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Study of assessment of cognitive function and its relation with different stages of chronic kidney disease.

[1]Bhanu Pratap Singh Dhakar, Department of General Medicine, Sri Aurobindo Medical College & Postgraduate Institute, Indore (M.P.)

[2]Shahid Abbas, Department of General Medicine, Sri Aurobindo Medical College & Postgraduate Institute, Indore (M.P.)

[3]Mohit Bhargava, Department of General Medicine, Sri Aurobindo Medical College & Postgraduate Institute, Indore (M.P.)

[4]Suyash Tated, Department of Cardiology, Sri Aurobindo Medical College & Postgraduate Institute, Indore (M.P.)

Corresponding Author: Shahid Abbas, Department of General Medicine, Sri Aurobindo Medical College & Postgraduate Institute, Indore (M.P.)

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Abstract

Background: Hemodialysis is a treatment for end-stage renal disease (ESRD) that is an underlying factor of cognitive impairment in patients.

Materials and Methods: This cross-sectional study was conducted on one hundred patients with ESRD who presented to the SAIMS Hospital between April 2021 and October 2022, with institutional ethics committee approval. Convenience sampling was used to choose the participants.

Results: 100 patients were examined in total, and 42 (42%) of them had cognitive impairment. Only age and a history of stroke showed a significant relationship with this impairment; that is, the possibility of cognitive impairment increases with increasing age, and a history of stroke can increase its risk six-fold.

Conclusion: In this study, cognitive impairment was a relatively common side effect of hemodialysis. Age and a history of stroke are risk factors for cognitive impairment in hemodialysis patients with chronic kidney failure.

Keywords: Cognitive Dysfunction; Renal Dialysis; Kidney Failure

Introduction

People with chronic kidney disease (CKD) frequently experience cognitive impair ment and dementia, especi ally in its advanced stages, but these conditions are still poorly diagnosed. (1) Dementia is a state of persistent and progressive cognitive dysfunction marked by impair ment in memory and at least one other cognitive function area, or domain, such as language, orientation, reasoning, attention, or executive functioning, the cognitive ability required for planning and sequencing tasks. (2) The term "cognitive impairment" refers to a deficit that is more severe than that brought on by ageing normally but is not dementia. However, people with the disease are prone to cognitive dysfunction at any stage, which is linked to a higher risk of death, poor treatment compliance, accele

rated progression of cere bro vascular disease, and longer hospital stays. In comparison to the general population, (3-5) CKD may be strongly associated with the incidence of dementia, particularly vascular dementia. (6,7) People with renal failure, especially those receiving dialysis, are more likely to have cognitive impairment. (8) Unlike dementia, mild cognitive impairment has no effect on a person's daily activities, setting it apart from the dementia syndrome. The causes of cognitive impairment are numerous, but CKD's chronic and crippling nature, combined with an extensive regimen of treatments, may be to blame for this change. (9) The impact of uremic toxins is also blamed for the cognitive impairment. (10) In patients with CKD, the high prevalence of ischemic, symptomatic, or asymptomatic cerebrovascular injuries increases the risk of cognitive impairment and dementia. (3) This vascular mechanism could be the cause of the link between risk factors for kidney and brain disease and their potential exacerbation. (11)

This decline in neuro-cognitive function may be caused by oxidative stress, immune inflammatory processes, anemia, hyper homo cysteine mia, and vitamin B12 deficiency. Pro throm botic factors like endo thelial dys function, abnormal vascular reactivity, athero sclerosis, and cardiovascular events are more prevalent in patients with CKD who receive hemodialysis. (12-17) According to a recent study that compared the cognitive perfor mance of dialysis patients with that of the general population, those receiving dialysis performed worse on tasks that assessed executive function, which are linked to vascular disease and risk factors. (18) Hemodialysis patients performed worse on tests measuring verbal learning, motor ability, verbal fluency, and visuospatial ability. By causing cerebral ischemia, dialysis procedures directly contribute to cognitive decline. Edema can develop and cerebral perfusion can be decreased by acute intravascular volume reduction and fluid changes that take place during sessions. (19) Even with inadequate diagnosis, a significant portion of hemodialysis patients exhibit moderate to severe cognitive impairment, despite evidence that early hemodialysis improves cognitive abilities in patients with CKD.

