Characteristics and prognostic outcome factors in elderly peritoneal dialysis patients:a prospective observational study

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Research article

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Abstract

Background: This study aimed to analyze the characteristics, outcomes and prognosis factors of survival in elderly peritoneal dialysis patients, so as to better understand the status of elderly peritoneal dialysis patients and improve their quality of life.

Methods: This study was a prospective, observational study that included peritoneal dialysis (PD)patients.Categorizing by age, elderly group aged ≥ 65, younger group aged < 65. Clinical characteristics, survival and transferring to hemodialysis were compared between two groups.Meanwhile, risk factors for death in elderly PD patients were explored.

Results: A total of 202 PD patients were enrolled, including 61 in elderly group and 141 in younger group. Among elderly individuals,serum albumin and normalized protein catabolic rate(nPCR) decreased, the incidence of previous cardiovascular, cerebrovascular diseases and Charlson Comorbidity Index(CCI) were higher.The major primary disease in elderly patients was diabetic nephropathy, significant differences were found between elderly and younger group($P < 0.01$). The mortality in elderly group was substantially higher, 27 patients (44.3%) died in elderly group and 21 patients(14.3%) died in younger group .The 1-year,2-year,3-year,4-year survival rate were 81.97%, 70.49%, 60.66%, 55.74% respectively. Cardiovascular disease was the main cause of death in elderly PD patients. Higher BMI, CCI, and previous ischemic heart disease were risk factors for long-term survival of elderly PD patients. Compared with the younger group, elderly patients were less likely to transfer to hemodialysis: 2 cases (3.3%) in elderly group and 23 cases (16.3%) in younger group. Peritonitis was the primary reason for converting to hemodialysis(HD) in both two groups.

Conclusions: Poor nutrition, more complications and diabetic nephropathy were characteristics of elderly PD patients. High BMI, CCI and previous ischemic heart disease were independent predictors of death in elderly PD patients. Cardiovascular disease was the main cause of death in elderly PD patients while the chief reason of transferring to hemodialysis was peritonitis.

Background

Chronic kidney disease is a global public health problem and becoming increasingly common. A survey in China found that patients with chronic kidney disease stage 3(CKD3) were about 1.2million in 2012, and the average age was 63.6 years [1]. With the development of CKD to the end stage, peritoneal dialysis has become one of the main renal replacement therapies and a better choice of elderly patients with end stage renal disease because of its small influence on hemodynamics, protection of residual renal function, low cost and simple operation [2].

Elderly PD patients have unique clinical characteristics, and incline to have multiple comorbidities, including diabetes, hypertension, cardiovascular and cerebrovascular diseases [3]. Many factors can influence the clinical outcomes of elderly PD patients such as comorbidities, complications, age and nutritional deficiency [4,5]. However, previous studies were mainly retrospective studies, and the

influencing factors of death varied in different countries. Some studies had shown that death was the main reason for patients to withdraw from peritoneal dialysis,moreover, age and peritonitis are the risk factors for patients to withdraw from peritoneal dialysis [6,7]. However, there are few reports about the causes of withdrawal from PD in China, especially transferring to hemodialysis.

In this study,we intended to analyze the characteristics, prognosis (death, transferring to hemodialysis) of elderly PD patients by comparing with younger group, and assess the influencing factors of mortality in elderly patients.

Methods

Patients and groups

The study was approved by the ethics committee of the Cangzhou Central Hospital in Cangzhou City, Hebei Province, China. Written informed consent was attained from each patient.202 patients who received continuous ambulatory peritoneal dialysis from January 2016 to January 2017 in the Department of Nephrology of Cangzhou Central Hospital were enrolled in this prospective observational study. They did the exchange themselves only after successful training by primary nurses. Conventional PD solutions (Dianeal 1.5%,2.5%, or 4.25% dextrose; Baxter Healthcare, Guangzhou, China), Y-sets, and twin-bag systems were used. According to age, PD patients were divided into elderly group (age ≥ 65) and younger group(age < 65). Elderly was defined as ≥65 years old at PD initiation. Patients should met the following criteria: age > 18 years old, first peritoneal dialysis treatment and dialysis time more than 3 months, complete data. The exclusion criteria included incomplete data, loss of follow-up, those who did not cooperate with follow-up, transferred to other dialysis centers, Additionally, we did not include patients who was diagnosed as acute renal failure, multiple organ failure. End of follow-up was defined as the day of the outcome (death or transfer to hemodialysis) or end of follow-up (January 2020).

