Original Article

Effect of Glomerular Filtration Rate at Peritoneal Dialysis Initiation on Clinical Outcomes: A Retrospective Cohort Study

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Background: The optimal time for peritoneal dialysis (PD) initiation remains controversial.

Objective: To assess the correlation between estimated glomerular filtration rate (eGFR) at PD initiation and clinical outcomes. The primary outcome was the patient's survival, and the secondary outcomes were PD-related complications and hospitalization.

Materials and Methods: The patients that underwent PD between January 1, 2013 and December 31, 2017 were enrolled in the present retrospective study. Demographic, laboratories, PD data, and adequacy of PD were collected from the medical records. Patients were categorized according to their eGFR at the initiation of PD into four groups including: less than 3, 3 to 5.9, 6 to 9.9, and 10 mL/minute/1.73 m^2 or more for assessing the association with the clinical outcomes.

Results: Data from 532 PD patients were analyzed. The mean eGFR at the initiation of PD was 5.07±2.56 mL/minute/1.73 m^2, residual urine 545.75±481.07 mL/day. One hundred sixty-nine (31.7%) patients died during follow-up period. Kaplan Meier survival analyses showed that patients who started PD at eGFR less than 3 and 3 to 5.9 mL/minute/1.73 m^2 had a lower mortality risk than the other groups ($p<0.001$). In multivariate analyses, age, coronary artery disease, and hospitalization were independent factors of death but the level of eGFR at the beginning of PD did not affect the outcome. There was no significant difference among the four groups in hospitalization ($p=0.83$) and peritonitis ($p=0.61$).

Conclusion: Initiation of PD at extremely-low and low eGFR were associated with better survival outcomes than the higher groups but were similar in the results of hospitalization and peritonitis.

Keywords: peritoneal dialysis, glomerular filtration rate, survival rate, peritonitis

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Currently, dialysis is the treatment of choice for end-stage renal disease (ESRD) patients. In the past, there was a belief that patients' mortality rate would increase if renal replacement therapy was used after failure of treatments to help control, slow down, or reduce complications[1,2]. The National Kidney Foundation Kidney Disease Outcomes Quality Initiative (NKF-KDOQI) provided clinical practice guideline recommendations in 1997 that Renal Replacement Therapy should be conducted when weekly total Kt/V urea is less than 2 or estimated glomerular filtration rate (eGFR) is less than 10.5 mL/minute/1.73 m^2[3]. After the clinical recommendations in 1997, the number of renal replacement therapy patients worldwide has increased significantly[4,5]. However, more studies are needed to determine an appropriate eGFR that yields the highest patients' survival rate. There was the Initiating Dialysis Early and Late (IDEAL) study that determined whether the timing of dialysis initiation influences patient survival. The IDEAL study was a randomized controlled trial where 828 chronic kidney disease patients were randomized to commence dialysis at an eGFR of either 10 to 14 mL/minute/1.73 m^2 (early initiation) or 5 to 7 mL/minute/1.73 m^2 (late initiation). The study concluded that there was no statistical difference in the survival rate between the two groups[6]. After the publication of the IDEAL study in 2010, many Nephrology Societies had provided a new clinical

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recommendation for dialysis that encouraged late initiation and the treatment should emphasize on patients' symptoms rather than eGFR alone[7-9].

After the announcement of the Thailand peritoneal dialysis (PD) first policy in 2010, the incidence of PD patients rapidly increased from 181.32 patient per million population (PMP) in 2010 to 317.71 PMP in 2015[10,11], which influenced the health care costs[12]. The Nephrology Society of Thailand also revised the clinical recommendation for renal replacement therapy for ESRD patients in 2012, and stated that renal replacement therapy should be considered if a patient had eGFR of less than or equal to 6 mL/minute/1.73 m² or more than 6 mL/minute/1.73 m² with complications of chronic kidney disease. To the authors' knowledge, there was no study for the optimum timing of dialysis initiation in the Thai people and lack of dialysis initiation data in patients with extremely low glomerular filtration rate on survival rate, hospitalization, and PD-related complications such as peritonitis. Hence, the present study was designed to find the correlation between the glomerular filtration rate of patients at PD initiation in the Thai people and their clinical results.

