Journal of Clinical and Biomedical Sciences

Original Article

Influence of cognitive status on motor ability, balance and functional independence in post stroke patients in rural Bangalore.

Raavi Abhinandana[1], Sarulatha Haridass[2*], Ramesh Kumar Jeyeraman[3]

1. EX. Senior Physiotherapist, Medicover hospitals, Hyderabad.
2. Professor, Department of Physiotherapy, Sri Devaraj Urs Academy of Higher Education & Research, Kolar.
3. Professor & HOD, Department of Physiotherapy, Sri Devaraj Urs Academy of Higher Education & Research, Kolar.

Abstract

Background: Stroke results in problems with attention, memory, language, balance disability, motor ability and functional independence. Apart from decline in physical functions, the cognitive impairments cause serious functional consequences. Intact Cognitive functions are considered as distinct factors to identify the performance outcome of activities of daily living. Cognitive impairment can result in significant disability in all aspects of patient life with self-care, independent living skills, work and leisure, social and interpersonal skills in acute as well as chronic stroke patients.
Aims: To explore and analyze the relationship of Cognitive Status on Motor Ability, balance and functional independence in acute post stroke patients.
Settings and Design: Epidemiological – observational study conducted in community nursing homes.
Methods and Material: 66 participants who were willing to involve in the study were enrolled with respect to the inclusion and exclusion criteria. The cognitive status, motor ability, balance and functional independence were measured with MMSE (mini mental status examination), FMA (Fugel Meyer Assessment Scale- motor component), and BBS (berg balance scale, FIM (Functional independence measure) respectively after one month and again repeated after 3 months post stroke.
Statistical analysis: chi square test with Pearson product correlation & regression used to analyse the impact of cognitive ability on motor activities, balance and functional independence.
Results: Among the three variables balance ability showed stronger co relation with cognitive status in stroke patients, with every unit of change in cognition there was 0.307 unit (B value in regression analysis) increase in balance measures. The scores of functional independence showed positive correlation with Pearson product correlation r = 0.698.
Conclusions: Cognitive functions were found to have better association on balance related activities. However the changes in cognitive status demonstrated higher influence on functional independence than balance parameters in post stroke patients.
Keywords: Attention, memory, cognition, balance, Cerebrovascular Accident (CVA).

Introduction

"Stroke can be characterized as a condition with rapidly emerging clinical indications of central loss of cerebral capacity with side effects enduring over 24 hours or prompting demise with no clear reason other than vascular origination".[1] Stroke is one of the prime reasons for death and usual source of long term disability. The primary cognitive capacities of orientation, attention and memory largely reflect the neuroanatomical and physiological integrity of brain.[2] They are thought to be prerequisite to higher grade of thinking capacities and to regulate meta processing. The cognitive abilities are observed to undergo changes with intervention of specific rehabilitation methods.

***Corresponding Author**
Dr. Sarulatha Haridass
Professor, Department of Physiotherapy,
Sri Devaraj Urs Medical College, Sri Devaraj Urs Academy of Higher Education & Research,
Tamaka, Kolar.
Mobile No: 9686235790
E-mail: charuparthe@gmail.com
Conflict of Interest: None
Financial Aid: Nil

Stroke causes motor deficits to one side of the body along with a variety of focal deficits such as altered levels of consciousness, cognition, sensation, impaired balance and functional independence. Stroke is one of the common reasons for cognitive Impairment [3-5] and the frequency of post-stroke cognitive deficits varies widely from 20% to 80% in many countries.[6] In India, the incidence of cognitive disability is estimated to be around 20%.[7]

Cognitive declines results due to lesion in the frontal cortex and develop impairments in memory, attention, orientation and executive function. An average of about 3.7 point drop in Mini Mental Scale Examination (MMSE) score observed post stroke. Pre-morbid changes associated with pathological aging may also account for some dysfunction noted and should be carefully determined by assessment.[8] Following stroke many patients are unable to maintain balance in sitting , standing or to move into a weight bearing posture due to impairments on steadiness, symmetry and dynamic stability. Difficulty in maintaining balance is due to delay in onset of motor activity, abnormal timing and sequence of muscle activity which result in disorganization of postural synergies. Functional performance and basic day to day activities like eating, grooming, cleaning etc are also weakened in around 67% to 88% of stroke patients manifesting total or partial dependency.[9]

Neurophysiological techniques used in rehabilitation require intact cognitive skills to learn exercise and follow simple commands and direction. Reduced attention results in difficulty of learning a task, adapting to environment with increased incidence of falls and declined alertness leads to lack of active participation in the rehabilitative measures. Hence presence of cognitive impairment is a major obstacle in patients recovery process. Studies were conducted to analyse the relationship between cognitive statuses with other variables in post stroke patients, concluded contradicting and mixed results.[10] Due to the ambiguity in literature searched within our context, this study intended to analyse the association of cognitive status on motor ability, balance and functional independence in acute post stroke patients.

