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Review Article

Cognitive Assessment with Neurocognitive Screening Tools

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ABSTRACT

Neurocognitive Disorders (NCDs) are widespread diseases, especially in elderly. The future possibility of having more effective treatments has to deal with the lack of early disorder detection, which would enable patients to benefit the most from them. Individual medical history, blood and cerebrospinal fluid tests, and neuroimaging, among other tools, support the diagnostic process; neurocognitive screening tests also have an irreplaceable role to play in NCD assessment. Ease of execution and low cost make these instruments to be so appreciate in clinical practice. Mini Mental State Examination (MMSE), Repeatable Battery for the Assessment of Neuropsychological Status (RBANS), Montreal Cognitive Assessment (MoCA), and Clock Drawing Test (CDT), used as first-level screening tools, will be at the centre of this mini review. In the present work we will highlight the contribution made by these tests in NCD assessment, emphasizing some interesting aspects recently emerged from the scientific literature.

Keywords: Neurocognitive disorders; Screening; MMSE; RBANS; MoCA; CDT

INTRODUCTION

Neurocognitive Disorders (NCDs) are clinical syndromes characterized by a significant decrease in cognitive performance, to which it is added a plethora of non-cognitive symptoms [1], by which diagnosis and management may be difficult and, moreover, expensive, and time-consuming. A treatment able to prevent or stop NCD progression is not yet available, for the time being. In order to enable patients to benefit the most by effective therapies, and better manage the disease, it would be desirable to reach an accurate diagnosis as soon as possible, anyway [2]. Easy, cheap, and highly informative standardized tools are needed to achieve this goal. Neurocognitive screening tests are rightfully inserted in this regard, although numerous other tools such as blood and cerebrospinal fluid, genetics, and neuroimaging tests should obviously not be ignored. Four tests will be at the centre of the present work: Mini Mental State Examination (MMSE), Repeatable Battery for the Assessment of Neuropsychological Status (RBANS), Montreal Cognitive Assessment (MoCA), and Clock Drawing Test (CDT). These tests are brethren in their use as first-level screening tools, and the aim of this review is to briefly describe their main features and examine their strengths and weaknesses, also taking account of some recent relevant scientific developments in the field.

LITERATURE REVIEW

MMSE

MMSE is a simple and largely used screening tool which evaluates five cognitive domains (orientation, immediate memory, attention and calculation, delayed memory, language and praxis) [3]. The total score is between 0-30 and is the sum of all domain partial score. This total score can be corrected on the basis of age and educational level [4,5]. The interpretation of this score is a matter of debate in the scientific literature: different cut-off scores are frequently reported to discriminate non-impaired and cognitively impaired subjects. Creavin, et al. wrote a review on the topic: the authors noticed a prevalence of 24- and 25- points cut-off studies, though also studies with "MMSE adjusted for education" had collected considerable numbers of subjects [6]. They have nevertheless considered also different cut-offs: every score between 14-30. Authors' conclusions revealed that 24- and 25-points cut-offs ensure superimposable sensitivity (0.85-0.87, respectively) and specificity (0.9-0.82), but remarking that isolated MMSE should not be used to diagnose or exclude NCDs. Some later studies tried to offer a contribute on this issue.

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Bertsias, et al. performed a study on 3140 patients aged >60 visiting primary care practices in Crete, Greece, using 24-point cut-off. Beyond the results the patients achieved, the authors noticed that chronic illnesses were associated with low MMSE scores, though this test was able to identify the presence of mild and major NCDs [7]. The chronic illness' role in causing or being associated with NCD is undoubtedly an interesting scientific research topic.

Kvitting, et al. suggested to use 26-points cut-off to distinguish impaired by healthy people up to the age of 93 [8]. They conducted a study on municipality of Linköping, Sweden aged 85 to 93 residents, and the proposed cut-off would aim to reduce the risk of false-negative cases.

