

Neuropsychological Assessment in Epilepsy

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Neuropsychological assessment in epilepsy

Abstract

The role of the neuropsychological assessment in the management of people with epilepsy has evolved considerably over the past 25 years. This paper describes some of the most common applications of a neuropsychological assessment in the diagnosis, management and treatment of people with epilepsy. It describes the factors that influence the interpretation of neuropsychological test scores in this patient group and outlines the limitations of the investigation. Guidelines for the optimal timing of a referral are given, together with timelines and indications for reassessment. A checklist is provided to help the referring clinician get the most from a neuropsychological assessment for their patients with epilepsy.

Introduction

The role of the neuropsychological assessment in the management of people with epilepsy has evolved considerably over the past 25 years. Prior to the advent of MRI, patterns of cognitive strengths and weaknesses derived from a neuropsychological assessment were used to lateralise and localise cerebral pathology in this group. The advances in structural and functioning imaging over the past quarter of a century mean that this is no longer the primary role of a neuropsychological assessment in this population.[1]

However far from hastening the demise of the neuropsychological assessment, new imaging techniques have enhanced the role of traditional tests in the clinical management of people with epilepsy.

This paper describes the ways in which a neuropsychological assessment can help in the diagnosis, management and treatment of people with epilepsy and provides some recommendations for getting the most out the investigation for this patient population.

What is a Neuropsychological Assessment?

A neuropsychological assessment consists of the administration of a number of tests which have been standardised and normed on healthy populations. Every neuropsychological test has a ceiling and a floor. These are the limits of the best and worst performances possible on the task. For example on a 'Count to 3' task, the ceiling of the test would be the ability to count to 3. Since well over 99% of the adult population can do this, it would be a test with a very low ceiling. Full marks on the test would not distinguish the patient whose counting limit is 4 from one who can solve complex quadratic equations in lightning speed. Most tests are therefore standardised so that the top and bottom scores are only returned by 2% of the general population. Anyone completing these standardised tests will obtain a score which will provide a measure of how well they are functioning compared to an age matched sample of their healthy peers and/or patients with similar or other conditions. These scores tend to be normally distributed and are converted to either z scores or a percentile rank to allow comparison between tests. See Figure 1.

Figure 1: The Normal Distribution and Psychometric Conversion Scores
<<here>>>

Not all neuropsychological test scores are normally distributed and some tests may be based on pass/fail criteria or have 'cut off' points for the identification of an abnormal pattern of response.

Most neuropsychological assessments will generate a large number of measures of function in a number of cognitive domains including general intellectual ability, memory function, expressive and receptive language skills, executive function and perceptual abilities. This creates a cognitive profile of strengths and weaknesses across multiple domains.

These cognitive profiles are examined to determine clinically significant deficits in relation to the individual's estimated pre morbid level of

function in each cognitive domain (where appropriate) and also in relation to the pattern and level function seen in their healthy, age matched peers.

When can a neuropsychological assessment help in the management of people with epilepsy?

Table 1 describes some of the most common applications of a neuropsychological assessment in the diagnosis, treatment and management of people with epilepsy.

<<Table 1 here>>

Interpreting the Results

Just as it is increasingly recognised that epilepsy is a disorder of cerebral networks [2] so we have moved away from a phrenological approach of assigning specific cognitive functions to the role of specific cerebral structures.

Figure 2. A neuropsychological assessment is not phenology! <<here>>

Rather we now understand that difficulties on particular neuropsychological tasks represent dysfunction within the underlying network that sub serves that function. This disruption of function can be the result of a large number of factors. These are illustrated in Figure 3.

Figure 3: Factors influencing performance on neuropsychological tests in epilepsy (© ILAE, reproduced with permission) [1] <<here>>

The neuropsychological assessment is unique amongst the standard diagnostic assessments in epilepsy. The clinical significance of the cognitive profile can only be fully interpreted in the light of the outcomes of other investigations. This is not the case with an MRI where a cavernoma will present as a cavernoma, regardless how a patient is feeling on the day of the scan or when they last had a seizure.

However, in a neuropsychological assessment a poor score on a test can reflect a large number of both organic and non organic factors, some of which may be permanent (eg underlying structural pathology), others of which may be transient (post ictal disturbance, interictal sub clinical EEG discharges, depression etc) or reversible (e.g. medication effects) or even specific to the assessment itself (e.g. poor motivation and test anxiety).

