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Geriatric Care

Geriatric Care 2026; 12:13963
doi:10.4081/gc.2026.13963

Clinical outcomes and complication rates of peritoneal dialysis in elderly patients: an 18-year retrospective analysis

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Abstract

Peritoneal dialysis (PD) is a gentle, self-managed modality that offers significant benefits for elderly patients with end-stage kidney disease (ESKD), particularly in preserving residual kidney function (RKF). Despite its advantages, PD remains underutilized in this population. This retrospective study evaluated clinical, nutritional, and metabolic outcomes, as well as quality of life, in 164 patients initiating PD, comparing elderly patients (≥65 years, n=22; mean age 71.1±5.5 years) to younger counterparts (<65 years, n=142; mean age 42.8±13.2 years). Parameters were assessed at baseline and after 24 months. Initially, the elderly group had a higher Charlson comorbidity index and lower RKF. Serum creatinine was the only significantly lower marker in older patients, with other metabolic and clearance parameters showing no notable differences. After 24 months, both groups exhibited improved clearance of urea, potassium, and alkaline reserves. In the elderly, serum albumin decreased and triglycerides increased significantly. Complication rates were similar across groups. While not statistically significant, elderly patients showed better technique survival but higher mortality, primarily from cardiovascular causes. These findings suggest that PD is a viable and safe treatment option for elderly ESKD patients, yielding comparable outcomes to younger individuals. However, ongoing monitoring of comorbidities and nutritional status remains crucial to optimize care in this population.

Key words: comorbidities, elderly patients, mortality, peritoneal dialysis.

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Introduction

With the aging of the population and increasing life expectancy, the number of elderly individuals with chronic kidney disease (CKD) continues to rise.[1,2] Comorbidities such as diabetes, hypertension (HTN), ischemic heart disease, and capillary fragility are factors that increase morbidity and mortality rates in this population. The choice of peritoneal dialysis (PD) as a replacement therapy helps improve the quality of life while prolonging the survival of these patients.[3]

It is gentler and more ideal for those at high cardiovascular risk, and the initiation of this technique depends on both medical indication and the patient's personal choice.[4,5]

The incidence and prevalence rates vary greatly, indicating significant geographical disparity, which impacts clinical outcomes for elderly patients on PD. CKD affects nearly 40% of individuals aged 65 years and older. The highest rates are found in Taiwan, Japan, and North America.[3,4,6-9]

In the United States of America, CKD is more common in individuals aged 65 years and older (38%) compared to other age groups.[6] In Canada, more than half of individuals starting dialysis are aged 65 or older.[8] In Morocco, 44% of patients with end-stage kidney disease (ESKD) are over the age of 64, according to the national dialysis registry MAGREDIAL.[10]

The aim of this study is to describe the clinico-biological profile of elderly patients undergoing PD, analyze age-specific prognostic factors, and compare the results with existing literature.

Materials and Methods

This is a retrospective, descriptive, and analytical study conducted at our PD unit from June 2006 to January 2024, including all consecutive PD patients registered in the French-language Peritoneal Dialysis Registry. Patients aged over 18 years were included. Exclusion criteria were age under 18, a history of cancer, missing essential data, or loss to follow-up within the first 3 months. Patients with incomplete follow-up beyond 3 months were included in analyses for which data were available (Figure 1).

According to the World Health Organization, an elderly person is defined as anyone aged over 65 years. We acknowledge the disparity in sample sizes between the elderly (n=22) and younger (n=142) groups, which may reduce statistical power. A post-hoc power analysis was performed to estimate the ability to detect differences between groups.

