

Peritoneal Dialysis Vs Hemodiafiltration for Elderly Patients over 75 Years with Com CKD Stage 5D: A Prospective Cohort Study

Gabriela Lucio Moraes¹, Ana Paula Rovani Cardoso¹, Biana Vitoria dos Santos Barbosa¹, Adriele Fogaça¹, Paula Migliori da Rocha Padron¹, Daniel Monte Costa², Elisa Marques Almeida Silva², Camila Albuquerque Alves², Daniela Ponce²

¹Department of Nephrology, Santa Maggiori Hospital, Sao Paulo, Brazil

²Nefrostar Nephrology Clinic, OSACO, Sao Paulo, Brazil

Email: ana.rovani@unesp.br

How to cite this paper: Moraes, G.L., Cardoso, A.P.R., dos Santos Barbosa, B.V., Fogaça, A., da Rocha Padron, P.M., Costa, D.M., Silva, E.M.A., Alves, C.A. and Ponce, D. (2025) Peritoneal Dialysis Vs Hemodiafiltration for Elderly Patients over 75 Years with Com CKD Stage 5D: A Prospective Cohort Study. *Open Journal of Nephrology*, **15**, 269-284.

<https://doi.org/10.4236/ojneph.2025.152026>

Received: March 31, 2025

Accepted: June 10, 2025

Published: June 13, 2025

Copyright © 2025 by author(s) and Scientific Research Publishing Inc.

This work is licensed under the Creative Commons Attribution International License (CC BY 4.0).

<http://creativecommons.org/licenses/by/4.0/>



Open Access

Abstract

Background: Chronic Kidney Disease (CKD) is a growing global public health concern, with diabetes, systemic arterial hypertension, and aging as key risk factors. A significant portion of the elderly population undergoes hemodialysis (HD), and prior studies have compared patient outcomes between peritoneal dialysis (PD) and HD. Despite the benefits of PD, such as home-based treatment and greater autonomy, its use has increasingly declined. More recently, hemodiafiltration (HDF) has emerged as an alternative to HD, showing improved outcomes. However, no studies have compared HDF with PD in elderly patients. **Objective:** This study aimed to compare mortality outcomes in elderly patients (≥ 75 years) newly initiated on renal replacement therapy (RRT) with PD or HDF. **Methods:** This prospective observational cohort study included patients aged ≥ 75 years who started PD or HDF at two hospitals (Hospital Sancta Maggiore - Liberdade and Botucatu Medical School Hospital) between January 2022 and December 2023. Patients were followed for one year. The outcomes assessed included mortality, treatment modality changes, infection, hospitalization, fluid status, and therapy quality. **Results:** A total of 70 patients with CKD stage 5D initiated HDF ($n = 30$) or PD ($n = 40$) between January 2022 and December 2023. Of these, 57.1% were men, with a mean age of 77.6 ± 5.9 years. Diabetes was the most common underlying condition (37.1%) followed by hypertension (35.7%). During the study period, 18.6% of patients died, and 5.7% switched treatment modalities. Age, sex, underlying diseases, comorbidities and laboratory values were similar between groups, except for differences in initial and 6-month urea levels, initial and 6-month hemoglobin levels, 6-month albumin levels, initial and 12-month phos-

phorus levels, and initial parathyroid hormone (PTH) levels. No significant differences were found between groups in terms of infection rates, hospitalization, modality changes, or mortality. Logistic regression analysis revealed that PD, infection, and 6-month albumin were independently associated with mortality ((OR = 31.855; [95% CI = 1.643 - 4.440]; $p = 0.040$); (OR = 2.033; [95% CI = 1.5]; $p = 0.026$); (OR = 0.363; [95% CI = 0.529]; $p = 0.049$)). Survival was higher in HDF patients (log-rank = 0.02). **Conclusion:** In very elderly dialysis patients, infection at 12 months, lower albumin after six months of therapy, and the PD modality were associated with higher mortality.

Keywords

Hemodiafiltration, Peritoneal Dialysis, Elderly

1. Introduction

Chronic Kidney Disease (CKD) is a global public health concern due to its growing prevalence and incidence. In 2017, the global CKD prevalence was 9.1%, with 697.5 million cases documented across all disease stages [1] [2]. Recent trends in life expectancy have led to an increasing number of elderly patients requiring Renal Replacement Therapy (RRT) [3]-[8]. The US Renal Data System (USRDS) shows that, among patients over 65 years, CKD prevalence rose from 8.0% in 2009 to 14.2% in 2019 [4]. Most of these patients rely on Hemodialysis (HD), a treatment pattern consistent across most developed and developing countries. For this age group, HD raises specific concerns, including a higher risk of hypotension, greater impact on myocardial and cerebral functioning, higher levels of inflammatory markers, difficulties establishing vascular access, longer recovery times after sessions, and challenges in transportation to the dialysis center that many elderly end up facing due to fragility and decreased mobility [9].

Peritoneal Dialysis (PD) is less common among elderly patients, with only 5-14% of those over 65 receiving this treatment. One of the reasons is that advanced age often reduces the patient's ability to perform PD exchanges [10].

Research comparing dialysis modalities in prevalent patients on RRT has not evidenced the superiority of one method over the other in terms of two-year mortality [11] [12].

