Association of Dialysis Duration with Outcomes after Transplantation in a Japanese Cohort

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Abstract

Background and objectives Evidence regarding the differences in clinical outcomes after preemptive kidney transplantation (PKT) and non-PKT in Japan is lacking.

Design, setting, participants, & measurements We conducted a retrospective cohort study at a single center in Japan. Consecutive patients ages >18 years old who had received a kidney transplant from a living donor between November of 2001 and December of 2013 at our institution (n=786) were enrolled. The primary study outcome was the occurrence of clinical events before the end of 2014. Clinical events were defined as any of the following: death with functioning graft (DWFG), graft loss, or post–transplant cardiovascular disease (CVD).

Results The median follow-up period was 61.0 (35.3–94.0) months. PKT was performed in 239 patients (30.4%). Clinical events occurred in 78 (9.9%). In the Cox proportional hazard model for univariate analysis, factors found to be associated with higher risk of clinical events included older age, men, ABO incompatibility, longer dialysis duration, diabetes, pretransplant CVD, and large ventricular mass index. PKT was associated with lower risk. Clinical event rate in patients who received a PKT was 3.3% compared with 10.8%, 11.1%, 10.4%, 10.2%, 16.7%, and 16.2% among patients who were on dialysis for <1, 1 to <2, 2 to <3, 3 to <4, 4 to <5, and ≥5 years before transplant, respectively (P=0.002). The multivariate analysis showed that ABO incompatibility (hazard ratio [HR], 2.98; 95% confidence interval [95% CI], 1.89 to 4.71), duration of dialysis per year (HR, 1.07; 95% CI, 1.03 to 1.11), and diabetes (HR, 3.54; 95% CI, 2.05 to 6.12) were only three independent risk factors for the incidence of clinical events.

Conclusions Even in Japan, where the long-term outcomes of patients on hemodialysis are excellent, PKT could be beneficial to reduce DWFG, graft loss, and post-transplant CVD.

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Introduction

Preemptive kidney transplantation (PKT) is generally preferred, because it confers increased graft and patient survival compared with transplantation after dialysis therapy. Waiting time on dialysis is a strong, independent risk factor for increased patient mortality and increased graft failure after kidney transplantation (KT) (1–5). Recent studies have suggested that PKT increases patient and graft survival in patients receiving organs from deceased donors (DDs) (6) but not those receiving organs from living donors (LDs) compared with patients transplanted after a 2-year period of dialysis (7). However, these data regarding patient outcomes are from studies in non-Japanese populations. The Dialysis Outcomes and Practice Patterns Study (DOPPS) reported a significantly lower risk of mortality in Japan than in Europe or the United States (8).

Waiting times for KT in Japan are higher than those in many other countries, and the majority of transplanted kidneys are from LDs. It is 16.5 years in ≥20 year olds (9).

The goal of this study was to identify predictors of graft survival, patient survival, and cardiovascular disease (CVD) events after KT in Japan, including patients with PKT versus patients without PKT and the duration of dialysis.

Materials and Methods

Study Design

We conducted a retrospective cohort study of recipients of living kidney transplants at a single center, the Nagoya Daini Red Cross Hospital (Nagoya, Japan). This study was approved by the institutional review board of the hospital.

Study Population

We included consecutive patients ages >18 years old who had received a kidney transplant from an LD between November of 2001 and December of 2013 at our institution (n=786).

Outcome Measures

The primary study outcome was the occurrence of clinical events before the end of 2014.

Clinical Events

Clinical events were defined as any of the following: death with functioning graft (DWFG), graft loss, or CVD event. DWFG is defined as death without previous returning dialysis. Graft loss is defined by return to chronic dialysis or retransplantation. The two hospitals, Nagoya Daini Red Cross Hospital and Masuko Memorial Hospital, followed up all of the patients. Deaths are ascertained by active phone calls of attending transplant physicians or surgeons when the patients do not visit an outpatient clinic.

CVD included cerebral infarction or hemorrhage, acute myocardial infarction, coronary revascularization, heart valve replacement, percutaneous angioplasty (PTA), bypass surgery, and amputation of a lower extremity.

In patients with signs and symptoms of stroke requiring head computed tomography or magnetic resonance imaging, diagnosis of cerebral infarction or hemorrhage was made by neurologists at our institution.

