Original Article

To Assess the Level of Cognitive Impairment in Hemodialysis Patient Using MoCA Scale: A Prospective Interventional Study

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ABSTRACT

Aim: To use the MoCA scale to measure the degree of cognitive decline in haemodialysis patients and to enhance cognitive function through training. **Materials and Methods:** Prospective interventional researches were carried out for a duration of 6 months. 57 haemodialysis patients were selected for the study. The decline in cognitive function was assessed using MoCA scale, and cognitive training was provided to improve cognition. **Results:** By observing the control and treatment groups without and with provision of cognitive training, the treatment group shows an improvement in the cognitive function from 57.33% to 63.07% and control group shows decline in cognitive function from 57.36% to 52.64%. **Conclusion:** This study demonstrates how cognitive training can stop cognitive aging. Therefore, starting cognitive training as soon as haemodialysis begins can reduce the likelihood of cognitive loss.

Keywords: Haemodialysis, Cognitive impairment, MoCA scale, Cognitive training.

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Received: 15-12-2023;
Revised: 08-01-2024;
Accepted: 19-02-2024.

INTRODUCTION

Recent research has revealed a link between cognitive decline and a higher chance of dementia in those suffering from Chronic Renal Failure (CKD), which is problematic since this group of individuals is already at risk.[1-3] In addition to acute events like strokes that cause cognitive impairment, most HD patients have vascular disease as a secondary condition and a high frequency of chronic illnesses such as high blood pressure and diabetes. Several theories have been put forth to try and explain this cognitive decline. HD patients have a lower incidence of Alzheimer's disease than vascular cognitive dysfunction and the combination of vascular and Alzheimer's disease.[4] The increased risk of cognitive impairment in dialysis patients, however, may also be related to vascular illness, Prolonged inflammation, oxidative stress, and uremic neurotoxicity, anaemia, and risks related to the dialysis process itself, including hypercoagulability, dialysis disequilibrium syndrome, and brain intradialytic ischemia.[5-8]

The US Centers for Disease Control and Prevention (CDC) estimates that 15% of adults, or 37 million people, have Chronic Kidney Disease (CKD). Ninety percent of adult patients with Chronic Kidney Disease (CKD) are unaware that they have the disease, and one in two people with severely impaired kidney function who are not receiving kidney medication are also unaware that they have it. Adults' primary causes of Chronic Kidney Disease (CKD) are diabetes and hypertension: According to the CDC, kidney failure may affect one in three people with Type 2 diabetes and one in five patients with high blood pressure. According to the most recent CDC data, the prevalence of Chronic Kidney Disease (CKD) is 3.8% overall and affects those 65 years of age and older more commonly than people between the ages of 18 and 44 (7%), 45 to 64 (13%), and 65 years of age or older. It is also somewhat greater in women (15%) than in men (12%). Furthermore, African Americans have a roughly three-fold increased risk of getting ESKD compared to White individuals.[9]

A number of factors have been linked in community-based studies of the general population to an increased risk of vascular cognitive impairment or Alzheimer's disease: aging, gender, inadequate schooling, race and ethnicity, diabetes, hypertension, lipids, stroke, anaemia, history of head trauma, midlife obesity, inflammatory variables, the APOE-4 allele, and various other genetic markers.[10,11] Most of these associated risk factors for cognitive impairment are common to populations with Chronic Kidney Disease (CKD) and those receiving haemodialysis. But compared to the entire population, stroke and the high prevalence of cardiovascular risk factors outweigh the effects of aging and nonvascular variables.[12] Moreover, it is still unknown how much secondary renal failure is caused by factors like hemodynamic

DOI: 10.5530/ijopp.17.2.23

Publishing Partner : EManuscript Tech. [www.emanuscript.in]

fluctuations during dialysis, anaemia, uraemia, and metabolic issues.[13]

The Mini-Mental State Examination, commonly referred to as MMSE was introduced in 1975 and has since become a valuable instrument for assessing cognitive abilities. This makes it more than 45 years old.[14] It is currently the most widely utilised screening technique in the clinical and research fields for determining the degree of dementia. Numerous researchers question the validity of the MMSE scale, despite the American Academy of Neurology's guidance recommending it as a crucial tool for identifying cognitive impairments in their early stages.[15] Concerns about the MMSE's utility as an MCI screening tool prompted the development of substitute techniques. One such measure is the Montreal Cognitive Assessment Scale (MoCA), about which the authors assert that there are no limitations in comparison to the MMSE.[16]

The following Table 1 compares the domains of the Montreal Cognitive Assessment (MoCA) scale and the Mini Mental State Examination (MMSE) (Table 1).