Some studies suggest that PD yields better outcomes in younger patients without comorbidities. Vonesh *et al.* [13] analyzed an American cohort of 352,706 HD patients and 46,234 PD patients (1995-2000) and found lower mortality in non-diabetic patients without comorbidities [RR 0.88 (0.83 - 0.99)]. Conversely, Termorshuizen *et al.* [14] studied 1222 incident RRT patients (742 on HD and 480 on PD) and observed lower two-year mortality rates in diabetic patients over 60 treated with HD [RR 0.53 (95% CI 0.31 - 0.91)]. In a cross-sectional study, Brown *et al.* [15] compared the quality of life in 140 patients aged ≥ 65 years on HD and

PD, reporting lower depression levels and fewer symptoms in PD patients ($p = 0.015$ and 0.039).

Although PD is an important treatment modality for end-stage CKD by offering the convenience of home treatment and increased freedom perception, with consequent better quality of life, the proportion of dialysis patients using this method has significantly declined over the past 20 years in both developed and developing countries. Hemodialysis remains the predominant global approach for both incident and prevalent dialysis patients [15]-[17].

A promising new modality, Hemodiafiltration (HDF), has shown compelling advantages. This approach, by using convective transport, in addition to diffusive transport, promotes greater removal of medium molecules, greater biocompatibility, and lower hypotension rates [18]. These factors are associated with several benefits when compared to conventional HD, including greater hemodynamic stability, less malnutrition, less vascular calcification, better preservation of residual renal function (RRF), better quality of life, and lower morbidity and mortality from all causes [19] [20].

In the CONVINCe study, Blankestijn *et al.* [20] randomized 1,360 patients to HDF ($n = 683$) or HD ($n = 677$) and found that online HDF significantly reduced all-cause mortality, particularly in patients over 65 years (HR 0.68; 95% CI 0.53 - 0.89). However, up to now, these benefits remain uninvestigated in the very elderly, and no studies comparing elderly patients treated with PD vs. HDF are available.

The objective of this study was to compare one-year mortality outcomes in elderly patients over 75 years newly initiated on RRT with PD or HDF. Secondary goals included comparing other clinical outcomes such as hospitalization, infection, and treatment modality changes at 6 and 12 months.

2. Patients and Methods

A prospective cohort observational study was conducted at two centers in São Paulo, Brazil.

Incident patients aged ≥ 75 years who started renal replacement therapy (RRT) with peritoneal dialysis (PD) or hemodiafiltration (HDF) from January 2022 onward were included. Patients were allocated to each modality of renal replacement therapy according to their preference, and, in the absence of complications during follow-up, the chosen method was maintained. They were followed for one year, and the assessed outcomes included mortality, treatment modality changes, hospitalization, nutritional status, and infection.

Exclusion criteria included patients without prior pre-dialysis follow-up, those who started RRT urgently, and those who chose hemodialysis (HD) as their treatment modality.

2.1. Ethical Issues

The basic ethical principles outlined in the guidelines and regulatory standards

for research involving human subjects, as per Resolution 466/2012, were followed in this study. This research project was submitted to the Research Ethics Committee of both institutions where the study was conducted and was only initiated after approval (CAAE: 66700822.0.3001.5411, CAAE: 66700822.0.1001.8114). All participants invited to take part in the study were informed about its objectives and expected outcomes and only participated after providing written informed.

2.2. Research Protocol

The study protocol included clinical data (such as CKD etiology and comorbidities), laboratory data, and information on dialysis procedures and patient follow-up.

After the dialysis modality was chosen by the patient and their family, the nephrologist arranged for vascular or peritoneal access, and treatment began once dialysis indications were present. Dialysis adequacy was monthly assessed during medical consultations using clinical and laboratory parameters. Treatment prescriptions were individualized, targeting a weekly Kt/V above 1.7 for PD and a convective volume greater than 18 L for HDF [18] [21].

Patients were followed for one year from the start of treatment or until discontinuation of the initial therapy. Outcomes assessed included mortality, treatment modality change, hospitalization, infection, nutritional status and fluid status. Nutritional and fluid status were evaluated using bioimpedance.

The study protocol was discontinued in cases of death, renal function recovery, or a switch to another dialysis modality.

2.3. Data Analysis

Considering an alpha error of 5%, beta error of 20%, statistical power of 80%, and detection of a survival difference between groups of 25%, the calculated sample size for each group was 39 patients.

As per the study protocol, data were entered into a spreadsheet with verification for typos. The analysis was conducted using SAS for Windows (version 9.2: SAS Institute, Cary, NC, USA, 2012).

Initially, a descriptive analysis was performed for all patients enrolled during the period, calculating measures of central tendency and dispersion for continuous variables and frequencies for categorical variables. Treatment modalities were compared using Chi-Square for categorical variables and T-Test for continuous variables. To determine the factors associated with death, multiple logistic regression was performed using all variables with $p < 0.1$ in the univariate analysis, excluding collinearity. Survival curves were constructed for both treatment modalities using the Kaplan-Meier method and the log-rank test.

Statistical differences were considered significant at $p < 0.05$.

