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Montreal Cognitive Assessment Capability after Cognitive Rehabilitationin Stroke Patients

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Abstract

Background: Screening tests are necessary tools in detecting post-stroke cognitive dysfunction. Montreal Cognitive Assessment is a sensitive scale for cognitive impairment. However, assessing its capability for detecting patient improvement after cognitive training is still unknown. **Purpose:** The study was conducted to examine Montreal Cognitive Assessment capability for detecting patient improvement after cognitive rehabilitation in stroke patients. **Methods:** Forty right sided Egyptian male stroke patients participated in the study. They were evaluated through using Montreal Cognitive Assessment (MoCA) and Computer-based Cognitive Assessment device (RehaCom) before and after cognitive training. Cognitive training was performed by RehaCom system for six weeks. Data were collected using the RehaCom system and MoCA scale.**Results:** It was revealed that RehaCom training significantly improved patient executive functions and working memory. The result revealed also that the mean values of RehaCom percentage of improvements aresignificantly higher than mean values of MoCA percentage of improvements. **Conclusion:** Montreal Cognitive Assessment has a lower capability than RehaCom device for evaluating patient progression after Cognitive Rehabilitation in stroke patients.

Keywords: Montreal Cognitive Assessment, Computer-Based Cognitive Rehabilitation, Stroke.

INTRODUCTION

Cognitive impairment after stroke is an important factor affecting independent function and activity participation of patients. Dementia syndrome has been known to occur in approximately 8 to 26% of stroke patients within 12 months of the onset of stroke. In cases of severe cognitive impairment, it decreases morale and motivation to participate in an intensive rehabilitation program during the acute phase. It may also affect the ability to acquire motor skills, thus becoming the main cause of poor prognosis for rehabilitation[1).]

Cognitive impairment after stroke is common and can cause disability with major impacts on quality of life and independence. There are also indirect effects of cognitive impairment on functional recovery after stroke through reduced participation in rehabilitation and poor adherence to treatment guidelines. Effective cognitive rehabilitation approaches have been reported for cortical deficits such as neglect and aphasia[2).]

Accurate assessment of cognitive function and prompt initiation of treatment is needed for successful rehabilitation [3).]The Mini-Mental State Examination (MMSE) has a low sensitivity for vascular cognitive impairment. The Montreal Cognitive Assessment (MoCA) is a screening test incorporates subtests assessing executive functions and psychomotor speed that are frequently impaired in vascular cognitive impairment[4).]RehaCom is a comprehensive system of procedures for computer-based cognitive assessment and rehabilitation. It includes activation and stimulation of several cognitive domains such as (attention, memory, visual-spatial processes and executivefunctions)[5).]

Montreal Cognitive Assessment is a cognitive scale assessment but assessing its capability for detecting patient improvement is still unknown. Thus, the current study would aim to provide information regarding the best assessment tool for detecting improvement of cognitive functions after computer-based cognitive training instroke patients. This study conducted also to investigate the capability of Montreal Cognitive Assessment after Cognitive Rehabilitation in stroke patients.

SUBJECTS, MATERIALAND METHODS

Subjects: Forty right sided Egyptian male stroke patients participated in the study and their age ranged from 40 to 60 years. They were recruited from Kasr Al AiniHospitals, Cairo University and Out-patient Clinic, Faculty of physical therapy, Cairo University, Egypt. Patients were recruited according the following inclusion criteria; patients with right side ischemic stroke in the domain of carotid artery based on careful clinical neurological assessment and confirmed by computed axial tomography and /or magnetic resonance imaging of the brain. All the patients were medically stable with mild degree of spasticity (grade 1 and 1+ according to Modified Ashworth Scale)[6].Their duration of illness was ranged from sixmonths to two years. Patients were excludedif they had hemiparesis due to any cause other than vascular insult (e.g.Hemiparesis due to vertebrobasilar stroke. Presence of visual, auditory and other neurological disorders that affecting their cognitive testing. In addition to, pre-stroke cognitive problems as it will be assessed by the Informant Questionnaire on Cognitive Decline in the Elderly. History of previous strokes, medications that may affect cognition, Illiterate patients, Uncooperative patients and any patients received previous cognitive training.

Procedures: The Ethical Committee of Faculty of Physical Therapy approved the protocol of this study with registry number: P.T.REC/012/001252.Consent form was obtained from all patients. A brief orientation session about the study, its aim and benefits was performed to all the patients. All patients evaluated by using Montreal Cognitive Assessment (MoCA) and Computer-based Cognitive Assessment device (RehaCom) twice (pre and post cognitive training)Patient's cognitive training was performed by RehaCom system for successive six weeks (as every other day).