MATERIALS AND METHODS

A Prospective Interventional study on cognitive impairment in Haemodialysis patient using MoCA scale was conducted in Haemodialysis Unit at VMCH. The Institutional Ethical Committee (IEC) of Vivekanandha Medical Care Hospital gave its approval for this study (Ref. No. EC/NEW/INIT/2021/1811). We looked at 57 patient records to determine the degree of cognitive decline in haemodialysis patients. The cognitive function of 57 haemodialysis patients was evaluated in the unit based on the criteria for inclusion and exclusion. A total of 54 study participants were selected based on the rules for inclusion and exclusion. Patient information was obtained through direct patient interviews, a self-created data collection form, and the patient's case sheet, including demographic information, the length of their dialysis, and their social history. The Montreal Cognitive Assessment Scale was used in this study to measure cognitive impairment (in Tamil or English). Following a three-month period of cognitive function observation, the patients were split into two groups: Control and Treatment. Then, for the control and treatment groups, cognitive ability was examined without and with a course of cognitive training i.e., 3 months. Then self-designed training pamphlet was given to the patients (treatment group only) to improve cognitive function. Microsoft Excel 2019 was used to perform a descriptive statistical analysis on the data, with percentages and numbers representing the findings.

Study criteria

Inclusion criteria

- Patients with a MoCA score greater than 10 who are at least 18 years old.
- Patients of both sexes.
- Individuals receiving haemodialysis who may or may not have co-morbid conditions (DM, HTN).
- Both inpatients and outpatients.

Table 1: Scale comparison between MoCA and MMSE.[17]

Cognitive function		MMSE (No. of points/trials)	MoCA (No. of points/trails)
Orientation		10 tasks (10 points)	6 tasks (6 points)
Memory	Learning	Learning of 3 words (3points/1 trial allowed)	Learning of 5 words (no points/2 trials allowed)
	Delayed recall	3 words (3 points)	5 words (5 points)
	Cued recall	Not present	5 words (no points)
	Recognition	Not present	5 words (no points)
Naming		2 items (2 points)	3 pictures (3 points)
Visuospatial functions		Copy of pentagons (1 point)	Copy of cube (1 point) Clock drawing (3 points)
Comprehension		3-stage command (3)	Not present
Vigilance		Not present	Tapping with hand at letter A (1 point)
Language		Repetition of sentence (1 point)	Repetition of 2 sentences (2 points)
Reading		Sentence (1 point)	Not present
Abstract thinking		Not present	Similarities (2 points)
Writing		Patient's sentence (1 point)	Not present
Alternating trail making		Not present	1 trial (1 points)

(MMSE: Mini Mental State Examination, MoCA: Montreal Cognitive Assessment scale).

Exclusion criteria

- Patients unwilling to take part in the research.
- A neurological condition (Parkinsonism, dementia, CVA, etc.) has already been diagnosed in the patient.
- Patients with tremor, hearing issues, and vision problems.

Study procedure

A prospective interventional study based in a hospital was conducted in the haemodialysis department at VMCH, Namakkal. This study was conducted prospectively over a six-month period. The ethics committee approved the study before it started. The criteria for inclusion and exclusion of the study were used to determine which patients were included. The patient information was gathered using a well-structured patient demographic form. Haemodialysis patients' degree of cognitive impairment was evaluated using the Montreal Cognitive Evaluation Scale (MoCA). The degree of cognitive decline was evaluated using the score derived from the aforementioned scale. The significance of the findings was assessed after statistical analysis of the data.

Data collection

In addition to direct patient interviews, a planned data collection form with patient demographic template was utilized to gather patient information such as age, gender, length of dialysis, and social history from the patient's case sheet. With Microsoft Excel 2019, a descriptive analysis of the data was conducted, and the findings were presented as percentages and numbers.

RESULTS

Out of the 57 patients receiving haemodialysis at Vivekanandha Medical Care Hospital, 49 were chosen based on inclusion criteria to have their cognitive impairment evaluated using the MoCA scale.

Gender wise frequency distribution

According to gender, there were more males in the study population than females. 84.21% (48 patients) of the study's 57 patients were men, and 15.79% (9 patients) were women. Gender wise frequency distribution is shown in Table 2.

Age wise frequency distribution

In the study, 42.11% of the population was between the ages of 60-69, 17.54% was between the ages of 50-59, 14.04% was between the ages of 30-39 and 70-79, and the remaining 12.28% was between the ages of 40-49. Age wise frequency distribution is shown in Table 3.