Demographic and clinical data collection

The demographic data including gender, age, body mass index(BMI), etiological diagnosis (diabetic nephropathy, hypertensive renal damage, primary glomerular disease), peritonitis, bacterial culture results (gram-positive or gram-negative bacilli) were collected.We also recorded outcomes of patients: continue PD, death, transferring to hemodialysis, kidney transplantation and time of death, reasons of death, causes of transferring to hemodialysis. The chalson index of comorbidity (CCI) was used to measure comorbidity [8]. The following variables were recorded: white blood cells (WBC), red blood cells (RBC),hemoglobin (HGB),

platelets (PLT), albumin, alanine aminotransferase (ALT), aspertate aminotransferase (AST), total bilirubin, direct bilirubin, serum creatinine, urea nitrogen, serum calcium, potassium, sodium, ferritin, total Kt/ V value, residual Kt/ V, weekly creatinine clearance rate(WCcr), residual creatinine clearance rate, nPCR, dialysis time; whether the patients used angiotensin-converting enzyme inhibitors/angiotensin receptor blocker (ACEI / ARB) drugs, ever had cerebrovascular disease, ISD, heart failure or not. All blood

samples were measured with commercial kits and an autoanalyzer.The albumin level was measured by using the bromocresol green method.Total Kt/V was calculated as the sum of residual renal Kt/V and peritoneal Kt/V using the urea clearances from 24-h urine and dialysate effluent collections by standard methods [9]. Protein catabolic rate normalized to body weight (nPCR) was measured by Manbu E-Heath Technology(Beijing),using 24-h urine and dialysate effluent collections[10].

Statistical analysis

Data analyses were performed by SPSS23.0 and R 3.6.1 version.

Results were expressed as mean ± standard deviation (SD) , median and inte rquartile ranges, numbers and percentages (%), as appropriate.

Kolmogorov–Smirnov test was used to examine the normality of all numeric continuous variables. Independent sample t- tests were used if with a normal d istribution.Nonparametric tests (Mann–Whitney U test) were used to examine variables without a normal distribution , when comparing between groups. Categorical data were compared between elderly and younger groups by chi-square test. When there was only less than 5 observations in an group-outcome combination, Fisher's test was used.The Kaplan-meier survival curve was performed to investigate the difference of survival and transferring to hemodialysis between the elderly and the younger group. Multivariate Cox regression analysis was used to screen risk factors of mortality in elderly patients. Using the backward method , the entry probability was set as 0.05, and the removal probability was set as 0.10. R 3.6.1 version was constructed to draw nomogram map for building model to predict survival. All tests were two-sided, and P values <0.05 were considered statistically significant.

Results

General characteristics of elderly patients

We enrolled 202 PD patients, including 61 in elderly group and 141 in younger group, with a median follow-up time of 44 months (Figure 1). Compared with the younger group, elderly patients were more likely to have lower albumin and nPCR, more comorbidity, especially with cardiovascular and cerebrovascular diseases.Diabetic nephropathy was common in elderly group , the difference was statistically significant (P < 0.01). Table 1 showed baseline characteristics of patients grouped by age(see below).

Outcomes of elderly patients

To the end of the study, 121 (59.9%) patients continued to receive PD, 48 (23.8%) died, 25 (12.4%) were transferred to hemodialysis, 8 (3.9%) received a kidney transplantation.Among elderly group, 27 (44.3%) died, 2 (3.3%) were transferred to hemodialysis, and 1 (1.6%) received a kidney transplantation. Due to small number of kidney transplantation patients in elderly group, the following was not further discussed. Table 2 showed the outcomes of all peritoneal dialysis patients.

Mortality of elderly patients

27 (44.3%) of elderly patients and 21 (14.3%) of younger patients died.

(Figure 2 Kaplan–Meier survival curve between elderly and younger patients)The survival time of elderly group was significantly lower than that of younger group. The 1-year, 2-year, 3-year and 4-year survival rate were 81.97%, 70.49%, 60.66% and 55.74% respectively. The main cause of death in elderly PD patients was cardiovascular disease, while in younger group was infection.Table 3

Transferring to HD in elderly patients

23.3%elderly PD patients, 23(16.3%) younger group transferred to HD. Elderly patients with PD were less likely to convert to HD. Peritonitis was the chief reason for both elderly and younger PD patients to transfer to HD (Table 4).