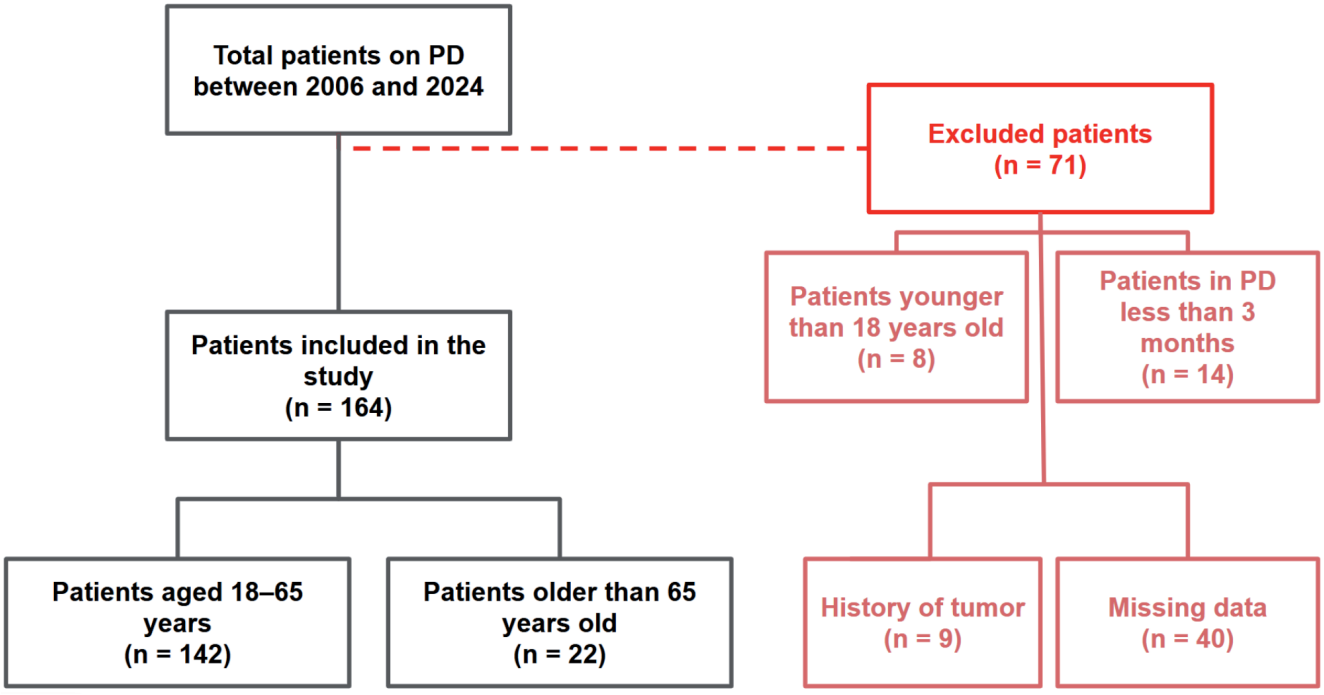

Figure 1. Study design. PD, peritoneal dialysis.

We assessed clinical parameters, including body mass index [weight (kg)/height (m^2)], cardiac status, and blood pressure (BP). HTN was defined as systolic BP ≥140 mmHg and/or diastolic BP ≥90 mmHg.

We also evaluated biological parameters at the beginning of PD (T0) and at 24 months (T1). We calculated the daily urea clearance (Kt/V), weekly creatinine clearance (WCC) (L/week/1.73 m^2), normalized protein catabolic rate (g per kg per day), and residual kidney function (RKF) calculated by the formula: [(urinary urea/plasma urea) + (urinary creatinine/plasma creatinine) × urine output / 1400) / 2].

We investigated mechanical complications (catheter migration, leaks, catheter perforation, and catheter dysfunction) as well as infectious complications (catheter exit infection, tunnelitis, and peritonitis). The peritonitis rate is calculated by the formula: peritonitis / years × patients. PD-peritonitis is defined according to the International Society for Peritoneal Dialysis guidelines as a symptom or sign (abdominal pain, fever, and cloudy dialysate) combined with a cell count in the effluent greater than 100/mL of leukocytes, with at least 50% polymorphonuclear neutrophils.[7] Finally, we assessed technique survival and mortality.

Statistical analysis

Quantitative variables were expressed as mean ± standard deviation or median (interquartile range) and compared using Student's *t*-test, Welch's test, or analysis of variance, as appropriate. Qualitative variables were expressed as numbers (percentages) and compared using the chi-square or binomial test. A p-value <0.05 was considered statistically significant.

Variables for inclusion in multivariate logistic regression models were selected based on clinical relevance and/or a univariate analysis with p<0.20. To reduce overfitting, given the small number of events in the elderly group, multivariate models were limited to a few key covariates. Sensitivity analyses using penalized regression were considered to account for sparse data.

Patients with missing essential data were excluded from the study. For the remaining patients, all available information was used. Those with incomplete follow-up beyond 3 months were included in analyses where data were available, and no imputation was performed. Data management and statistical analyses were conducted using Jamovi software, version 2.3.21.