Frequency distribution based on medical history

In this study, CKD, and Hypertension were diagnosed in 52.63% of the population; CKD, Hypertension and Diabetes in 36.84% of the population; CKD, Hypertension and Hepatitis in 8.77% of the population and CKD, Hypertension, Diabetes and Hepatitis in the remaining 1.75% of the population. Frequency distribution based on medical history is shown in Table 4.

Frequency distribution based on educational level

In this study, 63.16% of the population had less than a 12^{th}-grade education, while 36.84% had a higher education. Frequency distribution based on educational level is shown in Table 5.

Frequency distribution based on social history

In this study, 42.11% have a history of smoking, 26.32% have a history of consuming alcohol and smoking, 5.27% have a history of chewing betel leaf, 5.27% have a history of smoking and chewing betel leaf, 3.51% were alcoholic, 3.51% were alcoholic and betel leaf chewer, 3.51% have a history of chewing betel leaf, alcoholic, smoker and remaining 10.53% have no social history.

Comparison of neuropsychological assessment scales

By comparing the scales available, we can see that MoCA covers 88.89% of the domains, the Mini Mental State Examination covers 66.67% of the domains, the Mini Cog covers 44.45% of the domains, the Memory Impairment Screen covers 11.12% of the domains, the Eight-Item Informant Interview covers 33.34% of the domains, 7-Minute Screen Test covers 44.45% of domains, Abbreviated Mental Test Score covers 11.12% of areas, Saint Louis University Mental Status covers 44.45% of domains and Addenbrooke's Cognitive Assessment covers 55.56% of the domains. The comparison of neuropsychological assessment scales is given in Table 6.

Comparison of MoCA scores obtained by the study population during 1^{st} and 2^{nd} visit

The cognitive impairment in dialysis patients was assessed using the MoCA scale. On comparing the scores obtained in 2 visits, the cognitive function of the patient declines from 64.94% to 57.35% during 2nd visit. The comparison of scores is shown in Figure 1.

Scores obtained by the study population during 2^{nd} visit

During 2^{nd} visit of the study 43.86% of the population scored between 18 and 25 i.e., mild cognitive impairment, 36.84% of the population scored between 10 and 17 i.e., moderate cognitive impairment, and 5.26% of the population scored between <10 i.e., severe cognitive impairment and 14.04% of the population lost to follow-up. The scores obtained by the participants are shown in Table 7.

Comparison of MoCA scores obtained by the study population during 2nd visit and after providing training in 3rd visit

By comparing the scores obtained in 2nd visit and 3rd visit with provision of cognitive training, the scores have been increased from 57.33% to 63.07%. The comparison of the scores is shown in Figure 2.

Comparison of MoCA scores obtained by the study population during 2nd visit and without providing training in 3rd visit

By comparing the scores obtained in 2nd visit and 3rd visit without provision of cognitive training, the scores have been decreased from 57.36% to 52.64%. The comparison of the scores is shown in Figure 3.

DISCUSSION

The primary goal of this study is to evaluate the cognitive decline experienced by haemodialysis patients. The study included 57 haemodialysis patients, of whom 84.21% were male and 15.79% were female. At our study site, 52.63% of the patients appear to have been diagnosed with both CKD and hypertension.

To verify that the patients' cognitive deterioration is due to continuous haemodialysis, the patients' cognitive performance is evaluated using the MoCA scale during a three-month period. Over this time, the patient's cognitive performance declined from 64.94% to 57.35%.

A set of patients received cognitive training, and the improvements in their cognitive function were assessed. This demonstrates that

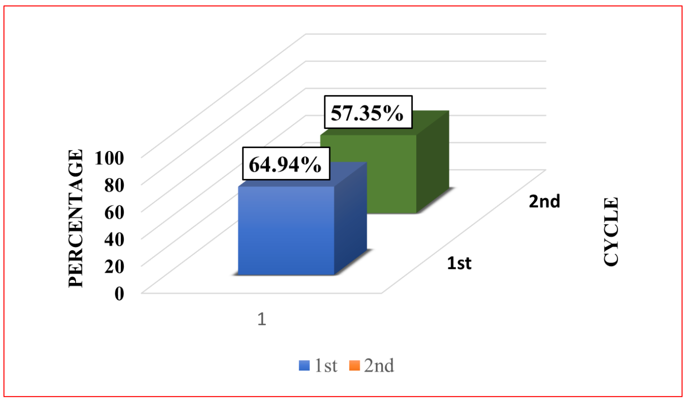

Figure 1: Comparison of MoCA score obtained by the study population in 1st and 2nd visit.

