DaVita Kidney Care
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Preserving Residual Kidney Function: Consider Home Dialysis First

Residual kidney function (RKF) has been associated with a significant reduction in mortality as well as impact on volume control, left ventricular remodeling and quality of life.[1-3] In patients who initiate dialysis, there continues to be decline in RKF, however the modality utilized impacts the rapidity of the decline.

In peritoneal dialysis (PD), RKF is monitored and measured with weekly Kt/V that is measured every 3-4 months. For in-center HD (ICHD), RKF is typically not measured as the standard Kt/V is a single pool measurement of the HD treatment. However, it may be measured in home hemodialysis (HHD) to obtain a standard weekly Kt/V.

Most patients will likely experience a number of renal replacement therapies during their kidney disease journey. A key deciding factor is whether a patient prefers and is capable of treating at home using PD or HHD, or whether the patient prefers or is a candidate for in-center hemodialysis due to various clinical or lifestyle considerations. Additionally, patients likely will alternate between home dialysis, in-center dialysis and kidney transplant. The modality decision is complex and requires a discussion with the patient's nephrologist. As of 2019, 85% of all incident dialysis patients in the US initiated dialysis utilizing ICHD and only 11% initiated utilizing PD.[4] Additionally, the mean eGFR initiation was 9.6 mL/min with >75% starting with eGFR >5 mL/min.

Preservation of the residual kidney function should be a priority factor when determining which dialysis modality a patient should choose to use.[5] Although there are a number of factors that go into this decision including various clinical and lifestyle considerations, RKF must be a high-priority consideration knowing the reduction in mortality and other clinical benefits.

Numerous studies have shown that home dialysis preserves RKF as compared to conventional ICHD. In particular, PD has a significantly reduced decline in RKF when compared to ICHD. In HHD, there is some clinical evidence to suggest more frequent hemodialysis treatments may help preserve RKF when compared to ICHD.

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[1] Paniagua R, Amato D, Vonesh E, Correa-Rotter R, Ramos A, Moran J, Mujais S. Effects of increased peritoneal clearances on mortality rates in peritoneal dialysis: ADEMEX, a prospective, randomized, controlled trial. J Am Soc Nephrol. 2002 May;13(5):1307-1320.

[2] Termorshuizen F, Korevaar JC, Dekker FW, van Manen JG, Boeschoten EW, Krediet RT; NECOSAD Study Group. The relative importance of residual renal function compared with peritoneal clearance for patient survival and quality of life: an analysis of the Netherlands Cooperative Study on the Adequacy of Dialysis (NECOSAD)-2. Am J Kidney Dis. 2003 Jun;41(6):1293-302.

[3] Wang AY, Wang M, Woo J, Law MC, Chow KM, Li PK, Lui SF, Sanderson JE. A novel association between residual renal function and left ventricular hypertrophy in peritoneal dialysis patients. Kidney Int. 2002 Aug;62(2):639-47.

[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, Bethesda, MD, 2021.

[5] Sarnak MJ, Auguste BL, Brown E, Chang AR, Chertow GM, Hannan M, Herzog CA, Nadeau-Fredette AC, Tang WHW, Wang AY, Weiner DE, Chan CT; American Heart Association Council on the Kidney in Cardiovascular Disease; Council on Arteriosclerosis, Thrombosis and Vascular Biology; Council on Cardiovascular Radiology and Intervention; Council on Clinical Cardiology; Council on Hypertension; and Council on Lifestyle and Cardiometabolic Health. Cardiovascular Effects of Home Dialysis Therapies: A Scientific Statement From the American Heart Association. Circulation. 2022 Sep 13;146(11):e146-e164.

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It is thought that this preservation of RKF is likely multifactorial including the fact that home dialysis more similarly resembles native kidney function in that it is performed more frequently and involves less significant clearance rates and ultrafiltration requirements with each treatment. Additionally, PD patients are slightly volume expanded, do not have exposure to bio-incompatible membranes and are less likely to experience intradialytic hypotension as compared to ICHD.

For these reasons, Home dialysis should be an initial dialysis modality consideration for those patients with RKF to preserve the function as long as the patient is agreeable and capable of performing home dialysis treatments.