Materials and Methods

The present study was approved by the Ethics Committee of Burapha University on December 30, 2018 (Number 223/2560).

Participants

The present research comprised of a 5-year retrospective cohort study between January 2013 and December 2017. All patients that received chronic continuous ambulatory peritoneal dialysis (CAPD) at Burapha University Hospital and Chonburi Hospital were enrolled. The patients who had incomplete data were excluded. Finally, 532 patients were included in the present study.

Data collection

The data were obtained by reviewing medical records from the hospital database. Patient demographics, etiology of renal failure, comorbidities, dialysis vintage, and PD treatment data were collected.

Laboratory data including blood urea nitrogen, creatinine, eGFR (calculated by CKD EPI-equation), electrolyte, calcium, phosphorus, albumin, hematocrit, ferritin, and parathyroid hormone level, and 24-hour urine volume were recorded.

PD adequacy was measured by weekly Kt/V and weekly creatinine clearance of peritoneal and renal components.

All patients were started on PD according to the Nephrology Society of Thailand criteria. Patients were categorized into four groups based on the glomerular filtration rate at the time of PD initiation as less than 3, 3 to 5.9, 6 to 9.9, and 10 or more mL/minute/1.73 m², to find the correlation between eGFR and clinical outcomes.

Outcome measurement

The primary outcome of the study was patient survival. The secondary outcomes were hospitalization and PD-related peritonitis.

PD-related peritonitis was diagnosed according to the presence of peritoneal signs and cloudy effluent with leukocyte counts of more than 100/μL together with more than 50% neutrophils, or positive peritoneal fluid culture, or both.

Peritonitis rate was reported as the episodes per patient-year calculated by

- Total number PD patient days at risk over 365 days per year = patient years-experience

- Episodes per patient-year = number of episodes of peritonitis over the number of years-experience

Statistical analysis

Continuous data were reported as means and standard deviation while categorized data were reported as number and percentage. The survival curve was estimated using the Kaplan-Meier method, and the statistical significance was calculated using the log-rank test. To determine predictors of outcome events, the univariable cox regression models were constructed to explore individually the potential risk factors for death including demographics, eGFR at initiation, residual urine, ultrafiltration of PD, PD adequacy, PD-related peritonitis, and hospitalization. The authors reported the multivariable-adjusted hazard ratios (HRs) with 95% confidence interval (CI). A p-value of less than 0.05 was considered significant. Statistical analyses were performed using Stata, version 14.1 (StataCorp LP, College Station, TX, USA).

Results

Data from 532 patients were collected. The mean age of the patients was 58.13±15.41 years, and 284 (53.4%) patients were female. The mean eGFR at PD initiation was 5.07±2.56 mL/minute/1.73 m². About half of the patients started PD at the range of eGFR 3 to 5.9 mL/minute/1.73 m². Mean eGFR in four groups were 1.94±0.6, 4.2±0.82, 7.35±1.14 and

11.49±1.83 mL/minute/1.73 m², respectively. The overall mean daily urine output was 545.75±481.07 mL. The group of eGFR 6 to 9.9 and 10 mL or more /minute/1.73 m² had significantly more urine volume per day than the other groups (p=0.005). The median follow-up duration were 24.12 months, and the mean dialysis vintage were 30.2±24.6 months. Diabetic kidney disease was the most common cause of ESRD (55.8%), followed by hypertensive nephropathy and unknown cause. The comorbidities did not differ between the four groups except coronary artery disease that mostly appeared in the eGFR 6 to 9.9 mL/minute/1.73 m² group, and gout, which was more commonly found in the GFR less than 3 mL/minute/1.73 m² group. Our center maintained PD adequacy that achieved the target weekly at Kt/V greater than 1.7. In the present study, mean weekly total Kt/V was 2.19±0.67, weekly total creatinine clearance was 71.82±29.17 (L/week/1.73 m²), and mean ultrafiltration of PD was 694.53±742.52 mL/day. The weekly total Kt/V and creatinine clearance were highest in the eGFR 10 or more group (weekly total Kt/V 2.52±0.88, creatinine clearance weekly total 92.27±39.99 L/week/1.73 m²). The demographics and laboratory characteristics of patients at the initiation of PD are summarized in Table 1.