Coronary revascularization, either by percutaneous coronary intervention (PCI) or coronary artery bypass grafting, may be indicated in patients with flow–limiting coronary stenosis to reduce myocardial ischemia and related adverse clinical manifestations (10–12). In addition to acute coronary syndrome, revascularization for stable coronary artery disease (CAD) was performed at our institution according to the 2014 European Society of Cardiology and the European Association for Cardio-Thoracic Surgery guidelines on myocardial revascularization (13). Indications for revascularization in patients with stable CAD included persistence of symptoms despite medical treatment and an expectation of improved prognosis (14). The diagnosis and treatment of CAD were performed by cardiologists at our institution.

Transthoracic echocardiography was performed every year after transplantation in all recipients. Recipients with previous or current–onset valvular disease regularly attended cardiology consultations. Indications for valve replacement were determined according to the guidelines on the management of valvular heart disease (version 2012) (15).

Recipients of transplants with a history or development of peripheral artery disease (PAD) were regularly evaluated by vascular surgeons. These included any recipients of transplants who developed claudication, any pain localized to the lower leg or foot associated with upright or recumbent positions while the body is in resting position, or any poorly healing wounds of the extremities requiring additional examination (*e.g.*, ankle-brachial index, Duplex ultrasound with continuous wave Doppler, or angiography). Indications for surgical revascularization (*e.g.*, angioplasty, bypass, or amputation of a lower extremity) were determined according to the guidelines on the diagnosis and treatment of PADs (16).

PKT

PKT was defined as transplantation performed before the initiation of chronic dialysis. We included transplantation with <1 month of dialysis period as a preparation for operation by nontunneled hemodialysis catheter without requiring an arteriovenous hemodialysis fistula or graft.

Definitions

Comorbid conditions were defined as follows:

CAD. CAD was defined as myocardial infarction, abnormal coronary artery angiogram with ischemia identified in the same area by stress myocardial scintigraphy, or a history of coronary angioplasty or bypass surgery. Patients presenting with chest discomfort without undergoing coronary artery angiography or stress myocardial scintigraphy were not considered to have CAD.

Cerebrovascular Disease. Cerebrovascular disease was defined as a history of cerebrovascular accident (infarction or hemorrhage), transient ischemic attack, or carotid endarterectomy.

PAD. PAD was defined as a history of PTA, arterial bypass surgery, or amputation because of PAD.

Diabetic Nephropathy. Diabetic nephropathy was defined as a histologic diagnosis by renal biopsy. In patients in whom a renal biopsy was not performed, a >10-year history of diabetes mellitus (DM) type 1 or 2 with retinopathy was defined as diabetic nephropathy. If a renal biopsy is not performed, <10-year history of DM without retinopathy was not considered diabetic nephropathy as the unknown original disease.

Hypertension. Hypertension was defined as use of antihypertensive medication for BP control.

Smoking. Both active smokers and recipients with a history of smoking were included.

Dyslipidemia. Dyslipidemia was defined as the use of any statin or other oral medications for dyslipidemia.

Left Ventricular Mass Index and Left Ventricular Hypertrophy. Diagnosis by transthoracic echocardiography was performed by an experienced echocardiographer at our institution. According to the recommendations of the American Society of Echocardiography, left ventricular mass (LVM) was calculated from M-mode records (17).

Immunosuppression

ABO-Compatible KT. Basiliximab was available for induction from 2002. The standard maintenance immunosuppression consisted of the following: a steroid, a calcineurin inhibitor: cyclosporin microemulsion (CsA-ME) or tacrolimus (TAC), and an antimetabolite: mycophenolate mofetil (MMF) or mizoribine. Prolonged release TAC became available in 2008, and everolimus became available in 2007.

ABO-Incompatible KT. Splenectomy was required before 2005. The induction immunosuppression consisted of basiliximab, a steroid, a calcineurin inhibitor, and a cyclophosphamide that was switched to mizoribine at 1 month. Rituximab was available from 2006 for use in avoiding splenectomy, and MMF was used instead of cyclophosphamide from then onward. The standard maintenance immunosuppression was the same as that for ABO-compatible KT.

The Target Levels for Calcineurin Inhibitors and MMF

The target levels for calcineurin inhibitors were as follows: for CsA-ME, an area under the curve (AUC) in 0–4 hours of 3500 ng·h/ml for the first 3 months tapered to 2000 ng·h/ml as a maintenance level; and for TAC, twice daily, an AUC=0–4 of 80 ng·h/ml for the first 3 months tapered to 50 ng·h/ml as a maintenance dose.

