Brief Communication

The Montreal Cognitive Assessment: Validity and Utility in a Memory Clinic Setting

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Objective: To prospectively validate the Montreal Cognitive Assessment (MoCA) in a UK memory clinic.

Method: We administered the MoCA and Mini-Mental State Examination (MMSE) to 32 subjects fulfilling diagnostic criteria for dementia, to 23 subjects fulfilling diagnostic criteria for mild cognitive impairment (MCI), and to 12 memory clinic comparison subjects, at baseline and then at 6-month follow-up. Clinical diagnoses for dementia and MCI were made according to ICD-10 and Petersen criteria. The sensitivity and specificity of both measures were assessed for detection of MCI and dementia.

Results: With a cut-off score of 26, the MMSE had a sensitivity of 17% to detect subjects with MCI, whereas the MoCA detected 83%. The MMSE had a sensitivity of 25% to detect subjects with dementia, whereas the MoCA detected 94%. Specificity for the MMSE was 100%, and specificity for the MoCA was 50%. Of subjects with MCI, 35% developed dementia within 6 months, and all scored less than 26 points on the MoCA at baseline.

Conclusions: The MoCA is a useful brief screening tool for the detection of mild dementia or MCI in subjects scoring over 25 points on the MMSE. In patients already diagnosed with MCI, the MoCA helps identify those at risk of developing dementia at 6-month follow-up.

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Clinical Implications

- The MoCA is a useful screening tool for the detection of mild dementia and MCI.
- The MoCA is a useful predictive screening tool for the development of dementia in subjects with MCI.
- Compared with the MMSE, the MoCA has no advantage in detecting change in cognition over a 6-month period.

Limitations

- The study size was small, with a short follow-up period of 6 months.
- The memory clinic comparision group had a high proportion of subjects with functional psychiatric illness.
- The conclusions regarding validity are restricted to a memory clinic setting.

Key Words: *Montreal Cognitive Assessment, mild cognitive impairment, Alzheimer's disease, Mini-Mental State Examination*

Mild cognitive impairment can be considered as an intermediate clinical state between normal cognitive aging and mild dementia. Subjects with MCI represent an at-risk group for the development of dementia, with around 10% to 40% of subjects developing dementia within 1 year.[1–5]

The MMSE is a widely used screening tool for the identification of dementia, with a diagnostic threshold usually set at less than 25 points.[6] However, the MMSE has very poor sensitivity for individuals with MCI, with about 80% of the latter scoring above 26 points on the MMSE.[7–10] Several studies have shown that a large proportion of patients with dementia, including those in the early stages of AD, those with a high premorbid IQ score, and those with non-AD dementia (including Lewy body dementia or frontotemporal lobe dementia) often score above recognized cut-off points on the MMSE (that is, a score of more than 24 points).[7–9] As a result, clinicians will often obtain more detailed neuropsychometric testing if available or repeat the MMSE at a later date.

The MoCA is a 10-minute, 30-point cognitive screening test designed to assist health professionals in the detection of MCI in patients scoring between 24 and 30 points on the MMSE.[10] The suggested cut-off point on the MoCA is 26.[10] The MoCA has more emphasis on tasks of frontal executive functioning and attention than the MMSE, which may make it more sensitive in detecting non-AD dementia.

We sought to validate the MoCA in a UK memory clinic setting where subjects with a wide variety of illnesses may present with memory impairment. We also examined the diagnostic outcomes of all subjects at 6-month follow-up to determine the usefulness of the MoCA as a predictive diagnostic tool.

Method

This was a prospective study of patients attending a memory clinic at the Memory Assessment Research Centre at Moorgreen Hospital, Southampton, between May 1, 2004, and June 30, 2005. Ethical approval for the study was granted by the Southampton and South West Hants Local Research Ethics Committee. All subjects seen in the memory clinic, with a next-of-kin in close contact with the subject and duration of illness of greater than 6 months, were approached by letter for inclusion in the study. Following consent procedures, patients were reinterviewed. Patients scoring above 24 points on the MMSE were classified into 3 groups: dementia, MCI, or MCC. Dementia was defined according to ICD-10 diagnostic criteria.[11] MCI was defined according to the criteria of Petersen and colleagues,[12] with objective evidence of memory loss determined by a clinician using the CAMCOG.[13,14] The MCC was defined as those patients who had a clearly identifiable psychiatric illness that explained subjective memory complaints or who had no objective evidence of memory loss (that is, those with a CAMCOG score > 89 points) at baseline or 6-month follow-up. An MMSE and MoCA were given to all participating subjects at baseline. All subjects were then seen 6 months later, at which time the MMSE and MoCA were repeated and a clinical diagnosis was made from the baseline diagnostic criteria. The neuropsychological assessments were completed by trained raters independent of, and blind to, the clinical diagnosis.