Prognostic mortality factors in elderly PD patients

For elderly PD patients, univariate analysis Cox regression analysis indicated that BMI, CCI, previous ISD, peritonitis, dialysis time were the risk factors for the long-term survival of the elderly PD patients. BMI, CCI and ISD remained independent significant predictors of long-term survival of elderly PD patients by multivariate Cox regression analysis (Table 5 and Figure 3). The impact of peritonitis,dialysis time disappeared in multivariate analysis. The survival model of elderly PD was establish ed by R 3.6.1 version(Figure4). CCI was related to peritonitis ($r = 0.471$, $P < 0.001$) and dialysis time ($r = 0.260$, $P = 0.043$), these may be a confounding factor.

Discussion

With the aging of the population, spiraling rates of end stage renal failure have increased and the elderly needing for PD is gradually increasing [11]. In order to improve the prognosis and quality of life in elderly patients with PD, it is especially important to explore the survival status of elderly patients and actively prevent and control the risk factors.

We analyzed the general condition of the elderly patients, the reasons for withdrawal from PD therapy, and the risk factors for survival of patients, to provide guidance for improving prognosis and prolonging the survival time of patients on PD with ESRD.

Compared with the younger group, elderly group of PD patients tended to have hypoalbuminemia and low nPCR, both of which are important indicators to evaluate the nutrition of patients [12], this result was consistent with the Kholshali et al study [13]. Wang XX et al also reported that serum albumin remained lower in elderly patients [14]. In the course of PD treatment, a large number of nutrients are lost in dialysis solution, and the absorption capacity of gastrointestinal function is decreased in elderly patients, leading to malnutrition. Peritoneal dialysis does not need to establish vascular access, has little impact on hemodynamics, so elderly patients with diabetes tend to choose PD. Arteriosclerosis and the incidence of

cardiovascular ,cerebrovascular events is often occurred in diabetic nephropathy [15,16]. Age is also a risk factor of vascular calcification [17]. Some studies have shown that elderly PD patients are inclined to develop peritonitis [18], but there was no difference in the incidence of peritonitis between elderly and younger group in this study, which was consistent with a Canada study.It was reported that elderly PD patients who were 70 years old or more had no relationship with peritonitis [19], considering that elderly patients had better family,social support and were treated with advanced antibiotics.

In this study, the mortality of elderly patients with PD was significantly higher than that of younger patients.Age is a risk factor for survival of PD patients [4,20]. The 1,2,3,4 year survival rates of elderly PD patients were as follows: 81.97% , 70.49% , 60.66% , 55.74% .A study in China found that the 1 -, 3 -, and 5-year mortality of elderly patients with PD respectively were 79%, 56% and 30% [21], which was generally consistent with our results. Cardiovascular disease was the leading cause of death, 53.4% of elderly PD patients existed with cardiovascular complications in a retrospective study [21]. The USRDS data showed that cardiovascular events were the main cause of death in dialysis patients [22], which was related with the metabolic abnormalities and the increased incidence of diabetic nephropathy in elderly PD patients.

In this study,we provided evidence that high BMI, high CCI and ISD were independent risk factors for predicting death in elderly PD patients. Patients with high BMI were inclined to have high risk of dialysis [23], and obesity could increase cardiovascular and cerebrovascular events, thus increasing the risk of death [24]. However, the relationship between BMI and survival in elderly patients with PD is controversial. Some studies found that obese PD patients lived longer than those with lower BMI [25,26]considering that patients with lower BMI will increase protein consumption and inflammation, and high BMI can increase hemodynamic stability and the isolation of fat tissue from toxins [27]. Another study found that baseline BMI was not related to the prognosis of peritoneal dialysis [28], so more studies are needed to explore the relationship between BMI and death in elderly PD patients. As mentioned, CCI was an important index to evaluate the complications. Sandrine genestier et al showed that CCI was positively correlated with the mortality of elderly patients [29]. A retrospective analysis of 292 patients found that 2-year survival rate of elderly patients with CCI score > 9 was 38%, and that of patients with CCI < 7 reached 69% [30]. Elderly PD patients often suffer with ISD, and the risk of recurrence with cardiovascular and cerebrovascular events increases [31],so elderly PD patients are at high risk of death.

In this study, peritonitis was main cause of transferring to hemodialysis in both elderly and younger patients. Minli et al. [32] and Sakaci et al. [33] also found that the main cause of turning to hemodialysis was peritonitis. Elderly patients turning to hemodialysis was fewer than that of younger patients. Elderly patients had a higher risk of peritonitis-related and all-cause mortality. In a recent study from Brazil, the only factor associated with death during peritoneal infection was age [34],so elderly patients had no chance to transfer to HD.

