Cognitive impairments in patients with cerebrovascular risk factors: A comparison of Mini Mental Status Exam and Montreal Cognitive Assessment

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ABSTRACT

Objective and background: Recent evidence suggests that cerebrovascular risk factors are contributing factors, not only to vascular cognitive decline, but also for Alzheimer's disease. The study aim was to compare Montreal Cognitive Assessment (MoCA) and MMSE tests in subjects with cerebrovascular risk factors.
Patients and methods: Fifty patients with cerebrovascular risk factors were administrated the MMSE and MoCA tests. Data collected for all subjects and the results were compared.
Results: Cognitive impairments revealed on both tests were more frequent in females, and correlated with the level of education (for MoCA $r = 0.75$, $p = 0.001$ and for MMSE $r = 0.662$, $p = 0.001$). Mean values of MoCA score were significantly lower in patients with two or more cerebrovascular risk factors compared with those with only one risk factor (19.92 ± 5.99 versus 23.81 ± 4.06; $p = 0.049$), a finding that was not evidenced by MMSE.
Conclusions: The most frequent impaired domain in MMSE (for scores both less and more than 26) was attention; but in MoCA the most frequent impaired domains were delayed recall (for scores above 26), and visuo-executive (for scores ≤ 26), which is a common domain involved in vascular cognitive decline. MoCA may be superior to MMSE in early detection of cognitive decline in patients with vascular risk factors.

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1. Introduction

According to the Delphi consensus study, if no reduction occurs in the incidence of dementia (through preventive measures) along with growth of the population, by 2040, 71% of 81 million patients with dementia would be in the developing countries [1]. The most common causes of dementia are Alzheimer disease and vascular dementia [2]. Recognition of cognitive impairments in patients with cerebrovascular risk factors is important as the increasingly emerging data emphasize the prominent role of vascular risk factors, not only in the development of vascular dementia but for Alzheimer's disease as well [3,4]. This close association is more than comorbidity in the aging population [5]. Meanwhile, modifying the lifestyle and diet can influence the vascular risk factors [1], and reinforcement of primary and secondary preventive strategies in patients with those risk factors could decrease the burden of cerebrovascular disease and the related dementia. Therefore, early detection of cognitive deficits is worthy in the management of these patients.

Several tests have been developed for the assessment of cognitive impairment (CI), but the gold standard is still formal neuropsychological assessment. These comprehensive tests (which evaluate multiple domains of cognition), are time consuming and lack simple performance and consequently are not routinely used by most clinicians.

One of the brief and widely used screening tests is the 30 point Mini Mental Status Exam (MMSE); however MMSE has some limitations: first, it is insensitive for detecting mild cognitive impairment (MCI), an intermediate clinical state between normal cognition and dementia [6]. Second, it primarily assesses memory and language function and lacks the ability to assess executive function [7] which is commonly involved in patients with cerebrovascular disease.

On the other hand, Montreal Cognitive Assessment (MoCA) has been found more sensitive for recognition of MCI [6–9], and contains tools to assess both executive and non-executive functions. In the first description of the test, it showed a sensitivity of 90% for detecting MCI compared with 18% for MMSE [9]. MoCA is a 30 point test which evaluates multiple domains of cognition (including visuo-executive, naming, attention, language, abstraction, delayed recall and orientation), during a short time (10 min in the original report) [9]. MoCA may be useful for early detection of MCI in patients who have vascular risk factors, but no deficit in their activities of daily living.

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The purpose of this study was to compare the commonly used MMSE with recently developed MoCA for detection of MCI in patients with common cerebrovascular risk factors (CVRFs), who represent a population with high probability for developing dementia.

Other objectives were to determine the association of demographic factors with the scores obtained in MMSE and MoCA, as well as the association of the number and type of vascular risk factors with scores obtained in MMSE and MoCA.

2. Patients and methods

With presumption of about 15% prevalence of MCI in developing countries, a sample size of 50 subjects was calculated for an acceptable difference of 10% and type one error of 0.05, based on normal distribution of MMSE and MoCA scores. Fifty patients with at least one of the CVRFs according to the epidemiological studies [1,3,4] including hypertension, diabetes mellitus, body mass index (BMI) (>25), hypercholesterolemia, atrial fibrillation, coronary artery disease, congestive heart failure, and smoking, were recruited. The subjects were randomly selected from normal function in-patients in internal medicine department of Shariati general hospital.

Those with any of the following were excluded from the study: previous stroke or transient ischemic attack, significant depression or other psychiatric disorders according to the Diagnostic and Statistical Manual of Mental Disorders, 4th edition (DSM-IV) [10], history of use of neuroleptics, anticholinergics, or other central nervous system depressants, history of habitual alcohol consumption, intra or extracranial malignancy, and history of significant head trauma.