Among the 532 prevalent PD patients, 169 patients died during follow-up, 27 were referred to hemodialysis center and five patients underwent renal transplantation. The patient survival was 70.68%, 50.19%, and 35.15% at the first, second, and third year, respectively. The median survival time was 4.64 years, 95% CI 4.02 to 5.29 years (Figure 1).

Patients were categorized into four groups, less than 3, 3 to 5.9, 6 to 9.9, and 10 or more mL/minute/1.73 m² according to their eGFR at the initiation of PD for assessing the overall survival (OS). Kaplan-Meier survival analysis revealed that the patient survival was significantly better in the groups that initiated PD at the range of eGFR at less than 3 and 3 to 5.9 mL/minute/1.73 m² compared with higher eGFR (eGFR 6 to 9.9 and 10 or more mL/minute/1.73 m², p<0.001) (Figure 2).

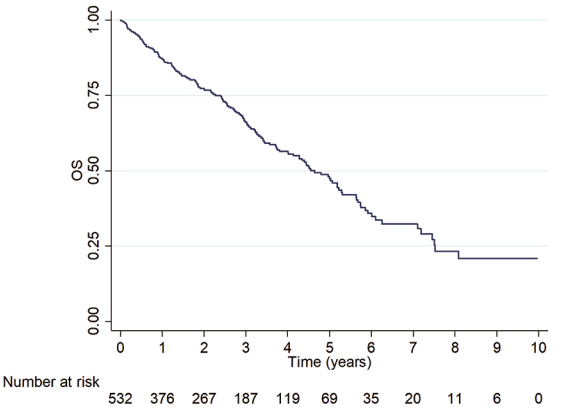

Figure 1. Kaplan-Meier analysis of cumulative overall survival according to the duration of peritoneal dialysis.

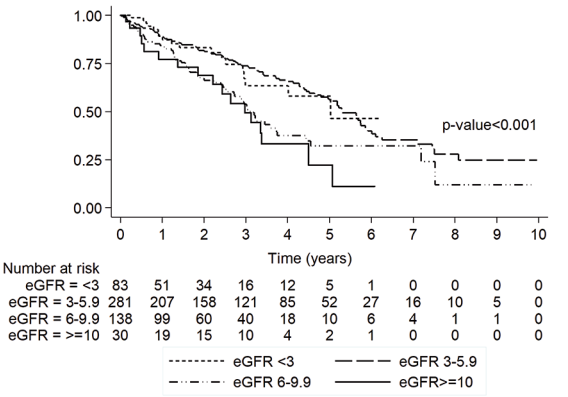

Figure 2. Comparison of cumulative incidences of overall survival according to eGFR at the initiation of PD calculated by Kaplan-Meier analysis. The comparison showed the patients in eGFR ≥10 mL/minute/1.73 m² group had significantly lower in overall survival than eGFR 3 to 5.9 mL/minute/1.73 m² and <3 mL/minute/1.73 m² group (p=0.001 and 0.015, respectively). Likewise, the overall survival in eGFR 5 to 9.9 mL/minute/1.73 m² group had significantly lower compared with eGFR 3 to 5.9 mL/minute/1.73 m² and eGFR <3 mL/minute/1.73 m² (p<0.001 and 0.027, respectively).