SUPPORTING DATA:

Importance of preserving RKF

- Each 1 mL/min of RKF is associated with a nearly 50% reduction in the rate of mortality.[1]
- Residual kidney function is associated with lower B2-microglobulin and p-cresol levels.[2]
- Anuric dialysis patients have a more adverse metabolic and cardiovascular profile, more severe anemia with greater erythropoietin resistance, more inflammation, higher calcium-phosphorus product, worse nutritional status, more hypertension, greater cardiac hypertrophy and greater overall and cardiovascular mortality than patients with preserved RKF. [3]
- CANUSA study, a 12% reduction in the relative risk of death was observed for a weekly 5 L/1.73 m2 increment in eGFR. Every 250 mL of urine output daily showed a 36% reduction in mortality.[4]
- ADEMEX study showed for each 10 L/1.73 m2 weekly increment in RKF, an 11% decrease in the relative risk of death was observed.[5]

PD's role in preserving RKF

- In one study, decline in RKF was observed in both PD and ICHD patients over 18 months, however only 8% of patients on PD became anuric and 56% of patients on ICHD became anuric.[6]

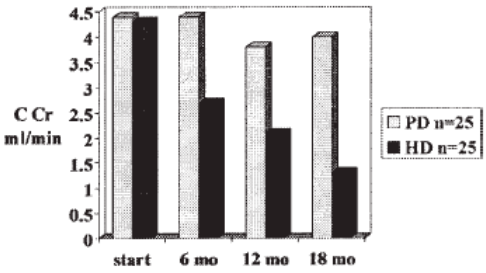

Figure 1 Residual renal function is preserved longer in peritoneal dialysis (PD).[a] CCr = creatinine clearance; HD = hemodialysis. [a]Based on data from (4).

[1] Maiorca R, Brunori G, Zubani R, Cancarini GC, Manili L, Camerini C, Movilli E, Pola A, d'Avolio G, Gelatti U. Predictive value of dialysis adequacy and nutritional indices for mortality and morbidity in CAPD and HD patients. A longitudinal study. Nephrol Dial Transplant. 1995 Dec;10(12):2295-305.

[2] Bammens B, Evenepoel P, Verbeke K, Vanrenterghem Y. Removal of middle molecules and protein-bound solutes by peritoneal dialysis and relation with uremic symptoms. Kidney Int. 2003 Dec;64(6):2238-43.

[3] Wang AY, Woo J, Wang M, Sea MM, Sanderson JE, Lui SF, Li PK. Important differentiation of factors that predict outcome in peritoneal dialysis patients with different degrees of residual renal function. Nephrol Dial Transplant. 2005 Feb;20(2):396-403.

[4] Bargman JM, Thorpe KE, Churchill DN. Relative contribution of residual renal function and peritoneal clearance to adequacy of dialysis: a reanalysis of the CANUSA study. J Am Soc Nephrol. 2001 Oct;12(10):2158-2162.
Misra M, Vonesh E, Van Stone JC, Moore HL, Prowant B, Nolph KD. Effect of cause and time of dropout on the residual GFR: a comparative analysis of the decline of GFR on dialysis. Kidney Int. 2001 Feb;59(2):754-63.

[5] (Paniagua R, Amato D, Vonesh E, Correa-Rotter R, Ramos A, Moran J, Mujais S. Effects of increased peritoneal clearances on mortality rates in peritoneal dialysis: ADEMEX, a prospective, randomized, controlled trial. J Am Soc Nephrol. 2002 May;13(5):1307-1320.)

[6] Rottembourg J. Residual renal function and recovery of renal function in patients treated by CAPD. Kidney Int Suppl. 1993 Feb;40:S106-10.

