Pretransplant Dialytic Modality and Outcomes of Kidney Transplantation: Analysis of the Nationwide Data from Thailand Transplant Registry

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Abstract

Background: Kidney transplantation (KT) is the best option for kidney replacement therapy. The data on the impact of pretransplant dialytic modality on outcomes of KT remain conflicting. The aim of the present study was to evaluate the association between pretransplant dialytic modality and outcomes of KT.

Methods: This is a retrospective cohort study of 8,097 patients that received KT between 1987 to 2020 from Thailand transplant registry database. There were 5,038 patients that met the inclusion criteria, 634 received peritoneal dialysis (PD) and 4,404 received hemodialysis (HD). The primary outcomes were 1-year, 5-year and 10-year patient and death-censored graft survival (DCGS). The secondary outcomes were delayed graft function (DGF) and acute rejection.

Results: There were no differences in patient survival (PD vs. HD, adjusted hazard ratio 1.23 (0.77-1.96), p=0.391) and DCGS (1.50 (0.95-2.39), p=0.083). Overall, the PD group experienced lower incidence of DGF (adjusted odds ratio 0.71 (0.56-0.91), p=0.006) which was more pronounced in the subgroup of decreased donor KT (0.69 (0.53-0.89), p=0.004). Lower incidence of DGF was also observed among deceased donor KT recipients that received maintenance HD for <12 months. The incidence of acute rejection was comparable between the two groups (adjusted odds ratio 0.47 (0.17-1.32), p=0.149).

Conclusion: There were no associations between pretransplant dialytic modality with patient and graft survival and the incidence of acute rejection. The incidence of DGF was significantly lower in the recipients that received PD especially in the subgroup that underwent deceased donor KT.

Keywords: dialysis; kidney failure; ESKD; ESRD; mortality; renal replacement therapy; RRT; southeast asia

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วิธีการบำบัดทดแทนไตและผลลัพธ์ของการปลูกถ่ายไต: การวิเคราะห์ข้อมูลทั่วประเทศจากฐานข้อมูลของสมาคมปลูกถ่ายอวัยวะแห่งประเทศไทย

อภิวรรณ บุญมาชัย, ฉันทิศา อารยางกูร

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บทคัดย่อ

บทนำ: การปลูกถ่ายไตเป็นวิธีการบำบัดทดแทนไตที่ดีที่สุด การศึกษาวิธีการบำบัดทดแทนไตก่อนปลูกถ่ายไตต่อผลลัพธ์หลังการปลูกถ่ายไตยังไม่มีข้อสรุปที่ชัดเจน การศึกษานี้มีวัตถุประสงค์เพื่อศึกษาความสัมพันธ์ระหว่างวิธีการบำบัดทดแทนไตก่อนปลูกถ่ายไตกับผลลัพธ์หลังการปลูกถ่ายไต

วิธีการวิจัย: การศึกษาย้อนหลังจากฐานข้อมูลผู้ป่วยที่ได้รับการปลูกถ่ายไตของสมาคมปลูกถ่ายอวัยวะแห่งประเทศไทยระหว่างปีพุทธศักราช 2530 ถึง 2563 จำนวนทั้งสิ้น 8,097 ราย มีผู้ป่วยที่เข้าเกณฑ์ศึกษาทั้งสิ้นจำนวน 5,038 ราย เป็นผู้ป่วยที่ได้รับการล้างไตทางช่องท้อง (peritoneal dialysis หรือ PD) จำนวน 634 รายและได้รับการฟอกเลือดด้วยเครื่องไตเทียม (hemodialysis หรือ HD) จำนวน 4,404 ราย ผลลัพธ์หลักของการศึกษา ได้แก่ การรอดชีวิต การอยู่รอดของไตที่ได้รับการปลูกถ่ายที่ 1 ปี 5 ปี และ 10 ปี ส่วนผลลัพธ์รอง ได้แก่ ภาวะไตที่ได้รับการปลูกถ่ายทำงานช้า และภาวะปฏิเสธไตฉับพลัน