Following methodology described elsewhere,[10] we calculated sensitivity as the percentage of subjects within a diagnostic category who scored less than 26 points on the MMSE or MoCA. We calculated specificity as the percentage of subjects in the MCC who scored at or above the cut-off score of 26 points. Direct comparison of MoCA and MMSE scores was made with Pearson correlation, and analysis of covariance was used for between-groups comparison.

Abbreviations used in this article

AD	Alzheimer's disease
CAMCOG	Cambridge Cognitive Examination
MCC	memory clinic comparison group
MCI	mild cognitive impairment
MMSE	Mini-Mental State Examination
MoCA	Montreal Cognitive Assessment
SD	standard deviation

Results

We identified 71 subjects who fulfilled the study inclusion criteria. Of these subjects, 67 (94%) agreed to take part in the study. The mean age of the study group at baseline interview was 73.6 years, SD 10.0, with a mean illness duration of 1.8 years, SD 1.9. The group had mean of 12.1 years of education, SD 2.5. Of the subjects, 33 (49.3%) were women. The mean MMSE score at baseline was 27.4 points, SD 1.6, with a range of 25 to 30 points; the mean MoCA score was 22.3 points, SD 3.6, with a range of 14 to 29 points.

At baseline, 32 subjects (48%) fulfilled ICD-10 diagnostic criteria for dementia (18 with AD, 13 with vascular dementia, and 1 with Parkinson's disease dementia), 23 subjects (34%) fulfilled diagnostic criteria for MCI, and 12 subjects (18%) fulfilled criteria for the MCC. Of the subjects defined as in the MCC, 4 fulfilled ICD-10 diagnostic criteria for psychiatric illness (3 with depressive episode and 1 with generalized anxiety disorder), and 8 had no objective evidence of memory loss.

Table 1 shows a significant difference in the distribution of age across the diagnostic groups, with subjects in the MCC group being younger than subjects with MCI or dementia ($F_{2,64} = 9.2$, η^2 0.22, $P < 0.001$). There was a significant difference in the distribution of MMSE scores by diagnostic group ($F_{2,64} = 5.2$, η^2 0.14, $P = 0.008$) that remained significant after correcting for age ($F_{2,63} = 3.8$, η^2 0.10, $P = 0.03$). Similarly, there was a significant difference in the distribution of MoCA

Table 1 Demographic and cognitive outcomes by diagnostic group

Diagnosis *n* (%)	MMSE Points (SD)	MoCA Points (SD)	Age Years (SD)	Duration Years (SD)	Education Years (SD)	Female sex *n* (%)
Dementia						
32 (48)	26.8 (1.5)	21.0 (3.4)	74.4 (9.3)	1.7 (2.0)	12.7 (2.5)	12 (37)
MCI						
23 (34)	27.6 (1.6)	22.5 (3.5)	77.5 (7.8)	2.2 (2.1)	11.3 (2.5)	13 (57)
MCC						
12 (18)	28.4 (1.5)	25.0 (3.1)	64.0 (10.8)	1.3 (1.1)	12.0 (2.5)	8 (67)

Table 2 Sensitivity and specificity of MMSE and MoCA by diagnostic group with a cut-off at 26 points

	Sensitivity (95%CI)		Specificity (95%CI)	
Test	MMSE	MoCA	MMSE	MoCA
MCI	0.17 (0.08 to 0.34)	0.83 (0.66 to 0.92)	1.00 (0.82 to 1.00)	0.50 (0.29 to 0.72)
Dementia	0.25 (0.15 to 0.39)	0.94 (0.83 to 0.98)	1.00 (0.82 to 1.00)	0.50 (0.29 to 0.72)

scores by diagnostic group ($F_{2,64} = 6.1$, η^2 0.16, $P = 0.004$) that remained significant after correcting for age ($F_{2,63} = 3.7$, η^2 0.09, $P = 0.03$). The correlation between the MMSE and MoCA was modest (Pearson 0.62, $P < 0.0001$).

Table 2 shows that the MoCA had high sensitivity in identifying MCI and dementia (83% and 94%, respectively). In contrast, the sensitivity of the MMSE was poor (17% and 25%, respectively). The MMSE had excellent specificity, correctly excluding 100% of those subjects in the MCC group, whereas the specificity of the MoCA was modest, at 50%.

The mean follow-up interval for the total group was 6.0 months, SD 1.3. For the MMSE, the mean rate of cognitive change for the all subjects over this period was –1.0 points, SD 2.4 (for the dementia group, the mean rate was –0.8 points, SD 2.6; for the MCI group, it was –1.7 points, SD 2.3; and for the MCC group, it was 0 points, SD 1.1). For the MoCA, the mean rate of cognitive change for all subjects over this period was –0.7 points, SD 2.7 (for the dementia group, the mean rate was –0.2 points, SD 2.7; for the MCI group, it was –1.7 points, SD 2.1; and for the MCC group, it was 0.2 points, SD 3.4). No significant differences in rates of cognitive decline were found between diagnostic groups, according to either the MMSE or the MoCA. Similarly, no significant differences were found between the rates of decline when the MMSE and MoCA were compared overall or within diagnostic groups.

