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Impact of hemodialysis versus continuous ambulatory peritoneal dialysis on cognitive function in chronic kidney disease

A. Rifai,[1]
A. Gunawan,[1]
I.M. Sagala[2]

[1]Division of Nephrology and Hypertension, Department of Internal Medicine, Universitas Brawijaya, Malang
[2]Department of Internal Medicine, Universitas Brawijaya, Malang, Indonesia

OBJECTIVE **To compare cognitive impairment in chronic kidney disease (CKD) patients undergoing hemodialysis (HD) and continuous ambulatory peritoneal dialysis (CAPD).** METHOD **This cross-sectional study was conducted at Saiful Anwar Hospital, Malang, from August 2024 to January 2025. Data were gathered through a combination of interviews, cognitive evaluations utilizing the Indonesian adaptation of the Montreal Cognitive Assessment (MoCA-INA), and the review of medical records. Statistical analyses included Chi-square, Mann-Whitney tests, and calculation of odds ratios (OR) with 95% confidence intervals (CI).** RESULTS **A total of 139 CKD patients participated in this study, divided into HD and CAPD groups. The proportion of cognitive impairment in CAPD (40.0%) was slightly higher than in HD (28.1%), but the difference was not statistically significant (OR: 1.71; 95% CI: 0.82–3.55; p=0.150). The severity of moderate-to-severe cognitive impairment also showed no significant differences. Mean total and cognitive domain scores in CAPD patients were not significantly different compared to HD.** CONCLUSIONS **There was no significant difference in the severity of cognitive impairment between CKD patients undergoing HD and CAPD.**

Σύγκριση αιμοκάθαρσης και συνεχούς περιτοναϊκής κάθαρσης στη γνωστική λειτουργία ασθενών με χρόνια νεφρική νόσο

Περίληψη στο τέλος του άρθρου

Key words

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Cognitive dysfunction represents a formidable challenge in the long-term management of chronic diseases, with individuals suffering from chronic kidney disease (CKD) experiencing disproportionately high rates of impairment.[1] Compared to the general population, CKD patients, particularly those undergoing dialysis, demonstrate a markedly elevated prevalence of cognitive deficits, affecting between 30% and 70% of this group and thereby exacerbating morbidity and mortality risks.[2] These impairments often manifest as deficits in attention, executive function, and memory, undermining patient's capacity to adhere to complex treatment regimens and diminishing their overall quality of life.[1]

Multiple interrelated factors intrinsic to CKD pathophysiology contribute to the development and progression of cognitive dysfunction.[3] Advancing age and coexisting cardiovascular disease potentiate risk, while malnutrition and disturbances in electrolyte and metabolic homeostasis further compromise neuronal integrity.[2] At the mechanistic level, the cerebral accumulation of uremic toxins, a state of chronic low-grade inflammation, and widespread vascular dysfunction converge to impair synaptic signaling and neurovascular coupling.[3] A comprehensive understanding of these determinants is essential for devising targeted intervention aimed at preserving cognitive function and improving clinical outcomes in the CKD population.[2]

The choice of dialysis modality, specifically continuous ambulatory peritoneal dialysis (CAPD) versus hemodialysis (HD), represents a significant factor that may influence cognitive function in individuals with CKD.[4] The type of dialysis employed can affect hemodynamic stability, toxin clearance, and metabolic status in CKD patients, all of which are associated with cognitive performance.[5,6] Some studies indicate that CAPD is associated with more stable clearance rates, while HD is linked to more pronounced fluctuations in blood pressure and fluid balance.[7] Notably, although one investigation suggests that CAPD is associated with enhanced cognitive performance within the same patient

population, recent research indicates no significant difference in cognitive outcomes between HD and CAPD.[8] To clarify the impact of different dialysis modalities on cognitive function, further research is warranted to reconcile these conflicting findings.

The objective of this study was to compare the extent of cognitive impairment in CKD patients undergoing HD with those receiving CAPD. It is anticipated that the findings may contribute to the scientific understanding of the cognitive implications of dialysis and may inform the development of strategies for the prevention, assessment, and management of cognitive dysfunction in individuals with chronic kidney disease.