ผลการศึกษา: ไม่พบความแตกต่างกันของอัตราการรอดชีวิตของผู้ป่วย (PD เปรียบเทียบกับ HD, adjusted hazard ratio 1.23 (0.77-1.96), p=0.391) และการอยู่รอดของไตที่ได้รับการปลูกถ่าย (1.50 (0.95-2.39), p=0.083) ผู้ป่วยที่ได้รับการล้างไตทางช่องท้องมีอุบัติการณ์ของภาวะไตที่ได้รับการปลูกถ่ายทำงานช้าต่ำกว่าผู้ป่วยที่ได้รับการฟอกเลือดอย่างมีนัยสำคัญทางสถิติ (adjusted odds ratio 0.71 (0.56-0.91), p=0.006) ความสัมพันธ์นี้มีความชัดเจนมากขึ้นในกลุ่มผู้ป่วยที่ได้รับการปลูกถ่ายไตจากผู้บริจาคที่เสียชีวิต (0.69 (0.53-0.89), p=0.004) นอกจากนี้ยังพบว่าโอกาสเกิดภาวะไตที่ได้รับการปลูกถ่ายทำงานช้าลดลงในกลุ่มที่ได้รับการปลูกถ่ายไตจากผู้บริจาคที่เสียชีวิตที่ได้รับการฟอกเลือดมาน้อยกว่า 12 เดือน ส่วนการเกิดภาวะปฏิเสธไตฉับพลันนั้นพบว่าไม่มีความแตกต่างกันในทั้ง 2 กลุ่ม (adjusted odds ratio 0.47 (0.17-1.32), p=0.149)

สรุป: ผู้ป่วยที่ได้รับการล้างไตทางช่องท้องและการฟอกเลือดด้วยเครื่องไตเทียมก่อนปลูกถ่ายไตมีการรอดชีวิต การรอดของไตที่ได้รับการปลูกถ่ายและภาวะปฏิเสธไตฉับพลันไม่แตกต่างกัน อย่างไรก็ตามผู้ป่วยที่ได้รับการล้างไตทางช่องท้องอาจมีโอกาสเกิดภาวะไตที่ได้รับการปลูกถ่ายทำงานช้าน้อยกว่าผู้ป่วยที่ได้รับการฟอกเลือดด้วยเครื่องไตเทียม โดยเฉพาะในกลุ่มผู้ป่วยที่ได้รับการปลูกถ่ายไตจากผู้บริจาคที่เสียชีวิต

คำสำคัญ: ฟอกไต; เปลี่ยนไต; สลัดไต; อัตราการตาย; อัตราการอยู่รอด; ไตวาย; โรคไตเรื้อรัง

Introduction

Kidney transplantation (KT) is the best option for kidney replacement therapy in eligible patients because of the remarkable improvement in quality of life and mortality risk.[1] Preemptive KT from living donor further reduces the incidence of acute rejection episodes and increases the allograft and patient survival.[2] However, a potential living donor is not always available; therefore,

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a long period of waiting for deceased donor is common.[2] The recent data from Thailand Transplantation Society revealed a total of 714 KTs between 1 January to 31 December 2020, 136 cases were living donor KT (LDKT) and 578 cases were deceased donor KT (DDKT). The average waiting periods for LDKT and DDKT were 1.89 and 5.02 years, respectively. Thus, almost all patients on the waiting list required maintenance dialysis prior to KT. The impact of pretransplant dialytic modality on the outcomes of KT remains conflicting. The meta-analysis by Tang et al published in 2016 found that peritoneal dialysis (PD) might be associated with better outcomes after KT compared with hemodialysis (HD).[3] In another large cohort of 92,884 patients, receiving maintenance HD prior to transplantation was associated with an increase in the risk for graft failure and recipient death.[4] On the other hand, the studies by Resende et al and Dipalma et al did not find any relationship between dialytic modality with graft function and patient survival.[5,6] Therefore, the influence of pretransplant dialytic modality on the outcomes of KT require further exploration.

Material and Methods

Study design and population

This was a retrospective observational cohort study that used the data from Thailand transplant registry. A total of 8,097 patients who underwent KT between January 1987 to December 2020 were screened. The inclusion criteria were age ≥18 years old and dialysis vintage ≥3 months prior to KT. The exclusion criteria were pre-emptive KT, having received at least 1 KT in the past, multi-organ transplantation and incomplete data. The present study was approved by Rajavithi hospital ethical committee and conducted according to the Declaration of Helsinki. An informed consent was not required.

Data collection

Donor data including age, sex, body weight, height, history of hypotension and cardiopulmonary resuscitation (CPR) prior to harvesting, last serum creatinine, cause of brain death, and viral serology test results were collected. For the recipients, the mode of dialysis, age, sex, body weight, height, cause of kidney failure, dialysis vintage, underlying diseases, and viral serology test results were recorded. The data related to KT including the type of KT (LDKT or DDKT), panel reactive antibody (PRA), HLA mismatching, cold ischemic time (CIT) and immunosuppressive regimens were also collected.