Study showed, patients with CKD receiving different types of dialysis had similar levels of cognitive dys function. (20) The importance of cognitive testing in people with CKD cannot be overstated. Early diagnosis and intervention helps to contain or mitigate the progress of cognitive impairment because of the complexity of this condition, patients must process and comprehend significant amounts of information in order to properly comply with the treatment. (20) As a result, the current study's goal was to assess the cognitive function of hemodialysis patients with chronic renal disease and its relationship to sociodemographic and clinical traits.

Materials and Methods

This cross-sectional study was conducted on one hundred patients with ESRD who presented to the SAIMS Hospital between April 2021 and October 2022, with institutional ethics committee approval. Convenience sampling was used to choose the participants. They started their hemodialysis session after signing informed consent forms. Based on the sample size equation for estimating the ratio of a trait in a community, taking into account P=30%, with a confidence interval of 95% and a precision of 0.06, the necessary sample size was determined to be 100. Being given an ESRD diagnosis based on the medical records was the only requirement for inclusion. Absolute illiteracy, refusal to participate in the study, use of brain-suppressants like opioids and sedative hypnotics, anxiety and severe depression based on medical history, use of anti-anxiety medications and

anti-depressants, and mental disability were among the exclusion criteria.

According to the inclusion and exclusion criteria, the subjects were chosen at random, and sampling continued until the estimated sample size was reached. The demo graphic information of the patients, such as gender, age, education level, and BMI, was gathered using a questionnaire created. Their clinical details, such as the length of hemodialysis, underlying illnesses, and more, were taken from the medical records.

The MMSE, which has a total score range of 0 to 30, is a practical tool for cognitive assessment and dementia screening. Orientation (5 points for time and 5 points for place), short-term memory (3 points for registry and 3 points for recall), paying attention while calculating (5 points), language (5 points), com prehension/ executive function (3 points), and copying interlocking pentagons are the components of the MMSE (1 point). A lower score (less than 24) denotes poorer cognitive perfor mance.

The MoCA has a high sensitivity in the diagnosis of Alzheimer's disease (100%) and mild cognitive im pairment (90%). The single-sheet screening tool has a Cronbach's alpha reliability of 92%, has a cut-off point of 26, takes less than 15 minutes to complete, and provides respondents with a maximum score of 30. The attention and con centration, executive functions, memory, langu age, visuo constructive skills, conceptual thinking, cal culations, and orientation are among the seven cognitive domains that are assessed by this test. People with a score of 26 are regarded as normal.

Results

Table 1: The frequency of gender, education, dialysis sessions, underlying diseases, and various stage of kidney disease in patients with and without cognitive impairment

Variables	Sub- Variables	Cognitive impairment				p-value
		Yes (42)		No (58)		
		n	%	n	%	
Gender	Male	25	59	30	51	1.00
	Female	17	40	28	48	
Education	Illiterate	10	23	15	25	0.0001
	High school	15	35	20	34	
	Higher secondary	12	28	20	34	
	Graduate	5	11	3	5	
Dialysis episode (in week)	1time	10	23	22	37	0.486
	2time	12	28	25	43	
	3time	10	23	6	10	
	emergency	10	23	5	9	
Underlying disease	Yes	30	71	38	65	0.014
	No	12	28	20	34	

Stage	Stage1[Signs of mild kidney disease with normal or better GFR; GFR->90%]	00	00	00	00	0.0682
	Stage2[Mild kidney disease with reduced GFR; GFR60-89%]	00	00	00	00	
	Stage3[Moderate chronic renal insufficiency; GFR30-59%]	5	11	11	19	
	Stage4[Severe chronic renal insufficiency; GFR15-29%]	12	13	22	37	
	Stage5[End stage renal disease; GFR<15%]	25	34	25	43	

Table 1 shows that out of 42 patients (42%) who had cognitive impairment 25 were males and 17 females wheres 58 (58%) had normal cognition. Fisher's exact test in table 1 showed p=1.000 for gender distribution between patients with and without cognitive impairment, but p=0.014 for underlying diseases, 71% cases with cognitive impairment had history of an underlying disease. In our study Chi-square test also showed that cognitive impairment was associated with a higher frequency of lower education (p<0.0001). However, dialysis frequency did not differ between groups (p=0.486). Using the serum creatinine, GFR was calculated using Cock groft Gault formula. Out of 100 patients' stage 3 patient were 25 and cognitive dysfunction was observed in 11 cases, stage 4 patient were 25 with 13 cases having cognitive dysfunction and stage 5 patient were 50 and cognitive dysfunction was observed in 34 cases.

