

Short Report

**A comparison between the MoCA and the MMSE visuoexecutive subtests
in detecting abnormalities in TIA/stroke patients**

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Figure 1. Results of Visuoexecutive Task Screening with MMSE vs. MoCA.

Figure 2. Proportion with incorrect MMSE Pentagon Copying Across Strata of Incorrect MoCA
Visuoexecutive Responses.

Table 1. Correct and Incorrect MoCA and MMSE Visuoexecutive Tasks

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ABSTRACT

Background. Executive dysfunction predicts stroke risk, dementia and mortality. The Montreal Cognitive Assessment (MoCA) detects more visuoexecutive dysfunction than the Mini-Mental State Examination (MMSE) but it is unclear which of the individual MoCA visuoexecutive items contribute to the better performance of the MoCA. We therefore determined the relative performance of the MoCA visuoexecutive sub-tests versus the MMSE pentagon copying in patients with stroke and transient ischemic attack (TIA).

Methods. MMSE and MoCA were administered to a prospective, population-based cohort of stroke and TIA patients from the Oxford Vascular Study at 6 month or 5 year follow-up between November 2007 and June 2009. We compared the proportion of participants with incorrect MoCA visuoexecutive tasks and sub-tasks but correct MMSE pentagon copying vs. the proportion with incorrect MMSE pentagon copying but correct visuoexecutive MoCA subtest and individual sub-test items.

Results. Among 412 patients assessed with the MMSE and MoCA, the MoCA detected more visuoexecutive dysfunction than the MMSE (OR 11.4, 95%CI 8.2-15.8, $p < 0.001$). The likelihood of incorrect MMSE pentagon copying increased as the numbers of correct MoCA visuoexecutive responses decreased: 2/106 (1.9%) and 9/10 (90.0%) incorrect MMSE pentagon copying for 5/5 and 0/5 correct MoCA visuoexecutive tasks, respectively (p for trend 0.005). Each MoCA visuoexecutive subtask, including trails (39.6%), cube copying (49.5%), and clock drawing (59.0%), detected more patients with visuoexecutive dysfunction than the MMSE pentagon copying (20.6%, $p < 0.001$).

Conclusion. All three of the MoCA visuoexecutive sub-tests detected more abnormalities than the MMSE pentagon copying and thus contributed to the over ten-fold superiority of MoCA over the MMSE for detection of visuoexecutive dysfunction.

INTRODUCTION

Progression to dementia can be as high as 20% within the first year after stroke.¹ Early impairment of executive function and attention are hallmarks of vascular cognitive impairment.² Executive dysfunction, detected in up to 77% of stroke survivors³, has been shown to be an independent predictor of stroke risk⁴, constitutes a marker of progression from mild cognitive impairment to dementia in those with hypertension⁵, and can predict long-term mortality after incident stroke or transient ischemic attack (TIA)⁶. Thus, screening for visuoexecutive dysfunction may help distinguish high-risk patients requiring more aggressive treatment of vascular risk factors and for selection in future clinical trials.

Both the Mini-Mental State Examination (MMSE) and the Montreal Cognitive Assessment (MoCA) are widely employed and feasible tools for screening for cognitive impairment.⁷⁻¹¹ The MMSE is less sensitive than the MoCA for identifying impaired cognition in subjects with cerebrovascular disease, in part owing to lower detection of executive dysfunction⁹⁻¹¹, but the relative performance of the individual elements of the MoCA visuoexecutive tasks, and thus whether all contribute to the superior sensitivity of the MoCA, has not previously been examined. We therefore aimed to determine how much visuoexecutive abnormality was detected by the MoCA and MMSE visuoexecutive sub-tests in a population-based cohort of stroke and TIA patients from the Oxford Vascular Study.

METHODS

The Oxford Vascular Study is a prospective longitudinal population-based cohort-study of all acute vascular events occurring within a defined population of 92,728 covered by around 100 general practitioners (GPs) in nine GP practices in Oxfordshire, UK. The Oxfordshire Clinical Research Ethics Committee approved the study and informed consent or assent from relatives was obtained.. All patients with TIA or stroke, who were alive and seen for either their 6-month or 5-year follow-up between November 2007 until June 2009, were included in the current study. The MMSE and the MoCA were administered during a 30 minute appointment that also included clinical and functional assessments. Subjects unable to complete either test because of speech or language barriers or inability to use the dominant arm were excluded.^{9,12-14}

Analysis

Impaired visuoexecutive functioning was defined as incorrect pentagon copying test for the MMSE (score 0/1) and a score of $\leq 4/5$ on the visuoexecutive tasks of the MoCA based on previous comparisons of MoCA sub-tasks to standard neuropsychological testing.¹⁵ We calculated the proportion of patients with incorrect MoCA visuoexecutive tasks (incorrect trails, cube, or clock) and sub-tasks (incorrect clock contour, numbers, or hands in clock drawing) that were not detected by the MMSE (correct pentagon copying), and the proportion of participants with incorrect pentagon copying that was not detected by MoCA visuoexecutive tasks and sub-tasks. We compared proportions by using two-tailed Z-tests. We analyzed trends in likelihood of incorrect MMSE pentagon copying across strata of number of correct MoCA visuoexecutive responses (Jonckheere-Terpstra test).