Outcomes

The primary outcomes were 1-year, 5-year and 10-year patient survival and DCGS. The secondary outcomes were the incidence of DGF and acute rejection. The latest dialytic modality recorded in the registry database was used to define the modality of dialysis of the recipients. DGF was defined as the need for dialysis during the first week of KT. The diagnosis of acute rejection required confirmation by allograft biopsy. Graft loss was defined as allograft dysfunction resulting in the return to dialysis, allograft nephrectomy, another KT, or recipient death.

Sample size calculation

According to the previously published data by Lopez et al, the sample size needed for the present study was 1,515 patients for each group of PD and HD.[1]

Statistical analysis

Data were presented as mean ± standard deviation or median (interquartile range). Differences between the two groups were analyzed by the unpaired t-test or nonparametric test. Categorical data were compared using the Chi-square test. Kaplan-Meier survival curve and log rank test were used to analyze the survival. Factors associated with survival were determined by Cox proportional hazards models. Relationships between the two variables were evaluated by regression analysis. The variables with P-value <0.2 in the univariate analysis were included in the multivariate model. The p-value <0.05 was considered statistically significant. All statistical analyses were performed using SPSS 26.0 software.

Results

The study flow diagram is shown in **Figure 1**. A total of 8,097 patients that received KT between 1 January 1987 to 31 December 2020 were screened and 5,038 patients were included in the final analysis. There were

634 patients in the PD group and 4,404 patients in the HD group.

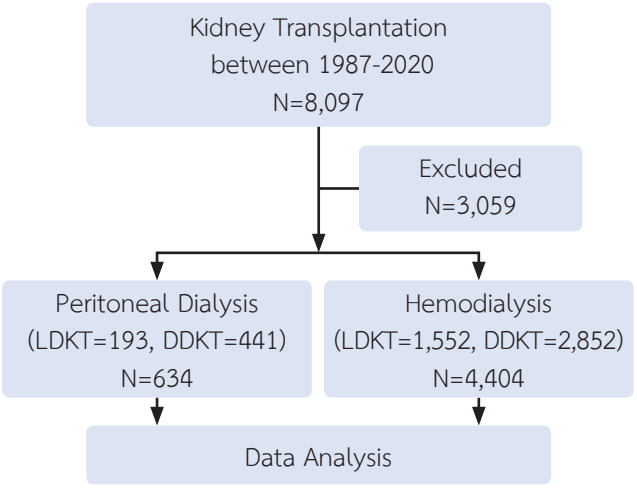

Figure 1. Study Flow Diagram
LDKT, living donor kidney transplantation; DDKT, deceased donor kidney transplantation

Characteristics of Donors and Recipients

Table 1 shows characteristics of the donors according to pretransplant dialytic modality of the recipients. The average age was 38.63±13.3 years. Most of the donors were male. The most common cause of death was traumatic brain injury. The average body mass index (BMI) was 23.64±3.73 kg/m^2. There were no differences in age, sex, and BMI between the PD and HD groups. The proportions of patients with last serum creatinine <1.5 mg/dL and CIT <24 hours were also not different between the two groups. The history of hypotension prior to harvesting was more common in the PD group, whereas the history of receiving CPR was comparable between the two groups. The PD group was more likely to receive donors with positive hepatitis B serology. The rest of the serology test results were comparable between the two groups.

Table 1 Characteristics of the donors

Parameters	PD	HD	p-value
Male sex (n/%)	431 (68.0)	2,922 (66.3)	0.389
Age (years)	38.27±13.22	38.68±13.32	0.460
Height (kg)	163.67±9.13	163.85±9.70	0.696
Body weight (kg)	63.10±11.89	63.86±12.57	0.197
Body mass index (kg/m^2)	23.49±3.72	23.65±3.73	0.261
HBsAg positive (n/%)	124 (34.6)	730 (29.0)	0.030
Anti HCV Ab positive (n/%)	3 (0.5)	21 (0.5)	1.00
Anti CMV IgG positive (n/%)	566 (96.1)	3,942 (95.7)	0.677
Anti-HIV Ab positive (n/%)	0 (0.0)	8 (0.2)	0.607
Hypotension prior to harvesting (n/%)	385 (66.6)	2,330 (58.4)	<0.001
Receiving CPR prior to harvesting (n/%)	60 (10.5)	396 (10.0)	0.722
Last serum creatinine <1.5 mg/dL (n/%)	484 (76.9)	3,236 (73.9)	0.104
Cold ischemic time <24 hours (n/%)	580 (91.6)	3,976 (90.8)	0.518
Cause of brain death (n/%)			0.572
• Head trauma	285 (64.6)	1,744 (61.2)	
• Stroke	108 (24.5)	794 (27.8)	
• Anoxia	2 (0.5)	22 (0.8)	
• Brain tumor	3 (0.7)	22 (0.8)	
• Others	43 (9.8)	270 (9.5)	