MATERIAL AND METHOD

Design

This study utilized a cross-sectional design, with the objective of comparing cognitive impairment among patients with CKD who are receiving HD and those undergoing CAPD. The research was conducted in the hemodialysis unit and CAPD clinic of Saiful Anwar Hospital, Malang, from August 2024 to January 2025. Data were gathered through direct interviews and cognitive evaluations utilizing the Indonesian adaptation of the Montreal Cognitive Assessment (MoCA-INA). The study protocol followed the STROBE checklist.

Ethical approval

This study received ethical approval from the Ethics Committee of Saiful Anwar Hospital, Malang, with approval number 400/055/K.3/102.7/2024 and was conducted in accordance with the Declaration of Helsinki. All participants received a complete explanation regarding the study's purpose, risks, and benefits. Participants who agreed to take part signed written informed consent and were allowed to withdraw at any time without consequences. No incentives were provided to participants during the study period.

Participants and eligibility criteria

Sample size was calculated based on a global CKD prevalence of 10%, a 5% margin of error, and a 95% confidence level, resulting in a minimum required sample size of 139 CKD patients. Participants were purposively selected from CKD patients undergoing HD or CAPD at the hospital during the study period. Inclusion criteria were CKD patients aged ≥18 years undergoing HD or CAPD and willing to participate. Exclusion criteria included patients with a history of cognitive impairment prior to CKD diagnosis and before initiating dialysis therapy.

Data collection

Data collection was carried out in the hemodialysis unit and CAPD clinic of Saiful Anwar Hospital, Malang, from August 2024 to January 2025. Data were obtained through interviews to collect demographic and clinical information, as well as cognitive assessments using the MoCA-INA tool. Data collection was performed by trained researchers, and cross-validation was conducted using patients' medical records to ensure data accuracy. Data collection was conducted by AA, BB, and CC.

Covariates

The primary independent variable in this study was dialysis modality (HD or CAPD), and the dependent variable was cognitive impairment as measured by the MoCA-INA. Cognitive function was classified based on MoCA-INA scores: ≥26 indicated normal cognitive function, 18–25 indicated mild to moderate impairment, and 10–17 indicated severe impairment. Additional covariates collected included age, sex, body mass index (BMI), education level, erythropoietin therapy history, and laboratory results.

Statistical analysis

Categorical variables were presented as percentages, and continuous variables were expressed as mean±standard deviation for normally distributed data or median (interquartile range, IQR) for non-normally distributed data. Normality was assessed using the Kolmogorov-Smirnov test. For baseline comparisons, the Chi-square test was used for categorical data, while the Mann-Whitney test was used for non-normally distributed continuous data, and the t-test for normally distributed continuous data. To reduce potential bias, relevant covariates were controlled with randomization during analysis. The primary analysis involved calculating odds ratios (OR) and 95% confidence intervals (CI) to compare the risk of cognitive impairment between HD and CAPD groups. A p-value of <0.05 was considered statistically significant. All statistical analyses were performed using GraphPad Prism software (GraphPad Software, Inc, California, USA).

RESULTS

Baseline characteristics of the study sample

In the population with CKD examined in this study, the baseline characteristics of the HD and CAPD groups were largely comparable; however, significant differences were observed in several variables. The average age of participants in the HD group was 44.18±11.05 years, while in the CAPD group it was 48.18±13.31 years. The CAPD group exhibited a significantly higher percentage of patients aged 18 to 60 years (94.0%) in comparison to the HD group (78.7%). Conversely, individuals over the age of 60 were more commonly represented in the HD group (21.2%) than