Material and Methods

Ethical clearance was obtained and the stroke patients, who came forward out of their own willingness, were recruited for the study. Written consent form was taken from patients and the study was explained to them. Patients with stable vital parameters between 40 to 60 years who had stroke for first time and upto four months post stroke were included. Patients with repeated stroke, visual & auditory impairments, aphasia & dysphasia, other associated neurological or musculoskeletal disorders were excluded from participation in the study.

The baseline characters like name, age, sex and time since stroke, side of paresis, occupation and address of patient were collected followed by assessment on cognitive status, motor ability, balance and functional independence. Patients were included irrespective of the side of paralysis, since the side of stroke has been shown to have no effect on the cognitive capacity or functional efficiency in stroke.[11]

The baseline information was taken after one month from onset of stroke and repeated again after 12 weeks. MMSE was used to detect cognitive abilities related to orientation, learning, calculation, abstraction, memory change and spatial relationship. Every task was given score 1(able to fully complete the task) or (unable to complete the task) with total possible score of 30. A score of less than 24 considered as impaired cognition. Motor performance was assessed by motor part of Fugl Meyer Assessment scale with items organized in sequential motor recovery following the stroke on balance, sensation, range of motion and pain in a 3 point ordinal scale. Balance was measured by Berg's Balance Scale which is an objective measure of static and dynamic balance activities. The scale consists of 14 functional tasks commonly performed in everyday life, in a 5 point ordinal scale with a maximum score of 56 points. Functional performance was measured by functional independence measure (FIM), 18 item scale measuring physical, psychological and social performance. FIM uses level of assistance an individual needs to grade functional status from total dependence to total assistance.

Statistical analysis

Pearson's correlation coefficient was used to determine the relationship of motor ability, balance and functional independence on cognition levels with p value at 0.01.Regression Analysis further explored the relationship between the variables.

Results

Chi-square statistical test was applied to analyse co relation between cognitive ability and motor activities, balance and functional independence and B value interpreted for regression analysis. Among the three variables balance ability showed stronger co relation with cognitive status in post stroke patients, with every unit of improvement in cognition there was 0.307 unit increases on balance. The excellent correlation with Pearson product

correlation r = 0.698 indicated significant changes in scores of functional independence with cognitive abilities in post stroke patients. The details of the gains in co relation and regression are shown in table 2,3,4.

Table 1: Mean and SD of age and frequencies of male and female. (N=number)

Participants	Mean (age) ± SD	Male N (%)	Female N (%)
Post Stroke Patients	56.33±9.15	41(62%)	25(38%)

Table 2: Shows gains in motor ability, balance and functional independence after one month and 12 weeks post stroke.

Variables	One month post stroke (N=66)		After 12 weeks (N=66)		Gain Scores (N=66)	
	Min to Max	Mean ± SD	Min to Max	Mean ± SD	Min to Max	Mean ± SD
MMSE	5-18	12.29±3.76	6-28	20.44±6.4	1-16	8.15±3.86
FMS	2-36	20.94±9.32	6-75	40.67±17.34	4-44	19.73±10.83
BBS	2-36	21.21-±5.82	4-54	37.52±9.74	2-29	16.3±8.44
FIM	10-23	15.95±2.22	16-69	48.41±10.65	6-46	32.42±10.11

Table 3: Correlation between Cognitive functions and Motor ability, balance, functional independence measures among the recovering Stroke patients.

(N=66)

Variables	Pearson's Correlation Coefficient	Level of Significance (P value)
Cognitive status vs. Motor Ability	0.657	0.01
Cognitive status vs. Balance	0.671	0.01
Cognitive status vs. Functional Independence	0.698	0.01

Table 4: Regression analysis stating relationship between cognition and motor performance, balance, functional independence in post stroke patients. (N=66, B – beta value in regression analysis).

Relationship between variables	B	Standard error	R value	Level of Significance (P value)
Cognition and Motor Ability	0.234	0.34	6.979	0.0001
Cognition and Balance	0.307	0.042	7.246	0.0001
Cognition and Functional Independence	0.267	0.034	7.790	0.0001

Discussion

66 participants were enrolled and the baseline measures for cognition, motor ability, balance and functional performance was done with MMSE, FMA- motor component, BBS and FIM respectively. Patients were undergoing conventional physiotherapy and the required information was collected one month and 12 weeks post stroke. Analysis of the scores included changes in the level of scores at baseline and at 12 weeks and to quantify the correlation and cause-impact effect Pearson products correlation coefficient regression analysis was used.

