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Topical Review: Cognitive and mood assessment tools for use in stroke

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Topical Review:Cognitive and mood assessment tools for use in stroke

Should stroke physicians assess cognition and mood?

It would seem intuitive that for a 'brain' disease such as stroke, the examination of memory, thinking and mood would be fundamental to the clinical assessment. Yet in contemporary stroke practice we have tended to focus on the physical manifestations of stroke and neuropsychological aspects have received little, if any, attention.¹ Thankfully the landscape is changing, there is an increasing recognition of the importance of the psychological consequences of stroke and a growing evidence base and standardisation around assessment.^{2,3,4} The stroke physician cannot be expected to take on the role of the neuropsychology specialist and there will always be cases where expert input is required. However, a basic appreciation of how to approach cognitive and mood assessment should now be mandatory for all working in stroke care.

In this review we discuss assessment of cognitive function and mood. We have drawn on evidence from recent research, particularly systematic review.³ We do not offer a comprehensive critique of all cognitive and mood assessment tools. Rather, we suggest a framework for assessment that emphasises the need for differing approaches to testing at differing points in the stroke pathway.(Figure 1)

The importance of cognition and mood in stroke

The arguments in favour of assessing cognition and mood in stroke are underscored by two fundamental facts. Cognitive and mood problems are common following stroke and are both associated with poor outcomes. One in three people will experience stroke, dementia or both.⁵ The definitive systematic review describing cognitive problems following stroke, reports incident dementia rates of around 10%, rising to 30% with recurrent events.⁶ Immediately following stroke, cognitive impairments are seen in around 70% of patients.⁷ The patient with cognitive problems has increased risk of poor functional outcome, increased length of stay and increased mortality.⁵ In recent research and policy the focus has shifted from those with frank dementia syndromes, to the much larger population of stroke survivors with cognitive impairments that are not sufficient to meet diagnostic criteria but still impact on quality of life. Here there is greater potential for prevention, modification or adaptation.

The data are similar for post stroke depression. At any point in time around one third of stroke survivors have depression and this is associated with increased disability and mortality.⁸ Perhaps the most compelling argument for the importance of the psychological aspects of stroke comes from stroke survivors themselves. In a recent priority setting exercise, stroke survivors voted that cognitive aspects of stroke are their key priority.⁹ This finding is echoed by results from patient and carer workshops organised by the Stroke Association, UK and other third sector groups.¹⁰

Screening for cognitive and mood issues following stroke

There are two broad approaches to neuropsychological assessment in stroke, targeted assessment of patients where there is concern about a cognitive or mood problem and unselected screening of all stroke patients. The two are not mutually exclusive and the patient who 'passes' a screening test but complains of cognitive or mood issues should not be denied a more detailed assessment.

The rationale for screening all stroke patients is plausible and guidelines from specialist societies recommend early screening.(Figure 2) Psychological problems are common and early identification should allow treatment initiation, rehabilitation that is personalised to the individual and appropriate goal setting. However, we have no empirical evidence of clinical or cost benefit of this approach. Those who argue against early cognitive screening, cite the limited understanding of the natural history of the condition, the lack of any proven treatment, and the potential harms of mislabelling a patient as having a neuropsychological syndrome. If we consider the Wilson-Junger criteria¹¹ for assessing a screening programme, in the context of stroke cognitive screening we see that there are several areas where knowledge is lacking and research in this field is urgently required.(Table 1)

Assessing pre-stroke problems

Although the theme of this review is post stroke assessment, to put these tests into context it is necessary to understand the pre-stroke state. Stroke is a disease of older adults and older adults often have cognitive and mood problems. Systematic reviews suggest that at least 10% of stroke admissions have a dementia diagnosis pre-stroke⁵, with similar prevalence for pre-stroke depression.¹² These figures are likely to be an underestimate, often cognitive and mood problems are only detected by healthcare professionals when the person is assessed for another medical conditions such as stroke.