Peritoneal dialysis-related peritonitis

During the follow-up period, there were 675 events of peritonitis in 306 patients with 0.5 episodes per patient-year. Positive pathogen cultures were found in 476 cultures. The most common pathogen was Staphylococcus aureus with 136 specimens (20.15%) followed by other Gram-negative bacteria at 99 specimens (14.67%), and Pseudomonas spp. at 48 specimens (7.11%) (Table 2).

The peritonitis rate did not differ among the four groups (p=0.61) (Figure 3).

Hospitalization

All causes of hospitalization occurred 779 times in 330 patients (62%). The most common cause of admission was PD-related complications (42.5%) especially, PD-related peritonitis (39.28%), followed by infection (18.62%), and volume overload (11.68%). The rate of admission did not differ among the four groups (p=0.83) (Table 3).

The authors found several factors that might

Table 1. Baseline characteristics of patients at the initiation of peritoneal dialysis

Baseline characteristic	Total (n=532)	eGFR at initiation (mL/minute/1.73 m^2)				p-value
		<3 (n=83)	3 to 5.9 (n=281)	6 to 9.9 (n=138)	≥10 (n=30)	
Age (year); median (IQR)	61 (50, 68.5)	58 (48, 64)	59 (49, 67)	64 (53, 72)	65 (52, 69)	0.003*
Sex; n (%)						
Female	284 (53.4)	36 (43.4)	151 (53.7)	76 (55.1)	21 (70)	0.077
Male	248 (46.6)	47 (56.6)	130 (46.3)	62 (44.9)	9 (30)	0.077
eGFR at initiation (mL/minute/1.73 m^2); median (IQR)	4.8 (3, 6.22)	2 (1.73, 2.3)	4 (3.7, 5)	7 (6.2, 8.2)	11 (10, 12)	<0.001*
Systolic blood pressure (mmHg); mean±SD	141.71±24.3	147.02±23.91	143.06±24.11	138.26±23.61	130.13±25.64	0.002*
Diastolic blood pressure (mmHg); mean±SD	74.54±15.21	78.23±13.05	75.14±15.29	72.99±15.54	65.87±15.13	0.001*
Body weight (kg); mean±SD	58.66±12.96	60.52±14.1	59.19±11.9	57.15±13.59	55.48±15.56	0.118
Body mass index (kg/m^2); mean±SD	22.81±4.01	23.16±3.96	22.95±3.74	22.45±4.27	22.22±5.18	0.432
Urine output (mL/day); median (IQR)	490 (200, 900)	400 (100, 700)	400 (200, 700)	500 (270, 1000)	350 (200, 950)	0.003*
Etiology of ESRD; n (%)						
Diabetic kidney disease	297 (55.8)	46 (55.4)	139 (49.5)	92 (66.7)	20 (66.7)	0.006*
Hypertension	134 (25.2)	24 (28.9)	79 (28.1)	26 (18.8)	5 (16.7)	0.112
Unknown cause	79 (14.8)	12 (14.5)	51 (18.1)	13 (9.4)	3 (10)	0.102
Chronic glomerulonephritis	17 (3.2)	0 (0)	9 (3.2)	6 (4.3)	2 (6.7)	0.212
Chronic interstitial nephritis	2 (0.4)	1 (1.2)	1 (0.4)	0 (0)	0 (0)	0.54
Obstruction	1 (0.2)	0 (0)	1 (0.4)	0 (0)	0 (0)	0.827
Stone	1 (0.2)	0 (0)	0 (0)	1 (0.7)	0 (0)	0.414
UTI	1 (0.2)	0 (0)	1 (0.4)	0 (0)	0 (0)	0.827
Comorbidities; n (%)						
Diabetes	300 (56.4)	44 (53)	155 (55.2)	83 (60.1)	18 (60)	0.680
