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Rapid Discontinuation of Prednisone in Kidney Transplant Recipients: 15-Year Outcomes from the University of Minnesota

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Abstract

Background—Short- and intermediate-term results have been reported after rapid discontinuation of prednisone (RDP) in kidney transplant recipients. Yet there has been residual concern about late graft failure in the absence of maintenance prednisone.

Methods—From October 1, 1999, through June 1, 2015, we performed a total of 1553 adult 1st and 2nd kidney transplants—1021 with a living donor (LD), 532 with a deceased donor (DD)—under our RDP protocol. We analyzed the 15-year actuarial overall patient survival (PS), graft survival (GS), death-censored graft survival (DCGS), and acute rejection-free survival (ARFS) rates for RDP compared to historical controls on maintenance prednisone.

Results—For LD recipients, the actuarial 15-year PS rates were similar between groups. But RDP was associated with increased GS ($p=0.02$) and DCGS ($p=0.01$). For DD recipients, RDP was associated with significantly better PS ($p<0.01$), GS ($p<0.01$) and DCGS ($p<0.01$). There was no difference between groups in the rate of acute or chronic rejection, or in the mean estimated glomerular filtration rate at 15 years. However, RDP-treated recipients had significantly lower rates of avascular necrosis, CMV, cataracts, NODAT and cardiac complications. Importantly, for recipients with graft survival >5 years, there was no difference between groups in subsequent actuarial PS, GS, and DCGS.

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Disclosure

The authors of this manuscript have no conflicts of interest to disclose as described by *Transplantation*.

Conclusion—In summary, at 15-years post kidney transplant, RDP did not lead to decreased in patient or graft survival, or an increase in graft dysfunction but as associated with reduced complication rates.

INTRODUCTION

Throughout the first 4 decades of clinical kidney transplantation, prednisone was a mainstay of long-term maintenance immunosuppression. However, because of the myriad of side effects associated with prednisone, numerous trials have attempted late (≥ 3 months posttransplant) dose reduction or complete withdrawal. In most of those trials, late prednisone withdrawal was associated with significantly higher acute rejection (AR) rates, and in some trials, with lower graft survival rates.^{1–3} With the introduction of new, more potent immunosuppressive agents (eg, cyclosporine [CsA], mycophenolate mofetil [MMF]), new trials attempted to address late steroid withdrawal, again demonstrating significantly higher rejection rates in the withdrawal group.^{4–9}

More recently, protocols have been developed that incorporate rapid discontinuation of prednisone (RDP), defined as prednisone tapering and discontinuation in the first 2 weeks posttransplant. Randomized controlled trials, meta-analyses, and literature reviews have found some increase in early AR rates after RDP, but no decrease in patient and graft survival rates.^{10–13} Importantly, RDP was associated with minimization of steroid-specific side effects (eg, cataracts, avascular necrosis, osteoporosis, mood and appearance changes) and with a markedly improved cardiovascular risk profile (eg, decreased rate of new-onset diabetes after transplant [NODAT], lower cholesterol and triglyceride levels).^{11,14–21}

One residual concern has been that RDP would be associated with an increased rate of late posttransplant graft loss, or a more rapid deterioration of graft function.^{2,10,12} We previously reported that with RDP, 10-year patient, graft, and death-censored graft survival rates were similar as compared with a control group on prednisone maintenance therapy.²¹ In the current study, we analyzed actuarial 15-year outcomes. Additionally, to examine differences in late deterioration of graft function and graft loss, we studied patients with 5-year graft survival to determine subsequent outcomes.

METHODS

From October 1, 1999, through June 1, 2015, we performed a total of 1553 adult kidney transplants—1021 with a living donor (LD), 532 with a deceased donor (DD)—under our RDP protocol (the RDP group). Immunosuppression entailed a prednisone taper and complete discontinuation on postoperative day (POD) 6. Initially, we limited our RDP protocol (approved by the University of Minnesota's Human Subjects Committee) to primary LD recipients. However, after promising results in this LD population, in October 2000, we expanded it to include all first and second LD and DD recipients. Of note, our RDP protocol was not limited to a low immunologic risk cohort.²² Exclusion criteria were 3 transplants and prednisone use at the time of the transplant.