Results

Clinical characteristics

At the initiation of PD, among the 164 patients included in the study, 37 (22.5%) patients were aged over 65 years. The average age of these patients was 71.1±5.51 years, with an age range between 65 and 85 years, and the sex ratio (M/F) was 1.875. Diabetic nephropathy predominated in 11 patients (50%) in the elderly group, while glomerular nephropathy was most common in younger subjects (21.1%) (Table 1).

Among these elderly patients, 74% were independent, and the modified Charlson score (3.17±1.23) was significantly higher (p=0.004). HTN (p=0.22), diabetes (p=0.009), and ischemic heart disease (p=0.007) were predominant in these patients.

On the cardiovascular level, left ventricular hypertrophy was found in 36%, the left ventricular ejection fraction was 56.6±14.4%, the inferior vena cava was thin, and filling pressures were low at the initiation of PD.

Paraclinical characteristics of elderly subjects

At the initiation of PD, the plasma creatinine level was signifi-

cantly lower in the elderly patients (p<0.001). This may be explained by the decreased muscle mass observed in these patients, while the plasma calcium level was higher (p=0.045) and alkaline phosphatases were lower (p=0.063) in elderly subjects. Although not statistically significant, older subjects exhibit better RKF, improved clearance as assessed by Kt/V and WCC, and a comparable nutritional status to that of younger subjects (Table 2).

Clinical evolution of the elderly patients

After 24 months of follow-up, our elderly subjects showed a significant decrease in urea levels (p=0.019), potassium levels (p<0.001), and an increase in bicarbonate levels (p<0.001). At the same time, we noted a lower albumin level (p<0.001) and a slight decrease in triglyceride levels (p=0.043).

Technique survival and mortality after 24 months on peritoneal dialysis

The technique survival at 24 months is 87% in elderly subjects (Table 3). The mortality rate in PD (18%) is higher in elderly patients, but statistically non-significant (p=0.908). The causes of death are primarily cardiac in origin (50%, p=0.034) in the elderly group, and no difference was observed regarding mechanical and infectious complications between the two groups. Patients who died or discontinued PD within the first 3 months were excluded from the survival and mortality analyses to ensure comparability of follow-up.

In univariate and multivariate analysis, although not significant, ischemic heart disease, diabetes, a non-optimized Kt/V (<1.7), and a low RKF (<3 mL/min) during the second year on PD are associated with mortality (Table 4).

Table 1. Clinical characteristics of patients at the initiation of peritoneal dialysis (T0).

Patient characteristics	Elderly patients (n=22)	Young patients (n=142)	p
Hypertension, n (%)	19 (87)	123 (75.4)	0.220
Diabetes, n (%)	11 (50)	31 (19)	0.009
Ischemic cardiopathy, n (%)	14 (65.2)	58 (35.5)	0.007
Vascular exhaustion, n (%)	1 (4.3)	14 (8.4)	0.498
Autonomy, n (%)	16 (74)	144 (88)	0.120
Charlson score	3.17±1.23	2.54±0.935	0.004
BMI (kg/m²)	24±5.06	24.2±4.74	0.024
APD, n (%) CAPD, n (%)	4 (18.2) 18 (81.8)	36 (21.8) 128 (78.2)	0.775
eGFR (mL/min)	7.05±2.76	6.47±2.97	0.133
Follow-up of CKD before dialysis initiation (months)	48 [15-123]	48 [0-120]	0.142
Initial nephropathy, n (%)			
Diabetic nephropathy	11 (50)	28 (16.9)	<0.001
Polycystic kidney disease	4 (18.2)	10 (6.3)	0.318
Glomerular nephropathy	0	35 (21.1)	0.013
Tubulo-interstitial nephropathy	1 (4.5)	28 (16.9)	0.048
Nephroangiosclerosis	3 (13.6)	18 (11.3)	0.740
Cortical necrosis	1 (4.5)	1 (0.7)	0.165
Undetermined nephropathy	2 (9.1)	43 (26.1)	0.426
Pauci-immune vasculitis	0	1 (0.7)	0.673

APD, automated peritoneal dialysis; BMI, body mass index; CAPD, continuous ambulatory peritoneal dialysis; CKD, chronic kidney disease; eGFR, estimated glomerular filtration rate.