3. Results

A total of 70 patients with CKD 5D who initiated HDF ($n = 30$) or PD ($n = 40$)

between January 2022 and December 2023 were included in the study. Among them, 57.1% were males, with a mean age of 77.6 ± 5.9 years. Diabetes was the most common underlying condition (37.1%), followed by hypertension (35.7%). At the start of therapy, laboratory values were as follows: hemoglobin (Hb) 10.0 ± 1.8 g/dL, albumin 3.4 ± 0.5 mg/dL, baseline creatinine 5.6 ± 2.1 mg/dL, urea 122.7 ± 41 mg/dL, potassium 4.1 ± 0.76 mmol/L, phosphorus 4.6 ± 1.3 mg/dL, parathyroid hormone (PTH) 352 ± 254 pg/mL, phase angle 3.7 ± 1.32 , and extracellular water (ECW) $47.1 \pm 14.1\%$, (**Table 1**).

Overall, 18.6% of patients died, and 5.7% switched dialysis modality. Within the first six months of treatment, 20% of patients developed access-related infections (peritonitis or vascular access infection), and 30% required hospitalization (**Table 1**).

Dialysis access was achieved via a Tenckhoff catheter in all PD patients (57.1%). Among HDF patients, an arteriovenous fistula (AVF) was used in 15.7% of cases, while a long-term catheter was used in 27.1% with an average convective volume of 18.5 ± 3.2 L over 12 months (**Table 1**).

There were no significant differences between the groups in age, sex, underlying disease, or comorbidities. However, differences were observed in initial and six-month urea levels, initial and six-month hemoglobin levels, six-month albumin levels, initial and 12-month phosphorus levels, and initial PTH levels. Nutritional assessment showed that the phase angle at therapy initiation and extracellular water (ECW) were higher after six months of therapy among patients on PD. Kt/V adequacy did not differ between groups (**Table 2**).

At six and 12 months, no significant differences in infection, hospitalization, or treatment modality switch were observed between groups. Mortality was 15% lower in HDF patients compared to PD patients, but this difference was not statistically significant (**Table 3**). The following factors were associated with mortality: baseline and six-month urea levels, six-month albumin levels, six-month hemoglobin levels, six-month potassium levels, baseline and six-month ECW, six-month phase angle, and hospitalization at six months and between six and 12 months. In the logistic regression analysis (**Table 4**), mortality was independently associated with PD modality, infection, and six-month albumin levels.

Kaplan-Meier survival analysis showed that survival was significantly higher in patients treated with HDF (log-rank $p = 0.020$).

Table 1. General characteristics of the patients included in the study.

Mean Age (years)	77.6 $\pm$ 5.9 years
Male Sex (%)	40 (57.1)
Underlying Disease (%)	Mean/Percentage
Diabetes	26 (37.1)
Hypertension	25 (35.7)

Continued

Glomerulonephritis	3 (4.3)
Undetermined Disease	9 (12.9)
Urological Diseases	2 (2.9)
Sequelae of Acute Kidney Injury (AKI)	1 (1.4)
Anephric	1 (1.4)
Others	3 (4.3)
Examinations at the Start of Therapy	
Hemoglobin (mg/dL)	10 ± 1.84
Albumin (mg/dL)	3.4 ± 0.52
Baseline Creatinine (ml/min)	5.6 ± 2.1
Urea (mg/dL)	122.7 ± 41
Potassium (mmol/L)	4.1 ± 0.76
Phosphorus (mg/dL)	4.6 ± 1.3
PTH (pg/mL)	352 ± 254
Phase Angle (Xc/R)	3.7 ± 1.32
Extracellular Water (%)	47.1 ± 14.1
Convective Volume (L)	18.5 ± 3.2
Therapy Duration (days)	333.2 ± 72.6
Dialysis Access (%)	
Tenckhoff Catheter	40 (57.1)
Arteriovenous Fistula	11 (15.7)
Long-Term Catheter	19 (27.1)
Outcomes (%)	
Access-Related Infection	14 (20)
Hospitalization	21 (30)
Death	13 (18.6)
Method Change	4 (5.7)

Values expressed as percentage (%); mean ± standard deviation; SD = standard deviation; AKI = Acute Kidney Injury; PTH = Parathyroid Hormone.

Table 2. Clinical characteristics of the patients included in the study according to the renal replacement therapy received (Peritoneal Dialysis and Hemodiafiltration).