This study elucidated the characteristics of elderly PD patients, the prognosis of elderly PD patients and the risk factors for predicting death, which help nephrologists better understand the characteristics of elderly PD patients and improve the prognosis of patients. However, this study has some limitations. First

of all, this study was a single center, relatively small sample study, which could not represent the situation of elderly PD patients in China, additional multiple studies are needed in larger populations to confirm the conclusion of our study. In addition, we did not analyze economic and social situation of each patient.

Conclusions

In conclusion,compared with younger group, elderly PD patients had poor nutritional status, more complications, majority of diabetic nephropathy and high mortality. High BMI, high CCI and previous ISD events were the independent risk factors to predict mortality of elderly PD patients. Cardiovascular disease was main cause of death in elderly group. Peritonitis was major reason for transferring to HD inPD patients.

Declarations

Ethics approval and consent to participate

The study was approved by the ethics committee of the Cangzhou Central Hospital in Cangzhou City, Hebei Province, China. Written informed consent was attained from each patient.

Consent for publication

Not applicable

Availability of data and materials The datasets generated and/or analyzed during the current study are not publicly available due to local regulations on the management of medical records but are available from the corresponding author on reasonable request.

Conflict of interest

None declared

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Not applicable

Authors' Contributions SF and MX: project development, data collection, and management, data analysis, manuscript writing and revising; XH: data collection, data analysis; XH: manuscript editing and revising; All authors have read and approved the manuscript.

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Abbreviations

PD peritoneal dialysis

HD hemodialysis

nPCR protein catabolic rate normalized to body weight

CCI Charlson Comorbidity Index

BMI body mass index

WBC white blood cell

RBC red blood cell

PLT platelet

ALB albumin

TBIL total bilirubin

DBIL direct bilirubin

Scr serum creatinine

BUN blood urea nitrogen

WCcr weekly creatinine clearance rate

Residual Ccr residual renal creatinine clearance rate

Total Kt/v total weekly urea clearance

Residual kt/v residual renal weekly urea clearance

DM diabetes mellitus

HRD hypertensive renal damage

ISD ischemic heart disease

HF heart failure

DN Diabetic Nephropathy

CG chronic glomerulonephritis

ACEI Angiotensin-Converting Enzyme Inhibitors

ARB Angiotensin receptor blocker

SD standard deviation

HR hazard ratio

CI confidence interval

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Tables

Table1 Basic characteristics of PD patients according to age

	All patients N=202	Elederly group N=61	Younger group N=141	P
Demography				
Age,years	57.00(45.00,65.00)	72.00(66.50,76.00)	50.00(37.00,57.50)	<0.001
Male,n (%)	121 (59.9)	34 (55.7)	87 (61.7)	.427
Laboratory parameter				
MI,kg/m^2	23.97±4.33	23.92±3.54	24.00±4.64	.903
C,x10^9/L	6.64(5.30,8.11)	7.13(5.33,9.32)	6.40(5.26,7.77)	.158
10^12/L	3.46±0.59	3.36±0.69	3.50±0.54	.159
GB,g/L	102.00(91.00,116.00)	100.00(85.00,115.50)	103.00(93.00,116.00)	.279
, x10^9/L	209.50(163.00,251.25)	202.00(146.50,252.00)	212.00(165.00,251.00)	.281
LB,g/L	37.20(33.70,40.10)	35.60(32.00,38.00)	38.40(34.95,41.00)	<0.001
LT,u/L	12.60(9.15,17.15)	13.00(9.80,16.90)	12.45(9.10,17.38)	.153
ST,u/L	15.80(12.00,20.30)	16.00(12.10,20.45)	15.45(12.00,20.15)	.171
L,umol/L	4.10(4.95,6.60)	3.90(4.50,6.10)	4.38(5.10,6.60)	.151
L,umol/L	1.70(1.20,2.30)	1.70(1.20,2.30)	1.70(1.20,2.30)	.759
r,umol/L	815.50(587.50,1039.75)	747.00(541.00,979.00)	607.00(828.00,1042.00)	.253
N,mmol/L	19.50(14.78,22.93)	18.20(13.90,22.20)	19.90(15.50,23.50)	.133
Ca,mmol/L	2.16(2.01,2.31)	2.12(1.96,2.29)	2.17(2.02,2.33)	.135
n K,mmol/L	4.20(3.70,4.80)	4.20(3.60,4.75)	4.20(3.80,4.80)	.414
Na,mmol/L	141.00(138.00,142.15)	141.00(137.00,143.00)	141.00(139.00,142.00)	.309
ritin,ug/L	269.70(137.70,573.50)	300.00(138.00,514.45)	257.00(136.25,584.80)	.725
otal kt/v	1.72(1.45,2.04)	1.69(1.50,2.04)	1.73(1.42,2.04)	.784
idual kt/v	0.08(0.00,0.33)	0.10(0.01,0.32)	0.06(0.00,0.34)	.343
nl/w/1.73m^2	45.67(39.89,53.94)	46.09(40.77,55.15)	45.17(39.58,53.68)	.769
idual Ccr w/1.73m^2	2.00(0.00,9.79)	2.82(0.07,15.07)	1.19(0.00,10.29)	.235
R,g/kg/day	0.82(0.71,0.92)	0.74(0.62,0.85)	0.85(0.76,0.93)	.003
lysis time	26.00(13.00,49.00)	21.00(9.50,46.00)	27.00(14.00,51.00)	.279
lson score	9.00(5.00,13.00)	11.00(6.50,15.00)	9.00(5.00,11.00)	.003
Medical and diseases history				
ISD,n(%)	58(28.7)	34(55.7)	24(17.0)	<.001
HF,n(%)	73(36.1)	27(44.3)	46(32.6)	.114
ebrovascular isease,n(%)	40(19.8)	19(31.1)	21(14.9)	.008
peritoneal				