RESULTS

The two cognitive tests were administered to 412 patients deemed testable of 493 consecutive patients (Figure 1). MoCA detected more patients with visuoexecutive dysfunction than MMSE: (308/412 vs. 85/412; OR 11.4, 95%CI 8.2-15.8, $p < 0.001$).

The likelihood of incorrect MMSE pentagon copying increased across decreasing numbers of correct MoCA visuoexecutive responses ($p = 0.005$ for trend, Figure 2).

The MoCA trail (39.6%), cube (49.5%) and clock (59.0%) detected more patients with visuoexecutive dysfunction than the MMSE pentagon copying (20.6%, $p < 0.001$ for all comparisons) (Table 1). Hand drawing was the MoCA clock sub-task showing best detection yields for visuoexecutive dysfunction (52.7%, $p < 0.001$ versus MMSE). Drawing the clock contour showed the worst performance among the MoCA clock sub-tasks and was the only task or sub-task detecting less visuoexecutive dysfunction than the MMSE pentagon copying (5.3%, $p < 0.001$).

DISCUSSION

The odds of detecting visuoexecutive dysfunction with the MoCA was over ten-fold higher than with the MMSE (OR 11.4). Each of the MoCA visuoexecutive sub-tests (trails, cube, and clock) detected more abnormalities than the MMSE pentagon copying. The most sensitive MoCA visuoexecutive sub-test was the clock drawing, with the clock hand placement the most difficult task.

The MMSE gives only one-point out of thirty for the visuoexecutive domain, while the MoCA visuoexecutive tasks comprise 5-points thus making it more likely for visuoexecutive function to be detected with the MoCA even if the tasks were of similar difficulty. Our findings demonstrate that all three sub-tests on the MoCA (trails, cube and clock copying) detect more abnormalities than the MMSE pentagon-copying and that within the clock task, the three items progress in difficulty from easiest (clock contour) to hardest (hand placement). Thus the odds of detecting visuoexecutive dysfunction with MMSE pentagon copying rises with increasing numbers of incorrect MoCA visuoexecutive responses. The greater difficulty of the MoCA tasks versus the MMSE pentagon copying relates to the tridimensionality of the cube versus the bidimensionality of the pentagon, and the complex planning (visual, spatial, and executive functions) required for clock hand placement and for completion of the trails task.

There are some limitations to our study. We were not able to estimate the actual specificity and sensitivity of the MoCA and MMSE visuoexecutive tasks against a Gold Standard because a more extensive cognitive battery was not done. Further, we did not specifically exclude patients with dementia, (although they were probably more likely to have been excluded than non-dementia patients through inability to complete cognitive testing¹⁴). However, within the group of testable TIA and stroke patients, there is a good correlation between the MMSE and MoCA even at low scores (eg where MMSE is $<24^{12}$) so it is unlikely that the presence of dementia in some testable individuals would have invalidated the comparison between the MoCA and MMSE subtests.

Our findings show that all three individual MoCA visuoexecutive sub-tests may contribute to the greater detection of visuoexecutive abnormalities using the MoCA as compared to the MMSE. Both quantitative and qualitative MoCA sub-task properties could explain these differences.

Disclosures

None

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TABLES

Table 1. Correct and Incorrect MoCA and MMSE Visuoexecutive Tasks

	Incorrect MoCA and MMSE	Correct MoCA and MMSE	Incorrect MoCA and Correct MMSE	Correct MoCA and Incorrect MMSE	Total	Total Incorrect MoCA	Total Incorrect MMSE	Incorrect MoCA vs. Incorrect MMSE, p-value
Overall MoCA Tasks	83	102	225	2	412	308 (74.8)	85 (20.6)	<0.001
MoCA Trail	61	225	102	24	412	163 (39.6)	85 (20.6)	<0.001
MoCA Cube	71	194	133	14	412	204 (49.5)	85 (20.6)	<0.001
MoCA Clock total	72	156	171	13	412	243 (59.0)	85 (20.6)	<0.001
MoCA Clock Contour	10	315	12	75	412	22 (5.3)	85 (20.6)	<0.001
MoCA Clock numbers	34	297	30	51	412	64 (15.5)	85 (20.6)	0.06
MoCA Clock hands	67	177	150	18	412	217 (52.7)	85 (20.6)	<0.001

Results are presented as absolute numbers. Numbers between parentheses indicate proportions (%).