	PD N = 40	HDF N = 30	P
Age	77.3 (6.0)	78.1 (6.1)	0.612
Male sex (%)	23 (57.5)	17 (56.7)	0.944
Underlying disease (%)			
Diabetes	15 (37.5)	11 (36.7)	0.429
Hypertension	14 (35)	11 (36.7)	
Laboratory Tests			
Creatinina inicial	6.0 ± 2.4	5.2 ± 1.5	0.101
Creatinine at 6 months	6.8 ± 2.7	6.6 ± 1.9	0.658
Creatinine at 12 months	7.7 ± 1.9	6.6 ± 2.6	0.134
Initial urea	132 ± 39.4	110 ± 40.4	0.026
Urea at 6 months	117 ± 40.7	150 ± 35.5	0.001
Urea at 12 months	127 ± 31.4	134 ± 32.4	0.428
Initial albumin	3.5 ± 0.5	3.3 ± 0.4	0.120
Albumin at 6 months	3.0 ± 1.2	3.4 ± 0.9	0.050
Albumina at 12 months	3.6 ± 0.4	3.7 ± 0.3	0.567
Initial hemoglobina	11 ± 1.6	8.8 ± 1.1	<0.001
Hemoglobin at 6 months	11 ± 1.8	12.4 ± 1.4	0.001
Hemoglobin at 12 months	11.4 ± 1.4	11.6 ± 1.0	0.502
Initial potassium	4.4 ± 0.79	4.5 ± 0.72	0.650
Potassium at 6 months	4.0 ± 1.7	4.7 ± 1.5	0.101
Potassium at 12 months	4.5 ± 1.1	5.0 ± 0.9	0.097
Initial phosphorus	5.1 ± 1.2	4.0 ± 1.1	<0.001
Phosphorus at 6 months	5.2 ± 1.9	4.8 ± 1.2	0.296
Phosphorus at 12 months	5.0 ± 0.9	4.1 ± 1.1	0.005
Initial PTH	411 ± 275	272 ± 199	0.022
PTH at 6 months	337 ± 335	198 ± 150	0.048
PTH at 12 months	316 ± 212	211 ± 175	0.059
Adequate Kt/V at 6 months (%)	38 (95)	29 (96.7)	0.911
Adequate Kt/V at 12 months (%)	37 (92.5)	28 (93.3)	0.921

Continued

Nutritional Assessment			
Initial phase angle	4.3 ± 1.1	3.6 ± 1.4	0.023
Phase angle at 6 months	4.2 ± 1.0	3.8 ± 1.4	0.071
Phase Angle at 12 months	4.3 ± 1.4	3.6 ± 1.5	0.096
Initial Extracellular Water (%)	49.9 ± 12.2	43.6 ± 15.9	0.065
Extracellular Water at 6 months	50 ± 9.2	42.8 ± 15.7	0.034
Extracellular Water at 12 months	48.2 ± 10.7	42.4 ± 16.7	0.121
Outcomes (%)			
Infection at 6 months	9 (22.5)	5 (16.7)	0.546
Infection at 6 - 12 months	6 (15)	4 (13.3)	0.844
Hospitalization at 6 months	11 (27.5)	10 (33.3)	0.598
Hospitalization at 6 - 12 months	8 (20)	6 (20)	0.600
Method Change	4 (10)	0 (0.0)	0.074
Death	10 (25)	3 (10)	0.101
Values expressed as percentage (%); mean ± standard deviation; SD = standard deviation; significant value for qui-square test or $p < 0.05$. HDF = Hemodiafiltration Group; PD = Peritoneal Dialysis Group; PTH = Parathyroid Hormone.			
Table 3. Clinical and laboratory characteristics of the patients included in the study are based on clinical outcome (Death vs. non-death).			
	Non-death <i>N</i> = 57	Death <i>N</i> = 13	<i>P</i>
Peritoneal Dialysis (%)	30 (52.6)	10 (76.9)	0.157
Hemodiafiltration (%)	27 (47.4)	3 (23.1)	
Age (years)	77.2 ± 5.8	79.5 ± 6.5	0.268
Male Sex (%)	34 (59.6)	06 (46.2)	0.375
Underlying Disease (%)			
Diabetes	20 (35.1)	06 (46.2)	0.871
Hypertension	20 (35.1)	05 (38.5)	
Laboratory Tests			
Initial Creatinine	5.7 ± 2.2	5.3 ± 3.5	0.617
Creatinine at 6 months	6.8 ± 2.1	6.0 ± 2.8	0.500

Continued

Initial Urea	126 ± 42.4	105 ± 29.3	0.002
Urea at 6 months	138 ± 39.7	91.7 ± 31.7	0.001
Initial Albumin	3.4 ± 0.5	3.2 ± 0.5	0.218
Albumin at 6 months	3.4 ± 0.8	2.2 ± 1.6	0.021
Initial Hemoglobin	10 ± 1.9	10.1 ± 1.4	0.433
Hemoglobin at 6 months	11.6 ± 1.8	12 ± 1.1	0.001
Initial Potassium	4.5 ± 0.7	4.2 ± 0.7	0.132
Potassium at 6 months	4.7 ± 2.2	2.5 ± 1.1	0.004
Initial Phosphorus	4.7 ± 1.3	4.6 ± 1.1	0.825
Phosphorus at 6 months	5.1 ± 1.5	4.5 ± 2.1	0.459
Initial PTH	350 ± 268	361 ± 189	0.855
PTH at 6 months	276 ± 273	255 ± 319	0.873
Kt/V at 6 months	1.0 ± 0.4	0.8 ± 0.7	0.340
Initial Phase Angle	3.7 ± 1.4	3.6 ± 0.9	0.952
Phase Angle at 6 months	4.4 ± 1.3	3.2 ± 1.5	0.042
Initial Extracellular Water (%)	45.9 ± 15.2	52.5 ± 2.1	0.003
Extracellular Water at 6 months	45.7 ± 13.8	53 ± 2.5	0.001
Dialysis Access (%)			
Tenckhoff Catheter	30 (52.6)	10 (76.9)	0.157
Arteriovenous Fistula	11 (19.3)	0 (0.0)	
Long-Term Catheter	16 (28.1)	3 (23.1)	
Outcomes (%)			
Infection at 6 months	10 (17.5)	04 (30.8)	0.282
Infection at 6 - 12 months	06 (10.5)	04 (30.8)	0.060
Hospitalization at 6 months	13 (22.8)	08 (62.5)	0.006
Hospitalization at 6 - 12 months	08 (14.0)	06 (46.2)	0.009
Method Change	04 (7)	0 (0.0)	0.325

Values expressed as percentage (%); mean ± standard deviation; SD = standard deviation; significant value for qui-square test or $p < 0.05$. Group 0 = Non-death; Group 1 = Death. PTH = Parathyroid Hormone.