Concentration-controlled administration of MMF was initiated in 2012. A target exposure of 40–80 ng·h/ml for an AUC=0–12 determined using the enzyme immunoassay technique.

Statistical Analyses

Data were expressed as numbers with percentages, means±SDs, or medians with quartile values (25%–75%). The differences in continuous variables between the two groups were compared by unpaired *t* test or Mann–Whitney test according to data distribution (normal or not). The differences in categorical variables between the two groups and among three or more groups were investigated by Fisher exact test and chi-squared test, respectively. The Kaplan–Meier method was used to estimate survival distributions, and the differences between the two groups were compared using the log-rank test. Cox proportional hazard regression model analysis was performed to identify the predictors of clinical events after renal transplantation and calculate hazard ratios (HRs) and 95% confidence intervals (95% CIs). Univariate and multivariate Cox regression analyses were performed with and without adjustment for other variables. As a result of comparisons with and without clinical event groups, variables of $P<0.10$ were selected and adopted for Cox proportional hazard regression models. In the case that there were collinearity characteristics between two variables, either of two variables was excluded from the multiple regression model. All statistical analyses were performed using IBM SPSS, version 18 (IBM SPSS, Chicago, IL). *P* values <0.05 were considered statistically significant.

Results

The median follow-up period was 61.0 (35.3–94.0) months. Table 1 shows the clinical characteristics of patients enrolled in this study. Among 786 recipients, 239 (30.4%) underwent PKT. ABO-incompatible KT was performed in 29.8% of patients. The preoperative prevalence of diabetes was 13%. Sixty-one (7.8%) patients had histories of preoperative CVD events. Among these patients, 46 experienced CAD, which were acute myocardial infarction (12), PCI (15), coronary artery bypass grafting (three), and angina pectoris (16). Sixteen experienced cerebrovascular disease, which were cerebral infarction (11) and cerebral hemorrhage (five). Three patients had histories of PAD, of which one was treated with bypass surgery and two were treated with PTA in a lower extremity. One patient had undergone carotid endarterectomy for carotid artery stenosis. Three patients had histories of two or three comorbidities.

The total daily doses and trough levels at the end of 2014 were not statistically different between PKT and non-PKT groups: 122±38 versus 125±42 mg ($P=0.92$) and 75±27 versus 74±26 ng/ml ($P=0.89$), respectively, in recipients taking CsA-ME; 3.4±1.3 versus 3.2±1.5 mg ($P=0.62$) and 4.9±1.5 versus 5.0±1.1 ng/ml ($P=0.85$), respectively, in those taking TAC two times per day; and 3.6±1.6 versus 3.4±1.6 mg ($P=0.96$) and 4.7±1.2 versus 4.3±0.9 ng/ml ($P=0.23$), respectively, in those taking prolonged release TAC. The proportion of recipients taking post-transplant angiotensin converting enzyme inhibitors and/or angiotensin receptor blockers at the end of 2014 was 25.2% in the PKT group and 39.2% in the non-PKT group ($P=0.02$).

Table 2 shows postoperative clinical events in PKT and non-PKT groups. Seventy-eight recipients (9.9%) had clinical events during the follow-up period. No deaths

Table 1. Characteristics of the patients who received renal transplantation

Characteristics	Total, *n*=786	PKT, *n*=239; 30.4%	Non-PKT, *n*=547; 69.6%	*P* Value
Age, yr	44.9±13.9	43.1±14.2	45.7±13.8	0.02[a]
Men, %	494 (62.8)	149 (62.3)	345 (63.1)	0.87[b]
BMI, kg/m^2	22.0±5.3	22.1±3.8	22.0±5.8	0.69[a]
ABO blood group incompatibility, %	234 (29.8)	66 (27.6)	168 (30.7)	0.40[b]
HLA mismatches range	3.6±1.4	3.4±1.3	3.7±1.5	0.17[a]
Smoking, %	356 (45.3)	110 (46.0)	246 (45.0)	0.82[b]
Diabetes, %	102 (13.0)	26 (10.9)	76 (13.9)	0.30[b]
Hypertension, %	632 (80.4)	215 (90.0)	417 (76.2)	<0.001[b]
Dyslipidemia, %	173 (22.0)	75 (31.4)	99 (18.1)	<0.001[b]
Everolimus use, %	30 (3.8)	12 (5.0)	18 (3.3)	0.31[b]
iPTH, pg/ml	188 [93–320]	304 [194–431]	140 [71–257]	<0.001[c]
Ca, mg/dl	9.2±1.0	8.6±0.8	9.4±0.9	<0.001[a]
P, mg/dl	5.4±1.4	5.3±1.2	5.5±1.5	0.04[a]
LVMI, g/m^2	137±41	124±33	143±44	<0.001[a]
Second graft, %	36 (4.6)	9 (3.8)	27 (4.9)	0.60[b]
CVD event history, %	61 (7.8)	11 (4.6)	50 (9.1)	0.03[b]

