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Correlative study between attention deficits and upper extremity motor dysfunction after stroke

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***Abstract*---**Background/aim: Motor dysfunction is one of the major byproducts of stroke; however, another domain that is severely affected yet mostly neglected is cognition. It is not certain yet whether a relationship between cognitive impairment (attention) and upper-limb motor impairment is present. The aim of our study was to investigate the correlation between attention deficits with upper limb motor dysfunction after stroke. Material and methods: Sixty stroke survivors were recruited in this correlational study. Upper limb motor function was evaluated by the Upper Limb Functional Index (ULFI). Attention deficits were evaluated by the Mini Mental State Examination (MMSE). For correlation, data were imported into Statistical Package for the Social Sciences (SPSS version 20.0). A result was considered statistically significant when p was <0.05. Chi-Square testX^2 was used to test the association variables for categorical data. Results: There was significant correlation between Mini Mental State Examination with motor functions MMSE with ULFI (r=.295*, p=.022). Conclusion: There is a significant correlation between

attention deficits and motor dysfunction of the upper extremities in patients after stroke.

***Keywords*---**attention deficits, motor impairment, stroke, upper extremity.

Introduction

The American Heart Association(AHA)/American Stroke Association (ASA) defined stroke by CNS hemorrhagic infarction leading to "brain, spinal cord, or retinal cell death due to ischemic injury with symptoms persisting ≥ 24 hours or until death, while excluding other causes." (McGrath et al., 2018). Although motor dysfunction is considered one of the major dysfunctions of stroke patients, cognition is another domain that is severely affected but mostly neglected (2). Cognitive impairments are 22% more likely to occur inpatients with stroke than normal individuals (3).

Arsic et al., 2015 reported that the level of recovery a stroke patient reaches, doesn't only depend on the patient age, severity of illness, amount of returned physical activity, but also depends on the amount of preserved cognitive functions (4). Stroke that affect cortical regions, prefrontal cortex and parietal cortex specifically in the right hemisphere would lead to attentional deficits (5, 6). Attention is seriously critical for cognitive potency even if all of the othercognitive functions are not harmed that even unharmed. Attention is not only important for cognitive function,but also considered vital for both balance and learning new motor skills (7, 8). Cengic et al. 2011 reported that stroke patients who preserved more cognitive functions during their acute and subacute stages ended by having greater motor recovery functions (9).

Materials and Methods

60 (32 males and 28 females) stroke survivors with age of 62.82 ± 13.2 were recruited from the outpatient clinic. The subjects who were diagnosed with mild-to-moderate paresis in the upper extremity were randomized in the study. Patients with dementia, Parkinson, Alzheimer, orthopedic problems that prevent voluntary participation, and any other neurologic disorders were excluded. A written informed consent was obtained from each patient after the study's purpose and methods were explained. Age, sex, duration of disease, and side of affection of the patients wererecorded.

All assessments for the same patient were applied by the same physiotherapist. Participants underwent assessments that evaluated both attention of cognitive functions and upper limb motor function. Attention assessment included the Mini Mental State Examination and the function of the upper extremity was evaluated through the Upper Limb Functional Index .

The Mini mental state examination (MMSE) is a questionnaire that detects an individual's degree of cognitive impairments. The 10-minute examination includes the following sections: orientation, attention and calculation,

registrations, recall, copying and language with 30 points as a total score. A score of 24 and above reflects intact cognitive functions. However, the range of score between 18-23 suggests mild impairment of cognitive abilities while a score below 18 indicates severe cognitive dysfunction (12,13). The Upper Limb Functional Index (ULFI) is a patient-reported outcome (PRO) measure that reflects a patient's performance and activity level. It is a 10-minute examination consisting of 15 points summed in a total score of 60. One evidence suggested that PRO outcomes tend to be of greater sensitivity and yield to more accurate reflections of an individual's functional state than specific measures do (16,17).

Statistical Analysis

Data were collected throughout both history taking process and clinical examination and the outcome measures were coded and analyzed using Microsoft Excel software. A Statistical Package for the Social Sciences (SPSS version 20.0) 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 variables were tested by Chi square test & Fisher's Exact Test were applied 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

None of the participants declined. No complications or side effects were observed during the study. Baseline characteristics of the patients are shown in Table 1. There were 32 males and 28 female patients, 31 right sided stroke and 29 with left stroke. The average age was 62.82 ± 13.2 years with average duration of illness 27.92 ± 13.2 months , as shown in table 1. As shown in table 2, Mini Mental State parameters of all patients regarding mean Attention and calculation was 3.22 ± 2.19. Table 3 illustrated total upper functional index ranged 0 – 60 with mean 7.23 ± 1.16. Table4 shows significant correlation between MMSE and motor functions.