PD, peritoneal dialysis; HD, hemodialysis; CPR, cardiopulmonary resuscitation; Ab, antibody

Table 2 shows characteristics of the recipients. The recipients in the PD group were significantly younger than those in the HD group. The average BMI was comparable between the two groups. Most of the recipients were male. The viral serology test results were comparable between the two groups. The most prescribed maintenance immunosuppressive regimen was the combination of corticosteroid, tacrolimus, and mycophenolate mofetil. HLA mismatching was more common in the HD group; however, the result of PRA was comparable between the two groups. The etiology of kidney failure was mostly listed as unknown. The average dialysis vintage was significantly longer in the HD group. As for the underlying diseases, DM was less common, whereas hypertension was more common in the PD group. The recipients in the HD group were more likely to receive LDKT compared with those in the PD group.

Table 2 Characteristics of the recipients

Parameters	PD	HD	p-value
Male sex (n/%)	406 (64.0)	2,778 (63.1)	0.640
Age (years)	40.41±11.42	45.39±11.95	<0.001
Height (kg)	162.33±8.25	163.56±8.31	0.001
Body weight (kg)	58.45±11.33	59.92±12.97	0.006
Body mass index (kg/m^2)	22.12±3.51	22.31±4.03	0.261
HBsAg positive (n/%)	14 (2.3)	159 (3.6)	0.077
Anti HCV Ab positive (n/%)	5 (0.8)	82 (1.9)	0.055
Anti CMV IgG positive (n/%)	579 (95.7)	4,044 (96.3)	0.501
Anti-HIV Ab positive (n/%)	2 (0.3)	7 (0.2)	0.379
Living donor kidney transplantation (n/%)	193 (30.4)	1,552 (35.2)	0.018
Dialysis vintage (years)	46.88±36.80	50.11±43.05	0.044
Dialysis vintage <12 months (n/%)	58 (9.1)	662 (12)	<0.001
Cause of kidney failure (n/%) • Diabetes mellitus • Hypertension • Glomerular disease • Others • Unknown	 31 (4.9) 107 (16.9) 122 (19.2) 20 (3.2) 354 (55.8)	 501 (11.4) 740 (16.8) 1,014 (23.0) 206 (4.7) 1,943 (44.1)	<0.001
Underlying diseases (n/%)			
Diabetes mellitus	46 (11.3)	644 (18.8)	<0.001
Hypertension	437 (84.4)	3,116 (76.6)	<0.001
Cardiac Diseases	12 (4.1)	153 (5.7)	0.242
Induction therapy (n/%) • None • Interleukin 2 receptor antibody • Anti-thymocyte/Anti-lymphocyte globulin • Anti-CD52 antibody • Others	 195 (30.7) 368 (58.04) 63 (9.9) 1 (0.2) 6 (0.9)	 1,345 (30.5) 2,541 (57.7) 451 (10.2) 27 (0.6) 30 (0.7)	0.612

Parameters	PD	HD	p-value
Maintenance therapy with prednisolone (n/%)			0.004
• Tacrolimus and mycophenolic acid	440 (69.4)	2,857 (64.9)	
• Cyclosporine and mycophenolic acid	84 (13.2)	699 (15.9)	
• Tacrolimus and azathioprine	0 (0.0)	22 (0.5)	
• Cyclosporine and azathioprine	5 (0.8)	116 (2.6)	
• Others	105 (16.6)	710 (16.1)	
HLA mismatching (n/%)			0.001
• 0-2	339 (53.5)	2,020 (45.9)	
• 3-4	251 (39.6)	1,941 (44.1)	
• 5-6	44 (6.9)	443 (10.1)	
Last panel reactive antibody (n/%)			0.334
• 0 %	568 (89.6)	3,901 (88.6)	
• 1-49 %	34 (5.4)	313 (7.1)	
• 50-79%	14 (2.2)	91 (2.1)	
• ≥80%	18 (2.8)	99 (2.2)	

PD, peritoneal dialysis; HD, hemodialysis; Ab, antibody

Outcomes

The primary and secondary outcomes of all patients are shown in **Table 3**. **Figure 2** illustrates the Kaplan-Meier survival curves of the primary outcomes of patent and graft survival. Subgroup analyses according to the type of donor (LDKT or DDKT) are shown in **Table 4**. The results of multivariate Cox proportional hazards models for the patient and graft survival are shown in **Table 5**.