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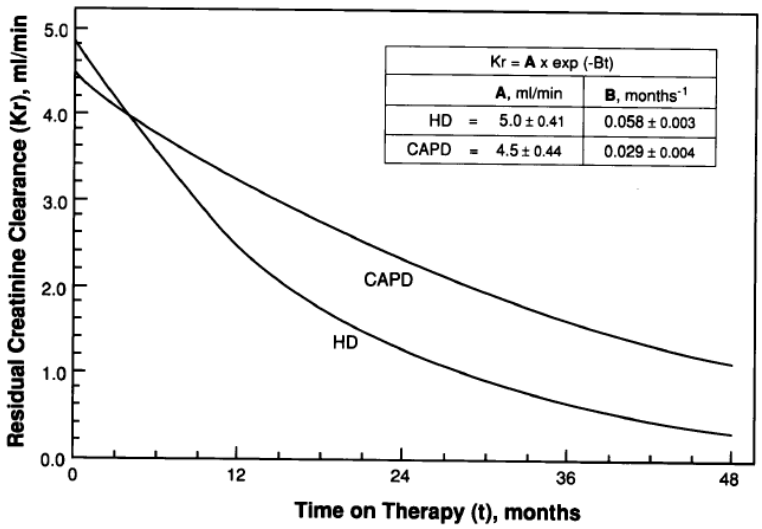
- In another retrospective cohort analysis, investigators showed that ICHD group rate of RKF decline was twice that of the CAPD group.[1]



- In another study, the rate of RKF decline was higher in ICHD than in PD with particular decline in ICHD noted in the first 6 months. PD patients had 30% higher GFR than ICHD patients and after 60 months PD patients had decreased 20% less than HD patients. [2]

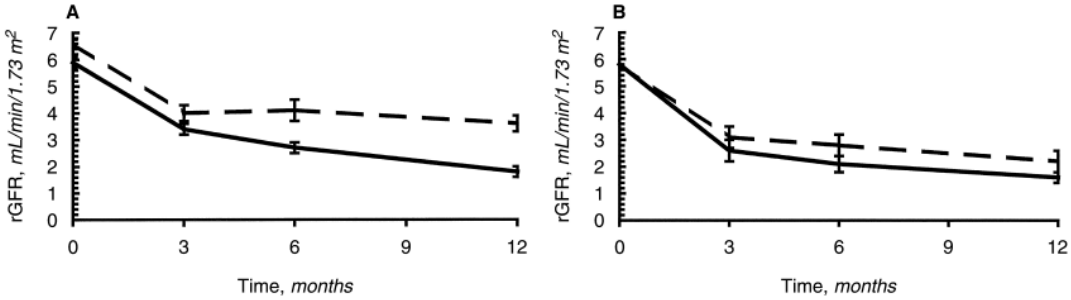


Fig. 1. Unadjusted (*A*) and adjusted (*B*) residual glomerular filtration rate (rGFR) values ± SE at the start of dialysis treatment, and at 3, 6 and 12 months after the start of dialysis treatment. The adjusted values were obtained after back transformation from ln(rGFR+1), which was the studied variable. Symbols are: (dashed lines) values in the PD patients; (solid lines) rGFR values in the HD patients. Adjustments were made for baseline GFR, age, primary kidney disease, comorbidity, body mass index, systolic and diastolic blood pressure, use of antihypertensive drugs, drop-out, time of dropout, and reason of dropout (including change of treatment). Unadjusted rGFR values were significantly higher in PD patients at all time points. After adjustment, averaged over time, PD patients had a higher rGFR than HD patients ($P < 0.0001$). The relative decline of rGFR was faster in HD compared to PD patients ($P = 0.04$).

- PD may be protective because PD patients may be slightly volume-expanded, osmotic drive is preserved, and are less prone to episodes of intradialytic hypotension and volume fluctuations compared with patients undergoing hemodialysis. Additionally, bio-incompatible membranes may activate inflammatory mediators.[3]

[1] (Lysaght MJ, Vonesh EF, Gotch F, Ibels L, Keen M, Lindholm B, Nolph KD, Pollock CA, Prowant B, Farrell PC. The influence of dialysis treatment modality on the decline of remaining renal function. ASAIO Trans. 1991 Oct-Dec;37(4):598-604.)
[2] (Jansen MA, Hart AA, Korevaar JC, Dekker FW, Boeschoten EW, Krediet RT; NECOSAD Study Group. Predictors of the rate of decline of residual renal function in incident dialysis patients. Kidney Int. 2002 Sep;62(3):1046-53.)
[3] (Horinek A, Misra M. Does residual renal function decline more rapidly in hemodialysis than in peritoneal dialysis? How good is the evidence? Adv Perit Dial. 2004;20:137-40.)