Hypertension	426 (80.1)	65 (78.3)	227 (80.8)	111 (80.4)	23 (76.7)	0.923
Gout	44 (8.3)	13 (15.7)	15 (5.3)	12 (8.7)	4 (13.3)	0.017*
Coronary artery disease	42 (7.9)	6 (7.2)	15 (5.3)	20 (14.5)	1 (3.3)	0.008*
HIV	6 (1.1)	1 (1.2)	4 (1.4)	1 (0.7)	0 (0)	0.857
COPD/asthma	5 (0.9)	1 (1.2)	1 (0.4)	3 (2.2)	0 (0)	0.304
Malignancy	3 (0.6)	0 (0)	1 (0.4)	1 (0.7)	1 (3.3)	0.183
Dialysis vintage (month); median (IQR)	24.07 (9.72, 44.18)	15.54 (8.07, 33.34)	29.57 (11.64, 52.92)	20.66 (8.46, 37.28)	24.62 (5.64, 40.2)	0.001*
Duration follow-up (month); median (IQR)	24.12 (9.72, 44.16)	15.6 (8.04, 33.36)	29.52 (11.64, 52.92)	20.64 (8.4, 37.32)	24.6 (5.64, 40.2)	<0.001*
Ultrafiltration (mL/day); median (IQR)	700 (300, 1050)	800 (400, 1150)	750 (350, 1050)	587.5 (200, 1000)	650 (350, 1000)	0.178
PD adequacy; median (IQR)						
Kt/V urine	0.11 (0, 0.47)	0 (0, 0.19)	0 (0, 0.33)	0.31 (0, 0.76)	0.49 (0, 1.36)	<0.001*
Kt/V PD; mean±SD	1.82±0.4	1.83±0.45	1.85±0.36	1.76±0.43	1.72±0.42	0.176
Kt/V total	2.08 (1.74, 2.42)	1.98 (1.67, 2.25)	2.05 (1.74, 2.38)	2.13 (1.8, 2.52)	2.41 (2.05, 2.76)	0.031*
CCr renal (L/week/1.73 m^2)	10.85 (0, 30.64)	4.76 (0, 9.73)	7.11 (0, 22.65)	29.11 (12.06, 53.45)	30.02 (10.34, 82.57)	<0.001*
CCr PD (L/week/1.73 m^2); mean±SD	50.04±9.48	50.48±9.21	51.15±8.63	47.67±10.05	48.7±13.86	0.030*
CCr total (L/week/1.73 m^2)	63.99 (54.11, 81.02)	56.5 (48.99, 65.88)	61.59 (52.42, 74.84)	77.71 (61.12, 99.84)	82.3 (62.21, 118.99)	<0.001*
Laboratories; mean±SD						
Blood urea nitrogen (mg/dL)	57.36±26.94	61.48±30.9	58.02±25.62	53.58±26.96	57.11±26.25	0.223
Creatinine (mg/dL); median (IQR)	8.75 (6.54, 11.65)	10.04 (6.55, 12.92)	9.13 (7.16, 12.04)	7.25 (5.74, 9.66)	6.59 (5.01, 11.23)	<0.001*
Serum sodium (mmol/L); median (IQR)	139 (136, 141)	139 (134, 141)	139 (136, 141)	139 (136, 141.5)	139 (135.5, 140.5)	0.977
Serum potassium (mmol/L)	4.02±1.35	4.05±0.87	3.99±0.76	4.08±2.28	3.85±0.88	0.817
Serum bicarbonate (mmol/L)	26.97±5.54	26.02±4.94	26.81±4.79	27.79±7.26	27.35±3.87	0.143
Serum calcium (mg/dL); median (IQR)	8.9 (8.3, 9.6)	8.9 (8.4, 9.5)	8.9 (8.3, 9.5)	8.8 (8.3, 9.6)	9.3 (8.45, 9.8)	0.573
Serum phosphorous (mg/dL); median (IQR)	4.4 (3.5, 5.5)	4.9 (3.9, 5.9)	4.4 (3.5, 5.5)	4.15 (3.2, 5)	4.2 (3.65, 5.65)	0.005*
Serum albumin (g/dL); median (IQR)	3.6 (3.15, 4)	3.7 (3.5, 4.2)	3.6 (3.2, 4)	3.5 (3.1, 3.9)	3.3 (2.8, 3.7)	0.001*
Hematocrit (%)	29.9±5.1	29.12±5.57	29.89±4.87	30.37±5.25	29.98±5.16	0.414
Ferritin (ng/dL); median (IQR)	486.5 (247, 916)	440.5 (219.61, 727.5)	486.5 (259.41, 900)	502 (307, 845)	725 (126, 1711)	0.956
Parathyroid hormone (pg/dL); median (IQR)	276.5 (134.95, 477.85)	288.4 (160.3, 378)	324.4 (159.6, 575)	212 (96.5, 386)	181.5 (173.9, 451)	0.245