Patient survival

Thirty-four (5.4%) patients in the PD group and 343 (8.7%) patients in the HD group died during the study period. In the PD group, the overall patient survival at 1, 5 and 10 years were 96.9, 94.2 and 88.5%, respectively. In the HD group, the overall patient survival at 1, 5, 10 years were 97.1, 93.0 and 87.2%, respectively. Kaplan-Meier curves showed no significant differences in the overall patient survival between the two groups (p=0.238). The most common cause of death for both groups were infection and cardiovascular disease. In the subgroup of 1,745 LDKT, 7 (3.6%) patients in the PD group and 91 (5.9%) patients in the HD group died (p = 0.520). In the subgroup of 3,293 DDKT, 27 (6.1%) patients in PD group and 252 (8.8%) patients in HD group died (p = 0.192). The most common cause of death for both subgroups was infection. In the multivariate Cox proportional hazards model adjusted for relevant factors, the overall patient survival was comparable between the PD and HD groups (PD vs. HD, adjusted hazard ratio 1.23 (0.77-1.96)). Similar findings were observed in the LDKT (1.77 (0.77-4.06)) and DDKT (0.96 (0.53-1.71)) subgroups.

Death-censored graft survival

Fifty-six (8.8%) patients in the PD group and 495 (11.2%) patients in the HD group lost their allograft. In the PD group, the overall DCGS at 1, 5, 10 years were 95.8, 90.0 and 80.6%, respectively. In the HD group, the overall DCGS at 1, 5, 10 years were 96.6, 90.2 and 79.9%, respectively. Kaplan-Meier survival curves showed no difference in DCGS between the two groups (p = 0.758). The most common causes of allograft loss were rejection in the PD group and interstitial fibrosis and tubular atrophy in the HD group. In the subgroup of 1,745 LDKT, 16 (8.3%) patients in the PD group and 166 (10.7%) patients in the HD group experienced allograft loss (p = 0.742). In the subgroup of 3,293 DDKT, 40 (9.1%) patients in PD group and 329 (11.5%) patients in the HD group experienced allograft loss (p = 0.395). The major causes of allograft loss in the LDKT subgroup were rejection in the PD group and interstitial fibrosis

and tubular atrophy in the HD group. The major cause of allograft loss In DDKT subgroup was rejection. In the multivariate Cox proportional hazards model adjusted for relevant factors, there was no significant difference in the overall DCGS between the PD and HD groups (PD vs. HD, adjusted hazard ratio 1.50 (0.95-2.39)). Similar findings were observed in both subgroups of LDKT (1.66 (0.80-3.44)) and DDKT (1.00 (0.71-1.42)).

Delayed graft function

One hundred thirty three (21%) patients in the PD group and 1,185 (26.9%) patients in the HD group experienced DGF (PD vs. HD, adjusted odds ratio 0.71 (0.56-0.91), P<0.001). The lower incidence of DGF in the PD group was more pronounced in the DDKT subgroup (0.69 (0.53-0.89), p=0.004). In LDKT subgroup, the incidence of DGF was higher in the PD group but the difference did not reach statistical significance. Among DDKT recipients, the lower incidence of DGF was also observed in the group of recipients that received maintenance HD for <12 months prior to KT (crude odds ratio 0.71 (0.52-0.95), p=0.021).

Acute rejection

Four (0.6%) patients in the PD group and 57 (1.3%) patients in the HD group developed acute rejection (PD vs. HD, adjusted odds ratio 0.47 (0.17-1.32), P=0.153). Similar findings were observed in both LDKT and DDKT subgroups.

Table 3 Primary and secondary outcomes of all patients

Outcomes (n/%)	PD	HD	p-value
Patient survival			0.238
• 1-year	519 (96.9)	3,686 (97.1)	0.879
• 5-year	230 (94.2)	1,863 (93.0)	0.373
• 10-year	26 (88.5)	647 (87.2)	0.232
Patient survival			0.030
• Alive	600 (94.6)	4,061 (92.2)	
• Dead	34 (5.4)	343 (7.8)	
Death-censored graft survival			0.758
• 1-year	510 (95.8)	3,638 (96.6)	0.293
• 5-year	222 (90.0)	1,785 (90.2)	0.697
• 10-year	22 (80.6)	609 (79.9)	0.987
Graft survival			0.069
• Functioning	578 (91.2)	3,909 (88.8)	
• Loss	56 (8.8)	495 (11.2)	
Delayed graft function[a]	133 (21.0)	1,185 (26.9)	<0.001
Acute rejection[b]	4 (0.6)	57 (1.3)	0.153
Cause of death			0.952
• Infection	14 (53.8)	134 (49.6)	
• Cardiovascular cause	6 (23.1)	63 (23.3)	
• Malignancy	0 (0.0)	6 (2.2)	
• Others	5 (19.2)	55 (20.4)	
• Unknown	1 (2.8)	12 (4.4)	