Various tools exist to retrospectively assess for cognitive impairments and if used in the immediate period following stroke can give a picture of the pre-stroke state. The usual format is a short questionnaire completed by a collateral information source, for example a spouse or relative. Examples include the Informant Questionnaire for Cognitive Decline in the Elderly (IQCODE)¹³; the Ascertain Dementia Eight-Item screen (AD-8)¹⁴ and the informant component of the General Practitioner assessment of Cognition (GP-Cog)¹⁵. These tools have features that make them suitable for assessment immediately after stroke. They are short, standardised and offer a method of describing function when the patient may be too unwell for direct assessment. Informant tools have reasonable test accuracy for detection of dementia in community and memory clinic settings¹⁶ and by using the informant's perception of cognitive and functional change these tools are less prone to cultural biases seen with other tests. However, to date there has been no validated assessment of their performance for the detection of pre-stroke dementia.¹⁷ IQCODE at time of stroke may also have prognostic utility; a higher IQCODE score is a specific but insensitive tool for predicting future dementia.¹⁷ There are limitations to informant questionnaires. The availability of an informant who is willing or able to comment on the patient's pre-stroke state is not guaranteed. If the tool is not used early after the stroke event then informants may struggle to give an account of pre-stroke cognition and often describe the cognitive problems that they see following the stroke.

The clinician may wish to assess other aspects of the pre-stroke condition. As part of a more formal neuropsychological assessment, a measure of premorbid intelligence is often useful. The National Adult Reading Test (NART) is used in this regard, as vocabulary is said to be better preserved in neurodegenerative conditions than other cognitive abilities.¹⁸ However, the correlation between NART and early life intelligence is not perfect¹⁸ and whether NART is useful in acute stroke, particularly dominant hemisphere stroke, is less clear.

Informant based depression screens have been described and could be used in a similar way to assess pre-stroke mood. However, as with cognitive assessments these tools have not been validated for use in acute stroke.¹⁹ Screening medical records for a previous diagnosis of mood disorder can be equally useful with a low opportunity cost. Assessment of cognition and mood should always be accompanied by an assessment of function. Traditionally the assessment of pre-stroke function has used the modified Rankin Scale (mRS).²⁰ Newer assessments designed to describe physical and cognitive frailty may also provide useful information.

Assessment in the hyper-acute stroke unit

Cognitive and mood assessment may not seem an immediate priority in the early period following stroke. A comprehensive multi-domain assessment is unlikely to be feasible, but brief assessments are possible and potentially useful in the hyper-acute setting. Even in very time limited settings, assessments for pre-stroke cognition, delirium and brief cognitive testing are possible and may be useful in guiding subsequent management.(Figure 1)

Examples of bedside cognitive tests of less than five minutes duration include Hodkinson's ten-point Abbreviated Mental Test (AMT)²¹; the Mini-Cog²² and abbreviated forms of the Montreal Cognitive Assessment (MoCA).²³ All have proven validity in assessment of older adults, but the evidence base for their use in stroke is limited.²⁴ Short screens for mood disorder are also available, for example the two-question based Patient Health Questionnaire (PHQ-2).²⁵ These tests are clearly not diagnostic, but can be used as a triage tool in the acute period. If a patient struggles with the brief assessments then the need for further assessment to determine the nature of the impairment can be highlighted to the team. Certainly, short tests are more sensitive to cognitive problems than unstructured clinical assessment.²⁶

Perhaps more pertinent to the hyper-acute setting is screening for delirium. The syndrome of delirium is a common complication of acute illness. Delirium is less well studied in stroke than in other conditions, but where data are available these suggest that delirium is seen in one in four stroke patients during the acute period.²⁷ The finding of delirium has implications for both the short and longer term.²⁷ Incident delirium can signal the emergence of a stroke related complication such as pneumonia and in the longer term the presence of delirium is associated with poor outcomes. Screening tools for delirium are available and many have good accuracy when compared to gold standard clinical assessment. The 4-A test is a short screening tool for delirium that is available in several languages, is quick to administer with little training and has some supportive data in stroke.²⁶ The Confusion Assessment Method (CAM) also has proven accuracy for diagnosis of delirium in stroke.²⁸ For patients with aphasia or other communication problems, the CAM modified for use in Intensive Care Settings (CAM-ICU) can be used as it does not require any verbal response for completion.²⁹

It is routine to assess stroke related neurological impairments on admission using a standardised tool such as the National Institutes of Health Stroke Scale (NIHSS). The information from this assessment can also be useful for subsequent cognitive and mood testing. NIHSS will detect those with severe communication or visuospatial problems who may require an adapted approach to

assessment. Physical impairments detected by NIHSS may also be relevant to the cognitive assessment, for example the person with severe weakness in the dominant hand may struggle with pencil and paper based assessments. Although not part of the traditional stroke examination, a screening assessment to detect major hearing or visual impairments will also inform any future testing.