Table 4. Logistic regression analysis for death.

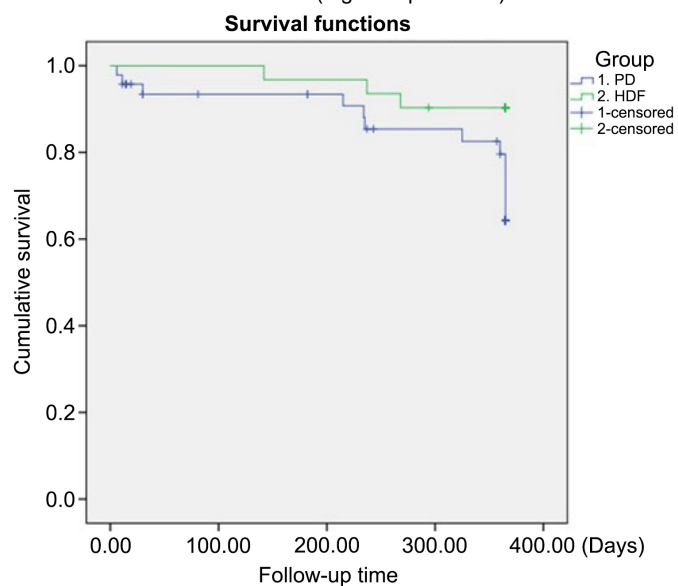
Variável	OR	CI 95	p-value
Peritoneal Dialysis	31.855	1.643 - 4.440	0.040
Initial Urea	0.956	0.026 - 3.053	0.070
Infection at 12 months	2.033	1.514	0.026
Hospitalization at 6 months	2.073	1.321	0.054
Potassium at 6 months	0.211	0.696	0.071
Albumin at 6 months	0.363	0.529	0.049
Phase Angle at 6 months	0.479	0.749	0.326

Results of the Logistic Regression Analysis for Factors Associated with Death - Presents the coefficients, confidence intervals (95% CI), p-values, and odds ratios (OR) for predictor variables in the regression model, with a significant value of $p < 0.05$.

4. Discussion

This study aimed to assess one-year mortality in incident patients over 75 years undergoing peritoneal dialysis (PD) versus hemodiafiltration (HDF). Additionally, it sought to compare modality switch, hospitalization, infection, and nutritional status at baseline and 12 months after treatment initiation. To this end, 70 patients with stage 5 chronic kidney disease who started PD or HDF between January 2022 and December 2023 were evaluated. The majority of the study population was male, with a mean age of 77.5 years. Diabetes was the most common underlying disease, followed by hypertension. The overall mortality rate was 18.6% (**Figure 1**).

The survival analysis presented by the Kaplan-Meier curve demonstrates a significant difference in survival between the groups, with statistically higher survival observed in patients treated with HDF (log-rank $p = 0.020$).

**Figure 1.** Survival functions.

Our results showed that the groups were comparable in terms of age, sex, underlying disease, comorbidities, and most laboratory parameters at baseline and after 6 and 12 months. Differences were observed in urea levels, baseline and six-month hemoglobin levels, six-month albumin levels, and baseline and twelve-month phosphorus and parathyroid hormone (PTH) levels. No differences were found in dialysis adequacy between the groups.

The nutritional assessment revealed differences between the groups. In PD patients, phase angle was higher at baseline and after six months of therapy, extracellular water (ECW) was higher after six months, and albumin levels were lower than in the HDF group.

Studies suggest that PD patients may have slightly higher phase angles than HD patients due to reduced hemodynamic and inflammatory stress. This contributes to better nutritional parameters and a higher phase angle [18] [21]–[23]. A lower albumin level was observed in PD patients at six months, which may be related to factors such as increased protein loss through the peritoneal membrane, reduced food intake due to discomfort from abdominal fluid, or other treatment adverse effects. Lai *et al.* found that low albumin levels are associated with higher mortality in PD patients [23].

Regarding ECW percentage, it was higher in PD patients than in the HDF group after six months. Similarly, Chen *et al.* found higher ECW percentages in PD patients compared to HD patients. This difference may be attributed to variations in fluid removal between the modalities, as PD relies on a slower, continuous exchange of dialysis solutions [23].

Data on dialysis modality switch did not differ between the study groups, which may be explained by the small sample size. In previous studies, a switch in dialysis modality was more frequently observed in PD patients, primarily due to clinical complications and peritoneal function deterioration [19] [22].

Hospitalization and infection rates were similar between the study groups. In HDF patients, lower rates have been observed compared to HD. However, no studies have compared PD and HDF.