RDP Cohort

Our RDP protocol has been described in detail previously.^{21,23} Briefly, all recipients in the RDP arm received Thymoglobulin (SangStat Corporation, Fremont, CA) at a dose of 1.25–1.5 mg/kg IV for 5 doses, with the 1st dose given intraoperatively. If DGF occurred, additional doses (up to a maximum of 10 doses) were given. Methylprednisolone (500 mg) was given intraoperatively. Prednisone was given at 1 mg/kg on posttransplant day 1; at 0.5 mg/kg, days 2 and 3; and at 0.25 mg/kg, days 4 and 5. After day 5, prednisone was discontinued, except in recipients with DGF, who were given 5mg/day of prednisone until Thymoglobulin treatment was discontinued; at that point, prednisone was also stopped.

Initially, maintenance therapy for all recipients consisted of CsA (4 mg/kg bid adjusted to achieve levels of 150–200 ng/mL, by HPLC, for the first 3 months; levels of 125–150 for the second 3 months; and levels >100 thereafter) and MMF (1 g bid orally, with the first dose given IV in the operating room). For recipients with DGF, introduction of CsA was delayed until evidence of improvement in renal function (increasing urine output and/or decreasing creatinine level) or 10 days if Thymoglobulin treatment, whichever came first. In March 2001, we began studying CsA-MMF vs. tacrolimus-sirolimus in our steroid minimization protocol. Recipients were divided into 3 subgroups: those on CsA-MMF (n = 85) vs. high-level tacrolimus (8–12 ng/mL), and low-level sirolimus (3–7 ng/dL) (n = 82) vs. low-level tacrolimus (3–7 ng/mL) and high-level sirolimus (8–12 ng/dL) (n = 72). The only exclusion criterion for enrollment into the study was current (ie, immediately pretransplant) steroid use. There was no difference between the 3 groups in the incidence of AR or in graft survival, so the entire RDP data was analyzed in aggregate.

Historical Control

The control group comprised a historical cohort of 459 adult kidney recipients—168 LD, 291 DD—who underwent transplants at our institution from January 1, 1996, through December 31, 2000, and who were treated with polyclonal antibody induction, a calcineurin inhibitor, MMF, and prednisone (1 mg/kg per day initially, then tapered to 0.4 mg/kg per day by 1 month and to 0.15 mg/kg per day by 1 year posttransplant). A description of the historical control cohort demographic characteristics has previously been reported in extensive detail.²⁵

Additional Care

Recipients in both groups were treated with prophylactic ganciclovir or valganciclovir for a minimum of 3 months posttransplant (or 6 months for EBV- recipients with EBV+ grafts). Recipients treated for an AR episode received an additional 6 weeks of prophylaxis against cytomegalovirus (CMV). Prophylaxis against *Pneumocystis* consisted of trimethoprim sulfamethoxazole; in recipients with sulfa allergies, dapsone or aerosolized pentamidine was used. Fungal prophylaxis was with oral clotrimazole or nystatin for 3 months posttransplant.

Recipients whose serum creatinine level increased by at least 25% from baseline underwent percutaneous graft biopsy. Mild to moderate AR episodes were treated with a rapid steroid taper; steroid-resistant AR episodes and histologically severe AR episodes were treated with antibody. For the RDP group, after antirejection therapy, recipients were maintained on

prednisone (5 mg/day) long-term; however, some recipients preferred returning to prednisone-free immunosuppression. A retrospective review of our outcomes showed that those who discontinued prednisone, compared to those who remained on 5 mg of prednisone per day, were significantly more likely to have a 2nd AR episode.²⁴ Subsequently, all recipients who successfully underwent antirejection therapy have continued on 5 mg prednisone daily.

