Clin Schizophr Relat Psychoses
Volume 16:1, 2022
Doi:10.3371/CSRP.HREE.010522

Clinical Schizophrenia & Related Psychoses

Research Article

Hybrid Open Access

Correlative Study between Memory Deficits and Upper Extremity Motor Dysfunction in Hemiplegic Stroke Patients

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Abstract

Background: Stroke patients majorly suffer from both motor and cognitive impairments. Rehabilitation programs focus more on treating motor impairments through using conventional treatments. However, if intact memory is required to perform motor functions; then can memory training/rehabilitation enhance motor recovery. The aim of this study was to investigate the relationship between memory deficits with upper limb motor dysfunction in patients with stroke.

Materials and methods: Fifty stroke patients were recruited in this correlational study. Upper limb motor function was evaluated by the Fugl-Meyer Assessment-Upper Extremity (FMA-UE). Cognitive functions were evaluated by the Addenbrooke's Cognitive Examination (ACE). For correlation, data were imported into Statistical Package for the Social Sciences (SPSS version 20.0) (Statistical Package for the Social Sciences) software for analysis. A result was considered statistically significant when p was <0.05. Chi-Square test X^2 was used to test the association variables for categorical data.

Results: There was a significant correlation between memory parameter of Addenbrooke's Cognitive and motor functions. ACE memory parameter with FM (r=.580**, p=.000).

Conclusion: There was a highly significant correlation between memory deficits and motor dysfunction.

Significant statement: This study confirmed that there was significant correlation between memory deficits and motor dysfunction in stroke patients with hemiplegia.

Keywords: Memory deficits • Motor impairment • Stroke • Cerebrovascular

Introduction

Stroke can be defined as the acute occurrence of cerebrovascular deficits leading to neurological manifestations which presented by persisting symptoms last for more than 24 hours with detection of a permanent lesion reported by neuroimaging techniques [1].

According to the WHO, approximately 15 million individual can be diagnosed with stroke annually with the rate of one person suffers from a stroke every 40 seconds in the world with occurrence of deaths every 4 minutes. 33.3% of stroke patients survive with permanent disability and only 10% can recover completely [2,3].

In the early stages after stroke, flaccid paralysis would occur followed by spasticity described by progressive increase in muscle tone with consequences of adverse affection of motor learning leading to motor dysfunction post-stroke [4,5].

Approximately, 70% of patients with stroke have moderate to severe upper extremity affection with the primary obstacle of isolating joint movements specifically wrist and finger extensors out of the flexion synergy [6,7].

Cognition is the umbrella term including attention, memory, perception, language, executive function, and visuospatial ability. Cognitive impairments include many features of speech and language deficits, memory loss and also reduced cognitive control. All these cognitive functions are correlated together so, failure of performing a task is not due to damage of one domain but may be due to a couple or more. Good memory with adequate attention and language are required in order to remember a list of items [8,9].

Materials and Methods

A50 (23 males and 27 females) stroke patients with mild-to-moderate paresis in the upper limb of age 63.68 ± 12.99 age referred to the outpatient clinic, who were assessed and medically diagnosed as stroke with hemiparesis, were randomized in the study. Patients with dementia, Parkinson, Alzheimer, orthopaedic problems that prevent voluntary participation and any other neurologic disorders were the exclusion criteria from the present study. Written informed consent was obtained from each patient prior to any assessments. Age, sex, duration of disease, and side of affection of the patients were recorded.

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Received: 08-Dec-2021, Manuscript No. CSRP-21-49510; **Editor assigned:** 10-Dec-2021, PreQC No. CSRP-21-49510 (PQ); **Reviewed:** 24-Dec-2021, QC No CSRP-21-49510; **Revised:** 29-Dec-2021, Manuscript No. CSRP-21-49510(R); **Published:** 05-Jan-2022, DOI: 10.3371/CSRP.HREE.010522.

All assessments for the same patient were applied by the same physiotherapist.

The subjects voluntarily agreed to participate in the study after the study's purpose and the research methodology were explained.

Participants underwent assessments that evaluated both memory of cognitive functions and upper limb motor function. Memory assessment included the Addenbrooke's Cognitive Examination and the function of the upper extremity was evaluated through the Fugl-Meyer Assessment (upper extremity).

The Addenbrooke's Cognitive Examination (ACE) is a 15-minute neuropsychological scale. It tests the five domains of cognitive functions including: attention, memory, fluency, visuospatial and language with a sum score of 100. A reduced score indicates deteriorated cognitive functions [10].

The Fugl-Meyer Upper Extremity Assessment (FMA-UE) constitutes of 33 items used to evaluate motor function, joint pain, sensation, and passive joint movement in post-stroke hemiplegic patients. The assessment can be completed within 30 minutes as each item is given a score out of 2 where 0=unable to perform, 1=partially able to perform, and 2=completely able to perform [11].

Statistical analysis

Data collected throughout history, basic clinical examination and outcome measures coded, entered and analysed using Microsoft Excel software. A Statistical Package for the Social Sciences (SPSS version 20.0) (Statistical Package for the Social Sciences) was used to evaluate the data obtained from the study. Descriptive statistical methods (frequency, proportion, mean and standard deviation) were used in the evaluation of research data. The data showed a normal distribution according to the Shapiro-Wilk testing. Difference and association of qualitative variable were tested by Chi square test and Fisher's Exact Test was used to test the association variables for categorical data. Difference between quantitative independent groups was tested by t test or Mann Whitney Test. Spearman's Product correlation coefficient was used to evaluate the linear association between variables.

The results were calculated at the 95% confidence interval, P<0.05 significance level and P<0.01 advanced significance level.