FIGURE LEGENDS

Figure 1.

No legends.

Figure 2.

Bars indicate the proportion of patients with incorrect pentagon copying.

p -value for trend=0.005 (Jonckheere-Terpstra).

FIGURES

Figure 1. Results of **visuoexecutive** task screening with MMSE vs. MoCA.

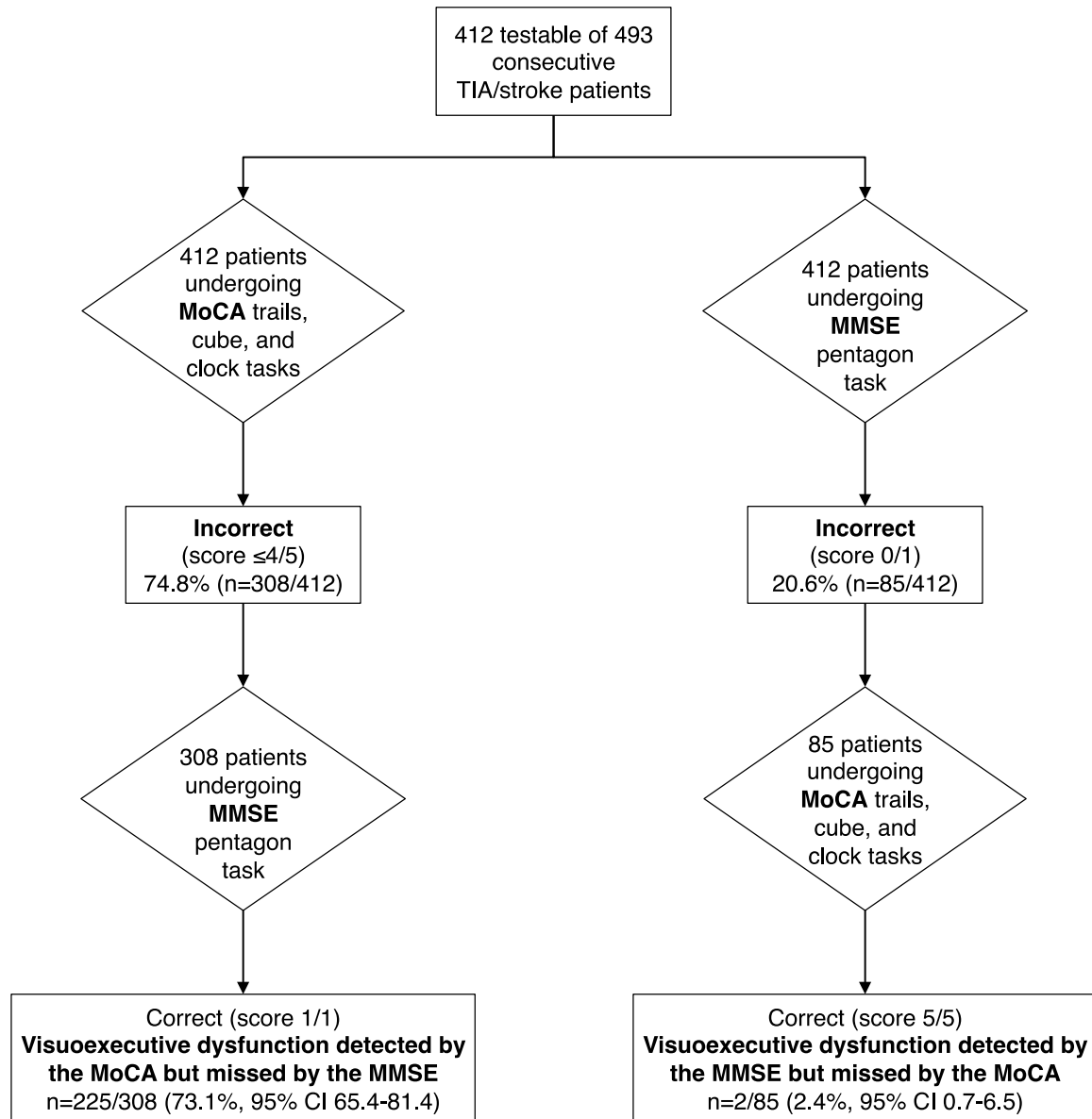


Figure 2. Proportion with incorrect MMSE Pentagon Copying Across Strata of Incorrect MoCA

Visuoexecutive Responses