The diagnosis of the 12 MCC subjects did not change from baseline to 6-month follow-up. Of the 23 subjects diagnosed as having MCI at baseline, 8 (35%) were diagnosed as having dementia (7 with AD and 1 with Parkinson's disease dementia); 15 (65%) were still considered to have MCI at 6-month follow-up. Patients diagnosed as having dementia at 6-month follow-up had a lower MoCA score at baseline than those still designated as MCI at follow-up (MoCA mean score 20.8 points, SD 3.1, compared with mean 23.5 points, SD 3.3; $P = 0.03$). A similar, but nonsignificant, trend also occurred for the MMSE score at baseline (MMSE mean score 26.9 points, SD 1.5, compared with mean 27.9 points, SD 1.5; $P = 0.07$). The MoCA (using the established cut-off of 26 points) had 100% sensitivity in identifying those MCI subjects at baseline diagnosed as having dementia at 6-month follow-up, whereas at 25%, the MMSE had poor sensitivity.

Discussion

We found sensitivity of the MMSE and the MoCA to detect MCI to be comparable to a previous study (17%, compared with 18%; and 83%, compared with 90%, respectively).[10] Similarly, we found the MoCA to have comparable sensitivity in detecting mild dementia (94%, compared with 100%).[10]

Compared with another study,[10] which reported a specificity of 87%, the specificity of the test in this study was just 50%. In this study, all MCC subjects had subjective complaints of memory loss and some had psychiatric comorbidity, reflecting the old age psychiatry setting of the memory clinic. Thus lowered specificity in this study is likely to be a reflection of the heterogeneous nature of the MCC that may well include subjects with subtle executive deficits that could be undetected by the CAMCOG but detected by the MoCA.

Unfortunately, because only one clinician completed each aspect of the diagnosis and the neuropsychometric testing and because clinicians were blind to the others' findings, we were unable to examine the interrater reliability of the clinical diagnosis and the MoCA.

No significant differences were found in the rate of cognitive change over a 6-month period when the MoCA and the MMSE were compared. It may be that the MoCA is more sensitive to changes in types of dementia that particularly affect the frontal lobe because of its greater emphasis on tasks of frontal executive functioning, compared with the MMSE, but the present study is unable to answer this question.

Although the results cannot be generalized to a larger population, it would seem that, by identifying early dementia or MCI, the MoCA is a useful additional screening for individuals in a memory clinic setting who score over 25 points on the MMSE.

In subjects with MCI, the MoCA also helps to identify those at risk of developing dementia at 6-month follow-up.

Conclusions

We believe that the MoCA promises to fill an unmet need for a brief screening tool that can help busy clinicians to identify at-risk individuals who would otherwise be missed if the MMSE alone were used.

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Résumé : L'évaluation cognitive de Montréal : validité et utilité dans une clinique de la mémoire

Objectif : Valider prospectivement l'évaluation cognitive de Montréal (MoCA) dans une clinique de la mémoire du R-U.

Méthode : Nous avons administré la MoCA et le mini-examen de l'état mental (MMSE) à 32 sujets satisfaisant aux critères diagnostiques de la démence, à 23 sujets satisfaisant aux critères diagnostiques du trouble cognitif léger (TCL), et à 12 sujets de comparaison de la clinique de la mémoire, au départ puis au suivi de 6 mois. Les diagnostics cliniques de démence et de TCL ont été posés d'après les critères du CIM-10 et de Petersen. La sensibilité et la spécificité des deux mesures ont été évaluées pour la détection du TCL et de la démence.

Résultats : Avec un score d'inclusion de 26, le MMSE avait une sensibilité de 17 % pour détecter les sujets souffrant de TCL, alors que la MoCA en détectait 83 %. Le MMSE avait une sensibilité de 25 % pour détecter les sujets souffrant de démence, alors que la MoCA en détectait 94 %. La spécificité du MMSE était de 100 %, et la spécificité de la MoCA était de 50 %. Sur les sujets souffrant de TCL, 35 % ont développé la démence en 6 mois, et tous avaient des scores inférieurs à 26 points à la MoCA, au départ.

Conclusions : La MoCA est un outil de dépistage bref utile pour la détection de la démence légère ou du TCL chez les sujets ayant des scores supérieurs à 25 points au MMSE. Chez les patients ayant déjà reçu un diagnostic de TCL, la MoCA aide à identifier ceux qui sont à risque de développer la démence au suivi de 6 mois.