Results

Baseline characteristics of the patients are shown in Table 1. Patients included 23 males and 27 female patients with 25 right side and 25 left side. The average age was 63.68 ± 12.99 years and the average duration of illness was 8.44 ± 3.4 months in, as shown in Table 1.

Table 1. Data are presented as mean ± SD or number of patients.

Characteristics	(n=50)
Age (years, mean ± SD)	63.68 ± 12.99
Duration of illness (months, mean ± SD)	8.44 ± 3.4
Sex (female/male)	27(54 %)/23 (46%)
Side of affection (right/left)	25 (50%)/25 (50%)

As shown in Table 2 memory Addenbrooke's Cognitive parameters of the all patients. Regarding mean memory was 8.48 ± 7.02.

Table 2. Addenbrooke's Cognitive memory parameter of all patients.

Variable	(n=50)
Memory	8.48 ± 7.02
Note: Data are presented as mean ± SD.	

Illustrated Fugl-Meyer assessment of upper extremity of the all patients. Mean Reflex activity 1.16 ± 1.89, mean Volitional movement within synergies was 2.24 ± 4.88, Volitional movement mixing synergies was .6–1.67 mean Volitional movement with little or no synergy was .48 ± 1.34, mean Normal reflex activity was .08 ± .4, as shown in Table 3.

Table 3. Fugl-Meyer assessment of upper extremity of all patients.

Variable	(n=50)
Reflex activity	1.16 ± 1.89
Volitional movement within synergies	2.24 ± 4.88
Volitional movement mixing synergies	.6-1.67
Volitional movement with little or no synergy	.48 ± 1.34
Normal reflex activity	.08 ± .4
Note: Data are presented as mean ± SD. *P<0.05.	

Table 4 illustrated that total of upper extremity scale ranged 0-36, total of hand scale ranged 0-14 and total motor function ranged 0-50 with mean 5.64 ± 12.57.

Table 4. Total Fugl-Meyer scale of upper limb of all patients.

Variable	(n=50)
Upper extremity	4.04 ± 8.71
Hand	1.6 ± 4.01
Total motor function	5.64 ± 12.57
Note: Data are presented as mean ± SD.	

Tables 5 and 6 Shows significant correlation between Addenbrooke's Cognitive with motor functions.

Table 5. Correlation of memory Addenbrooke's Cognitive function with motor function parameters.

		Addenbrooke's (memory)
Reflex activity	r	.367**
	p	.009
Volitional movement within synergies	r	.596**
	p	.000
Volitional movement mixing synergies	r	.565**
	p	.000
Volitional movement with little or no Synergies	r	.552**
	p	.000
Normal reflex activity	r	.349*
	p	.013
Total upper extremity	r	.587**
	p	.000
Hand	r	.567**
	p	.000
Total motor function	r	.588**
	p	.000

Table 6. Fugl-Meyer scale with Adenbrooke's memory function parameters.

		FMA
Memory	r	.000
	P	0580**
Note: *P<0.05.		

Discussion

Memory can be defined in humans as the domain where new data is encoded and reserved until future use [12].

Memory is one of the most important domains that may be prominently affected by stroke as one study reported that about 30% of stroke patients may suffer from memory deficits [13].

The severity of memory affection depends on the patient's well-being prior to the stroke incidence as well as the affected brain area as each hemisphere in the brain is responsible for different aspects of the body leading to different memory deficits from right to left hemispheric lesion. Memory loss has common manifestations characterized by difficulty in performing elementary tasks, slow thinking, diminished attention as well as sluggish movement making it a burden to live independently carrying out daily activities [14].

Many studies reported that memory deficits reach their peak at about 3 months post stroke with a percentage ranging from 23% up to 55% and reaching their lowest level by the end of the first year dropping down to reach 11% to 31% [15-17].

The present study found significant correlation between Mini Mental State Examination and Addenbrooke's Cognitive with motor functions.

Mullick et al. reported different correlations results between cognitive functions and motor functions varied among acute and chronic stroke cases. Mullick et al. also demonstrated no correlation found between memory and motor recovery [18].

Working memory is in charge for temporary retaining of data in mind for use not only in cognitive tasks such as solving problems, making decisions and reading, but also in motor skills learning and practicing as, the working memory is responsible for sorting the movement sequences offering adjustments from previous errors while simultaneously acting the motor action [19].

Memory deficits can shift the patient's recovery process to the wrong path. So, working memory training should be included during interventions as play an important role during the rehabilitation process [19]. One study tested the effect of working memory training on the quality of functional activities on patients after brain injuries and reported that such memory training had decreased the fatigue level as well as improved the quality of functional activity [20].

Moreover, another study suggested that even if the patient has reached complete physical recovery, such cognitive dysfunctions can still impede complete full motor-wise and mental rehabilitation process because of preventing the patient from living independently [9]. In other words, the level of recovery of stroke patients not only depends on the patient age, severity of illness, amount of regained physical strength, but also depends on the amount of cognitive functions preserved and retrieved because of the highly dependence of the motor performance on cognitive functions [21,22].

Conclusion

Our study described a significant correlation between memory parameter of Addenbrooke's Cognitive Examination and motor functions that increases the evidence of the complex relation between motor dysfunction and memory deficits so while examining hemiplegic stroke patients it will be a good advice to not examine the cognitive function and motor performance in a separate way.

Acknowledgment

Authors of the present study express thanks and appreciation to all patients participated in the study and their relatives for their respected cooperation.

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How to cite this article: Hegazy, Rasha, Elbadawy Ibrahim Elheneidi, Youssef Elbalawy and Ibrahim Mohamed Hamoda, et al. "Correlative Study between Memory Deficits and Upper Extremity Motor Dysfunction in Hemiplegic Stroke Patients." *Clin Schizophr Relat Psychoses* 16 (2022). Doi:10.3371/CSRP.HREE.010522.