eGFR=estimated glomerular filtration rate; ESRD=end-stage renal disease; UTI=urinary tract infection; COPD=chronic obstructive pulmonary disease; CCr=creatinine clearance; PD=peritoneal dialysis; IQR=interquartile range; SD=standard deviation

Table 2. The pathogen culture results from peritoneal fluids in the patients with PD-related peritonitis

Pathogen	Events (times); n (%)
Gram positive	232 (34.37)
Staphylococcus aureus (MSSA)	131 (19.41)
Staphylococcus aureus (MRSA)	5 (0.74)
Coagulase negative *Staphylococcus*	33 (4.89)
Streptococcus spp.	24 (3.56)
Enterococcus spp.	1 (0.15)
Other Gram positive	38 (5.63)
Gram negative	222 (32.89)
Escherichia coli	44 (6.52)
Escherichia coli (ESBL)	5 (0.74)
Klebsiella spp.	18 (2.67)
Pseudomonas spp.	48 (7.11)
Acenetobacter baumanii	4 (0.59)
Shigella spp.	1 (0.15)
Salminella spp.	1 (0.15)
Acinetobacter lwoffii	2 (0.30)
Other Gram negative	99 (14.67)
Culture negative	181 (26.81)
Unknown results	18 (2.67)
Fungus	13 (1.93)
Multiple organism	5 (0.74)
Mycobacterium	4 (0.59)
Total	675 (100)

MSSA=methicillin-sensitive *Staphylococcus aureus*; MRSA=methicillin-resistant *Staphylococcus aureus*; ESBL=extended-spectrum β-lactamase

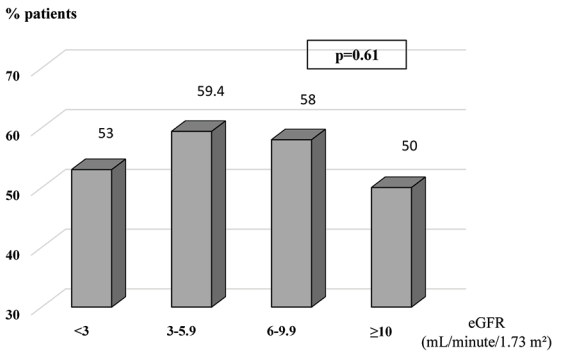

Figure 3. Incidence of PD-related peritonitis in each groups during the study period.

affect patient survival. In the univariate-analysis, age, eGFR at PD initiation 6 or more mL/minute/1.73 m², residual urine, diabetes, coronary artery disease, serum sodium, serum albumin, blood glucose, and hospitalization were significant factors associated

Table 3. Causes of hospitalization

Hospitalization	Events; n (%)
PD-related complications	
Peritonitis	306 (39.28)
Exit site infection	5 (0.64)
Tunnel infection	2 (0.26)
Catheter malfunction	7 (0.90)
Leakage	3 (0.39)
Hernia	8 (1.03)
Volume overload	91 (11.68)
Infection	
Urinary tract infection	33 (4.24)
Pneumonia	38 (4.88)
Foot ulcer	19 (2.44)
Diarrhea	38 (4.88)
Septicemia	17 (2.18)
Myocardial infarction	16 (2.05)
Stroke	17 (2.18)
Hypotension[a]	29 (3.72)
Hypertension[b]	10 (1.28)
Hypokalemia[c]	3 (0.39)
Hyponatremia[d]	1 (0.13)
Hyperglycemia[e]	11 (1.41)
Hypoglycemia[f]	3 (0.39)
Others	122 (15.66)