Outcomes (n/%)	PD	HD	p-value
Cause of graft loss			0.007
• Death with functioning graft	1 (2.2)	16 (3.8)	
• Rejection	15 (33.3)	142 (33.6)	
• Glomerular disease	4 (8.9)	34 (8.1)	
• Interstitial fibrosis/Tubular atrophy	8 (17.8)	152 (36.0)	
• Vascular or urologic causes	9 (20.0)	20 (4.7)	
• Non-compliance	0 (0.0)	5 (1.2)	
• Others	8 (17.8)	53 (12.6)	

PD, peritoneal dialysis; HD, hemodialysis

[a]adjusted for donor factors including age, donor type, history of hypotension and CPR prior to harvesting, last serum creatinine and recipient factors including age, dialysis vintage, cause of kidney failure, types of immunosuppression, last PRA, HLA mismatching, and acute rejection

[b]adjusted for donor factors including age, history of hypotension prior to harvesting, donor type, last serum creatinine, and cold ischemic time and recipient factors including age, cause of kidney failure, dialysis vintage, types of immunosuppression, last PRA, and HLA mismatching

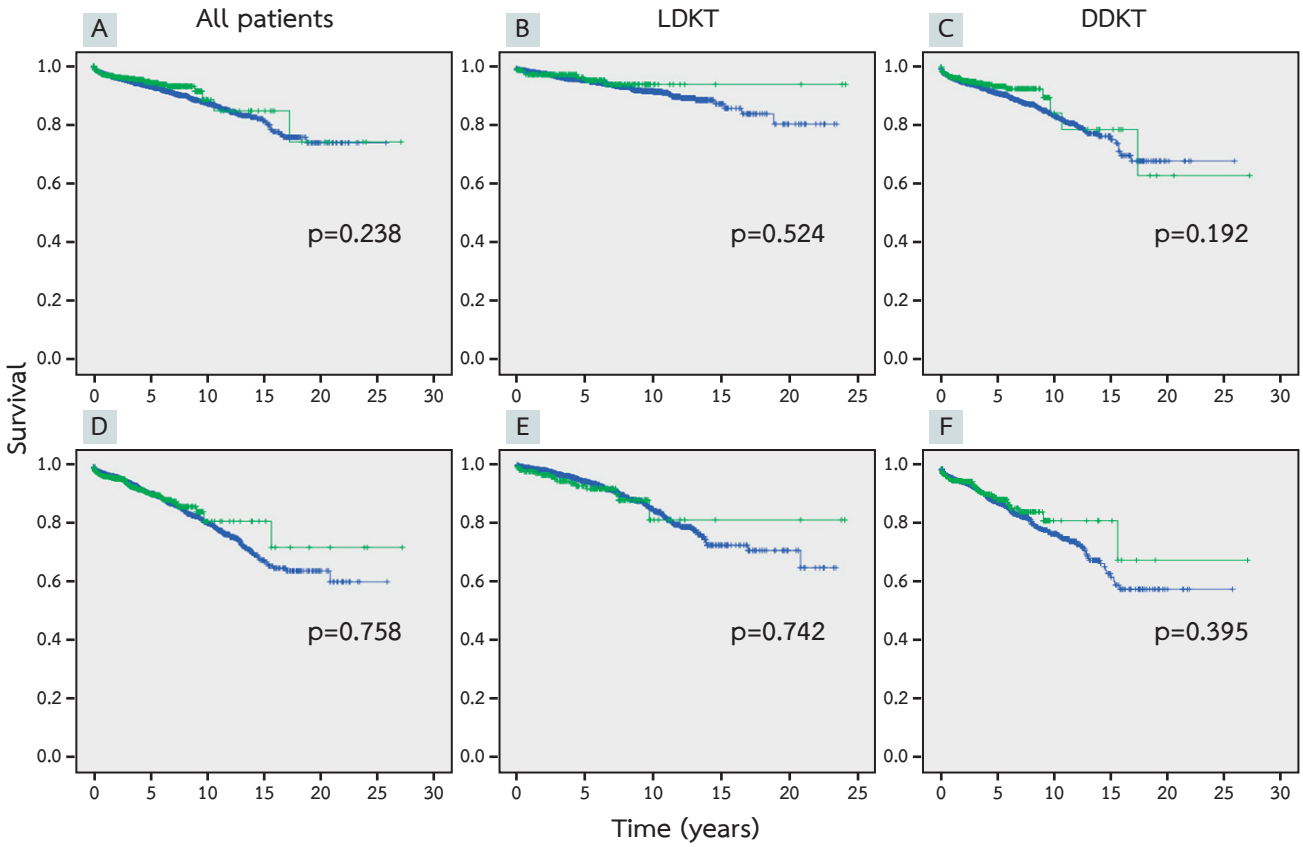

Figure 2 Kaplan-Meier survival curves of patient and death-censored graft survival