Data are expressed as means±SDs, medians [25%–75%], or numbers (percentages). Four values were missing. PKT, preemptive kidney transplantation; BMI, body mass index; iPTH, intact parathyroid hormone; Ca, calcium; P, phosphorous; LVMI, left ventricular mass index; CVD, cardiovascular disease.

[a]*P* value was determined by unpaired *t* test.

[b]*P* value was determined by Fisher exact test.

[c]*P* value was determined by Mann–Whitney test.

Table 2. Clinical events after renal transplantation

Clinical Events	PKT Group, *n*=239	Non-PKT Group, *n*=547	Total, *n*=786
Death with functioning graft (%)	0	26 (5.5)	26 (3.3)
CVD event	0	4	4
Infection	0	7	7
Malignancy	0	8	8
Others	0	7	7
Graft loss (%)	5 (2.1)	30 (5.5)	35 (4.5)
Rejection (acute/chronic)	3 (0/3)	16 (4/12)	19
Infection	0	8	8
Others	2	6	8
CVD event (%)	3 (1.3)	14 (2.6)	17 (2.2)
Cerebrovascular disease	1	0	1
Coronary heart disease	1	6	7
Heart valve replacement	0	3	3
PTA, bypass, or amputation of a lower extremity	1	5	6
Total (%)	8 (3.3)	70 (12.8)	78 (9.9)

PKT, preemptive kidney transplantation; CVD, cardiovascular disease; PTA, percutaneous angioplasty.

occurred in the PKT group, and 26 deaths occurred in the non-PKT group. Graft loss occurred in five recipients in the PKT group and 30 recipients in the non-PKT group. CVD events without death occurred in three recipients in the PKT group and 14 recipients in the non-PKT group.

Seven hundred eighty-six patients were divided into two groups: patients with events after transplantation (event group; *n*=78) and those with no events after transplantation (no event group; *n*=708). Age, sex, ABO incompatibility, PKT, duration of dialysis, preoperative diabetes, LVM index, and a history of CVD events before transplantation were found to significantly differ between the two groups (Table 3).

Four Kaplan–Meier estimates of clinical events after renal transplantation are shown in Figure 1. PKT was associated with longer event–free survival compared with non-PKT (log rank; P=0.003). The median follow-up time was 66.3 months in the PKT group and 49.4 months in the non-PKT group.

Other factors associated with shorter event–free survival included ABO blood group incompatibility, diabetes, and age >50 years old. The median follow-up time was 66.5 months in patients receiving a compatible organ and 48.5 months in patients receiving an incompatible organ, 63.3 months in patients without diabetes and 45.5 months in patients with diabetes, and 69.2 months in patients ages <50 years old and 52.2 months in patients ages ≥50 years old.

In univariate Cox proportional hazard regression analysis, age ≥50 years old (HR, 2.30; 95% CI, 1.47 to 3.61; P<0.001), ABO incompatibility (HR, 3.13; 95% CI, 2.00 to

Table 3. Comparison of patient characteristics with or without clinical events after renal transplantation