Statistical Analyses

For both groups (RDP and controls), we analyzed the 15-year actuarial overall patient survival, graft survival, death-censored graft survival (DCGS), and AR-free survival (ARFS) rates; the biopsy-proven AR and chronic rejection (interstitial fibrosis and tubular atrophy) rates; the yearly estimated glomerular filtration rate (eGFR); and the incidence of side effects. To calculate eGFR, we used the Modification of Diet in Renal Disease study equation. For recipients with graft survival >5 years, we performed additional statistical analyses to determine outcomes between 5 and 15 years posttransplant, especially any late deterioration of graft function and any late graft loss in the RDP group. We compared outcomes between the LD and DD subgroups.

To analyze categorical variables, we used the chi-square test and Fisher exact test (for small sample size); continuous variables, the Student *t* test. We assumed variables to be statistically significant if the *p* value was <0.05 at a 95% confidence interval. To estimate actuarial patient survival, graft survival, DCGS, and ARFS (intention to treat analysis) rates, we used Kaplan-Meier life tables. To compare differences between groups, we used the log-rank test. A time-to-event analysis was performed for posttransplant side effects, including avascular necrosis, fractures, cataracts, cardiovascular complications, nonmelanomatous skin cancer, posttransplant lymphoproliferative disease, nonskin/non-PTLD malignancies, NODAT, and CMV-related complications.

RESULTS

Demographic Characteristics (RDP Group)

The demographic characteristics of the 1553 1st and 2nd adult kidney transplant recipients in the RDP group, as well as of their donors are shown in Table 1. Of the 1153, 1021 were LD recipients (572 LRD, 449 LURD), and 532 were DD recipients. The median follow-up time was 163 months for LD recipients and 139 months for DD recipients. The median age was 48.2 ± 13.6 years for LD recipients and 54.3 ± 13.9 years for DD recipients. Most were white (88.5% of LD recipients, 70.3% of DD recipients) and male (62.9% of LD recipients, 56.4% of DD recipients). The peak panel-reactive antibody level was > 10% in 14% of LD recipients and 22% of DD recipients; > 50%, in 5.4% of LD recipients and 10.9% of DD recipients.

For the donors, the median age was 42.5 ± 11.1 years for LDs and 38.9 ± 17.3 years for DDs. Most LDs were female (60.3%), whereas most DDs were male (59.6%). The overwhelming majority of donors were white (90% of LDs, 91.5% of DDs).

Outcomes for All Recipients (RDP versus Control Group)

Actuarial patient survival, graft survival, and DCGS rates for all LD and DD recipients, in both the RDP group and the control group, at 1, 5, 10, and 15 years posttransplant are shown in Table 2. For LD recipients, the actuarial 15-year patient survival rates were similar in the RDP group and the control group (Fig. 1A). But in the RDP group (*versus* the control group), graft survival (Fig. 1C; $p=0.02$) and DCGS (Fig. 1E; $p=0.01$) were significantly better. For ARFS (Fig. 1G), we found no difference between the RDP group and the control group.

For DD recipients, those in the RDP group (*versus* the control group) had significantly better actuarial 15-year patient survival (Fig. 1B; $p<0.01$), graft survival (Fig. 1D; $p<0.01$) and DCGS (Fig. 1F; $p<0.01$). For ARFS (Fig. 1H), we found no difference between the RDP group and the control group.

Outcomes for Recipients with Graft Survival >5 Years (RDP versus Control Group)

An important consideration is whether there is increased late graft loss for RDP-treated recipients. For RDP and control recipients with 5-year graft survival, we studied subsequent patient survival, graft survival, and DCGS rates (Table 3). At the time of our analysis, 859 recipients (607 LD, 252 DD) in the RDP group and 317 in the control group had graft survival >5 years. For LD recipients with 5-year graft survival, the actuarial 15-year patient survival (Fig. 2A), graft survival (Fig. 2C), and DCGS (Fig. 2E) rates were similar between the RDP group and the control group. Likewise, for DD recipients with 5-year graft survival, the actuarial 15-year patient survival (Fig. 2B), graft survival (Fig. 2D), and DCGS (Fig. 2F) rates were all similar between the RDP group and the control group.