In all subjects, the data of conventional CVRFs were evaluated prior to cognitive assessment. In addition, demographic data such as age, gender education, location of living (urban or rural), and occupation were also collected. All patients provided informed consent about the aim of collecting and publishing the data. The protocol was approved in the ethical committee of Shariati general hospital (Tehran University of Medical Sciences) where the study was performed. The reason for hospital recruitment of the patients was ascertainment of vascular risk factors as their data are more accessible and accurate in hospital setting. We checked their medical data in hospital recording system including laboratory test, electrocardiogram, echocardiography, chart of vital sign, and the result of angiography if they had done. Smoking was asked the patients and BMI was calculated after measuring their height and weight.

2.1. Cognitive assessment

Standard MMSE was administered with a cutoff point of 26 which has been considered as MCI in other studies [9,11]. MMSE is a 30 point cognitive test which evaluates arithmetic, memory and orientation domains by following items and related scores: orientation to time (5), orientation to place (5), registration (3), attention and calculation (5), recall (3), language (2), repetition (1) and complex commands (6). Total scores equaled or more than 26 considered as normal cognitive status.

English MoCA test was translated into Persian (Farsi) by a neurologist and conversed with the original author, Dr Z. Nasreddine. The Persian-MoCA test form and instructions are available for download at the MoCA official website (http://www.mocatest.org). The 10 min MoCA test evaluated 7 cognitive domains (visuospatial/executive functions, naming, verbal memory registration and learning, attention, abstraction, 5 min delayed verbal memory, and orientation). In the Persian version of MoCA test some changes were used for developing better cultural and language compatibility. In

the visuospatial/executive item Arabic numbers and Persian alphabets were used for alternating trail marking. In the Attention Item for auditory vigilance part Persian alphabet were recruited with identical response order and character number to original English test. The related scores were same in both Persian an English version for each items. For evaluation of internal consistency of the Persian MoCA, we initially administered MoCA in 10 healthy persons with intact cognition and no underlying disease.

MoCA scores of less than 26, suggested by the original study [9] as well as others [6,12], have shown sensitivity and specificity for detection of MCI. One point was added to the total score for individuals with ≤12 years of formal education. Application of the tests was in a similar order in all subjects. Moreover, analogous items with different scoring in both tests (such as serial 7s), were asked just one time to prevent the effect of repetition.

2.2. Data analysis

Before making analysis, the Kolmogorov–Smirnov test was used for examination of normal distribution in the collected data. For the normally distributed data, Student t-test and for the non-normally distributed data, Mann–Whitney Rank Sum test were used. The frequency of the variable between the two groups was compared using chi-square and Fisher exact tests and McNemar test in the paired groups. Differences with $p < 0.05$ were considered as statically significant. Logistic analysis was used for the assessment of linear correlation between scores of the tests and other quantitative variables. For assessing the internal consistency of MoCA, the Cronbach's alpha was measured on standardized items. Spearman correlation coefficient for MMSE and MoCA scores were also measured.

All the statistical analyses were done using SPSS software (Statistical Package for Social Sciences 17.0).

3. Results

From the total of fifty patients with cerebrovascular risk factors, most of the recruited subjects were female (68%) and housewife (52%), and all of the subjects had the same ethnicity (Caucasian), with a mean age of 51.8 ± 13.18 years (range: 21–82 years). The most frequent CVRFs in females and males were diabetes mellitus (76.5%) and coronary artery disease (75%). Other characteristics are summarized in Table 1.

The Cronbach's alpha of the standardized items was 0.79. The Spearman correlation coefficient between MoCA and MMSE was 0.68.

The mean score of MMSE in patients was 25.44 ± 3.7, and of MoCA was 20.78 ± 5.8, with a p-value of 0.001 in paired t-test. The frequency of cognitive impairments based on MMSE and MoCA was 50% ($n = 25$) and 66% ($n = 33$), respectively.

Table 1
Characteristics of patients recruited in the study.

	Female	Male	p value
Age (mean ± SD)	50.1 ± 13.04	55.31 ± 13.20	0.199
Education (mean ± SD)	5.4 ± 5.5	9.06 ± 6.4	0.046[*]
Rural living area (%)	20.6	6.3	0.194
Multiple CVRFs (≥2) (%)	82.4	68.8	0.233
MMSE score (mean ± SD)	24.7 ± 3.92	26.93 ± 2.9	0.052
MoCA score (mean ± SD)	19.73 ± 5.8	23.4 5	0.064
MMSE ≤ 26 (%)	61.8	25	0.016[*]
MoCA ≤ 26 (%)	76.5	43.8	0.026[*]

CVRF: cerebrovascular risk factor.

[*] p value < 0.05.