in the CAPD group (6.0%), with a statistically significant difference observed (p=0.033). In terms of occupation, the HD group had more individuals who were unemployed or retired (57.3%), while the CAPD group had more non-civil servants (52.0%) and civil servants (10.0%). A history of erythropoietin therapy was found in 88.8% of the HD group and 54.0% of the CAPD group (p=0.000). In terms of laboratory parameters, the average calcium concentration in the HD group was 8.72±0.95 mg/dL, whereas the CAPD group exhibited a mean calcium level of 8.13±1.09 mg/dL, with a statistically significant difference observed (p=0.001); sodium levels were 137.77±4.42 mg/dL in the HD group and 135.1±3.13 mg/dL in the CAPD group (p=0.002); potassium levels were 4.16±0.79 mg/dL in the HD group and 3.25±0.45 mg/dL in the CAPD group (p=0.000); and chloride levels were 100.71±4.71 mg/dL in the HD group and 92.60±9.60 mg/dL in the CAPD group (p=0.000). Other variables, such as sex, education level, CKD etiology, body weight, height, BMI, hemoglobin, phosphorus, albumin, and iron levels, showed no statistically significant differences between the two groups. Complete baseline characteristics are presented in table 1.

Table 1. Baseline characteristics of the study sample.

Variable	Group		p-value
	HD	CAPD	
Gender n (%)			
Male	48 (53.9%)	33 (66.0%)	0.228*
Female	41 (46.1%)	17 (34.0%)	0.228*
Age (mean±SD)	44.18±11.05	48.18±13.31	
18–60 years	70 (78.7%)	47 (94.0%)	0.033*
>60 years	19 (21.2%)	3 (6.0%)	0.033*
Job n (%)			
Not working/retired	51 (57.3%)	19 (38.0%)	0.028*
Non civil servants	36 (40.4%)	26 (52.0%)	0.028*
Civil servants	2 (2.2%)	5 (10.0%)	0.028*
CKD etiology n (%)			
Diabetes	16 (18.0%)	5 (10.0%)	0.623*
Hypertension	56 (62.9%)	35 (70.0%)	0.623*
Kidney stones	1 (1.1%)	1 (2.0%)	0.623*
Others	16 (18.0%)	9 (18.0%)	0.623*
Erythropoietin treatment history n (%)	79 (88.8%)	27 (54.0%)	0.000*
BMI (mean±SD) (kg/m²)	23.38±3.82	22.50±3.69	0.255**
Laboratory			
Hemoglobin (mean±SD) (g/dL)	10.05±1.59	10.16±1.60	0.956**
Calcium (mean±SD) (mg/dL)	8.72±0.95	8.13±1.09	0.001**
Phosphorus (mean±SD) (mg/dL)	4.66±2.00	4.71±1.62	0.431**
Albumin (mean±SD) (g/dL)	3.87±0.53	3.66±0.49	0.069**
Natrium (mean±SD) (mg/dL)	137.77±4.42	135.1±3.13	0.002**
Potassium (mean±SD) (mg/dL)	4.16±0.79	3.25±0.45	0.000**
Chloride (mean±SD) (mg/dL)	100.71±4.71	92.60±9.60	0.000**
Iron (mean±SD) (µg/dL)	60.04±22.76	71.60±38.60	0.116**

HD: Hemodialysis, CAPD: Continuous ambulatory peritoneal dialysis, CKD: Chronic kidney disease, BMI: Body mass index, SD: Standard deviation

* Chi-square test, ** Mann-Whitney test

Comparative analysis of cognitive impairment and its severity in patients undergoing hemodialysis and continuous ambulatory peritoneal dialysis

The proportion of cognitive impairment among CAPD patients reached 40.0%, slightly higher than the 28.1% observed in the HD group. However, this difference did not reach statistical significance (OR: 1.71; 95% CI: 0.82–3.55; p=0.150). The prevalence of moderate-to-severe cognitive impairment was also similar between groups –12.0% in CAPD and 10.0% in HD– with no significant difference observed (OR: 1.23; 95% CI: 0.184–8.13; p=0.608). A summary of this analysis is presented in table 2.