Table 2. Biological characteristics of patients at the initiation of peritoneal dialysis (T0).

Patient characteristics	Elderly patients (n=22)	Young patients (n=142)	p	Normal range
Hemoglobin (g/dL)	11.4±2.19	10.3±2.19	0.061	12-16 (men), 11-15 (women)
Albumin (g/L)	37.4±5.73	37.9±6.52	0.579	35-50 g/l
Creatinine (mg/L)	66.4±31.4	112±46.4	<0.001	7-13 mg/l
Calcium (mg/L)	87.3±9.13	82.5±11.3	0.045	85-105 mg/l
APL (UI/L)	103 [91-129]	107 [72.5-139]	0.063	40-130 UI/L
Kt/V (mL/min)	1.81±0.890	1.60±0.643	0.200	≥1.7 mL//min
nPCR (g/kg/day)	0.852±0.261	0.803±0.266	0.494	0.8-1.2 g/kg/day
WCC (mL/min)	89.6 [57-123]	66 [47-97.5]	0.094	32-36 mL/min
RKF (mL/min)	5.53 [3.1-7.95]	4.10 [2.15-6.25]	0.194	

APL, alkaline phosphatases; Kt/V, daily urea clearance; WCC, weekly creatinine clearance; nPCR, normalized protein catabolic rate; RKF, residual kidney function.

In univariate and multivariate analysis, we did not observe a significant relationship between technique failure and overweight, diabetes, and RKF at 24 months of follow-up (Table 5).

We did not find a significant relationship between mechanical complications or peritonitis rate and PD discontinuation in these elderly subjects.

Discussion

Since the 1990s, the survival of dialysis patients has improved with both modalities [hemodialysis (HD) and PD].[11] However, apart from contraindications, the use of PD in elderly patients, particularly those at high cardiovascular risk, can be more beneficial than HD, especially during the first 2 years. This is to preserve venous access, avoid intradialytic HTN, reduce hemorrhagic risk, as well as the risk of atherosclerosis and cardiovascular morbidity.[12] In our study, the echographic parameters, including the left ventricular mass index, left ventricular ejection fraction, inferior vena cava diameter, and filling pressures, remained unchanged after 24 months of PD.

Nonetheless, the quality of life of elderly dialysis patients is an important parameter to consider. When aware of a short life expectancy, these patients seem to focus more on supportive care

Table 3. Technique-related complications between elderly patients and young patients at T1.

	Elderly patients (n=22), n (%)	Young patients (n=142), n (%)	p
Complications at T1			
Mechanical	13 (58)	87 (61)	0.785
Migration	9 (39)	82 (57.4)	0.393
Leaks	3 (13)	15 (10.5)	0.334
Catheter perforation	4 (17)	14 (9.85)	0.227
Catheter dysfunction	3 (13)	18 (12.6)	0.590
Infectious	11 (52)	89 (63)	0.645
Number of ES infections	2 [0-2]	1 [1-2]	0.310
≥1 tunnelitis	2 (9)	5 (3.5)	0.955
Peritonitis rate at T1			
Peritonitis/years×patients	0.47	0.46	0.937
PD survival at T1	19 (87)	105 (74)	0.317
Mortality rate at T1	4 (18)	13 (9.15)	0.908
Causes of death			
Cardiac	2 (50)	5 (38.5)	0.034
Septic shock	1 (25)	6 (46)	0.452
Covid	0	1 (7.7)	0.159
Peritonitis	1 (25)	1 (7.7)	0.767

ES, exit site; PD, peritoneal dialysis.

Table 4. Logistic regression table in univariate and multivariate analysis determining the risk of mortality in elderly subjects.

	Univariate analysis		Multivariate analysis	
	OR [CI 95%]	p	OR [CI 95%]	p
Diabetes	2.14 [0.28-16]	0.467	0.493 [0.026-9.3]	0.637
Ischemic cardiopathy	1.71 [0.131-22.51]	0.682	1.177 [0.05-26.11]	0.918
Kt/V <1.7 at T1	2 [0.146-27.4]	0.604	2.826 [0.16-47]	0.469
RKF <3 mL/min at T1	2.5 [0.256-24.4]	0.430	1.16 [0.05-24]	0.940

CI, confidence interval; Kt/V, daily urea clearance; OR, odds ratio; RKF, residual kidney function.

Table 5. Logistic regression table in univariate and multivariate analysis related to technique dropout in elderly subjects.