Motor ability and cognitive status was strongly correlated with Pearson correlation value as 0.657 but some patients who initially demonstrated lesser cognitive and motor scores, showed motor improvement after 12 weeks in spite of low cognitive levels. This may be due to initial physiological recovery such as resolution of neuronal shock, which restores complete action of uninjured neural channel and recruitment of previously silent synopsis to certain amount. However the maximum motor gain observed were only up to four points out of total score in FMA scale owing to the fact that improvement due to physiological functioning was limited. The initial recovery follows recovery through motor learning by CNS reorganization. Attention, memory, knowledge of results and few basic cognitive control functions essential for effective motor learning, to acquire knowledge and perform a relatively novel motor task. Regression analysis showed significant changes (B=0.234) in motor activity execution for each unit change in cognitive scale.

Balance functions and cognitive abilities indicated excellent correlation with Pearson product correlation value of 0.671. The max gain in balance was 2 points in patients with low cognitive score but maximum increments observed in balance was up to 54 scores in Bergs balance scale corresponding to increases with MMSE scores. Further, regression analysis showed significant changes (B=0.307) , i.e. increase in balance measures for every unit increase in cognitive status. The improvements in cognitive ability would have impacted the balance related requirements like active postural reaction and stability during body positioning in environment. Hence it may be concluded that stroke patient require intact cognitive skills to maintain balance related activities.

The scores of functional independence showed excellent correlation with Pearson product correlation r = 0.698. The influence of cognitive abilities such as memory, comprehension and attention on the motor skills evident the improvements in functional independence.

Among the three variables balance ability showed stronger co relation with cognitive status in stroke patients, with every unit of changes in cognition there was 0.307 increases on balance. However functional performance was strongly related with cognitive status, with an R value of 7.790. The association observed in the present study between cognitive functions and mobility, balance and functional independence were similar to the results of previous studies indicating better functional outcomes with higher cognitive status.[12] Post stroke patients with a certain degree of cognitive abilities may achieve independent living and its ideal to focus on optimizing functional recovery during the acute to sub acute post stroke period.[13] The cognitive processes were more involved in making use of critical information about adapting motor behaviour to improve efficiency. Effective memory, cognition, motor planning and execution were related to improvements in clinical symptoms.[14] Stroke patients with hemiplegia demonstrated larger duration to perform a coordinated upper limb task; the lack of sufficient cognitive effort was related to clumsy movement performance[15]. Studies which analysed association of cognitive and motor ability reported strong links between gait[16] and balance activities with cognitive dimensions of attention and daily activities. The amount of association was influenced by the type of tools used for assessment.[17]

Balance abilities predicted cognitive impairment in acute stroke patients than walking ability. The prevalence of cognitive impairment varies significantly between 20 to 80 percent in post stroke patients, and the probable cause could be the heterogeneous population, period of study, and diagnostic methods used in the studies.[18] Initial cognitive status was evidenced as predicting factor of improvement in motor skills and functional independence, in post-stroke patients.[19]

Stroke patients with chronic balance disability presented severe strokes, impairments, and disabilities.[20] In stroke patients higher cognitive impairment resulted in functional impairment, poor long -term outcomes, falls including death and disability, and higher institutionalization. Attention deficits correlated with balance, ADL ability and proning to falls emphasising that declines would impart to accident prone activities and falling.[21] The amount of cognitive deficiency caused demanding ADL as the ability to perform physical activity was managed by cognitive and higher centre system factors[22] and cognitive factors.[23, 24]

Thus the findings of present study propose a positive correlation between cognition on motor ability, balance and functional independence with emphasis on intact cognition for effective rehabilitation process in acute post stroke patients. Patients with better cognitive scores at baseline showed significant recovery after 12 weeks post stroke.

However the findings of the present study may not be widely generalized due to the relatively small and homogenous sample size of this study. Further certain co morbidities were not considered, such as age related cognitive and functional changes, educational levels, and mood changes. The effects on the recovery of motor and cognitive skills to functional recovery in stroke patients were not considered. Future research on diverse stroke population with controlled variables can throw much light on this area of research.