lysis-related	88(43.6)	21(34.4)	67(47.5)	.085
itonitis n(%)				
ositive, n(%)	32(15.8)	10(16.4)	22(15.6)	.888
ative, n(%)	20(9.9)	8	12	.314
CEI/ARB Use,n,(%)	74(36.6)	18(29.5)	56(39.7)	.167
Primary disease				
DN,n(%)	46(22.8)	22(36.1)	24(20.6)	.003
HRD,n(%)	27(13.4)	11(18.0)	16(10.9)	.200
CG,n(%)	30(14.9)	6(9,8)	24(14.8)	.187

Note:If normally distributed,values for continuous variables with normal distribution are provided as mean ± SD, or they are provided as median(interquartile range).Categorical variables expressed as number (percent).

Abbreviations:

PD = peritoneal dialysis;BMI=body mass index (weight/height^2); WBC= white blood cell;
RBC=red blood cell;PLT=platelet;ALB=albumin;TBIL=tota lbilirubin;
DBIL=direct bilirubin;Scr=serum creatinine;BUN=blood urea nitrogen;
Total Kt/v=total weekly urea clearance; Residual kt/v=residual renal weekly urea clearance
WCcr=Total weekly creatinine clearance rate;
Residual Ccr=residual renal creatinine clearance rate
nPCR= protein catabolic rate normalized to body weight;DM=diabetesmellitus;
HRD=hypertensive renal damage;ISD=ischemic heart disease;
HF=heart failure;DN=Diabetic Nephropathy; CG=chronic glomerulonephritis
ACEI/ARB= Angiotensin-Converting Enzyme Inhibitors/ Angiotensin receptor blocker

Table2 Outcomes of patients according to age

Outcomes	All patients N=202	Elederly group N=61	Younger group N=141
ay on PD n(%)	121(59.9)	31(50.8)	90(63.8)
ath, n (%)	48 (23.8)	27 (44.3)	21 (14.9)
ansferred to HD, %)	25(12.4)	2(3.3)	23(16.3)
lney transplant, %)	8(3.9)	1(1.6)	7(5.0)

Note:Values expressed as number (percent).
Abbreviations: PD= peritoneal dialysis;HD= hemodialysis.

Table2 Outcomes of patients according to age

Outcomes	All patients N=202	Elederly group N=61	Younger group N=141
ıy on PD□n(%)	121(59.9)	31(50.8)	90(63.8)
ath, n (%)	48 (23.8)	27 (44.3)	21 (14.9)
ınsferred to HD, %)	25(12.4)	2(3.3)	23(16.3)
lney transplant, %)	8(3.9)	1(1.6)	7(5.0)

Note:Values expressed as number (percent).

Abbreviations: PD= peritoneal dialysis;HD= hemodialysis.