The mortality incidence was clinically higher in the PD group, exceeding the HDF group by 15%, though this difference did not reach statistical significance. Kaplan-Meier survival analysis, however, demonstrated a significant difference in survival probability between the groups throughout the study period, with HDF patients showing superior survival rates. This finding has important clinical implications, as it may guide dialysis modality selection based on patient survival prognosis.

Comparisons of clinical outcomes between PD and HDF are scarce in the literature. While numerous studies have described the differences, advantages, and disadvantages of each method, only some have investigated the efficacy and benefits of HDF compared to conventional HD [23]–[25].

A recent comprehensive meta-analysis by Vernooij *et al.* provides significant insights on this topic. This study compiled data from five randomized clinical tri-

als involving 4153 patients, directly comparing HDF (n = 2083) with HD (n = 2070). Results revealed that all-cause mortality was 23.3% in the HDF group versus 27.3% in the HD group. This represents a significant mortality reduction among HDF-treated patients compared to those receiving HD (HR = 0.84 [95% CI: 0.74 - 0.95]). Importantly, the analysis demonstrated a dose-dependent relationship—patients receiving higher convection volumes during HDF experienced more pronounced clinical benefits. These findings substantiate HDF's potential superiority over conventional HD, particularly for patients who can achieve higher convection volumes, suggesting that this method may significantly improve clinical outcomes in patients with CKD 5d on dialysis [23].

Furthermore, the meta-analysis reveals that when patients were divided into subgroups, significantly lower mortality rates were observed among patients over 65 years of age treated with HDF (HR = 0.69 [95% IR: 0.53 - 0.89]) than in those on HD, corroborating our own results when comparing HDF to PD [23].

Among the several benefits of HDF, its transport mechanisms—diffusion and convection—stand out as they enable the removal of a wide spectrum of middle molecules. This method is also associated with reduced inflammation levels and fewer cardiovascular complications, ultimately resulting in lower mortality rates for patients [23] [24].

Several observational studies, primarily based on registries, have compared the survival of patients undergoing PD and HD. These studies found no significant difference in overall mortality when adjusting for age, comorbidities, and clinical characteristics. Winkelmayer *et al.* compared HD and PD in elderly patients and found that PD may provide comparable or even better quality of life due to its less intrusive nature and greater flexibility. However, survival rates were similar between the two modalities [25].

To date, no studies have compared the clinical outcomes of patients treated with PD versus HDF. In our study, HDF was associated with lower mortality than PD. Kaplan-Meier survival analysis showed a significantly higher survival probability for patients treated with HDF (log-rank = 0.02).

Independent factors associated with mortality, as identified by logistic regression, were dialysis modality (PD), the presence of infection, and lower albumin levels at six months.

The literature highlights recurrent infections as a major cause of morbidity and mortality in these patients, primarily due to immunosuppression and the presence of permanent access devices, which increase the risk of severe infections. Infection ranks second only to cardiovascular events as a cause of mortality among CKD 5D patients. Kumbar *et al.* reported that, in HD patients, infections are particularly associated with the use of central venous catheters, which carry a higher risk compared to AVF [26] [27].

On the other hand, in PD patients, peritonitis is the primary complication and is directly linked to increased mortality. Recurrent episodes of peritonitis can lead to treatment failure, forcing the discontinuation of PD and transition to another

dialysis modality [28].

Low albumin levels were also associated with mortality. The literature widely recognizes this factor as a marker of poor prognosis, strongly linked to an increased risk of death in dialysis-dependent chronic kidney disease patients. Albumin is essential for maintaining oncotic pressure and transporting various substances in the body. Low levels reflect not only protein-energy malnutrition, which is common in kidney disease but also a chronic inflammatory state—an independent risk factor for mortality. Studies have associated hypoalbuminemia with greater susceptibility to infections, higher hospitalization rates, and impaired recovery after adverse events. Thus, low albumin levels indicate clinical vulnerability and a poor prognosis [29] [30]. Nutritional interventions and strict inflammation management are essential to improving clinical outcomes and reducing mortality risk [24] [25].

Our findings highlight infection prevention and control strategies, as well as nutritional interventions, as essential components in the management of dialysis patients in order to improve survival and quality of life.

Our study has some limitations, including its observational design, a small sample size, and a relatively short follow-up period. However, a key innovative and highly relevant aspect is that it addresses a significant gap in the medical literature by comparing the effects of peritoneal dialysis and hemodiafiltration specifically in elderly patients—a population often underrepresented in similar studies. This analysis, which has not been explored in previous research, provides a unique perspective on dialysis modality selection for a group with distinct characteristics and needs.

Although the calculated ideal sample size was 59 patients per group, the final study included 70 patients. This smaller sample size may limit statistical robustness and the ability to detect subtle differences between treatment modalities. However, it was sufficient to highlight differences between therapies and identify factors associated with mortality. These findings provide valuable insights into the effects of dialysis in elderly patients and emphasize the need for future studies with larger sample sizes and longer follow-up periods to confirm and expand upon these results.

Survival analysis showed that HDF was associated with a significantly higher survival rate than PD ($p = 0.020$). Logistic regression identified the PD modality, infections, and low six-month albumin levels as independent risk factors for mortality, highlighting the importance of nutritional monitoring and infection control in patient survival.