References

1. Aho K, Harmsen P, Hatano S, Marquardsen J, Smirnov VE, Strasser T. Cerebrovascular disease in the community: results of a WHO collaborative study. Bull World Health Organ 1980; 58(1):113-130.
2. Radomski MV. In Occupational Therapy for Physical Dysfunction. Trombly C and Radomski ME (Eds). Fifth Edition: Lippincott Williams and Wilkins 2001: 197-209.
3. O'Brien JT, Erkinjuntti T, Reisberg B, Roman G, Sawada T, Pantoni L et al. Vascular cognitive impairment. Lancet Neurol 2003 ;2(2):89-98.
4. Ankolekar S, Renton C, Sare G, Ellender S, Sprigg N, Wardlaw JM et al. Relationship between poststroke cognition, baseline factors, and functional outcome: data from "efficacy of nitric oxide in stroke" trial. J Stroke Cerebrovasc Dis 2014;23(7):1821-9.
5. Leys D, Hénon H, Mackowiak - Cordoliani MA, Pasquier F Poststroke dementia. Lancet Neurol 2005;4(4): 752-9.
6. Sun JH, Tan L, Yu JT. Post-stroke cognitive impairment: epidemiology, mechanisms and management. Ann Transl Med 2014;2(8):80.
7. Das S, Paul N, Hazra A, Ghosal M, Ray BK, Banerjee TK et al. Cognitive Dysfunction in Stroke Survivors: A Community-Based Prospective Study from Kolkata, India. J Stroke Cerebrovasc Dis 2013; 22(8):1233-42.
8. Zinn S, Dudley TK, Bosworth HB, Hoenig HM, Duncan PW, Horner RD. The effect of poststroke cognitive impairment on rehabilitation process and functional outcome. Arch Phys Med Rehabil 2004 ;85(7):1084-90.
9. Janet Carr and Roberta sphere; Neurological rehabilitation – "Optimizing motor performance"; Chapter 1, first edition; butter worth – Heinman Publications.2011:376.
10. Rabadi MH, Rabadi FM, Edelstein L, Peterson M. cognitively impaired patients do benefit from admission to acute rehabilitation unit. Arch Phys Med Rehabil 2008; 89(3):441 – 8.
11. Osmon DC, Smet IC, Winegarden B, Gandhavadi B. Neurobehavioral Cognitive Status Examination: its use with unilateral stroke patients in a rehabilitation setting. Arch Phys Med Rehabil 1992 ;73(5):414-8.
12. Heruti RJ, Lusky A, Dankner R, Ring H, Dolgopiat M, Barell V et al. Rehabilitation outcome of elderly patients after a first stroke: effect of cognitive status at admission on the functional outcome. Arch Phys Med Rehabil 2002; 83 (6):742 – 9.
13. Lee KB, Lim SH, Kim KH, Kim KJ, Kim YR, Chang WN et al. Six-month functional recovery of stroke patients: a multi-time-point study. Int J Rehabil Res 2015;38(2):173-80.
14. Cirstea C. M, Ptiti, Levin M.F. Feedback and cognition in arm motor skill reacquisition after stroke. Stroke 2006; 37(5):1237 –42.
15. Fang Y, Yue GH, Hrovat K, Sahgal V, Daly JJ. Abnormal cognitive planning and movement smoothness control for a complex shoulder/ elbow motor task in stroke survivors. J Neurol Sci 2007; 256(12):21 – 9.
16. Wesselhoff S, Hanke TA, Evans CC : Community mobility after stroke: A systematic review. Top Stroke Rehabil 2018; 25(3): 224-238.
17. Verstraeten S, Mark R, Sitskoorn M. Motor and Cognitive Impairment after Stroke: A Common Bond or a Simultaneous Deficit? . Stroke Res Ther 2016: 1(1):1-10.
18. Chaurasia RN, Sharma J, Pathak A, Mishra VN, Joshi D. Poststroke Cognitive Decline: A Longitudinal Study from a Tertiary Care Center. J Neurosci Rural Pract 2019;10(3):459-464.
19. Ursin M H, Bergland A, Fure B, Tørstad A, Tveit A, Ihle-Hansen H. Balance and Mobility as Predictors of Post-Stroke Cognitive Impairment. Dement Geriatr Cogn Disord Extra 2015; 5(2): 203-11.
20. Tyson SF, Hanley M, Chillala J, Selley A, Tallis RC. Balance disability after stroke. Phys Ther 2006 ;86(1):30-8.
21. Tatemichi TK, Desmond DW, Stern Y, Paik M, Sano M, Bagiella E. Cognitive impairment after stroke: frequency, patterns, and relationship to functional abilities. J Neurol Neurosurg Psychiatry 1994;57(2):202-207.

22. Zinn S, Bosworth HB, Hoeing HM, Swartzwelder HS. Executive function deficits in acute stroke. Arch Phys Med Rehabil 2007; 88(2):173 – 80.
23. Saxena SK, Ng TP, Koh G, Yong D, Fong NP. Is improvement in impaired cognition and depressive symptoms in post-stroke patients associated with recovery in activities of daily living? Acta Neurol Scand 2007 ;115(5):339-46.
24. Isha SA. Impact of Cognitive Impairments on Functional Ambulation in Stroke Patient. Int J Phys Med Rehabil 2019; 7(5): 528.