Table4 Causes of transferring to HD according to patient age

Transfer to HD	Elderly group	Younger group
	Cases,n(%)	Cases,n(%)
Peritonitis	2(3.3)	18(12.8)
Inadequate dialysis	0	2(1.4)
Dialysis failure	0	2(1.4)
Others	0	1(0.7)

Note:Values expressed as number (percent).

Abbreviations: HD= hemodialysis.

Table5 Cox proportional hazard analyses of all-cause mortality in elderly PD patients

	univariate analysis				multivariate analysis			
			95%CI				95%CI	
Factor	P	HR	Lower Limit	Upper Limit	P	HR	Lower Limit	Upper Limit
BMI	.016	1.139	1.025	1.265	.005	1.0	1.0	1.1
CCI	.018	1.073	1.012	1.137	.022	1.1	1.0	1.2
ISD	.011	3.084	1.301	7.315	.042	2.5	1.0	6.1
Peritonitis	.042	2.305	1.031	5.154	.284	N/A	N/A	N/A
Dialysis Time	.089	1.014	.998	1.030	.310	N/A	N/A	N/A

Note:Values express as HR and 95% CI.

Abbreviations: HD= hemodialysis;BMI=body mass index (weight/height^2);
CCI= Charlson Comorbidity Index ;ISD= ischemic heart disease;

HR= hazard ratio; CI= confidence interval.