Graft Function

For those surviving with function, there was no difference between groups in change of allograft function over time. For LD on RDP, the mean eGFR at 1 year was 53.8 ± 16 ; at 5 years, 51.2 ± 17.7 ; at 10 years, 50.7 ± 19.8 ; and at 15 years, 49.7 ± 17.9 . For LD in the control group, mean eGFR at 1 year was 47.2 ± 18.0 ; 5 years, 46.5 ± 16.9 ; at 10 years, 46.1 ± 19.0 ; and at 15 years, 51.4 ± 22.3 .

For DD recipients on RDP, the mean eGFR at 1 year was 55.9 ± 20.2 ; at 5 years, 51.6 ± 21.9 ; at 10 years, 51.2 ± 23.7 ; and at 15 years, 57.0 ± 25.2 . For DD in the control group, mean eGFR at 1 year was, 46.8 ± 18.0 ; at 5 years, 45.1 ± 19.3 at 10 years, 49.3 ± 22.1 ; and at 15 years, 51.1 ± 24.2 .

Graft Loss

The causes of graft loss at 15 years posttransplant, for all LD and DD recipients, in both the RDP group and the control group, are listed in Table 3. Graft loss occurred in 388 LD recipients (277 in the RDP group; 111 in the control group) and in 369 DD recipients (148 in the RDP group, 221 in the control group). The 2 most common causes of graft loss for both groups were death with function and the entity of slow deterioration of function that, over the years has been called “chronic rejection”, “chronic allograft nephropathy”, and more recently “interstitial fibrosis and tubular atrophy” (IF/TA).

Comparison of RDP to Contemporaneous Recipient Cohort from the Scientific Registry of Transplant Recipients

We compared patient survival and DCGS between our RDP-treated recipients and contemporaneous transplants throughout the United States, as reported by the 2014 OPTN/SRTR Annual Data Report produced by the national Organ Procurement and Transplantation Network and the Scientific Registry of Transplant Recipients.²² For both LD and DD recipients, 5- and 10-year patient survival and DCGS rates were similar between those on RDP and the SRTR cohort (Table 4).

Posttransplant Side Effects

For both LD and DD recipients, when compared to controls, RDP-treated recipients had a significantly lower rate of posttransplant CMV disease ($p<0.004$; Fig. 3A), cataracts ($p<0.01$; Fig. 3B), cardiac complications ($p<0.02$; Fig. 3C), avascular necrosis ($p<0.003$; Fig. 3D) and NODAT ($0<0.001$; Fig 3E). Interestingly, both LD and DD RDP recipients had a significantly lower rate of cardiac complications compared to controls ($p<0.02$); however, when only considering those without pretransplant cardiac complications there was no difference between groups. There was a trend to a lower rate fractures in DD recipients ($p=0.06$). There were no significant differences between groups in rates of osteoporosis or malignancies.

DISCUSSION

Steroid minimization after a kidney transplant had been an elusive goal for 4 decades. Ideally, a minimization or elimination protocol would reduce the incidence of steroid-related adverse effects, without leading to increased rates of graft loss. An increased rate of early AR episodes has been reported with RDP—but with no detrimental impact on graft or patient survival.^{11–13} Indeed, some studies have shown better outcomes with RDP than with protocols incorporating long-term prednisone maintenance therapy.^{27–35} Those studies were possibly limited by selection bias, but it is also possible that the better outcomes observed with RDP may be due to decreased cardiovascular risk.¹¹

The immunosuppressive protocol used in conjunction with RDP has had an impact on AR rates. In a prospective multicenter randomized trial comparing RDP with prednisone maintenance therapy, Woodle et al, noted that the AR rate was lower in the RDP group when polyclonal antibody (rather than an IL-2R inhibitor) was used for induction.¹³ These findings have been corroborated in other nonrandomized studies.^{36,37} In a recent Cochrane analysis, Pascual et al, reported that for those treated with RDP and either CsA or TAC, there were no differences in patient and graft survival compared to recipients treated with prednisone maintenance.¹⁰ However, AR rates were increased in recipients on CsA (but not Tac), when compared with those on prednisone maintenance therapy. In contrast, in our prospective randomized trial of maintenance therapy in RDP recipients treated with polyclonal antibody induction, we found no difference in AR rates between those on CsA plus MMF *versus* those on Tac plus sirolimus.³⁸ In their Cochrane analysis, Pascual et al, also noted that with RDP, the rate of new-onset posttransplant diabetes increased in RDP recipients on Tac (but not CsA).¹⁰

