPK,P- cohort and contributed to additional comorbidities (infection, repeated operations, rejection) that not only impacted pancreas graft survival within the first year, but also patient survival in subsequent years. Since the incidence of rejection was not different between the SPK,P- and SPK,P+ groups, and the graft loss due to rejection formed only a small percentage (3.2%) of causes of pancreas graft loss, rejection is an unlikely distinguishing feature between the SPK,P+ and SPK,P- groups. Another potential explanation for the differences between SPK,P+ and SPK,P- outcomes is that if pancreas graft loss was associated with diminished kidney function at 12 mo (*e.g.,* due to prolonged acute kidney injury or concurrent acute rejection episodes), both patient and kidney graft survival may be diminished. Unfortunately, kidney function data were not captured reliably at 12 mo in our dataset to stratify patients by degree of renal function, but given the similar death-censored kidney graft loss data for all four cohorts (Figure 3c), it is less likely that significant differences in renal function were present at the 12-mo time point.

A novel finding within this study is that SPK recipients with function at 12 mo had greater patient survival than LD KA cohorts, regardless of whether the LD KA recipient underwent a subsequent PAK. This difference was noted on unadjusted analysis, was present despite a very low acute rejection rate in the LD KA cohort, and persisted after multivariate analysis. These findings add to the ongoing debate regarding the benefit of LD KA/PAK *versus* SPK (15,16) and support the concept that SPK transplant may be superior to PAK. While it was shown that the cohort of LD KA recipients who undergo PAK have better kidney graft survival, but a nonstatistically significant improvement in patient survival compared with LD KA alone, the possibility of selection bias in the selection of patients who ultimately receive PAK must be taken into consideration.

This study provides novel findings that are distinct from the current literature. Other studies have shown that pancreas graft function contributes to improved patient and kidney graft survival, but fail to quantify this degree of benefit (or cost) compared with LD KA. SPK recipients without pancreas function at 90 d(28) or 12 mo (29) posttransplant suffer worse kidney (28) and patient (29) survival when compared with SPK recipients with preserved pancreas function. Notably, these studies were hindered by the single-center nature of one trial (28) and the outcomes reported from an earlier era (1987 to 1996) in the other (29). Neither study compares the outcomes of the SPK recipient with a failed pancreas to a KA cohort with or without PAK. Recently, another study of SPK and KA recipients who had maintained kidney function 10 yr posttransplant demonstrated greater 18-yr patient survival with SPK *versus* LD KA, further noting that SPK recipients had greater survival if their pancreas was also functional at 10 yr (30). Like the authors' study, this study provided evidence of the long-term benefit of a functional pancreas, but no comparison of SPK recipients with a failed pancreas to a KA cohort was made, and thus the authors' study is the only one of its kind to quantify both the "benefit" of a successful SPK transplant and "cost" of a failed pancreas *versus* the option of KA transplant.

While this information may assist in the ongoing comparison of the relative benefits of SPK compared with LD KA, a number of limitations of this study deserve mention. This study is retrospective and observational in nature, and, therefore, the authors are unable to specifically describe why patients with preserved pancreas graft function benefit from improved patient survival. In addition, because of its retrospective design, the researchers were only able to analyze and report the variables available through the Standard Analysis Files from SRTR, in which certain variables are universally collected, while others are less complete. In particular, acute rejection reporting is complicated by various definitions and is underreported in database formats. The differences in acute rejection between KA cohorts and SPK cohorts should therefore be interpreted with caution. Analysis was limited to the period 1997 to 2005 to account for the implementation of newer immunosuppressive agents (tacrolimus, mycophenolate) rather than relying on initial immunosuppression medications reported to United Network for Organ Sharing/Scientific Registry for Transplant Recipients, given the frequency that these medications are altered posttransplant (31,32) and the recent data-reduction plans to eliminate these data from collection.

In conclusion, the status of the pancreas graft at one year is a significant determinant to the SPK recipient's long-term outcomes, both in terms of kidney graft function and survival. When comparing these outcomes to LD KA transplantation, an SPK with a functional pancreas is associated with improved survival, and a failed pancreas is associated with worse comparative outcomes. This information can readily be used when discussing transplant options for patients with Type 1 Diabetes and advanced kidney disease.

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Disclosures

None.

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