Figures

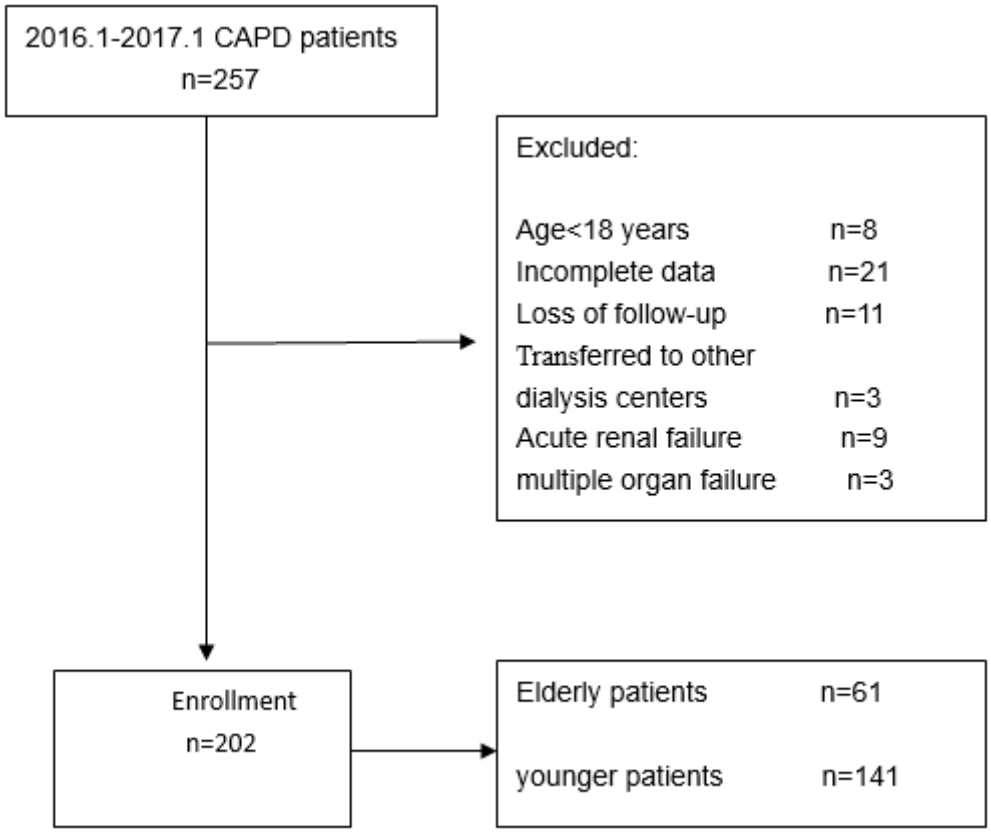

Figure 1

Flow chart of the participants in this study

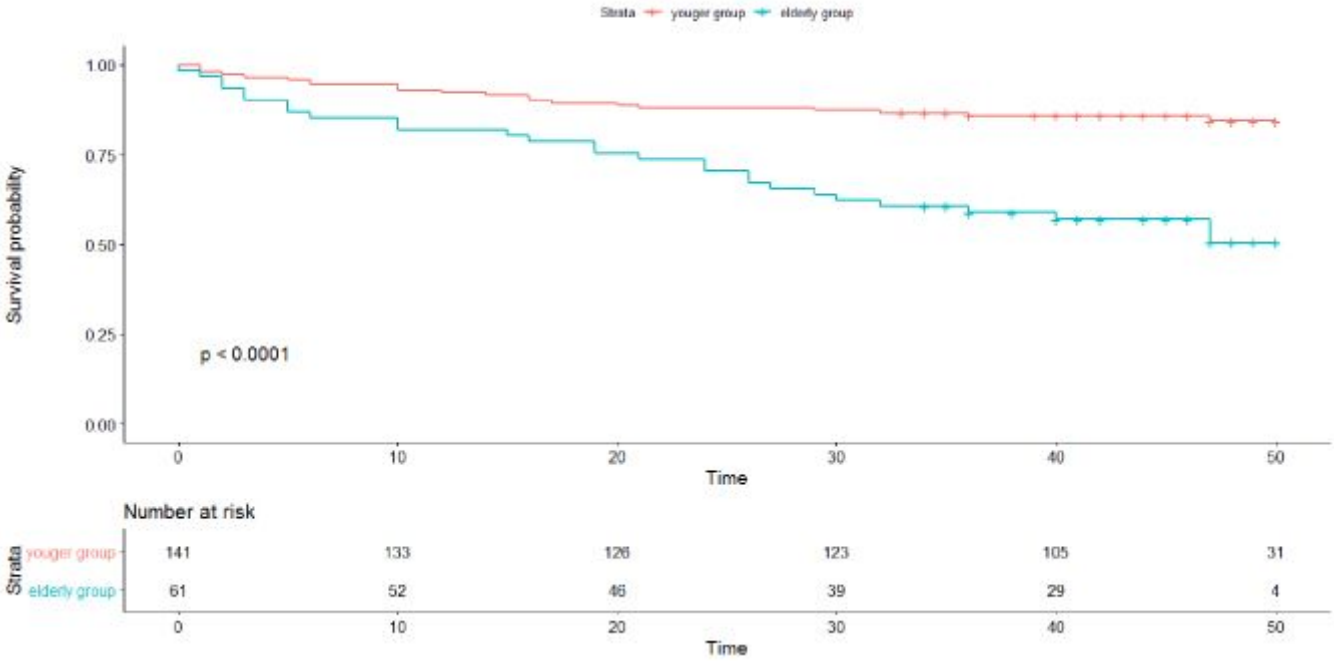

Figure 2

Kaplan-Meier survival curves showing the survival probability based on patient age among PD patients during follow-up time(months).