Instrumentations:A. Instrumentations for evaluation,MoCA was conducted from comfortable sitting position on chair with back support and suitable seat height compared to the table in front of the patient. The patients were asked to write and draw by the non-affected handif they can't do this by the affected one. Scores were recorded for each item and then sum of the scores was calculated. Computer-based Cognitive devicewas used to assessthe cognitive functions (Attention/ concentration, Figural memory, and Logical thinking). Assessment time of each area lasted for 30 minutes. After performing assessment session, there was a report generated by RehaCom device reflecting patient evaluation in the cognitive functions.**B. Instrumentations for treatment,**all the patients received cognitive training by RehaCom device for six weeks, three sessions / every other day.The duration of the session was 60 minutes with five minutes rest in between each procedure. Every session consisted of three modules. Each patient trained starting from level one and when it is completed successfully, the training then progress to the next level of difficulty.

The study design was pretest-posttest single group experimental design. Paired t test used to compare between pre and post training mean difficulty level scores of computer-based cognitive assessment device (RehaCom). Paired t test used to compare between Percentages of improvement for Montreal Cognitive Assessment (MoCA) mean scores and computer-based cognitive assessment device (RehaCom) mean scores.The alpha point of 0.05 will be used as a level of statistical significance.

RESULTS

Regarding computer-based cognitive training, the paired t-tests revealed that there was statistically significant increase in RehaCom assessment scores (Difficulty level) following computer-Based cognitive training from 14.92 ± 4.49 to 23.22 ± 3.65 ($p<0.05$).***(Table1)*** This indicates improvement of patient performance after training program.

Table 1: ***Descriptive statistics and t-tests for the mean (pre" and "post" RehaCome assessment scores) after computer-based cognitive training.***

	Mean± SD (N= 40)	t-value	p-value
Pre-Training	14. 92 ± 4.49	16.59	0.0001*
Post-Training	23.22 ± 3.65		

****Significant at alpha level < 0.05.***

Considering Montreal Cognitive Assessment Capability, paired t-test revealed that the mean value of Percentage of improvement for Montreal Cognitive Assessment (MoCA) scores were significantly lower than computer-based cognitive assessment device (RehaCom) percentage of improvement ($t = 2.77$, $p = 0.01$) ***(Table 2).***

Table 2: Descriptive statistics and t-tests for the Percentage of improvement for Montreal Cognitive Assessment (MoCA) scores and computer-based cognitive assessment device (RehaCom)scores after computer-based cognitive training.

	Mean± SD (N= 40)	**t-value**	**p-value**
(MoCA) percentage of improvement	50 ± 3.43 %	2.77	0.01*
(RehaCom) percentage of improvement	89 ± 2.92%		

Significant at alpha level < 0.05.

DISCUSSION

Cognitive impairment is a common consequence of stroke with a significant impact on response to rehabilitation, ability to return to work and ability to resume participation in society. Cognitive impairment is common among patients with stroke[7)]. Recognition and monitoring of mild cognitive impairment is thus essential to good patient care. The Montreal Cognitive Assessment (MoCA) has been suggested as a brief screening test of vascular cognitive impairment. It is considered as an optimal brief protocol for the assessment of vascular cognitive impairment[8)]. In addition, it compares favorably to the Mini Mental State Examination as a screening test that is sensitive to the milder forms of cognitive impairment that often accompany cerebrovascular disease[9)].

However, further research is needed to provide evidence for the validity of the MoCA in longitudinal assessment of vascular cognitive impairment is required and sensitivity to change and clinically important change in stroke samples. Therefore, the purpose of the present study was to investigate if Montreal Cognitive Assessment could detect patient improvement as the same capability as Computer-Based Cognitive Assessment after Cognitive Rehabilitation in stroke patients.

Cognitive rehabilitation is necessary for stroke patients to improve their functional capabilities for performing independent daily activities. Cognitive rehabilitation has a mechanism that can compensate for an impaired nervous system through there enforcement, promotion and relearning. Two major categories of cognitive training (traditional and computer-assisted) are widely used. Traditional cognitive rehabilitation varies depending on the therapist, and feedback is not consistent. However computer-assisted cognitive rehabilitation provides instant and direct feedback for patient performance. In addition, the level of difficulty can be adjusted to the patient[10)].