Comparison of total score and domain of cognitive impairment in patients undergoing continuous ambulatory peritoneal dialysis and hemodialysis

The comparison of total cognitive scores and individual cognitive domains between patients undergoing CAPD and HD showed a trend toward higher scores in the CAPD group. However, the differences were not statistically significant. Complete results for the total and domain-specific cognitive scores are presented in figure 1.

DISCUSSION

This study involved a total of 139 CKD patients undergoing dialysis therapy, comprising both HD and CAPD groups. The results indicated that the prevalence of cognitive impairment among patients with CAPD was 40.0%, which did not differ significantly from the 28.1% observed in patients undergoing HD. Additionally, the severity of moderate-to-severe cognitive impairment was also comparable between the two groups. These findings are consistent with previous studies reporting that cognitive impairment is commonly observed in dialysis patients –whether on HD or CAPD– yet differences between dialysis modalities are not always consistent.[9–11] Furthermore, the results

Table 2. Comparative analysis of cognitive impairment and its severity in patients undergoing hemodialysis (HD) and continuous ambulatory peritoneal dialysis (CAPD).

Dialysis type	Outcome category	n (%)	Comparator	n (%)	OR	95% CI	p-value
CAPD	Cognitive impairment	20 (40.0%)	Normal	30 (60.0%)	1.71	0.8–3.55	0.150
HD		25 (28.1%)	Normal	64 (71.9%)	1.71	0.82–3.55	0.150
CAPD	Moderate-severe impairment	3 (12.0%)	Mild impairment	22 (88.0%)	1.23	0.184–8.13	0.608
HD		2 (10.0%)	Mild Impairment	18 (90.0%)	1.23	0.184–8.13	0.608

OR: Odds ratio, CI: Confidence interval

demonstrated that the mean total cognitive scores and cognitive domain scores in CAPD patients did not exhibit any statistically significant differences when compared to those in HD patients. This trend has also been supported by other studies indicating that cognitive performance in CAPD patients is often comparable to that in HD patients.[12] Thus, our results align with earlier studies and reaffirm that dialysis modality is not the sole determinant of cognitive function in CKD patients.[13]

Theoretically, cognitive impairment in CKD patients can be explained by multifactorial mechanisms, including the accumulation of uremic toxins, endothelial dysfunction, chronic inflammation, and metabolic disturbances affecting the brain.[14] Dialysis modality may influence the rate of toxin clearance and hemodynamic stability, both of which could impact cognitive function.[15] The accumulation of uremic toxins such as urea and creatinine may impair neuronal function and neurotransmission.[16] Endothelial dysfunction ultimately can lead to compromised cerebral blood flow and or ischemia, contributing further to cognitive deficits.[17] Chronic inflammation can predispose the patient to accelerated neurodegeneration.[18] Dialysis methods, especially HD, can contribute to oscillations in blood pressure and fluid shifts, which may compromise cerebral perfusion.[19] Comorbidities such as anemia and malnutrition can also contribute to cognitive deficits through mechanisms such as hypoxia and general systemic inflammation.[20] These processes interact in a rather complicated manner to affect the cognitive function of CKD patients.[14] But the evidence from this study suggests that differences in dialysis method are not important enough to affect cognitive function at a clinical level in this patient population and that this has implications for other factors such as age, nutritional levels, and comorbidities being more important determinants or mediators for cognitive functioning in the CKD population.

This study described a number of important implications for clinical practice. First, it emphasized that cognitive impairment is common among patients with CKD who are