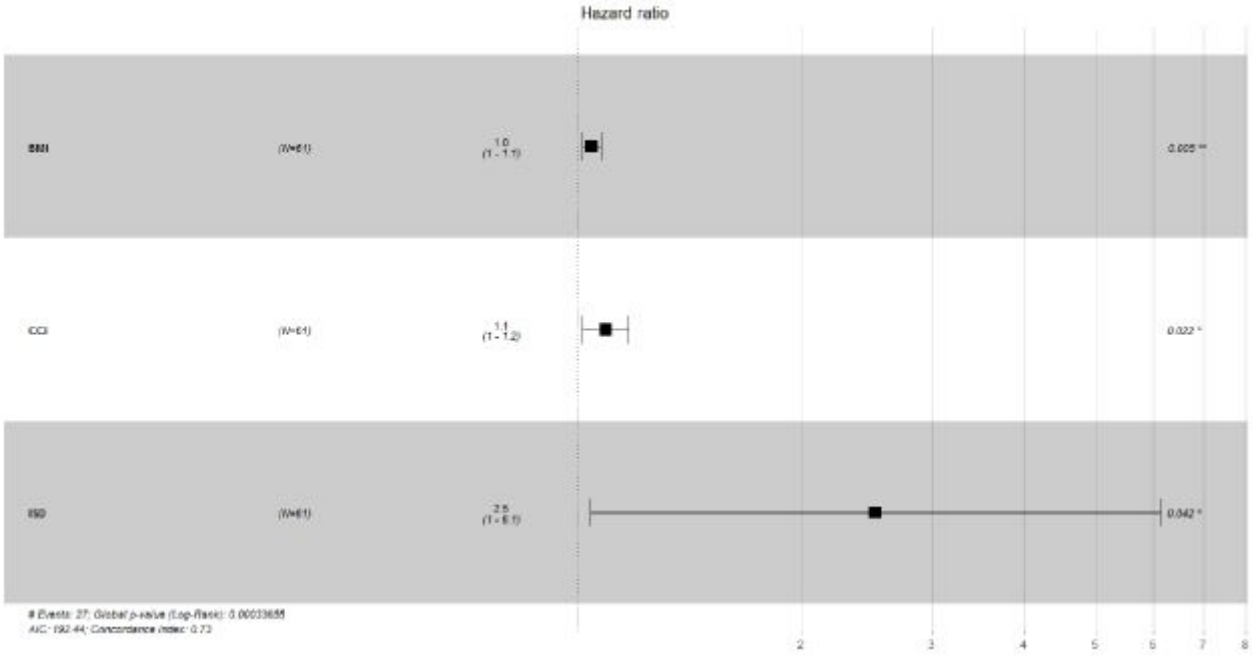

Figure 3

Cause-specific hazards model of different variables in elderly peritoneal dialysis patients by Forest Plot Abbreviations: BMI=body mass index (weight/height2); CCI= Charlson Comorbidity Index ;ISD= ischemic heart disease;

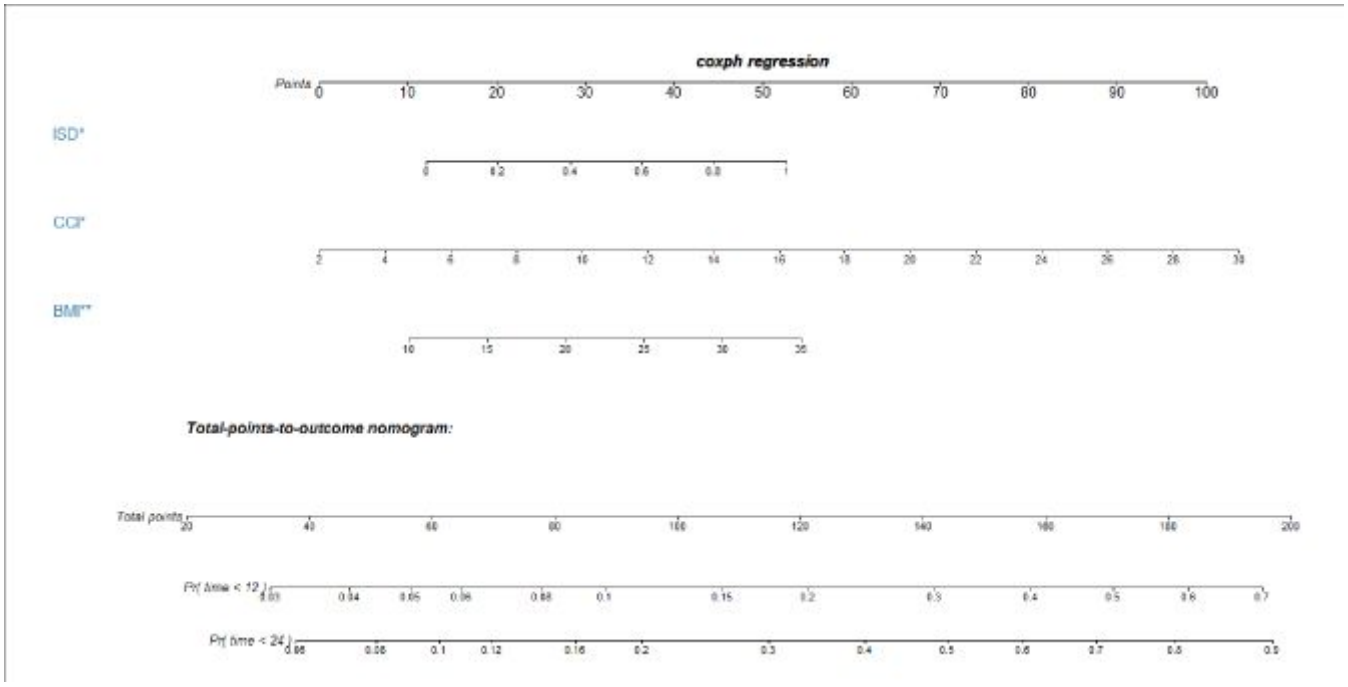

Figure 4

Nomograms predicting12-month and 24-month survival of elderly PD patients Abbreviations: CCI= Charlson Comorbidity Index ;ISD= ischemic heart disease; BMI=body mass index (weight/height2);

Supplementary Files

This is a list of supplementary files associated with this preprint. Click to download.

- STROBEchecklist.docx