Table 2: Hemodialysis patients with and without cognitive impairment: mean age, BMI, duration of dialysis and MSME Score.

Variables	Cognitive impairment	n	M±SD	p-value
Age (in years)	Yes	42	63.40±15.15	0.0001
	No	58	54.58±16.41	
BMI	Yes	42	26.26±2.61	0.616
	No	58	26.16±2.70	
Dialysis duration (in month)	Yes	42	15.62±11.88	0.724
	No	58	14.79±10.93	
MMSE Score	Yes	42	23.4 ± 5.2	<0.001
	No	58	25.9 ± 3.7	

Table 2: The independent t-test showed that the group of patients with cognitive impairment had a significantly higher mean age than the other group (p<0.0001), but Mann-U-test Whitney's showed no significant differences in BMI or dialysis duration (p=0.616 and p=0.724, respectively) while MSME score in group of patients with cognitive impairment had a significantly lower mean than the other group (p<0.0001).

Table 3: The mean score of the MoCA and its seven sub-domains in the patients undergoing hemodialysis (n=100)

Cognitive domains	M±SD	range
Visuospatial/executive	1.12±1.64	0-5
Naming	1.80±1.06	0-3
Attention & Memory	2.33±1.88	0-6
Language	1.48±1.28	0-3
Abstraction	0.82±0.83	0-2
Delayed recall	1.31±0.64	0-5
Orientation	4.78±1.57	0-6
Mo CA Total Score	20.76±9.22	0-30

Table 3 shows the mean and standard deviation of the MoCA and its seven subdomains for 100 patients revealed that orientation had the highest mean score and conceptual thinking and memory the lowest. Study MoCA scores were 20.76±9.22.

Table 4: The patients' clinical data by cognitive status

Variables	Sub-Variables	Cognitive impairment				p-value
		Yes (42)		No (58)		
		n	%	n	%	
Diabetes mellitus	Yes	22	53	38	65	0.003
	No	20	47	20	35	
Stroke	Yes	30	72	40	68	0.009
	No	12	28	18	32	
Hypertension	Yes	28	67	32	55	0.761
	No	14	33	26	45	
	No	24	57	38	65	
Hyperlipidemia	Yes	25	60	35	60	0.451
	No	17	40	23	40	
Kidney stone	Yes	35	83	45	77	0.459
	No	7	17	13	23	

Table 4 showed that out of the total patients having cognitive impairment 53% were diabetics (P= 0.003) whereas 72% of the patients with cognitive impair ment, had history of CVA associated (P=0.009). Among the cases with cognitive decline 83% had kidney stones, 67% were hypertensive and 60% had hyperlipidemia.

Discussion

Previous studies conducted throughout the world and in India have mostly used the MMSE to assess cognitive impairment, which does not have a high sensitivity for the early detection of mild cognitive impairment and has a reported low specificity of 53%. A study conducted in Iran although it was done based on the MMSE, estimated the frequency of cognitive impairment as 47.22% which is higher than our results (15). This and similar studies cited have unanimously concluded that cognitive impair ment is worryingly common in patients with renal failure. The prevalence of cognitive impairment was reported as 18.8% in Japanese patients undergoing hemodialysis (12) and as 25% in Moroccan patients by Wechsler memory test (16).

Different studies have thus reported different prevalence rates for cognitive impairment in hemodialysis patients; this disparity may be attributed to the different diagnostic methods used, the different measures used for assessing cognitive impair ment and the different sample popu lations examined and methods of sampling used. In a study by Murray et al. (25) on hemodialysis patients aged over 55, severe cognitive impairment was reported as 37 %.