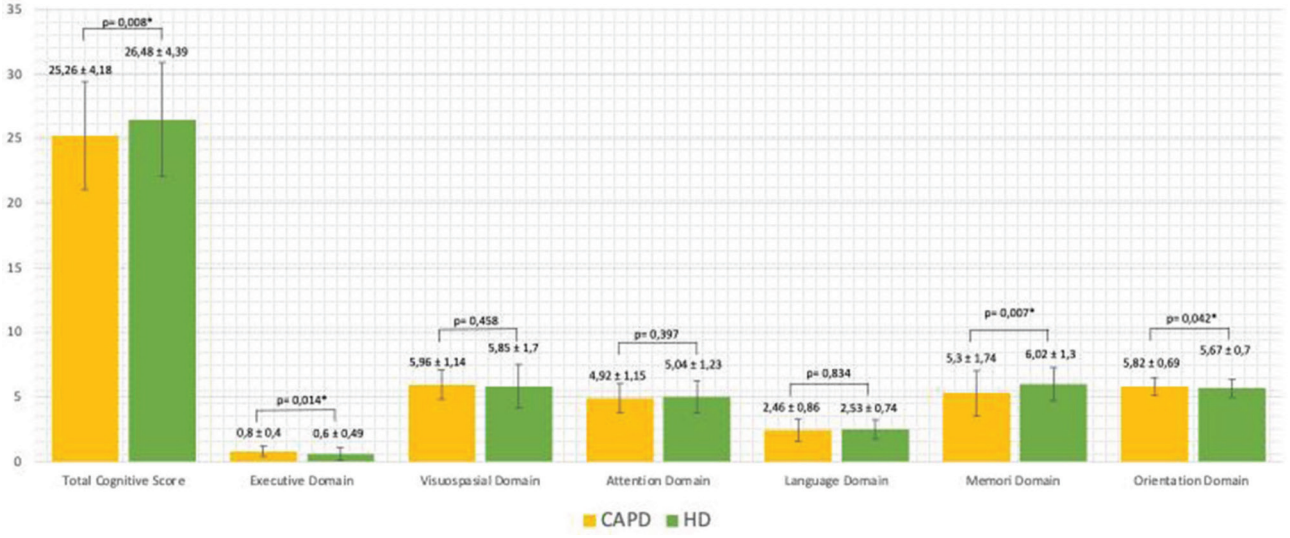

Figure 1. Comparison of total score and domain of cognitive impairment in patients undergoing continuous ambulatory peritoneal dialysis (CAPD) and hemodialysis (HD).

undergoing dialysis and exhibit a necessity for regular cognitive screening and monitoring as an integral component of standard care practices. Second, the finding that there is no notable distinction in the prevalence and severity of cognitive impairment among patients undergoing hemodialysis or CAPD supports the decision-making model for dialysis modalities – that is, selecting one modality over another does not carry excess worry about cognitive outcomes. Third, while dialysis modality may be a suspect intervention for addressing cognitive impairment, the current study emphasized the need to better understand non-dialysis variables –like age, employment status, and other biochemical measures that are modifiable– when attempting to prevent or delay cognitive decline. Fourth, the findings from this study might offer a platform from which interdisciplinary education or clinical pathways can be developed to improve clinical and cognitive health in CKD patients. Fifth, in addition to defining the severity of cognitive impairment in our CKD participants, this study might create an opportunity for longitudinal and interventional research, which could establish causal relationships with cognitive impairment, as well as determine how best to prevent and manage declines in cognitive health in CKD patients.

There were a number of limitations associated with the present research which should be taken into account for the interpretation of the results. First, cross-sectional data did not allow for causal relationships to be established between dialysis modality and cognitive impairment. Second, the fact that groups differed at baseline in age, occupation, or biochemical status may lead to confounding factors influencing our results. Third, the small sample size and purposive sampling to some extent limit the ability to generalize to the wider population. Fourth, the assessment of cognitive function, while using MoCA-INA for this research, assumed less than a full duration of neuropsychological testing. Fifth, the limited discussion of other potential confounding characteristics, such as depression and anxiety.

In conclusion, the findings of this research demonstrated that no statistically significant difference was noted between patients with CKD receiving hemodialysis and with CAPD concerning the prevalence and or outcome of cognitive impairment. This research might have implications for future research activity and development of comprehensive interventions to prevent cognitive decline in people with chronic kidney disease.