Assessment in the stroke unit

The opportunity for slightly more detailed cognitive and mood assessment can come once the patient has stabilised medically. A full neuropsychological battery or diagnostic interview may still not be appropriate or feasible at this point, however a multi-domain screening tool can be a useful part of the clinical assessment.

The number of cognitive screening tests available to the clinician is large and continues to grow. Historically there has been little consistency in the cognitive or mood test employed in stroke³⁰ and choice of assessment often elicits strong opinion that is not always grounded in evidence. Stroke specific data on the properties of psychological assessment tools has recently become available and we no longer have to extrapolate from studies performed in community or memory clinic settings.

There is no perfect psychological assessment and the preferred tool will vary with the intended purpose of testing, the case-mix of the population and the skills of the person administering the test. We suggest some criteria for a psychological screening tool to be used in the stroke unit.(Figure 3) The key features are:feasibility for use in acute stroke setting; acceptable test properties and coverage of core cognitive domains (DSM-5 suggests including tests of complex attention; executive function; learning & memory; language; perceptual-motor; social cognition). Most screening tests cover these domains to a greater or lesser extent and if the clinician is particularly interested in assessing a certain domain then this can guide the preferred test strategy.(Table 2). Assessment of cognition and mood must be interpreted in the context of language and culture. Local adaptation with robust validation is required for international use of assessment tools, indeed this was the core rationale for the National Institute of Neurological disorders and stroke–Canadian Stroke network (NINDS-CSN) Harmonization effort.⁴

Test accuracy is an important consideration i.e. does the test correctly select people with the condition of interest as diagnosed by a gold standard.³¹ In the context of acute stroke it is debatable which gold standard is the appropriate comparator. Diagnostic testing for dementia is not recommended immediately after stroke and so comparison with a clinical diagnosis may not be

suitable. Arguably a more meaningful analysis would compare a short screening test with a more detailed assessment. Alternatively one could look at how well a screening tool assessment predicts subsequent cognitive problems (delayed verification).³¹ The 'optimal' test accuracy is also not straightforward. There is an inverse relationship between the test properties of sensitivity and specificity and depending on the purpose of testing one may be preferred over the other. For example, if the intention is to pick up all patients with possible psychological problems, at the cost of 'false positives', then a higher sensitivity may be preferred.

Recent reviews have used novel meta-analytical techniques to collate and compare the test accuracy of cognitive and mood assessments in the stroke setting.^{19,24} For cognitive assessment in stroke, despite the large number of tests potentially available, only two tests had sufficient numbers of papers to allow meta-analysis: Folstein's Mini-Mental State Examination (MMSE) and MoCA.²⁴ The pooled data show that at usual test threshold, MoCA is extremely sensitive but has poor specificity. Using an adjusted threshold (MoCA<22) the sensitivity and specificity are less extreme.(Table 2) Defining the optimal threshold for a stroke assessment scale is an area that requires more research, ideally this work should be based on data from the population in which the test will be employed. Since the publication of this review, new screening tools developed specifically for stroke have been described such as the Oxford Cognitive Screen (OCS).³² Initial data suggest that OCS may have some advantages over other cognitive screens. In particular it is designed to offer domain specific results rather than a reductionist pass/fail; it allows finger pointing response to minimize bias from aphasia and incorporates assessment of apraxia and neglect.

For depression assessments, five tests had sufficient data to allow meta-analysis (Beck Depression Index; PHQ-2; PHQ-9; Hospital Anxiety and Depression Score [HADS] and Hamilton Rating Scale for Depression).¹⁹ Accuracy was broadly similar across the tests and all were best suited to 'rule-out' depression. The majority of these tests assess for symptoms of depression rather than diagnose the clinical syndrome of depression. When using these tools there may be overlap of potential depression symptoms with non-psychological stroke effects, for example weight loss is often seen following acute illness such as stroke. A depression screen with less weighting for somatic symptoms would seem reasonable in acute stroke settings.