A, B and C demonstrated patient survival, and D, E and F demonstrated death-censored graft survival. PD, green line; HD blue line

PD, peritoneal dialysis; HD, hemodialysis; LDKT, living donor kidney transplantation; DDKT, deceased donor kidney transplantation

Table 4 Subgroup analyses according to the type of donor

Outcomes (n/%)	PD	HD	p-value
Living donor kidney transplantation			
Patient survival • Alive • Dead	 186 (96.4) 7 (3.6)	 1,461 (94.1) 91 (5.9)	0.203
Graft survival • Functioning • Loss	 177 (91.7) 16 (8.3)	 1,386 (89.3) 166 (10.7)	0.302
Delayed graft function[a]	14 (7.3)	63 (4.1)	0.060
Acute rejection[b]	1 (0.5)	11 (0.7)	1.000
Deceased donor kidney transplantation			
Patient survival • Alive • Dead	 414 (93.9) 27 (6.1)	 2,600 (91.2) 252 (8.8)	0.057
Graft survival • Functioning • Loss	 401 (90.9) 40 (9.1)	 2,523 (88.5) 329 (11.5)	0.127
Delayed graft function[a]	119 (27.0)	1,122 (39.3)	<0.001
Acut Acute rejection[b]	3 (0.7)	46 (1.6)	0.132

PD, peritoneal dialysis; HD, hemodialysis

[a]adjusted for donor factors including age, history of hypotension and CPR prior to harvesting, last serum creatinine, and recipient factors including age, dialysis vintage, cause of kidney failure, types of immunosuppression, last PRA, HLA mismatching and acute rejection

[b]adjusted for donor factors including age, history of hypotension prior to harvesting, last serum creatinine, and cold ischemic time and recipient factors including age, cause of kidney failure, dialysis vintage, types of immunosuppression, last PRA and HLA mismatching

Table 5 Multivariate Cox proportional hazards regression models

	Patient Survival (PD vs. HD) Hazard Ratio (95% Confidence Interval)	Death-Censored Graft Survival (PD vs. HD) Hazard Ratio (95% Confidence Interval)
All patients	1.23 (0.77-1.96)[a]	1.50 (0.95-2.39)[d]
Living donor KT	1.77 (0.77-4.06)[b]	1.66 (0.80-3.44)[e]
Deceased donor KT	0.96 (0.53-1.71)[c]	1.00 (0.71-1.42)[f]

[a]adjusted for donor factors including age, donor type, history of hypotension prior to harvesting, last serum creatinine and recipient factors including age, dialysis vintage, cause of kidney failure, DM, cardiac disease, types of immunosuppression; last PRA, HLA mismatching and delayed graft function

[b]adjusted for donor age and recipient factors including age, dialysis vintage, cause of kidney failure, DM, cardiac disease, types of immunosuppression, last PRA, HLA mismatching, delayed graft function and graft loss

[c]adjusted for donor factors including age, history of hypotension prior to harvesting, last serum creatinine and recipient factors including age, dialysis vintage, cause of kidney failure, DM, cardiac diseases, types of immunosuppression; last PRA, HLA mismatching, delayed graft function and allograft loss

[d]adjusted for donor factors including history of CPR prior to harvesting, donor type, last serum creatinine, cold ischemic time and recipient factors including age, dialysis vintage, types of immunosuppression, last PRA and HLA mismatching, delayed graft function and acute rejection

[e]adjusted for recipient factors including age, dialysis vintage, cause of kidney failure, types of immunosuppression, last PRA, HLA mismatching, delayed graft function and acute rejection

[f]adjusted for donor factors including history of CPR prior to harvesting, donor type, last serum creatinine and cold ischemic time and recipient factors including age, dialysis vintage, types of immunosuppression, last PRA, HLA mismatching, delayed graft function and acute rejection

Discussion

The present study used the data from Thailand kidney transplant registry between 1987 to 2020 to determine the relationship between pretransplant dialytic modality and outcomes of KT. The main findings of the study were no significant differences in the patient and graft survival between the group of recipients that received PD and HD prior to KT. Similar findings were observed in subgroups of LDKT and DDKT. However, lower incidence of DGF was observed in the PD group compared with HD group especially in the subgroup of recipients that received DDKT. The incidence of acute rejection was similar between the two groups.