It is interesting that early AR rates have been reported with increasing frequency under RDP without any decrease in long-term graft survival. Early studies of late graft loss reported that patients with 1 or more AR episodes had increased late graft loss and this was reflective of a deteriorating graft function, readily monitored by baseline creatinine.^{22,39–42} However, more recent data suggests that patients with AR episodes are at no increased risk of graft loss, especially if serum creatinine level returns to baseline.^{43–46} Additional support for this concept comes from the prospective randomized trials of Belatacept *versus* CsA maintenance therapy, in which the Belatacept cohort has had an increased AR rate but no decrease in patient or graft survival.^{47,48}

The major advantage of RDP is minimization or elimination of prednisone-related side effects. Although no study has measured skin and appearance changes, prednisone-free recipients at a transplant clinic can no longer be identified by their appearance. We previously reported that adult RDP-treated recipients had a significantly lower incidence of NODAT, cataracts, avascular necrosis, fractures and CMV infection.^{21,23} A review and meta-analysis by Knight and Morris found that RDP was associated with significant benefits in cardiovascular risk (significantly decreased incidence of hypertension [$p<.0001$], NODAT [$p<.0006$] and hypercholesterolemia [$p<.0001$]).¹¹ In a Cochrane Database Review, Pascual et al, similarly reported decreased cardiovascular risk for RDP, but noted differences in CsA- and Tac-treated recipients: reduced antihyperlipidemic drug use was only seen with Tac, whereas reduction in NODAT and in infection rates were only seen with CsA.¹⁰ Furthermore, in pediatric recipients, RDP protocols have been associated with a significant reduction in steroid-attributed morbidity, namely osseous, cardiovascular and metabolic complications, as well as body disfigurement and growth retardation.^{16,19,49,50}

To date, almost all the literature on RDP has involved recipients with follow-up less than 5 years. A lingering concern has been the possibility of increased rates of late deterioration of graft function in RDP recipients.^{12,51} That concern stems from an early Canadian study of prednisone discontinuation in which outcomes for the prednisone-free and maintenance groups did not differ for about 2 years, but subsequently the prednisone-free group suffered increased rates of graft loss.² However, more recent studies have not reported a similar increase in graft loss after 2 years. We previously reported that at 10 years posttransplant there was no decrease in patient and graft survival between with RDP compared to maintenance prednisone therapy.²¹ Once again, in our current study of 15-year outcomes, we found no decreased patient, graft, or death-censored graft survival with RDP. Unique to the current analysis was the study of subsequent outcomes in recipients with graft survival >5 years. For these patients, we found that RDP, compared to maintenance prednisone, did not lead to increased rates of late graft loss or a more rapid deterioration of graft function.

A limitation of our study is that this is not a prospective randomized trial. Our historical control group was transplanted over the first 5 years of the study, whereas the RDP group was transplanted over 15 years. During the 15-year interval, there have been other changes in recipient care which may have impacted outcomes. Notably, however, when compared to a contemporaneous cohort as reported by the SRTR, there is no difference in patient survival or death-censored graft survival between our RDP treated recipients and the SRTR cohort. Of note, the characteristics of our RDP recipients and those reported by the SRTR may

differ, and some SRTR- reported recipients are on an RDP protocol; however, our cohort comprises all first and second transplants (except those on prednisone at the time of transplant) and includes high risk recipients. At a minimum, RDP recipients do not do worse than the national average

It is important that our data is not limited to ideal, low immunologic risk recipients.⁵² Consequently, our findings are generalizable to a larger transplant population; for instance, in our series high PRA recipients have also been treated with RDP (Table 1). Recently, there has been renewed interest in pragmatic clinical trials for which the information learned could be applied to the typical clinical population.⁵¹ Our data falls into this category. A caveat is that ours is a single-center series and our patient population is mostly homogenous (82.3% white). However, our 10-year outcomes were similar to contemporaneous, nationally reported, SRTR outcomes.²¹ In nonrandomized studies, we and others have reported, short- or intermediate-term, successful RDP protocols in a number of subgroups including children, minorities, highly sensitized patients, those with potentially recurring disease, kidney/pancreas transplants and retransplants.^{53–55}