Post stroke neuropsychological recovery is a dynamic process and this must be borne in mind when interpreting cognitive and mood screening tools. In studies describing assessment in the first days post stroke, the majority of patients screen 'positive' for cognitive and mood disorders.³³ This is perhaps not surprising in the context of a potentially life changing brain injury. Over the next days and weeks many show improvement, highlighting the need for continued assessment over time.

Post stroke checklists for use in outpatient services have been described that could be used in this regard. Differing patients have differing cognitive and mood trajectory and the time-point of neuropsychological stability, if such a state exists, is not clear.

Assessment in the rehabilitation unit or outpatient clinic

Following the acute period, detailed assessment becomes more feasible and comprehensive neuropsychological assessment may have a role. A neuropsychological battery (NPB) is considered a gold standard for detection of cognitive impairments, although is not sufficient alone to make a diagnosis of a dementia syndrome. Neuropsychological batteries are substantially longer than screening tests with associated increased test burden for the patient. The administration and interpretation of NPB data requires specialist training and ideally test results should be judged against population normative data. For these reasons, assessment using a NPBs are reserved for selected patients (guidance suggests deferring this until at least three months post ictus).³⁴ Even with case selection the aspiration of comprehensive neuropsychological assessment may be challenging to realise in a stroke setting. Issues include, but are not limited to, training, availability of assessors, appropriate test materials and space for testing.

NPBs comprise a series of individual tasks designed to assess each cognitive domain. There is not a preferred battery for use in stroke and even within each domain, there is no agreed consensus on a preferred test. Often the assessor will individualise the tests specific to the patient's problems or the clinical question to be answered. NINDS-CSN Harmonisation workshops have suggested a suite of NPBs for detection of vascular cognitive impairment⁴ with test protocols suitable for screening (5 minutes); multi-domain testing (30 minutes) and comprehensive assessment (60 minutes). The NINDS-CSN comprises validated domain specific tests, with population normed data and validated versions in several languages.⁴

Although our focus is on formal psychological assessment, we should not under-estimate the utility of functional assessment in the stroke unit or rehabilitation facility. Direct observation of a patient attempting a task such as meal preparation can give useful information on many aspects of cognition and this approach is often used by allied health professionals in their assessment. A multidisciplinary assessment informed by neuropsychological testing, functional assessment and results of investigations such as neuroimaging are the ingredients required to make a diagnostic formulation and treatment plan.

Assessment in clinical trials

Historically, endpoints for stroke trials have mirrored those seen in cardiology with a composite outcome comprising vascular events and mortality. For primary and secondary prevention trials this outcome is suitable but is overly reductionist for studies looking at stroke recovery. In this instance, the guidance is to assess function and the most commonly reported measures are mRS, NIHSS and Barthel Index (BI).⁴ These assessments all focus on physical function and are poor measures of neuropsychological recovery. Despite calls to include cognitive assessments in stroke trials, an assessment of cognition or mood is the exception rather than the rule and where psychological assessments are employed in trials there is little consistency in the choice of tool or the method of application.³⁰

The recent European Stroke Organisation/Karolinska Stroke Update offers guidance on the preferred measures for trials.³⁵ The consensus statement recommends use of an informant measure such as IQCODE to assess pre-stroke cognitive impairment for participant selection or case mix adjustment. Two approaches to patient assessment are described, a short battery that can be administered by most researchers (MoCA, trail making tests and digit span) and an extended multi-domain test battery. In addition they recommend consideration of other neuropsychological factors such as depression, fatigue, apathy and care-giver status.

In clinical practice direct assessment is preferable, but in the context of a large multicentre trials or registries, remote centralised assessment may need to be considered for logistic and economic reasons. Options include assessment via telephone, postal questionnaire, internet based questionnaires or remote video interview. The most commonly used telephone cognitive assessment is the Telephone Interview for Cognitive Status (TICS). TICS is based on MMSE although subsequent modification (TICS-m) offers a more comprehensive memory assessment. TICS and TICS-m have reasonable test accuracy for detection of Alzheimer's dementia, but properties in stroke are less well studied.³⁶ Modifications of the MoCA to make it suitable for telephone assessment have been described for use in stroke cohorts, with test accuracy similar to TICS-m.³⁷ An obvious disadvantage of telephone assessment is that pencil and paper tests and assessment of visuospatial function are not possible. In the future we will see increasing use of internet based self-assessment questionnaires. Use of e-health resources is high and increasing among older adults in Europe making this a potentially feasible platform. However, validation in stroke cohorts will still be required before this approach could be recommended.