Several investigators that examined the relationship between pretransplant dialytic modality and outcomes of KT also reported comparable patient survival between the PD and HD groups.[2,7-9] In the Taiwanese nationwide cohort study of 1,812 patients published by Lin et al, no difference in the overall patient survival was observed (PD vs. HD, hazard ratio 0.85 (0.61-1.18)).[7] A small study that included 38 PD and 268 HD patients by Freitas et al also observed no significant difference in recipient survival at 1 year (p=0.800) and 3 years (p=0.657).[2] The characteristics of the recipients in the Freitas et al' study were similar to the present study in terms of donor age and higher percentage of LDKT in the PD group. Another retrospective study of 143 patients who received first LDKT by Ardalan et al showed no significant difference in the overall 5-year patient survival (p=0.13).[8] As for the cause of death, similar to the present study, Lopez et al

reported infection as the most common cause of death in the PD group. However, the most common cause of death in the HD group was problems related to vascular access.[1] In the retrospective analysis of a large database from the Centers for Medicare and Medicaid Services in the USA (n=22,776 patients), Snyder et al reported similar patient survival between PD and HD modalities (PD vs. HD, hazard ratio 0.95 (0.85-1.06)).[9] There have also been reports of better recipient survival with PD compared with HD.[1,4,10]

As for DCGS, the previous findings have been conflicting. Higer DCGS in the recipients receiving PD as well as comparable DCGS between different modes of dialysis have been reported[3-4,12] Similar to the findings from the present study, the recent meta-analysis by Tang et al[3] reported no significant difference in DCGS between PD and HD groups (p=0.080). Lopez et al also found no significant difference in the incidence of DCGS between PD and HD groups (PD vs. HD, hazard ratio 0.68 (0.41-1.10), p=0.120) but observed shorter allograft lifespan in the group of younger recipients that received older donors.[1] Among patients that received LDKT, Ardalan et al reported no significant difference in the 5-year DCGS between the PD and HD groups (p=0.260).[8]

The present study observed a lower incidence of DGF in the PD group. This relationship was more pronounced in the subgroup of patients that received DDKT. The explanation for this finding could be related to the dialysis procedure. The use of artificial membrane in HD could increase the production of free radicals, oxidative stress and inflammation which might increase the risk of DGF.[13-14] On the other hand, PD is associated with better cell-mediated immunity, preservation of residual kidney function and less oxidative stress compared with HD.[2,15] Similar to the present study, the meta-analysis by Tang et al also reported a lower risk of DGF in the group of recipients that received PD compared with HD (PD vs. HD, odds ratio 0.67 (0.62-0.72), p=0.024).[3] However, this difference was more pronounced in the LDKT subgroup but not significant in the DDKT subgroup. Among patients that received LDKT, Ardalan et al reported no difference in the incidence of DGF between PD and HD groups.[8] The lack of the difference in the incidence of DGF in LDKT could be explained by better donor and recipient preparations.

The incidence of acute rejection in the present study was comparable between PD and HD in the overall cohort and in the subgroups of LDKT and DDKT. The prior study suggested an increased risk of acute rejection in patients receiving HD.[16] It is possible that PD causes less suppression of the cell-mediated immunity, whereas HD aggravates the activation of immune system. Furthermore, DGF was found to be associated with an increase in the incidence of acute rejection.[16-17] The incidence of acute rejection in the present study was low (PD vs. HD, 0.6 vs. 1.3%) and there was no difference in the incidence of acute rejection between PD and HD. Similar findings have also been reported by others.[2,8,18] The meta-analysis by Tang et al reported no significant difference in the incidence of acute rejection between the two pretransplant dialytic modalities (PD vs. HD, odds ratio 0.96 (0.75-1.16)).[3]

The strengths of the present study were the large number of patients nationwide and the long follow-up period up to 10 years post KT. The limitations included the substantially lower number of patients in the PD group. The latest dialysis modality was used in the analyses and the switching of dialysis modality (from PD to HD or vice versa) within the same patient was not taken into account. The data on dialysis adequacy was also not available in the present study.

In conclusion, there were no associations between pretransplant dialytic modality with patient and graft survival and the incidence of acute rejection. The group of patients that received PD showed lower incidence of DGF which was more pronounced in the DDKT subgroup. The lower risk of DGF was also observed among the DDKT recipients that received maintenance HD for <12 months.

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