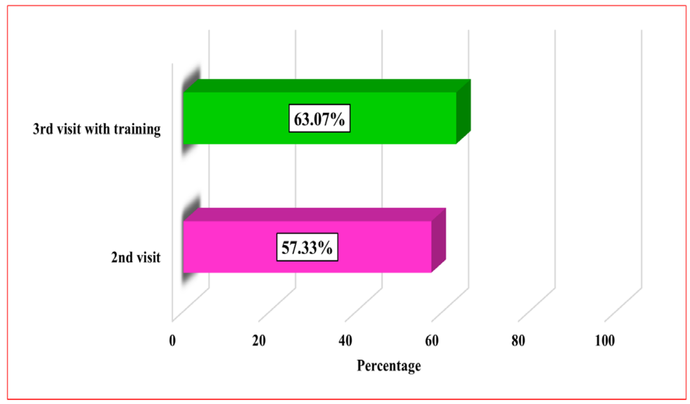

Figure 2: Comparison of MoCA scores obtained by the study population during 2nd visit and after providing training in 3rd visit.

Table 2: Gender wise frequency distribution.

S.No	Gender	Number of patients	Percentage (%)
1	Male	48	84.21
2	Female	9	15.79

Table 3: Age wise frequency distribution.

S.No	Age (years)	Male	Female	No. of patients	Percentage (%)
1	30-39	4	4	8	14.04
2	40-49	7	0	7	12.28
3	50-59	8	2	10	17.54
4	60-69	22	2	24	42.11
5	70-79	7	1	8	14.04

Table 4: Frequency distribution based on medical history.

S.No	Medical history	Male	Female	No. of patients	Percentage (%)
1	CKD, HTN	26	4	30	52.63
2	CKD, HTN, DM	20	1	21	36.84
3	CKD, HTN, Hepatitis	2	3	5	8.77
4	CKD, HTN, DM, Hepatitis	0	1	1	1.75

Table 5: Frequency distribution based on educational level.

S.No	Educational level	Male	Female	No. of Patients	Percentage (%)
1	Below 12th	31	5	36	63.16
2	Above 12th	17	4	21	36.84

Table 6: Comparison of neuropsychological assessment scales.

Domains/ Scales	MoCA	MMSE	Mini Cog	MIS	AD8	7-min screen test	AMTS	SLUMS	ACE
Memory	1	1	1	1	1	1	1	1	1
Visuospatial	1	0	1	0	0	0	0	0	1
Executive	1	0	1	0	1	1	0	1	0
Attention	1	1	0	0	0	0	0	1	1
Concentration	1	0	0	0	0	0	0	0	0
Working memory	1	1	0	0	0	0	0	0	0
Language	1	1	1	0	0	1	0	0	1
Orientation	1	1	0	0	1	1	0	1	1
Registration	0	1	0	0	0	0	0	0	0
Percentage (%)	88.89	66.67	44.45	11.12	33.34	44.45	11.12	44.45	55.56

Table 7: Scores obtained by the study population during 2nd visit.

Category	Male	Female	No. Of participants	Percentage (%)
18-25	17	8	25	43.86
10-17	20	1	21	36.84
<10	3	0	3	5.26
Lost to follow up	8	0	8	14.04

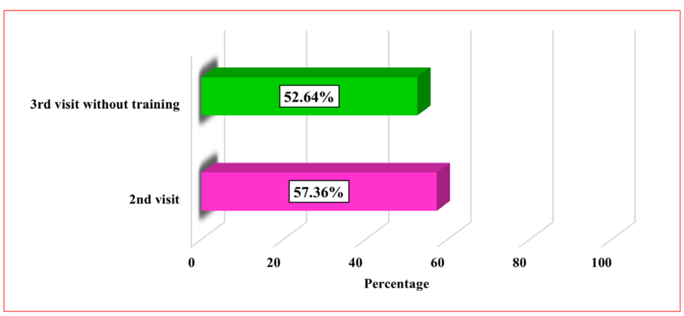

Figure 3: Comparison of MoCA scores obtained by the study population during 2nd visit and without providing training in 3rd visit.

the patient saw an increase in cognitive function from 57.33% to 63.07%.