The analysis of cognitive and mood data for trials presents further challenges. A dichotomous outcome of impairment present or absent allows for ease of analysis but lacks granularity and may not have power to show between group differences. Other approaches include creating hierarchical categories, assessment as a continuous scale and assessing against population normative data. A composite of vascular events, physical recovery and cognition may have particular utility in trials of minor stroke or TIA.³⁸ If a study is to include a range of stroke severities then inevitably not all assessments or items within an assessment will be completed. For cognitive assessment this is a particular challenge and study protocols should have clear rules for how these missing data are handled in analyses.³⁹

Additional assessments

For this review we have focussed on assessment of cognition and depression. Within the rubric of psychological consequences of stroke are a number of other equally common and disabling conditions that should also be considered. There is considerable overlap between many of these conditions and often in screening for one condition the assessor may notice issues suggestive of another neuropsychiatric problem. Depression is not the only mood disorder associated with stroke and anxiety in various forms is increasingly recognised as a post stroke phenomenon. Compared to depression, there are fewer anxiety screening tools and little validation of these tools in stroke cohorts. For an initial brief screening assessment, the two-item Generalised Anxiety Disorder (GAD-2) could be considered. Other syndromes such as fatigue, emotionalism and apathy are also common although under-researched in the context of stroke. There are assessment tools for all these conditions, but no consensus on the optimal assessment strategy. The Neuropsychiatric Inventory Questionnaire for informants is often used in stroke cohorts and has been validated for this purpose.⁴⁰

Cognitive assessment to assign a diagnostic label

An important purpose of assessment should be to make a diagnosis of dementia or depression. However, none of the tools discussed in this review are diagnostic in their own right. The clinical label of dementia requires more than a demonstration of cognitive impairments. This should not detract from the utility of cognitive screening. Forming a dementia diagnosis is not the only rationale for assessing cognition. Understanding a patient's cognitive problems can help target the

rehabilitation approach; can provide useful prognostic information and can highlight the emergence of complications such as delirium.

Historical definitions of dementia that required impaired memory and evidence of progression over time were problematic in stroke where the patient could have disabling cognitive problems but preserved memory and/or where the cognitive deficits would not necessarily show a steady temporal decline. The new terminologies of neurocognitive disorder (NCD) as outlined in Diagnostic and Statistical Manual of Mental Disorders, Fifth Edition (DSM-5) are better suited to stroke.

Whichever classification is used, evidence of cognitive impairment is only part of the assessment there must also be an assessment of functional ability. In DSM-5 the ability to perform instrumental activities of daily living (ADL) distinguishes minor from major NCD, while loss of basic ADL defines severe NCD. The importance of functional assessment should not be underestimated and recent reviews describe the tools available.⁴ In stroke we are very familiar with using scales mRS and BI and we should also incorporate these assessments into cognitive formulations.

Going beyond 'unspecified dementia' to assign a more detailed pathological dementia diagnostic label comes with increased complexity. DSM-5 recognises post stroke cognitive impairment as a distinct condition, but this is only one of a number of terms that have been used to describe dementia in the context of stroke disease.³⁵ Recent attempts to provide a harmonised framework for the classification of vascular cognitive impairments are welcome and will hopefully be adopted by the clinical and research community.^{2,4} Most classifications define post-stroke dementias based on time from stroke, for example '...cognitive decline that begins after, but within six months of the stroke and does not recover'.² The implications for assessment are that we should avoid assigning a diagnostic label until at least six months post ictus and longer periods of assessment may be preferable.