Characteristics	With Event, *n*=78	Without Event, *n*=708	*P* Value
Age, yr	48.4±14.8	44.5±13.8	0.02[a]
Men, %	57 (73.1)	437 (61.7)	0.05[b]
BMI, kg/m^2	21.8±3.1	22.0±5.4	0.76[a]
ABO incompatibility, %	38 (48.7)	196 (27.7)	<0.001[b]
PKT, %	8 (10.3)	231 (32.6)	<0.001[b]
Dialysis period, mo	34.3 [6.7–91.1]	11.3 [0.0–45.8]	<0.001[c]
Diabetes, %	22 (28.2)	80 (11.3)	<0.001[b]
iPTH, pg/ml	160 [82–250]	193 [94–329]	0.07[c]
Ca, mg/dl	9.34±1.07	9.17±0.95	0.15[a]
P, mg/dl	5.68±1.59	5.40±1.41	0.11[a]
LVMI, g/m^2	152±44	136±41	<0.001[a]
Second graft, %	6 (7.7)	30 (4.2)	0.16[b]
CVD event history, %	11 (14.1)	50 (7.1)	0.04[b]

Data are expressed as means±SDs, medians [25%–75%], or numbers (percentages). BMI, body mass index; PKT, preemptive kidney transplantation; iPTH, intact parathyroid hormone; Ca, calcium; P, phosphorous; LVMI, left ventricular mass index; CVD, cardiovascular disease.

[a]*P* value was determined by unpaired *t* test.

[b]*P* value was determined by Fisher exact test.

[c]*P* value was determined by Mann–Whitney test.