	Univariate analysis		Multivariate analysis	
	OR [CI 95%]	p	OR [CI 95%]	p
BMI ≥27 kg/m^2	2.75 [0.211-35.8]	0.440	2.11 [0.07-59]	0.661
Diabetes	2.75 [0.211-35.8]	0.440	0.892 [0.02-29.9]	0.949
Peritonitis ≥2 in 24 months	1.87 [0.134-26.3]	0.641	5.012 [0.11-228]	0.408
RKF <3 ml/min at T1	2.20 [0.113-42.7]	0.602	1.386 [0.05-38.4]	0.847

BMI, body mass index; CI, confidence interval; OR, odds ratio; RKF, residual kidney function. The peritonitis rate was calculated as the number of peritonitis episodes per patient-year.

than on prolonged survival.[13] Several studies have shown a better psychological profile,[14] and good adaptation to emergency healthcare situations, as described by Jin Qiu *et al.* during the Omicron pandemic in 2022.[15] Other studies have shown a lower hospitalization rate in PD patients compared to those on HD.[16-20]

As shown in the BOLDE study, there is no difference in quality of life between HD and PD patients, and PD patients also have fewer symptoms, less depression, and a lower intrusion of illness.[21] Our study also showed similar results in terms of clinical outcomes between younger and older patients treated with PD.

However, we observed a peritonitis rate similar in both elderly and younger subjects, contrary to what was reported by Portoles (2021),[22] Wu (2020),[23] and Duquennoy (2016),[3] and we found good control of various biological parameters.

Our study demonstrated that the mortality rate (18%) and technique failure rate (13%) at 24 months of follow-up did not differ significantly between elderly and younger patients; while these findings are consistent with reports by Lim *et al*.,[9] and, to some extent, Taveras *et al*.,[24] they should be interpreted with caution given the small number of elderly patients and the limited statistical power. Importantly, we did not demonstrate superior survival or lower complication rates in elderly patients; rather, our results suggest comparable outcomes between age groups. However, some studies suggest that elderly PD patients with high comorbidity may opt for conservative treatment, rather than transitioning to HD when PD is no longer feasible, which could result in shorter survival.[13]

These observations may in part reflect survivor bias or selection bias, since fitter elderly patients are more likely to be selected for PD, whereas frailer patients may be preferentially treated with HD or conservative management. This possibility could attenuate true differences between groups. Despite these limitations, our data support the notion that PD remains a feasible and safe dialysis modality for elderly patients when appropriately selected.

Limitations of the study

This study is limited by its retrospective design and the small number of PD patients, which may reduce statistical power and generalizability. Prospective studies with larger cohorts are needed to confirm these findings.

Conclusions

In conclusion, our results indicate that after 24 months on PD, although not statistically significant, the mortality risk is higher in elderly patients, primarily due to cardiovascular causes. The risk of technique-related complications and survival is similar regardless of age. However, proper management of comorbidities in these elderly patients could reduce the mortality rate.

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Received: 9 May 2025; Accepted: 15 January 2026.

Contributions: Hmaidouch Nabil: conceptualization of the study, data collection, and initial drafting of the manuscript. El Kadiri Nada: data curation, literature review, and critical revision of the text. Ouzeddoun Naima: methodological guidance, supervision, and manuscript review. Benamar Loubna: overall project administration, senior supervision, and final approval of the version to be submitted. All the authors read and approved the final version of the manuscript and agreed to be accountable for all aspects of the work.

Conflict of interest: the authors declare that they have no competing interests.

Ethics approval and consent to participate: this study involved a retrospective analysis of previously collected data. Institutional ethical approval was not required, and the institutional review board explicitly waived the need for written informed consent. Oral consent was obtained and documented when appropriate, in accordance with local regulations and guidelines.

Patient consent for publication: for this retrospective study, oral consent was obtained from each patient or their legal guardian prior to the inclusion of their data. Given the nature of the study, which involves data already collected from medical records, written consent was not feasible. However, oral consent was thoroughly documented in compliance with the ethical guidelines and was reviewed and approved by the institutional review board. All patients were informed of the study's purpose, their right to privacy, and the use of their data for publication. Additionally, all data was anonymized to ensure the protection of patient confidentiality.

Availability of data and materials: all data generated or analyzed during this study are included in this published article.