ΠΕΡΙΛΗΨΗ

Σύγκριση αιμοκάθαρσης και συνεχούς περιτοναϊκής κάθαρσης στη γνωστική λειτουργία ασθενών με χρόνια νεφρική νόσο

A. RIFAI,[1] A GUNAWAN,[1] I.M. SAGALA[2]

[1]*Division of Nephrology and Hypertension, Department of Internal Medicine, Universitas Brawijaya, Malang,*
[2]*Department of Internal Medicine, Universitas Brawijaya, Malang, Ινδονησία*

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ΣΚΟΠΟΣ Να συγκριθεί η γνωστική εξασθένηση σε ασθενείς με χρόνια νεφρική νόσο (ΧΝΝ) που υποβάλλονται σε αιμοκάθαρση (HD) και συνεχή περιτοναϊκή κάθαρση (CAPD). **ΥΛΙΚΟ-ΜΕΘΟΔΟΣ** Η παρούσα μελέτη διεξήχθη στο Νοσοκομείο Saiful Anwar, στο Malang, από τον Αύγουστο του 2024 έως τον Ιανουάριο του 2025. Τα δεδομένα συλλέχθηκαν μέσω ενός συνδυασμού συνεντεύξεων, γνωστικών αξιολογήσεων, εφαρμόζοντας την ινδονησιακή προσαρμογή της γνωστικής αξιολόγησης του Montreal (MoCA-INA) και την ανασκόπηση ιατρικών αρχείων. Οι στατιστικές αναλύσεις περιλάμβαναν x^2, δοκιμές Mann-Whitney και υπολογισμό σχετικών λόγων (OR) με διαστήματα εμπιστοσύνης 95% (CI). **ΑΠΟΤΕΛΕΣΜΑΤΑ** Συνολικά, συμμετείχαν 139 ασθενείς με ΧΝΝ σε αυτή τη μελέτη, χωρισμένοι σε ομάδες, HD και CAPD. Το ποσοστό γνωστικής εξασθένησης στη CAPD (40%) ήταν ελαφρώς υψηλότερο απ' ό,τι στην HD (28,1%), αλλά η διαφορά δεν ήταν στατιστικά σημαντική (OR: 1,71, 95% CI: 0,82–3,55, p=0,150). Η σοβαρότητα της μέτριας έως σοβαρής γνωστικής έκπτωσης δεν έδειξε επίσης σημαντικές διαφορές. Οι μέσες συνολικές βαθμολογίες και οι βαθμολογίες γνωστικού τομέα σε ασθενείς με CAPD δεν ήταν σημαντικά διαφορετικές σε σύγκριση με τους ασθενείς με HD. **ΣΥΜΠΕΡΑΣΜΑΤΑ** Δεν υπήρξε σημαντική διαφορά στη σοβαρότητα της γνωστικής έκπτωσης μεταξύ ασθενών με ΧΝΝ που υποβάλλονταν σε HD και CAPD.

Λέξεις ευρετηρίου: Αιμοκάθαρση, Γνωστική δυσλειτουργία, Διατομεακές μελέτες, Περιτοναϊκή κάθαρση, Χρόνια νεφρική νόσος