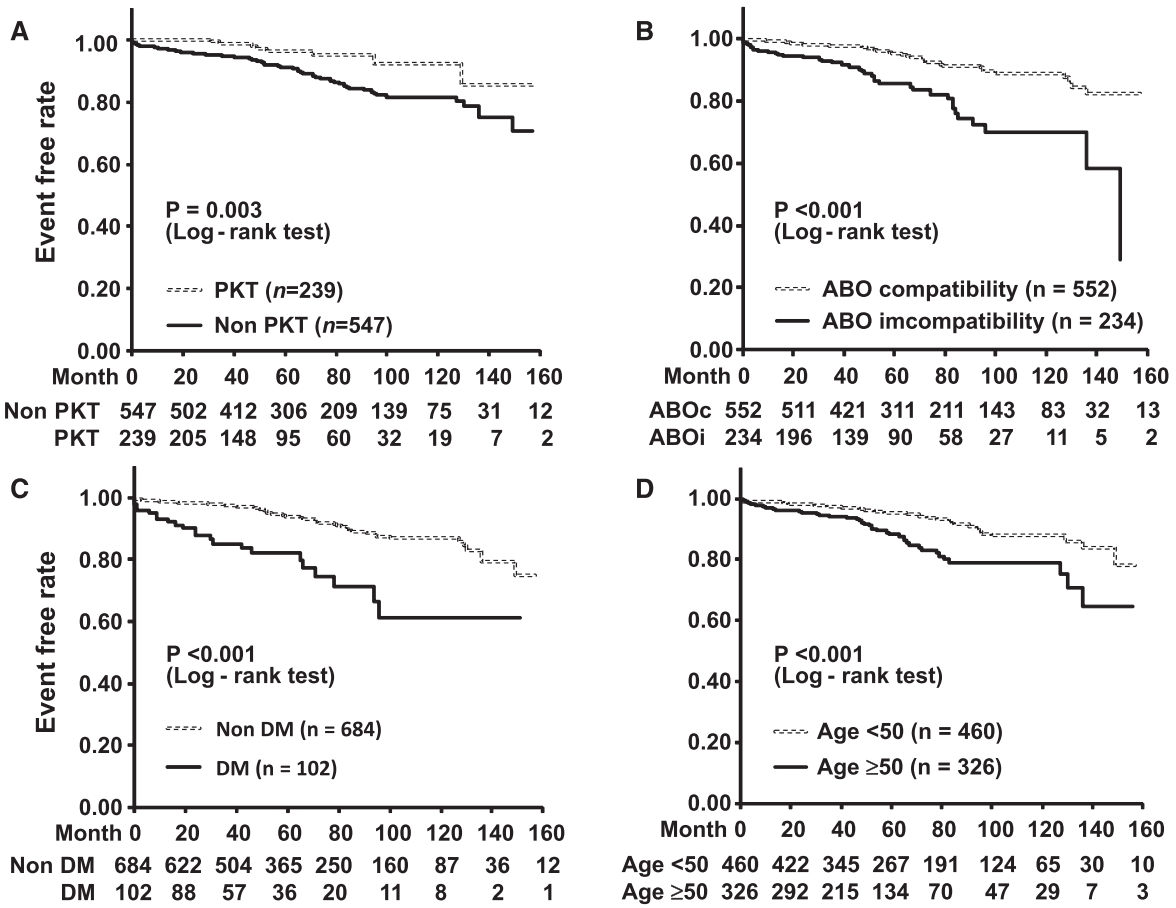

Figure 1. | Clinical event–free survival stratified according to kidney transplantation type. (A) shows Kaplan–Meier estimates for preemptive kidney transplantation (PKT) and non-PKT groups. (B) shows Kaplan–Meier estimates in patients with and without ABO blood group compatibility. (C) shows Kaplan–Meier estimates in patients with and without diabetes. (D) shows the results of analysis stratified by age. ABOc, ABO compatible; ABOi, ABO incompatible; DM, diabetes mellitus.

4.90; $P<0.001$), non-PKT (HR, 2.95; 95% CI, 1.41 to 6.13; $P=0.004$), the duration of dialysis per year (HR, 1.06; 95% CI, 1.02 to 1.09; $P=0.001$), preoperative diabetes (HR, 3.68; 95% CI, 2.24 to 6.05; $P<0.001$), and CVD event history before transplantation (HR, 2.78; 95% CI, 1.46 to 5.27; $P=0.002$) were found to significantly differ between the event group and no event group. In multivariate analysis, ABO incompatibility (HR, 2.98; 95% CI, 1.89 to 4.71; $P<0.001$), the duration of dialysis per year (HR, 1.07; 95% CI, 1.03 to 1.11; $P<0.001$), and preoperative diabetes (HR, 3.54; 95% CI, 2.05 to 6.12; $P<0.001$) were found to be statistically significant independent predictors of clinical events after KT (Table 4).

Clinical events after transplantation were found to significantly increase with increasing dialysis duration. The observed clinical event rates were 3.3%, 10.8%, 11.1%, 10.4%, 10.2%, 16.7%, and 16.2% in patients with pretransplant dialysis periods of 0 (patients with PKT), <1, 1 to <2, 2 to <3, 3 to <4, 4 to <5, and ≥5 years, respectively (Figure 2).

Discussion

Dialysis duration in Japanese patients before KT was an independent risk factor for DWFG, graft loss, and post-transplant CVD. Greater dialysis periods were associated with worse prognosis.

Although many studies conducted before 2000 reported improved graft and patient survival with PKT (3–5), recent studies have suggested that these benefits are limited to PKTs that use grafts from DDs (6,18–20). One study reported no benefit on graft survival between PKT and non-PKT using grafts from LDs after a median dialysis period of 25.6 months (7).

The DOPPS showed that mortality rate is significantly lower in Japan compared with that in Europe and the United States (8). Moreover, CAD incidence is significantly lower in Japan compared with that in the United States and Western countries (21), and Japan has two to five times lower CAD mortality than that in the United States and Europe (22).

Left ventricular hypertrophy (LVH) is the most powerful predictor of mortality in patients with CKD (23). Increased LVM is correlated with GFR impairment severity (24–26). Between 75% and 80% of patients with CKD on dialysis therapy have been reported to have LVH (27,28), and LVM has been shown to be associated with dialysis duration (29). In this study, LVM index was shown to be significantly worse in patients with clinical events after KT

Table 4. Predictors for clinical events after renal transplantation: Cox proportional hazard regression analysis

Variables	Univariable Analysis		Multivariable Analysis	
	HR (95% CI)	*P* Value	HR (95% CI)	*P* Value
Age ≥50 yr	2.30 (1.47 to 3.61)	<0.001	1.53 (0.96 to 2.47)	0.08
Men	1.63 (0.99 to 2.69)	0.06	1.54 (0.93 to 2.56)	0.09
ABO incompatibility	3.13 (2.00 to 4.90)	<0.001	2.98 (1.89 to 4.71)	<0.001
Non-PKT	2.95 (1.41 to 6.13)	0.004	NA	
Dialysis period (per yr)	1.06 (1.02 to 1.09)	0.001	1.07 (1.03 to 1.11)	<0.001
Diabetes	3.68 (2.24 to 6.05)	<0.001	3.54 (2.05 to 6.12)	<0.001
iPTH≥180 pg/ml	0.79 (0.50 to 1.23)	0.30	NA	
CVD event history	2.78 (1.46 to 5.27)	0.002	1.35 (0.68 to 2.70)	0.40
LVH	1.21 (0.68 to 2.16)	0.52	NA	

Univariable analysis was executed before adjustment with other variables. The cutoff value in iPTH was the median value. HR, hazard ratio; 95% CI, 95% confidence interval; PKT, preemptive kidney transplantation; NA, not applicable; iPTH, intact parathyroid hormone; CVD, cardiovascular disease; LVH, left ventricular hypertrophy.

compared with those without clinical events after KT; however, LVH was not found to be an independent risk factor for DWFG, graft loss, or post-transplant CVD. Therefore, the presence of LVH could not influence decisions regarding KT.