PD=peritoneal dialysis

[a] Systolic blood pressure <90 mmHg and/or diastolic blood pressure <60 mmHg, [b] Systolic blood pressure >180 mmHg and/or diastolic blood pressure >110 mmHg with target organ damage, [c] Serum potassium (K) <3.5 mmol/L, [d] Serum sodium <135 mmol/L, [e] Blood glucose >350 mg/dL with positive serum ketone, [f] Blood glucose <70 mg/dL

with mortality. Multivariate analyses showed that age (95% CI 1 to 1.04, p=0.017), coronary artery disease (95% CI 1.05 to 3.4, p=0.033), and hospitalization (95% CI 1.01 to 2.41, p=0.045) were the significant predictors of patient survival. On the other hand, there were no statistically significant differences on mortality among the four groups (Table 4).

Discussion

The optimal time to start PD has been debated. The CANADA-USA investigators reported that diminish weekly creatinine clearance below 5 L/1.73 m² was associated with an increase in mortality and early initiation of PD-related to better nutritional status[13]. A prospective study in 233 Hong Kong patients by Tang et al reported that the mortality at 1-year increased when uremic symptoms occurred

Table 4. Cox-proportion analysis of patient survival

Variables	Univariate		Multivariate	
	Crude HR (95% CI)	p-value	Adjusted HR (95% CI)	p-value
Age (year)	1.04 (1.02 to 1.05)	<0.001*	1.02 (1 to 1.04)	0.017*
Female	1.31 (0.99 to 1.74)	0.06		
eGFR at PD initiation				
<3	Reference	1	Reference	1
3 to 5.9	1 (0.6 to 1.65)	0.988	0.74 (0.38 to 1.42)	0.359
6 to 9.9	1.82 (1.07 to 3.07)	0.026*	1.09 (0.54 to 2.19)	0.806
≥10	2.32 (1.2 to 4.51)	0.013*	1.61 (0.64 to 4.05)	0.31
Residual urine	1.01 (1.01 to 1.02)	0.017*	1 (0 to 1)	0.35
Ultrafiltration	1 (0 to 1)	0.131		
Kt/V urine	1.06 (0.8 to 1.4)	0.68		
Kt/V PD	1.24 (0.79 to 1.96)	0.354		
Kt/V total	1.11 (0.85 to 1.45)	0.437		
CCr renal	1 (1 to 1.01)	0.436		
CCr PD	1.02 (1 to 1.04)	0.084		
Total CCr	1 (1 to 1.01)	0.524		
Diabetes	1.86 (1.39 to 2.5)	<0.001*	1.45 (0.92 to 2.26)	0.106
Coronary artery disease	2.42 (1.61 to 3.64)	<0.001*	1.89 (1.05 to 3.4)	0.033*
Serum sodium	0.97 (0.94 to 1)	0.043*	0.99 (0.94 to 1.03)	0.603
Serum potassium	1.02 (0.93 to 1.11)	0.667		
Hematocrit	0.98 (0.95 to 1.01)	0.158		
Albumin	0.62 (0.5 to 0.77)	<0.001*	0.83 (0.6 to 1.14)	0.245
Glucose	1 (1 to 1.01)	0.008*	1 (0 to 1)	0.806
Peritonitis	1.04 (0.77 to 1.39)	0.809		
Hospitalization	1.82 (1.3 to 2.55)	<0.001*	1.56 (1.01 to 2.41)	0.045*

eGFR=estimated glomerular filtration rate; CCr=creatinine clearance; PD=peritoneal dialysis; HR=hazard ratio; CI=confidence interval

at the time of dialysis initiation and the late dialysis group showed significantly more cardiovascular death than the early initiation group[14]. Whereas Shio et al found an advantage of early initiation of dialysis (eGFR of more than 6 mL/minute/1.73 m²) on patient survival and hospitalization[15]. Prior studies had limitation in patient selection, study population, time to refer to nephrologist, and being a prospective randomized control trial so the optimum timing of PD initiation is still unclear.