References

1. XIE Z, TONG S, CHU X, FENG T, GENG M. Chronic kidney disease and cognitive impairment: The kidney-brain axis. *Kidney Dis (Basel)* 2022, 8:275–285
2. BRONAS UG, PUZANTIAN H, HANNAN M. Cognitive impairment in chronic kidney disease: Vascular milieu and the potential therapeutic role of exercise. *Biomed Res Int* 2017, 2017:2726369
3. FRANCO AO, STAROSTA RT, RORIZ-CRUZ M. The specific impact of uremic toxins upon cognitive domains: A review. *J Bras Nefrol* 2019, 41:103–111
4. MARUKI T, NAKAYAMA T, MORIMOTO K, UCHIYAMA K, WASHIDA N, MITSUNO R ET AL. Combining hemodialysis with peritoneal dialysis improves cognitive function: A three-case report. *CEN Case Rep* 2024, 13:517–521
5. POP-BUSUI R, ROBERTS L, PENNATHUR S, KRETZLER M, BROSIUS FC, FELDMAN EL. The management of diabetic neuropathy in CKD. *Am J Kidney Dis* 2010, 55:365–385
6. RAHARJO FM, ANJARWANI S. From joint to heart: Cardiovascular implications of rheumatoid arthritis. *Deka in Medicine* 2024, 1:e361
7. ALROWIYTI IM, BARGMAN J. A review of residual kidney function in peritoneal dialysis patients. *Indian J Nephrol* 2023, 33:239–246
8. KALIRAO P, PEDERSON S, FOLEY RN, KOLSTE A, TUPPER D, ZAUN D ET AL. Cognitive impairment in peritoneal dialysis patients. *Am J Kidney Dis* 2011, 57:612–620
9. MURRAY AM. Cognitive impairment in the aging dialysis and chronic kidney disease populations: An occult burden. *Adv Chronic Kidney Dis* 2008, 15:123–132
10. MAZEN M, RIFAI A, GUNAWAN A. The association between albumin levels, platelet-to-albumin ratio, and the likelihood of peritonitis occurrence in individuals undergoing peritoneal dialysis. *Deka in Medicine* 2024, 1:e887
11. WIDIAPUTRO DP, SUWITO H, ELDATARINA H, FIRMANSAH W, AKBAR MJT, WATTIMURY RB ET AL. Investigating the connection between age progression and erectile dysfunction incidence in chronic kidney disease patients undergoing hemodialysis. *Deka in Medicine* 2024, 1:e210
12. TIAN X, GUO X, XIA X, YU H, LI X, JIANG A. The comparison of cognitive function and risk of dementia in CKD patients under peritoneal dialysis and hemodialysis: A PRISMA-compliant systematic review and meta-analysis. *Medicine (Baltimore)* 2019, 98:e14390
13. RADIĆ J, LJUTIĆ D, RADIĆ M, KOVAČIĆ V, SAIN M, CURKOVIĆ KD. The possible impact of dialysis modality on cognitive function in chronic dialysis patients. *Neth J Med* 2010, 68:153–157
14. BOLIGNANO D, SIMEONI M, HAFEZ G, PEPIN M, GALLO A, ALTIERI M ET AL. Cognitive impairment in CKD patients: A guidance document by the CONNECT network. *Clin Kidney J* 2024, 18:sfae294
15. GUO Y, CUI W, YE P, LUO Y. Association between cerebral blood flow variation and cognitive decline in older patients undergoing hemodialysis. *Front Aging Neurosci* 2024, 16:1457675
16. MALEK M. Brain consequences of acute kidney injury: Focusing on the hippocampus. *Kidney Res Clin Pract* 2018, 37:315–322
17. WANG F, CAO Y, MA L, PEI H, RAUSCH WD, LI H. Dysfunction of cerebrovascular endothelial cells: Prelude to vascular dementia. *Front Aging Neurosci* 2018, 10:376
18. GLASS CK, SAIJO K, WINNER B, MARCHETTO MC, GAGE FH. Mechanisms underlying inflammation in neurodegeneration. *Cell* 2010, 140:918–934
19. WOLFGRAM DF. Intradialytic cerebral hypoperfusion as mechanism for cognitive impairment in patients on hemodialysis. *J Am Soc Nephrol* 2019, 30:2052–2058
20. KARISMAZ A, PASIN O, KARA O, EREN R, SMITH L, DOVENTAS A ET AL. Associations between anemia and dependence on basic and instrumental activities of daily living in older women. *BMC Geriatr* 2024, 24:741
21. VON ELM E, ALTMAN DG, EGGER M, POCOCK SJ, GØTZSCHE PC, VANDENBROUCKE JP ET AL. The Strengthening the Reporting of Observational Studies in Epidemiology (STROBE) statement: Guidelines for reporting observational studies. *Ann Intern Med* 2007, 147:573–577

Corresponding author:

I.M. Sagala, Department of Internal Medicine, Brawijaya University, Dr Saiful Anwar Hospital, Malang, Indonesia
e-mail: idameitasagala@gmail.com