The general public reports that the more white matter damage an HD person has, the worse they do on cognitive tests. This shows that cerebrovascular disease may contribute to cognitive impairment in the HD population.[18]

When the brain receives a significant amount of blood (15-20%) of cardiac output, ischemia damage may occur. Over a broad range of cerebral perfusion pressures (60-160 mm Hg), blood flow to the brain is essentially constant in normal physiology. The main reason for this is variations in pressure, which lead to the dilation and constriction of the great and small cerebral capillaries. This vascular tone may be disrupted by a number of medical disorders. It is believed that vascular endothelial dysfunction mediates the relationship between decreased cerebral blood flow and chronic renal disease.[19]

Increased performance in cognitive tests like speed and accuracy, visuomotor coordination, attention, memory, working memory, and global cognitive function has been documented in numerous BTG intervention trials.[20]

According to certain research, Brain-Derived Neurotropic Factor (BDNF) and Apolipoprotein E (APOE) may be important factors in the development of cognitive abilities. Although APOE has been linked to late-onset Alzheimer's Disease (AD), its exact contribution to the decline in normal cognitive function is yet unknown.[21,22]

The neurotrophins, in addition to being crucial for neural plasticity, BDNF has the capacity to both establish and preserve neuronal function. It has been observed that BDNF promotes long-term potentiation of the cortical and hippocampal regions, which are crucial mechanisms for learning and memory.[22,23]

CONCLUSION

Hemodialysis patients usually suffer cognitive impairment. For these reasons, cognitive training or exercise may be beneficial in treating or preventing cognitive decline in hemodialysis patients. Thus, in order to lessen cognitive loss, hemodialysis patients in this study received cognitive training.

Therefore, to avoid or lessen the changes in cognition, cognitive training could be started at the start of hemodialysis in the future. It is a good idea to assign a clinical pharmacist to each hemodialysis facility. This specialist has the potential to significantly improve patient outcomes and treatment. Their responsibilities could include:

Medication supervision: Guaranteeing that patients receive the right prescriptions at the right dosages and being aware of any possible drug interactions.

Patient consultation: Providing patients with individualised advice, clarifying their prescription regimens, talking about possible side effects, and answering any questions or worries they might have.

Lifestyle Suggestions: To improve general well-being, help patients make lifestyle changes including stopping smoking, exercising, and practising stress management.

ACKNOWLEDGEMENT

The study was made possible by Dr. S. Arthanareeswaran MD., our hospital's joint managing director and Consultant Internal Medicine, Diabetology and Obesity, for which we are incredibly grateful. We are grateful to Dr. P. Sharmila Nirojini, our department head, for her support. We also thank Dr. C. Vaishnavi Devi and Dr. P. Malarvizhi, who served as our study advisors, for their invaluable advice. Additionally, we would appreciate the support of the Vivekanandha Medical Care hospital's dialysis technicians.

ETHICS APPROVAL

The Institutional Ethical Committee (IEC) of Vivekanandha Medical Care Hospital gave its approval for this study (Ref. No. EC/NEW/INIT/2021/1811).

CONSENT TO PARTICIPATE

Self-designed consent form was used to obtain consent from the patient which is attached hereby.

CONFLICT OF INTEREST

The authors declare that there is no conflict of interest.

ABBREVIATIONS

CKD: Chronic Kidney Disease; **HD:** Hemodialysis; **CDC:** Centres for Disease Control and Prevention; **APOE:** apolipoprotein E; **MIS:** Memory Impairment Screen; **AD8:** Eight-Item informant interview; **AMTS:** Abbreviated Mental Test Score; **SLUMS:** Saint Louis University Mental Status; **ACE:** Addenbrooke's Cognitive Assessment.

SUMMARY

The current study was a prospective interventional study with the aim to evaluate the level of cognitive impairment in hemodialysis patients using the Montreal Cognitive Assessment Scale. The study helped in providing substantial information on cognitive impairment and treating or preventing the cognitive decline among the hemodialysis patients in Haemodialysis Unit at VMCH. The present study has revealed a link between cognitive decline and a higher chance of dementia in those suffering from chronic renal failure (CKD), which is problematic since this group of individuals is already at risk. This study indicates that the hemodialysis patients usually suffer cognitive impairment. For these reasons, cognitive training or exercise may be beneficial in treating or preventing cognitive decline in hemodialysis patients. Thus, in order to lessen cognitive loss, hemodialysis patients in this study received cognitive training. Therefore, to avoid or lessen the changes in cognition, cognitive training could be started at the start of hemodialysis in the future. It is a good idea to assign a clinical pharmacist to each hemodialysis facility. This specialist has the potential to significantly improve patient outcomes and treatment.

An ideal information leaflet should be easily accessible, contain sufficient cognitive function-related information and have appropriate design elements that support patient learning. The self-designed training pamphlet was given to the patients (treatment group only) to improve cognitive function. The creation of informational pamphlets can help patients better comprehend not only the effect of cognitive training but also the nature of their disease (cognitive impairment).

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Cite this article: Palanivel M, Saravanan M, Sivakumar M, Harish M, Shanmugam A. To Assess the Level of Cognitive Impairment in Hemodialysis Patient Using MoCA Scale: A Prospective Interventional Study. Indian J Pharmacy Practice. 2024;17(2):140-6.