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- Clinical and demographic factors such as diabetes, congestive heart failure, female sex and non-white race predicted faster rate of RKF decline in patients starting dialysis. In this same study, the use of PD was associated with 65% less RKF loss compared to ICHD.[1]
- In another small case series evaluating early start of PD vs natural progression of CKD and found that earlier start of PD was associated with a slower decline of RKF, suggesting that incremental PD earlier may help preserve RKF.[2]

These studies suggest that PD preserves RKF when compared to in-center hemodialysis and that there are likely a number of factors that contribute to reasons that this occurs. Based on these studies, Dr. Paul Tam concluded that "One potential strategy to preserve RKF may be to preferentially use PD over HD in all incident patients with RRF."[3]
Additionally, the International Society for Peritoneal Dialysis recommends that RKF should be determined for all individuals doing PD and management should focus on preserving this function.[4]

[1] Moist LM, Port FK, Orzol SM, Young EW, Ostbye T, Wolfe RA, Hulbert-Shearon T, Jones CA, Bloembergen WE. Predictors of loss of residual renal function among new dialysis patients. J Am Soc Nephrol. 2000 Mar;11(3):556-564.
[2] Berlanga JR, Marrón B, Reyero A, Caramelo C, Ortiz A. Peritoneal dialysis retardation of progression of advanced renal failure. Perit Dial Int. 2002 Mar-Apr;22(2):239-42.
[3] Tam P. Peritoneal dialysis and preservation of residual renal function. Perit Dial Int. 2009 Feb;29 Suppl 2:S108-10.
[4] Brown EA, Blake PG, Boudville N, Davies S, de Arteaga J, Dong J, Finkelstein F, Foo M, Hurst H, Johnson DW, Johnson M, Liew A, Moraes T, Perl J, Shroff R, Teitelbaum I, Wang AY, Warady B. International Society for Peritoneal Dialysis practice recommendations: Prescribing high-quality goal-directed peritoneal dialysis. Perit Dial Int. 2020 May;40(3):244-253.)(Chen CH, Perl J, Teitelbaum I. Prescribing high-quality peritoneal dialysis: The role of preserving residual kidney function. Perit Dial Int. 2020 May;40(3):274-281.

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Short daily HHD role in preserving RRF

- ACTIVE trial demonstrated that increasing the hours of dialysis per week improved blood pressure control without an adverse effect on residual kidney function. [1]
- Nocturnal HD experienced a more rapid decline in RKF compared with conventional ICHD patients. At 4 and 12 months, 52% and 67% of NHD patients became anuric compared to 18% and 36% respectively. However, in short daily hemodialysis compared to conventional ICHD, there was no significant difference.[2]

Although there are only a few studies evaluating the role of home hemodialysis and preservation of residual kidney function, the data seems to suggest that slower or more frequent treatments which minimize the degree of intradialytic hypotensive episodes may preserve RKF compared to conventional hemodialysis. Additionally, experts believe that some of the challenges of these studies remain the small number of participants and the degree of variability across providers and how HHD may be prescribed (i.e. focus on reducing anti-hypertensives and reducing target weight such that patients do have relative hypotension and renal ischemia with treatment or small centers with less experience with HHD prescription management).[3]

Sincerely,

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[1] Jardine MJ, Zuo L, Gray NA, de Zoysa JR, Chan CT, Gallagher MP, Monaghan H, Grieve SM, Puranik R, Lin H, Eris JM, Zhang L, Xu J, Howard K, Lo S, Cass A, Perkovic V; ACTIVE Dialysis Steering Committee; Paul. A Trial of Extending Hemodialysis Hours and Quality of Life. J Am Soc Nephrol. 2017 Jun;28(6):1898-1911.

[2] Daugirdas JT, Greene T, Rocco MV, Kaysen GA, Depner TA, Levin NW, Chertow GM, Ornt DB, Raimann JG, Larive B, Kliger AS; FHN Trial Group. Effect of frequent hemodialysis on residual kidney function. Kidney Int. 2013 May;83(5):949-58.

[3] Pauly RP, Miller BW. Contextualizing the FHN Nocturnal Trial a Decade Later: How Nocturnal Home Hemodialysis Is Performed Matters to Outcomes. Clin J Am Soc Nephrol. 2021 Jun;16(6):966-968.