Immunosuppression management continues to be a fine balance between prolonging patient and graft survival whilst minimizing drug-related complications. RDP is associated with significantly fewer prednisone-related side effects, while maintaining similar early patient and graft survival to those recipients on prednisone maintenance therapy. Our data, in unselected 1st and 2nd transplant recipients, suggests that an RDP-protocol after kidney transplantation, is not associated with decreased long-term patient and graft survival, or an increase in late (15 year) deterioration of function.

ABBREVIATIONS

RDP	rapid discontinuation of prednisone
LD	living donor
DD	deceased donor
LRD	living related donor
LURD	living unrelated donor
AR	acute rejection
DCGS	death-censored graft survival
ARFS	acute rejection–free survival
eGFR	estimated glomerular filtration rate
NODAT	new-onset diabetes after transplant
CsA	cyclosporine
MMF	mycophenolate mofetil

Tac	tacrolimus
POD	postoperative day
CMV	cytomegalovirus
EBV	Epstein Barr virus
SRTR	Scientific Registry of Transplant Recipients

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Figure 1. Survival outcomes following RPD. Patient (A,B), graft (C,D), death-censored graft survival (E,F), and acute rejection-free survival (G,H) in recipients after transplant of LD (A,C,E,G) and DD (B,D,F,H). Recipients treated with RPD (red) are compared to historical controls (blue). Statistical significance is noted in overall survival among DD recipients ($p=0.001$); graft survival among LD ($p=0.016$) and DD recipients ($p<0.001$); and DCGS among LD ($p=0.01$) and DD recipients ($p=0.002$).

Figure 2.

Survival outcomes following RPD in patients with graft survival >5 years. Patient (A,B), graft (C,D), and death-censored graft survival (E,F) in recipients after transplant of LD (A,C,E) and DD (B,D,F). Recipients treated with RDP (red) are compared to historical controls (blue). No statistical significance is noted between the RPD and historical control groups.

Figure 3.

Posttransplant Side Effects. For both LD and DD recipients, when compared to controls, RDP-treated recipients had a significantly lower rate of posttransplant CMV disease ($p<0.004$; Fig. 3A), cataracts ($p<0.01$; Fig. 3B), cardiac complications ($p<0.02$; Fig. 3C), avascular necrosis ($p<0.003$; Fig. 3D) and NODAT ($p<0.001$; Fig 3E).

Table 1**Patient Demographic Characteristics**

	LD	DD
Recipients (n, %)	1021 (65.7)	532 (34.3)
LRD	572 (36.8)	
LURD	449 (28.9)	
Median follow-up (months)	163.0	139.1
Age (years±SD)	48.2±13.6	54.3±13.9
Male Gender (n, %)	642 (62.9)	300 (56.4)
Race (n, %)		
Caucasian	904 (88.5)	374 (70.3)
African-American	46 (4.5)	61 (11.5)
Asian	40 (3.9)	76 (14.3)
Renal Disease (n, %)		
DM 1	217 (40.8)	45 (4.4)
DM 2	119 (22.4)	121 (11.9)
IgA nephropathy	90 (16.9)	30 (2.9)
Hypertensive nephropathy	79 (14.8)	68 (6.7)
PCKD	139 (26.1)	61 (6.0)
FSGS	53 (10.0)	27 (2.6)
Other	324 (31.7)	180 (17.6)
Peak PRA level (n, %)		
0	468 (45.8)	153 (28.8)
1–10	223 (21.8)	98 (18.4)
11–50	88 (8.6)	59 (11.1)
51–100	55 (5.4)	58 (10.9)
Donor		
Age (years±SD)	42.5±11.1	38.9±17.3
Male Gender (n, %)	405 (39.7)	317 (59.6)
Race (n, %)		
Caucasian	919 (90.0)	487 (91.5)
African-American	43 (4.2)	24 (4.5)
Asian	29 (2.8)	9 (1.7)

Abbreviations: LD, living donor; DD, deceased donor; LRD, living related donor; LURD, living unrelated donor; DM 1, type 1 diabetes mellitus; DM 2, type 2 diabetes mellitus; PCKD, polycystic kidney disease; FSGS, focal segmental glomerulosclerosis; PRA, panel reactive antibody; SD, standard deviation.