A meta-analysis conducted by Breton, et al. compared diagnostic accuracy of eight cognitive screening tests: Addenbrooke's Cognitive Examination Revised, Consortium to Establish a Registry for Alzheimer's Disease (CERAD) Neuropsychological Battery, CDT-Sunderland, Informant Questionnaire for Cognitive Decline in Elderly, Memory Alteration Test, MMSE, MoCA, and Quick Screen for Mild Cognitive Impairment [9]. The authors concluded that MMSE had the lower sensitivity in mild cognitive disorder detection. According to the literature, MMSE is largely used also in patient follow-up, in order to assess cognitive impairment after pharmacological or non-pharmacological therapies [10-13].

RBANS

RBANS is a screening tool which evaluates five cognitive domains (immediate memory, visuospatial/constructional abilities, language, attention, delayed memory), each of which is represented by an "Index Score" (IS) [14]. The total score, called "Total Scale Index" (TSI), is the result of the five IS' sum conversion. ISes and TSI <85 indicates a probable cognitive deficit, while <70 indicates full-blown impairment. RBANS requires approximately 30 minutes-and dedicated specialists to administer. It is certainly less widespread than other tests, but given the possibility to evaluate every single domain, it is being exploited in several disease cognitive assessment. Some interesting recent studies on the topic will be now examined. Our research group performed a study [15] on 166 HIV-infected subjects, demonstrating that RBANS may identify HIV-related cognitive impairment. Immediate and delayed memory, and attention were the most compromised domains. A neuropsychological panel for RBANS comparison should help to recognize effective RBANS' utility on this topic.

De la Torre, et al. performed a study on a Spanish-speaking population with "severe mental illness": patients with schizophrenia, mood disorder and borderline personality disorder were enrolled, while patients with any central nervous system disease or alcohol or drug abuse - in addition to the psychiatric diagnosis–were excluded [16]. Schizophrenia revealed the most important differences from controls, but the small size of the other samples could have weakened the result. The authors concluded anyway that RBANS may be a valid tool for cognitive impairment in psychiatric patients.

Hantke, et al. studied 153 veterans referring "complicated postdeployment heath concerns" [17]. Patients were assessed with RBANS and also with Wechsler Test of Adult Reading and Wechsler Adults Intelligence Scale. The authors noticed patients with a diagnosis of post-traumatic stress disorder (PTSD) achieved low scores on "story recall" a subtest of "delayed memory" domain - while patients with traumatic brain injury - with or without PTSD were not well assessed by any administered test. These results suggest an unclear RBANS' role in PTSD assessment.

Progressive supranuclear palsy (PSP) was the center of the study performed by Duff, et al. [18]. Three hundred four patients were enrolled: one of the inclusion criteria was having a MMSE ≥ 15. In this cohort, RBANS scores were related to PSP symptoms, functional abilities and depression; visuospatial/constructional abilities and attention were the most compromised domains.

Loughan, et al. studied RBANS scores performed by 82 patients with primary brain tumor [19]. The age range was 19-81, in line with RBANS' validation [8]. Among the five domains, memory and attention seemed to be the most impaired.

Cao, et al. compared 60 patients with alcohol-dependence with 40 healthy controls with RBANS and event-related potentials [20]. The authors concluded that the combined use of these two tests may be useful to assess cognitive impairment in alcohol-dependent people. The study Beath, et al. performed comparing RBANS and MoCA in mild cognitive impairment (MCI) assessment will be discussed in the next section [21].

MoCA

MoCA is a quick screening tool which evaluates seven cognitive domains: visuospatial/executive function, naming, attention, language, abstraction, delayed memory and orientation [22]. It requires approximately 10 minutes administering. The total score is between 0-30 and is based on the partial scores from all domains: a score ≥ 26 indicates normal cognitive abilities. As in MMSE case, the original cut-off is in question in the literature: various authors propose to lower it to 23-24/30 [23,24] in order to avoid a number of false positives. The similarities between MoCA and MMSE brought several research groups to compare their accuracy [9,25,26]: MoCA's superiority in MCI detection was agreed by all the authors, while MMSE was supposed to be able to assess more advanced NCDs.