In conclusion, our findings, along with the lifestyle, preferences and personal circumstances of elderly patients, should be considered when selecting a dialysis modality. Clinical trials are needed to better compare dialysis modalities, particularly in specific populations such as elderly patients.

Conflicts of Interest

The authors declare no conflicts of interest regarding the publication of this paper.

References

- [1] GBD Chronic Kidney Disease Collaboration (2020) Global, Regional, and National Burden of Chronic Kidney Disease, 1990-2017: A Systematic Analysis for the Global Burden of Disease Study 2017. *Lancet*, **395**, 709-733.
- [2] Nerbass, F.B., Lima, H.d.N., Moura-Neto, J.A., Lugon, J.R. and Sesso, R. (2024) Brazilian Dialysis Survey 2022. *Brazilian Journal of Nephrology*, **46**, e20230062. <https://doi.org/10.1590/2175-8239-jbn-2023-0062en>
- [3] Brown, E.A., Finkelstein, F.O., Iyasere, O.U. and Kliger, A.S. (2017) Peritoneal or Hemodialysis for the Frail Elderly Patient, the Choice of 2 Evils? *Kidney International*, **91**, 294-303. <https://doi.org/10.1016/j.kint.2016.08.026>
- [4] United States Renal Data System (2021) USRDS Annual Data Report: Epidemiology of kidney disease in the United States. National Institutes of Health, National Institute of Diabetes and Digestive and Kidney Diseases.
- [5] Castrale, C., Evans, D., Verger, C., Fabre, E., Aguilera, D., Ryckelynck, J., *et al.* (2009) Peritoneal Dialysis in Elderly Patients: Report from the French Peritoneal Dialysis Registry (RDPLF). *Nephrology Dialysis Transplantation*, **25**, 255-262. <https://doi.org/10.1093/ndt/gfp375>
- [6] Nerbass, F.B., Lima, H.d.N., Thomé, F.S., Vieira Neto, O.M., Lugon, J.R. and Sesso, R. (2022) Brazilian Dialysis Survey 2020. *Brazilian Journal of Nephrology*, **44**, 349-357. <https://doi.org/10.1590/2175-8239-jbn-2021-0198>
- [7] Iyasere, O.U., Brown, E.A., Johansson, L., Huson, L., Smee, J., Maxwell, A.P., *et al.* (2016) Quality of Life and Physical Function in Older Patients on Dialysis: A Comparison of Assisted Peritoneal Dialysis with Hemodialysis. *Clinical Journal of the American Society of Nephrology*, **11**, 423-430. <https://doi.org/10.2215/cjn.01050115>
- [8] Joly, D., Anglicheau, D., Alberti, C., Nguyen, A., Touam, M., Grünfeld, J., *et al.* (2003) Octogenarians Reaching End-Stage Renal Disease: Cohort Study of Decision-Making and Clinical Outcomes. *Journal of the American Society of Nephrology*, **14**, 1012-1021. <https://doi.org/10.1097/01.asn.0000054493.04151.80>
- [9] van de Luijngaarden, M.W.M., Noordzij, M., Stel, V.S., Ravani, P., Jarraya, F., Collart, F., *et al.* (2011) Effects of Comorbid and Demographic Factors on Dialysis Modality Choice and Related Patient Survival in Europe. *Nephrology Dialysis Transplantation*, **26**, 2940-2947. <https://doi.org/10.1093/ndt/gfq845>
- [10] Segall, L., Nistor, I., van Biesen, W., Brown, E.A., Heaf, J.G., Lindley, E.J., Farrington, K. and Covic, A. (2017) Escolha da modalidade de diálise em pacientes idosos com doença renal terminal: Uma revisão narrativa das evidências disponíveis. *Nephrology Dialysis Transplantation*, **32**, 41-49.
- [11] Guo, A. and Mujais, S. (2003) Patient and Technique Survival on Peritoneal Dialysis in the United States: Evaluation in Large Incident Cohorts. *Kidney International*, **64**, S3-S12. <https://doi.org/10.1046/j.1523-1755.2003.08801.x>
- [12] Nissenson, A.R., Prichard, S.S., Cheng, I.K., Gokal, R., Kubota, M., Maiorca, R., Rella, M.C., Rottembourg, J. and Stewart, J.H. (1993) Non-Medical Factors That Impact on ESRD Modality Selection. *Kidney International*, **40**, S120-S127.
- [13] Vonesh, E.F., Snyder, J.J., Foley, R.N. and Collins, A.J. (2006) Mortality Studies Comparing Peritoneal Dialysis and Hemodialysis: What Do They Tell Us? *Kidney International*, **70**, S3-S11. <https://doi.org/10.1038/sj.ki.5001910>
- [14] Termorshuizen, F., Korevaar, J.C., Dekker, F.W., van Manen, J.G., Boeschoten, E.W. and Krediet, R.T. (2003) Hemodialysis and Peritoneal Dialysis. *Journal of the American Society of Nephrology*, **14**, 2851-2860.