Post-transplant CVD events have been associated with pretransplant histories of CVD only in recipients with DM in retrospective studies of pretransplant medical records. However, in patients without DM, post-transplant CVD and patient survival have not been associated with pretransplant history of CVD (30). Where required, coronary artery angiography was performed, despite residual renal function in candidates for PKT in our study. No patient required dialysis immediately after PCI, and all PKT operations were performed as scheduled.

In this study, pretransplant CVD history was not found to be an independent risk factor for DWFG, graft loss, or post-transplant CVD. After the patients are deemed suitable for general anesthesia, KT should not be avoided because of a pretransplant history of CVD.

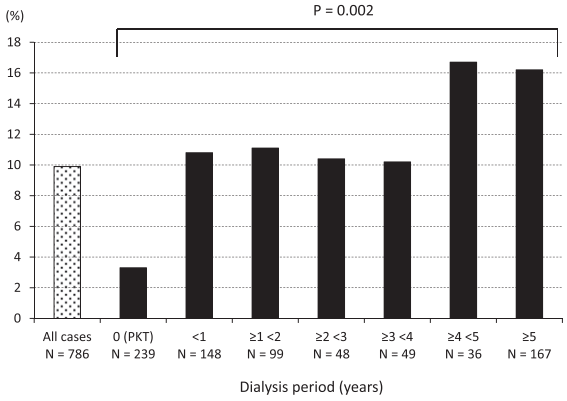

Figure 2. | Clinical event rate according to duration of dialysis. White bar shows a clinical event rate of 9.9% in all patients. Black bars show clinical event rates of 3.3%, 10.8%, 11.1%, 10.4%, 10.2%, 16.7%, and 16.2% in patients according to dialysis durations of 0 (patients with preemptive kidney transplantation [PKT]), <1, 1 to <2, 2 to <3, 3 to <4, 4 to <5, and ≥5 years, respectively. A *P* value of 0.002 was determined by chi-squared test for the difference between patient groups stratified by dialysis duration.

There were 1586 kidney transplants performed in Japan in 2013. Among them, there were 1431 (90.2%) recipients from LDs, and the rate of PKT from LDs was 25.5%. Our institution performs at least 100 kidney transplants per year and has one of the nation's largest kidney transplant programs. The rate of PKT from LDs was between 50% and 54% over a 2-year period. It was reported that 9.3% of DD transplants were preemptive and that 27.7% of LD transplants were preemptive in the United States in 2012 (31). Few candidates have the opportunity of PKT using DD grafts in Japan.

The number of patients with CKD caused by diabetic nephropathy and age is set to continue to increase. To compensate for overall worsened prognoses in patients with CKD because of increased numbers of these high-risk patients, it could be beneficial to shorten the dialysis period. To perform KT shortly after the initiation of dialysis or PKT, if possible, nephrologists should promote early referral to transplant centers, and transplant nephrologists or surgeons should aim to reduce the time required for KT evaluation.

There are several limitations to this study. First, retrospective data cannot directly show a causal relation between PKT and a reduced risk of events. Second, the population of our single-center study might be patients with CKD with a higher number of risk factors for CVD, because our institution is a large kidney transplant center that does not select just low-risk patients. Thus, the result may not be applicable to patients with CKD in other centers in Japan. Third, when considering shorter or longer dialysis period as an explanatory variable, we chose to assign PKT to a dialysis period of 0 years. Fourth, when considering shorter or longer dialysis period as an explanatory variable, it was a problem of how to handle PKT as a no dialysis period. We used PKT as a reference of dialysis period zero.

In conclusion, in Japan, where long-term outcomes of patients on hemodialysis are excellent, earlier KT could be beneficial to reduce DWFG, graft loss, or post-transplant CVD.

Disclosures

None.

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