Future Directions

Neuropsychological assessment in stroke is moving from a niche, opinion based endeavour to an evidence based part of the standardised stroke assessment. Considerable progress has been made in our understanding of cognitive and mood assessment in stroke but there is more work to be done.(Figure 4) Future research should look at the utility of the very early assessment recommended in many guidelines. Prospective cohorts with multi-domain assessment will allow a better understanding of the natural history of cognitive and mood problems. Finally we should not forget the patient and carer's voice and we need qualitative work to identify which

neuropsychological aspects are of greatest importance and how the experience of cognitive and mood assessment can be optimised. As we collect study level cognitive and mood data we should share this resource with other researchers and registries such as VISTA-Cog are important in this regard.

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Table 1:Wilson-Jugner criteria applied to early cognitive assessment

Criteria for neuropsychological screening	Applicable to (H)ASU
Condition must be important	Yes
Epidemiology & prognosis should be understood	Partly
Test should be simple and safe	Partly
Test should be validated for population	Partly
Test should be acceptable to patients / testers	Unknown
There should be an effective treatment	No
There should be RCT evidence of screening efficacy	No
The opportunity & economic cost should be described	No

Table 2: Domain specific content and properties of commonly used cognitive screening tools (using DSM-5 domains)

	ACE-R	MMSE	MoCA	OCS	TICS-m
Duration	15-20 minutes	≤10 minutes	10 minutes	15-20 minutes	10 minutes
Copyright status	Freely available	Copyrighted, charge for use	Freely available	Freely available	Freely available
Complex Attention	Serial subtraction Backwards spelling	Serial subtraction	Digit span Letter A tapping Serial subtraction	Calculations	Serial subtraction Count backwards
Executive Function	Verbal fluency		Trails Verbal Fluency Abstraction	Trails	
Learning & Memory	Orientation Three item recall Address recall Recognition	Orientation Three item recall	Orientation Five item recall	Orientation Sentence recall Recognition	Orientation Ten item recall
Language	Reading Comprehension Writing Repetition Naming	Object naming Repetition Reading Writing	Animal naming Repetition	Object naming Semantics Sentence reading	Semantics Repetition
Perceptual-motor	Intersecting pentagons Clock draw Cube copy Counting dots Identify letters	Intersecting pentagons	Cube copy Clock draw	Gesture imitation Cancellation test	
Social Cognition					
Sensitivity Specificity	Cut off <88 0.96 (0.90-1.00) 0.70 (0.59-0.80)	Cut off <27 0.88 (0.82-0.92) 0.62 (0.50-0.73)	Cut off <26 0.95 (0.89-0.98) 0.45 (0.34-0.57)		

Table of commonly used multi-domain screening tools and domain specific content. Domain items are labelled as per test authors. We recognise that test items often overlap, and an item may test more than one domain. Test accuracy data are against reference standard of neuropsychiatric battery or clinical assessment using data from meta-analyses where available.

ACE-R: Addenbrookes Cognitive Examination Revised; MMSE: Mini Mental State Examination; OCS: Oxford Cognitive Screen; TICS-m: Telephone Interview for Cognitive Status Modified

Figure 1:Neuropsychological assessment throughout the stroke pathway

Schematic illustrating a potential approach to neuropsychological assessment at various stages in the stroke pathway. The tests named are given as examples rather than recommendations. Note how all elements are used to inform the clinical diagnosis. Note also that the early assessments focus on pre-stroke cognition, delirium and stroke impairments rather than detailed cognitive assessment.

IQCODE:Informant Questionnaire for Cognitive Decline in the Elderly; mRS:modified Rankin Scale; MoCA:Montreal Cognitive Assessment; (mini-MoCA:short form of the MoCA; MoCA plus:MoCA with additional test as recommended by ESO); PHQ:Patient Health questionnaire; CAM-ICU:Confusion Assessment Method for the Intensive Care Unit; NIHSS:National Institutes Health Stroke Scale; NINDS-CSN:National Institute Neurological Disorders and Canadian Stroke Network; Centre for Epidemiologic Studies Depression; SCID:Structured Clinical Interview Depression; E-ADL:Extended Activities of Daily Living; HR-QoL:Health Related Quality of Life

Figure 2:Guidelines on neuropsychological assessment in stroke

Figure 3: MuSCoW chart detailing preferred properties of a neuropsychological screening tool

Figure 4:Key messages for cognitive and mood assessment in stroke