As mentioned in the previous section, Beath, et al. [21] performed a cross-sectional study on a sample of 370 healthy people comparing MoCA and RBANS. The authors found quite similar performances from the two tests in predicting MCI, suggesting a MoCA cut-off lowering to 24. MoCA revealed good results also in HIV-associated neurocognitive disorder assessment, but again denouncing a cut-off lowering need [27]. Cognitive impairment after stroke is another field of application. Potocnik, et al. x revealed that patients performed worse than healthy controls on MoCA [22].

Chapman, et al. carried out an interesting study on 48 stroke survivors: the aim of the study was to prove the equivalence of videoconference and face-to-face MoCA administration [28,29].

Every patient completed the test in both "versions" on approximately two weeks apart. The results revealed variability between the two administrations, unfortunately. In spite of this, we believe that research should promote the implementation of similar studies, in order to further spread neurocognitive screening.

CDT

CDT is a very simple neuropsychological test, whose administration is extremely short [30]. Existing as an independent test, clock drawing is also included in "visuospatial/executive function" MoCA section [22].Various CDT interpretations are reported in the literature, each one with deeply different rating scales and cut-off scores [31]. Among them, CERAD-CDT scores from 0 normal clock to 3 severe impairment and appears to have a quite good sensitivity [32,33]; Schulman-CDT [34] scores from 1 normal clock to 6 unreasonable representation (e.g. the subject writes a word instead of drawing a clock); Sunderland-CDT [35] and Rouleau-CDT [36] score from 1 "worst" to 10–"best", although using different criteria to interpretate the drawing; finally, Tuokko-CDT [37] considers clock drawing but also clock setting and clock reading. It's interesting to note that various scoring systems seem correlate with different gray matter volume in different brain areas [38,39], though a systematic review conducted by Supasitthumrong, et al. concluded that CDT scores are not associated with consistent specific anatomical lesions [40].

Duro, et al. studied the relationship between CDT and decreased cerebral blood flow assessed with single-proton emission computer tomography in MCI patients [41]. The authors concluded that CDT scores correlated to low flow in Alzheimer's disease key areas. In any case, the quick and easy administration and the acceptability by subjects made CDT a good partner for MMSE in NCD screening and monitoring [42].

Despite the improvements to diagnostics, CDT continues to be recognized a valid screening tool in clinical practice for various NCD etiologies. Duro, et al. performed a cross-sectional study using CDT, MMSE, and MoCA [43]. Their conclusion confirmed CDT's sensitivity in Alzheimer's disease identification, however recommending caution for MCI patient assessment.

Lolekha, et al. concluded that CDT may serve as a screening tool for Parkinson's disease dementia [44]. Cerezo, et al. studied hypertension-mediated brain damage with CDT in 1414 hypertensive adult subjects [45]. The authors confirmed CDT's usefulness to detect the damage, recognizing to CDT a better sensitivity than MMSE's.

Champod, et al. were able to demonstrate that performance on CDT in acute stroke patients were related to long-term functional and cognitive outcomes, e.g. degree of independence in daily living activities [46]. Finally, referring to delirium, which is another common NCD [47], Meagher, et al. conducted a systematic review in 2020 concluding that CDT had quite good performances in delirium detection if used alone, but if MMSE was used together with it, CDT did not seem to add value to the analysis [48]. We do not recommend CDT or MMSE use in delirium assessment, anyway, preferring the 4 "A"s Test (4AT) in the first instance, due to its sensitivity and specificity [49].

CONCLUSION

As in other medical fields, the more sensitive the tests, the more specialist knowledge require. MMSE continues to be the most used test, despite its relatively low sensitivity, especially due to the ease of its administration. RBANS finds small space both in the literature and in clinical practice, because its administration is time-requiring and only dedicated specialist can perform it. Much more attention to this battery should be given, due to the possibility to explore different cognitive domains separately, and its application in different NCD etiologies. By the way, small samples continue to limit scientific value of RBANS.

MoCA is a useful and spread cognitive tool; many authors agree on the need to lower the original cut-off, in order to further improve the test's performances. CDT, perhaps surprisingly, continues to enjoy a high reputation in the literature, and its use is extended too many NCD etiologies. In conclusion, the need of early detection in NCD is partially satisfied by neurocognitive screening tests, but their use in clinical practice is undoubtedly necessary in order to identify patients for further evaluations.

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