Chi-square test; Fisher exact test (for small sample size) between LD and DD cohorts revealed $p>0.05$ for all tested categories.

Table 2

Patient outcomes

Table 2a. All patients									
	Patient	Survival	p	Graft	Survival	p	DC	GS	p
	RDP	Control		RDP	Control		RDP	Control	
1 year									
LD	98.2%	95.2%		96.7%	91.1%		98.3%	93.4%	
DD	97.9%	91.4%		96.9%	86.3%		98.6%	93.3%	
5 years									
LD	90.7%	88.0%		83.9%	76.8%		91.2%	84.5%	
DD	88.7%	75.7%		80.4%	66.2%		87.9%	80.8%	
10 years									
LD	76.7%	71.4%		66.4%	58.2%		82.0%	73.3%	
DD	63.8%	55.3%		53.4%	43.1%		79.6%	66.7%	
15 years									
LD	59.6%	54.7%	0.22	51.3%	36.5%	<0.05	72.0%	59.8%	<0.05
DD	54.9%	40.1%	<0.01	38.7%	25.8%	<0.01	65.8%	53.0%	<0.01

Table 2b. Patients with >5 year graft survival									
	Patient	Survival		Graft	Survival		DC	GS	
	RDP	Control		RDP	Control		RDP	Control	
5 years									
LD	100.0%	100.0%		100.0%	100.0%		100.0%	100.0%	
DD	100.0%	100.0%		100.0%	100.0%		100.0%	100.0%	
10 years									
LD	85.7%	83.5%		79.2%	75.8%		90.0%	86.7%	
DD	72.8%	76.2%		66.5%	65.1%		90.6%	82.5%	
15 years									
LD	67.0%	63.8%	0.59	61.1%	52.5%	0.24	79.0%	70.7%	0.31
DD	62.2%	56.1%	0.70	48.2%	38.9%	0.79	74.8%	65.5%	0.12

Abbreviations: RDP, rapid discontinuation of prednisone; LD, living donor; DD, deceased donor; DCGS, death-censored graft survival.

Log-rank test was used to compare the overall survival experience between RDP and control cohorts.

Table 3**Renal Allograft Loss**

	RDP		Control	
	LD (n=277)	DD (n=148)	LD (n=111)	DD (n=221)
Death with function, n (%)	139 (50.1)	82 (55.4)	52 (46.8)	117 (52.9)
Chronic rejection, n (%)	33 (11.9)	15 (10.1)	20 (18.0)	33 (14.9)
Chronic allograft nephropathy, n (%)	15 (5.4)	5 (3.4)	5 (4.5)	9 (4.1)
Transplant glomerulopathy, n (%)	18 (6.5)	6 (4.1)	2 (1.8)	4 (1.8)
Patient discontinuation of immunosuppressive medications, n (%)	11 (4.0)	4 (2.7)	1 (0.9)	10 (4.5)
Recurrent disease, n (%)	15 (5.4)	1 (0.7)	4 (3.6)	9 (4.1)
Acute rejection, n (%)	5 (1.8)	7 (4.7)	0 (0)	2 (0.9)

Abbreviations: RDP, rapid discontinuation of prednisone; LD, living donor; DD, deceased donor.

Table 4

Comparison of overall patient survival and DCGS of patients treated under RDP to contemporaneous national data (SRTR).

	LD		DD	
	RDP	SRTR	RDP	SRTR
5-year				
Patient Survival	84%	86%	80%	73%
DCGS	91%	92%	88%	86%
10-year				
Patient Survival	66%	63%	53%	47%
DCGS	82%	79%	80%	72%

Abbreviations: RDP, rapid discontinuation of prednisone; LD, living donor; DD, deceased donor; DCGS, death-censored graft survival; SRTR, Scientific Registry of Transplant Recipients.