The results of the current study revealed a statistically significant increase in RehaCome assessment scores following Computer-Based cognitive training .This indicates improvement of patient performance after the training program and might be contributed to thecomputer-based cognitive training. The increased RehaCom assessment scores before and after cognitive training can be attributed to the increased level of difficulty of all the trained domains including attention/ concentration module, figural memory module, and logical thinking module.

This indicates increased ability of patients to focus and response to a specific stimulus and level of concentration. Also, it indicates increased patient ability of temporarily storing and manipulating information process that is important for reasoning, comprehension, learning and memory updating. Similar results were obtainedby Lundqvist et al.[11)]who used computerized therapy to train working memory.In addition to, it indicates increased patients improvement in the conclusive thinking (excutive functions) and in the problem solving. Also,abilities such as conclusive thinking attention and memory functions (in particular the working memory), register visual perception/exploration and visual-spatial functions were improved[12)].

These improvements were achieved through computer-based cognitive training program. This may be explained by, thatprogram was conducted in the forms of the game that could induce motivation and interest of the patients, leading to the improvement of procedural memory and the reactivation of brain neurotransmitters. This was reflected by improvement of the patient’s level of alertness and visual attention during the treatment by providing continuous visual stimulus through the dynamic screen along with various auditory stimuli[3)].

The result of the present study was consistent with Fernandez et al. [13)]and Lin et al. [14)]studies**.** They reported that non-specific computer training result in more beneficial effects than to train one specific domain. Most studies that combined several cognitive domains included attention and working memory games. For example, there was one RehaCom training program used by these two studies. The RehaCom training consists of several graphical games that adapt to the performance of the participant and use a variety of stimuli. The training focuses on several cognitive domains. Attention tasks, working memory tasks, and executive functions were trained. Training improved performance on seven working memory tasks (both auditory and visual) and attention tasks.

Computer-based training has effects on the neural level. Recently two studies reported both functional and structural changes in the brain after computer-based cognitive training. Structural white matter connectivity measures changed during the training period[15)].Also, increased functional connectivity of several brain areas was reported after the same previous training[14)].

The result of this study showed that the mean value of Percentage of improvement for Montreal Cognitive Assessment (MoCA) scores (50 ± 3.43%) was significantly lower than computer-based cognitive assessment device (RehaCom) percentage of improvement (89 ± 2.92 %). This indicates that Montreal Cognitive Assessment has lower capability to detect patient improvement than computer-based cognitive assessment device (RehaCom). Also, Patient follow-up after training should be conducted with more objective assessment tool like computer-based cognitive assessment device.

The association between cognitive status measured by the MoCA and rehabilitation outcomes was studied among 47 patients admitted to the geriatric rehabilitation inpatient service. Patients had an orthopedic injury, neurological condition, medically complex condition and cardiac diseases. MoCA had good sensitivity (80%), but poor specificity (30%), at the cutoff scores 25/26 to predict successful rehabilitation outcome. The patients who reached the successful rehabilitation criteria tended to have higher MoCA scores at admission than the patients who did not achieve the rehabilitation goal[16)].

The validity of the MoCA has not been thoroughly tested; in particular, there is limited information regarding its use in the post-stroke population. Some concerns have also been noted regarding the cut-off scores recommended by the scales authors. Specifically, using the recommended cut-off score, the specificity of the MoCA has been found to be much lower than that was reported in the original validation study [17)].

Consequently, it was suggested that the sensitivity and specificity of the MoCA are optimized when a lower cut-off score of ≤ 23 for the identification of impairment is used. It is important to emphasize that MoCA is a cognitive screening instrument and not a diagnostic tool, hence clinical judgment, based on thorough clinical evaluation, is important in interpreting MoCA test results and correctly diagnosing patients who present with cognitive complaints[18].

The results of the current study revealed that, computer-Based cognitive training improved cognitive function in stroke patients, so it can be effective and valuable tool than other traditional cognitive training programs for stroke patients. Also, MoCA has low capability in detecting patient improvement after cognitive training. Based on these results, computer-Based cognitive training can be used as a treatment modality for cognitive impairment in stroke patients. In addition, MoCA scale is a screening tool for cognitive impairment but has lower ability to detect patient improvement after training than computer-Based cognitive assessment. Thus, the field of physical therapy may improve the rehabilitation protocol regarding cognitive impairment by introducing computer-Based cognitive training and assessment to post-stroke patients rehabilitation.

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