The present study found that the possibility of cognitive impairment increases with age and that a history of stroke increases the risk of cognitive impairment by sixfold. Many studies have examined whether hemodialysis is an independent factor that causes cognitive impairment or if other risk factors are also at play, and different results have been obtained. For example, Odagiri et al. (12) argued that hemodialysis treatment is an independent risk factor for cognitive impairment in patients with renal

failure. Fadiliet al. (16) also found that lower levels of education and anemia are risk factors for the incidence of cognitive impairment in patients undergoing hemo dialys is. In a study by Eslami-Amirabadiet al. (15), cognitive impairment was found to be associated with age, lower levels of education and diabetes mellitus, depression and positive qualitative CRP. A review of previous studies and the noted dispersion in the assessment of factors associated with cognitive impairment suggest that a clear direction has not yet been developed for the treatment and prevention of cognitive impairment in renal failure patients or for their rehabilitation. Old age and a low level of education are common associated factors both in the present study and in previous studies.

In justifying the mechanism through which aging can make patients susceptible to cognitive impairment, it seems that aging is an independent factor that can lead to cognitive changes with the atrophic changes it brings to the brain tissue.

In line with the results of previous studies (15,16), the present findings show that a lower level of education increases the risk of cognitive impairment in hemo dialysis patients. This finding can be justified by noting that a low level of education is generally associated with lower cognitive and functional reserves and may lead to a poorer lifestyle (26). The concept of cognitive reserve was first introduced by Yaakov Stern and holds that, when injured, the brain is assisted by certain com pensation processes that allow the brain to escape cognitive impairment unless with a greater amount of injury; the present finding implies that a higher cognitive reserve, which is itself affected by a higher level of education, can help combat cognitive impairment (27).

In the present study, a history of stroke was one of the underlying diseases that were proposed as an effective and significant risk factor for cognitive impairment in hemodialysis patients. Previous studies have also shown that hemodialysis patients with a history of stroke are more likely to score below 24 on the MMSE (34.6%) compared to patients without a history of stroke (15.6%) (12). In support of this finding, researchers have proven over the years that patients with a history of stroke with large infarcts involving the cerebral cortex or the anterior and posterior arteries in the left hemisphere of the brain experience significant cognitive impairment in their memory functions, attention, orientation and language abilities (28). Researchers also believe that stroke can cause cognitive impairment, especially in areas of executive functioning, attention, memory and recall by the lesions it creates in the white matter (29). Researchers have also found that learning ability and verbal recall can be weakened even in patients with a mild stroke (30). Nonetheless, stroke explains only part of the cause of cognitive impairment in hemodialysis patients and cannot justify this defect entirely (12,15) Cognitive function was not significantly related to the duration of dialysis and the number of dialysis sessions per week in the present study, which may be due to the early diagnosis and treatment of renal failure in the patients and their being monitored by the physicians, which have led to the lower exposure of their brain tissue to the toxins of uremia and its complications; this finding explains how, despite the long period of suffering from renal failure and the adequate number of dialysis sessions, the patients have survived the cognitive side-effects of this treatment. Further studies are still needed on this subject to achieve more accurate results. Odagiriet al. (12) found that the duration of hemodialysis has no significant relationships with cognitive impairment in renal failure patients. It can thus be concluded that hemodialysis is not a risk factor for cognitive impairment per se, and the hypothesis of "associated factors" should thus be further investigated.

One of the limitations of this study was lack of coope ration of some patients because of their poor physical and medical condition.

Conclusion

The current research indicates that hemodialysis patients with renal failure have a significant prevalence of cognitive impairment (42%). The prevention and prompt treatment of renal dysfunction can help patient's personal and social functioning. Cognitive impairment is one of the common problems faced by patients with renal failure and those receiving dialysis, and it is frequently undia gnosed or neglected. Prevention and early diagnosis are essential given the rising prevalence of chronic renal failure and the impact that cognitive impairment has on these patient's quality of life and mortality. Therefore, it is advised that cognitive functioning be assessed during all of a patient's periodic examinations for renal failure in order to ensure an early diagnosis and appropriate care for this impairment. Additionally, it is important to identify the factors that exacerbate cognitive impairment in patients receiving hemodialysis because these patient's mental health and quality of life depend heavily on optimal cognitive functioning. Cognitive reha bilitation programs are therefore strongly advised for these patients. Age and a stroke history have been found to be separate risk factors for cognitive impairment in hemo dialysis patients with chronic renal failure.

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