Discussion

The objective of our study is to examine the correlation between attention deficits and upper extremity motor dysfunction in patients after stroke to encourage a newunconventional treatment approach that can accelerate the recovery process.

Stroke patients have been documented to suffer from cognitive impairments and about 30%-40% of the stroke patients have deficits in attention, memory and orientation impairments which lead to poor prognosis and adversely affect the recovery phase (14). The main finding of the study demonstrated significant correlation found between ULFI with and attention function parameters.

A systematic review achieved by Van der Fels et al., 2015 investigated the correlation between both motor and cognitive functions in children from 4 to 16 years old and reported opposite results as no correlation was detected (15). Insignificant association between ADL and cognitive functions can be explained by the use of MMSE which did not evaluate executive functions that may be strongly accompanied with ADL (16).

A meta-analysis of six studies come in agreement with the present study as showed variation of a range of no correlation to positive correlation in specific cognitive domains although different criteria from the the present study such as including more severely cognitive impaired subjects rather than the current study that included subjects with only mild cognitive impairments, also their use of sensitive kinematic measures instead of the upper limb functional index used in the present study and finally including stroke subjects in the acute phase while the present study recruited subjects with 27.92 ± 13.2 months duration of illness (17).

A review report of studying the link between motor dysfunction and cognitive deficits after stroke, found a consistent association between disturbances in balance, limb activity and gait within 9 researches. Verstraeten et al., 2016 reported different correlation results between attention and executive functioning among different 20 papers that may be due to the type of measures used as When objective measures were used, a stronger correlation was detected rather than when subjective or global measures were used, a weaker correlation was reported (18). Another study reported a positive correlation between attention and motor function recruited with participants were of similar ages with a mean of 69.9 ± 7.71 opposite to the present study patients age of a younger age (4).

Many limitations were reported in the current study including the narrow time frame available to conduct the study and also few numbers of participants. Attention disorders are most obvious at the time of diagnosis with marked consequences on the patients' quality of life rates from 46% up to 92% foreshadowing. Another study reported that almost 80% of their patients had prominent deficits in at leastone of their attention functions (19, 20, 21).

There are few studies examined the connection between attention deficits and motor impairments in patients with stroke population that reported a positive correlation between the two variables. That phenomenon can be explained by the attributed fact that the motor system in a healthy subject is automated to a certain degree; but, in patients with stroke , the motor system is more under the conscious level control as performing activities may need concentration and much more effort parallel to the physical burden that accompanies such patients (8). Cengic et al. explained that patients with stroke who have more preserved cognitive functions in their acute and subacute stages also showed greater motor recovery (9).

Hydnman and Ashburn mentioned that attention is the basis for cognitive functions (6). According to a meta-analysis done in 2016 attention is also considered the fundamental cognitive domain for physical activities. A functional magnetic resonance imaging (fMRI) was done for patients while fulfilling physical

activity tasks that require attention at certain points. Increased activity was recorded at the prefrontal and parietal cortices during the physical task when high levels of attention were needed that explain a strong association between attention and physical activity. Concerning attention networks in the brain there are two main ones, the dorsal attention network (DAN) and the ventral attention network (VAN). The dorsal one is linked to activities concerning the upper-limb and makes it a vital concern for stroke rehabilitation programs (22). Stroke patients with attention disorders demonstrate much more impairments in the functional activity hindering their rehabilitation process showing once again the importance for attention training in stroke rehabilitation programs (Spaccavento et al., 2019).

Conclusion

This study demonstrated the significant correlation between attention deficits and motor dysfunction.

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Table 1. Baseline characteristics of the patients

Characteristics	(n = 23)
Age (years, mean ± SD)	62.82 ± 13.2
Duration of illness (months, mean ± SD)	27.92 ± 13.2
Sex (female/male)	28 (46.7%) / 32 (53.3%)
Side of affection (right/left)	31 (51.7%) / 29 (48.3%)

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

Table 2. Attention assessment by Mini Mental State for all patients

variable	(n=60)
Attention and calculation	3.22 ± 2.19

Data are presented as mean ± SD.

Table 3. Upper limb functional index of all patients

	(n=60)
Upper limb functional index	7.23 ± 1.16

Data are presented as mean ± SD.

Table 4. Correlation between attension parameter of MMSE and ULFI

	MMSE attension
ULFI	
r	.295*
p	.022
*P < 0.05.	