Subgroup analysis from IDEAL study presented no difference in the patient survival between early and late initiation of PD or the incidence of peritonitis[16]. A study from Canada by Jain et al of 8,047 end-stage kidney patients undergoing PD divided the patients into three groups according to eGFR at beginning of dialysis as more than 10.5, 7.5 to 10.5, and less than 7.5 mL/minute/1.73 m². They found the overall mortality rate was not different among these groups. However, in the first year of the study, the early initiation group had a significantly higher mortality rate[5].

Although, the trend from the recent studies showed no difference in patient survival between late and early initiation of dialysis, there have been concern about the increase of risk in the early initiation group such as catheter related complications, peritonitis, and hospital stay. Oh et al studied the outcomes of early PD initiation and found no increase in OS, PD-related mortality, technical failure, and cardiovascular events[17].

The present study result showed that the patient who started PD at eGFR of less than 3 mL/minute/1.73 m² had significant benefit on survival rate than the higher eGFR groups, and there were no differences of PD-related peritonitis and hospitalization among the four groups. The baseline data of patients in the eGFR of less than 3 mL/minute/1.73 m² group

showed lower residual urine, and PD adequacy than the other groups, however, patients in this group had less diabetic nephropathy, shorter dialysis duration, and higher serum albumin. The lowest eGFR group had higher serum albumin. This may be because of the less severity in comorbidities and that the other groups were less healthy. According to the last study that preferred late dialysis, the baseline albumin levels were not significantly different between early and late dialysis groups. The multivariate analysis showed that age, coronary artery disease, and hospitalization were significantly associated with mortality. Thus, timing of dialysis in the elderly or patients with cardiovascular disease should be adjusted with careful consideration.

To determine the optimal time of dialysis, the authors suggest following the patient's sign and symptom plus serial laboratory data. Creatinine vary on muscle volume and nutritional status and is not suitable for access to the eGFR. A more precise tool to access the glomerular filtration rate in ESRD patients should be used.

The strength of the present study is that it is the first real-world study in Thailand that analyzed CAPD patients who started dialysis at extremely low of eGFR of less than 3 mL/minute/1.73 m^2 (15.6%). Furthermore, the authors collected the data affecting the patient survival such as residual urine and PD adequacy.

There are a few limitations in the present study. Firstly, this was the retrospective cohort study. A future prospective study to find the optimal time that present the least mortality, least dialysis related complications, good quality of life, and cost-effectiveness should be conducted. Secondly, the glomerular filtration rate was measured by creatinine-based, which depended on the degree of muscle volume and nutritional status. Thirdly, only two centers were included, and a high mortality rate was exhibited because the present study centers are tertiary care hospitals that received ESRD patients from community hospitals. The present study's results may not be generalized to the whole country.

Conclusion

The present study demonstrated that the extremely-low of eGFR at PD initiation showed better survival outcome, while the rate of PD-related peritonitis and hospitalization did not increase. Therefore, late initiation of dialysis could reduce the health care costs and improve the patient's quality of life.

What is already known on this topic?

The optimal timing of initiation of maintenance dialysis is currently unknown. There is no study for the optimum timing of dialysis initiation in Thai people and lack of dialysis initiation data in patients with extremely low eGFR on survival rate, hospitalization, and PD-related complications.

What this study adds?

This study is the first real-world study in Thailand that analyzed CAPD patients who started dialysis at extremely low eGFR and showed the better survival outcome.

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Conflicts of interest

All authors have no conflict of interests to declare.

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