- <https://doi.org/10.1097/01.asn.0000091585.45723.9e>
- [15] Brown, E.A., Johansson, L., Farrington, K., Gallagher, H., Sensky, T., Gordon, F., *et al.* (2010) Broadening Options for Long-Term Dialysis in the Elderly (BOLDE): Differences in Quality of Life on Peritoneal Dialysis Compared to Haemodialysis for Older Patients. *Nephrology Dialysis Transplantation*, **25**, 3755-3763. <https://doi.org/10.1093/ndt/gfq212>
 - [16] Chaudhary, K., Sangha, H. and Khanna, R. (2011) Peritoneal Dialysis First. *Clinical Journal of the American Society of Nephrology*, **6**, 447-456. <https://doi.org/10.2215/cjn.07920910>
 - [17] Sood, M.M., Tangri, N., Hiebert, B., Kappel, J., Dart, A., Levin, A., *et al.* (2014) Geographic and Facility-Level Variation in the Use of Peritoneal Dialysis in Canada: A Cohort Study. *CMAJ Open*, **2**, E36-E44. <https://doi.org/10.9778/cmajo.20130050>
 - [18] National Kidney Foundation (2015) KDOQI Clinical Practice Guideline for Hemodialysis Adequacy: 2015 Update. *American Journal of Kidney Diseases*, **66**, 884-930.
 - [19] Schiff, H. (2020) High-volume Online Haemodiafiltration Treatment and Outcome of End-Stage Renal Disease Patients: More than One Mode. *International Urology and Nephrology*, **52**, 1501-1506. <https://doi.org/10.1007/s11255-020-02489-9>
 - [20] Blankestijn, P.J., Vernooij, R.W.M., Hockham, C., Strippoli, G.F.M., Canaud, B., Hegbrant, J., *et al.* (2023) Effect of Hemodiafiltration or Hemodialysis on Mortality in Kidney Failure. *New England Journal of Medicine*, **389**, 700-709. <https://doi.org/10.1056/nejmoa2304820>
 - [21] Guida, B., Guerra, G., Severo, S., Cibelli, G., Buzzi, M., Trio, R., Memoli, B., *et al.* (2011) The Role of Bioimpedance Analysis in Peritoneal Dialysis Patients. *Journal of Renal Nutrition*, **21**, 312-321.
 - [22] CANUSA Peritoneal Dialysis Study Group (1996) Dialysis Adequacy and Nutrition in Continuous Peritoneal Dialysis: Association with Clinical Outcomes. *Journal of the American Society of Nephrology*, **7**, 198-207.
 - [23] Vernooij, R.W.M., Hockham, C., Strippoli, G., Green, S., Hegbrant, J., Davenport, A., *et al.* (2024) Haemodiafiltration versus Haemodialysis for Kidney Failure: An Individual Patient Data Meta-Analysis of Randomised Controlled Trials. *The Lancet*, **404**, 1742-1749. [https://doi.org/10.1016/s0140-6736\(24\)01859-2](https://doi.org/10.1016/s0140-6736(24)01859-2)
 - [24] Maduell, F., Moreso, F., Pons, M., Ramos, R., Mora-Macià, J., Carreras, J., *et al.* (2013) High-Efficiency Postdilution Online Hemodiafiltration Reduces All-Cause Mortality in Hemodialysis Patients. *Journal of the American Society of Nephrology*, **24**, 487-497. <https://doi.org/10.1681/asn.2012080875>
 - [25] Winkelmayer, W.C., Glynn, R.J., Mittleman, M.A., Levin, R., Pliskin, J.S. and Avorn, J. (2002) Comparing Mortality of Elderly Patients on Hemodialysis versus Peritoneal Dialysis. *Journal of the American Society of Nephrology*, **13**, 2353-2362. <https://doi.org/10.1097/01.asn.0000025785.41314.76>
 - [26] Gomes, G.A., Maronezi, L.F.C., Kasperavicius, J.P., Lindemann, I.L. and Lara, D.M. (2024) Desfechos clínicos e fatores associados à mortalidade de doentes renais crônicos que realizam hemodiálise: um estudo multicêntrico. *Brazilian Journal of Health Review*, **7**, e73636. <https://doi.org/10.34119/bjhrv7n5-469>
 - [27] Kumbar, L. and Yee, J. (2019) Current Concepts in Hemodialysis Vascular Access Infections. *Advances in Chronic Kidney Disease*, **26**, 16-22. <https://doi.org/10.1053/j.ackd.2018.10.005>
 - [28] Dzekova-Vidimliski, P., Nikolov, I.G., Gjorgjievski, N., Selim, G., Trajceska, L., Stojanoska, A., *et al.* (2021) Peritoneal Dialysis-Related Peritonitis: Rate, Clinical Outcomes and Pa-

tient Survival. *PRILOZI*, **42**, 47-55.

<https://doi.org/10.2478/prilozi-2021-0034>

- [29] Santos, N.S.J.d., Draibe, S.A., Kamimura, M.A. and Cuppari, L. (2004) Albumina sérica como marcador nutricional de pacientes em hemodiálise. *Revista de Nutrição*, **17**, 339-349. <https://doi.org/10.1590/s1415-52732004000300007>
- [30] Lai, K., Hsieh, Y., Chiu, P. and Lin, P. (2022) Association of Albumin and Globulin with Mortality Risk in Incident Peritoneal Dialysis Patients. *Nutrients*, **14**, Article 2850. <https://doi.org/10.3390/nu14142850>