A skilled neuropsychologist will need to examine the evidence for each of the factors illustrated in Figure 3 and their interactions in order to interpret the test results for each patient. This means the more information the neuropsychologist has about the patient at the time of the assessment, the better their interpretation will be. In most settings they will be relying solely on the referral letter from the neurologist for this information.

Limitations

Unlike a scan or an EEG, a neuropsychological assessment assesses the person and not the brain. There are a number of limitations associated with this kind of assessment and it will not yield useful results for everyone. The following limitations should be considered when considering referring someone with epilepsy for a neuropsychological assessment.

1. Most of the tests we use are culturally specific and have been standardised using a British population who have English as their first language. This means that the norms are only valid for this

population, i.e. people who have been educated within the UK and for whom English is their first language. Although there are some non-verbal tests which have been designed to be culturally neutral, any assessment using just these tasks will be limited. Whilst interpreters can be used to administer some tests, even qualified interpreters are not trained in the standardised administration of psychometric tests. It is possible to end up with a measure of the 'joint IQ' of both the patient and the translator in these situations! Even in faithful translation, the problems of the unrepresentative normative sample remain. Caution should therefore be applied in the interpretation of the findings from a neuropsychological assessment in people who differ in important respects from the normative sample of the test.

2. Most neuropsychological tests are pencil and paper tasks or require the patients to answer questions put to them by the neuropsychologist (who then records their answers, with a pencil on paper). Computerised test batteries are gradually becoming more widespread in use, but technology has not transformed the neuropsychological assessment in the way that it has in other disciplines. This is because an integral part of a neuropsychological assessment is the observation of 'how and why' someone is failing on a task, not just whether or not they can do it, and this requires close observation and the engagement of the clinician with the patient throughout the assessment. Because most of our tests rely on someone being able to see, hear and manipulate a pencil, our range of investigations is limited if someone has significant sensory or motor impairments. This does not mean that a neuropsychological assessment cannot provide useful information in these cases, but it does mean that the assessment will have to be tailored to accommodate these impairments and that it may not be possible to get a reliable measure of function in all cognitive domains
3. As stated earlier, every neuropsychological test has a ceiling and a floor. By definition, people who have been diagnosed with learning disability will have an IQ of 70 or less and will score at or

below the second percentile on tests of intellectual function. Although not always the case, it is common for function in other cognitive domains to be similarly compromised in the learning disability population. This can result in a very flat neuropsychological profile, with every score on every task falling below the 2nd percentile. This does not mean that the individual does not have cognitive strengths and weaknesses but rather that the standardised tests are not sensitive to these patterns in this population, limiting the value of the assessment in some cases.

4. By far the biggest factor that can limit the validity and reliability of neuropsychological test scores is the motivation of the patient. If a patient is not willing to do their best on the tests, we will not get valid data. A neuropsychological assessment can be a tough investigation. Unless they are in the top 2% of the population, every patient will be pushed until they can't answer the questions. As they reach the limits of their cognitive capacity it requires increasing effort not just to give up. Patients who are anxious and depressed or who just don't see the point of the investigation will often give up before the limits of their capacity have been established.

Reassessment

If a patient has undergone a full neuropsychological assessment, most neuropsychologists will advise waiting at least nine months before any reassessment is attempted. This is because practice effects can have a significant impact on performance the second (or third or fourth...) time around. These practice effects can mask underlying deterioration if a reassessment is carried out too soon. Exceptions to this rule are specialist serial assessments that are conducted as part of a treatment evaluation (for example surgical follow-up) where the standardised test batteries at each stage of treatment and follow-up have been carefully designed, employing parallel test batteries to minimise practice effects. Shorter test-retest intervals can also be used in circumstances where the initial

assessment was clearly compromised by factors that have since resolved such as drug toxicity or psychological disturbance.

Routine reassessment is not advised for most people with epilepsy since over exposure results in a reduction of the power of the tests to detect both impairment and change in function. If a patient has undergone an assessment that revealed significant memory impairment with function below the 2nd percentile, further assessment a year down the line when they continue to complain of memory problems is unlikely to help in their management since it is likely to show the same pattern. In the absence of any other features of progressive deterioration such a patient should be referred for memory rehabilitation rather than undergo serial assessments that are highly likely to yield the same results. Unless you think it is likely that something has changed, a reassessment is unlikely to help.

The impact of Antiepileptic Drugs

Given the volume of the literature on the effects of antiepileptic drugs (AEDs) on cognition, there are surprisingly few well controlled studies published. As a general rule of thumb, older AEDs are thought to have more impact on cognition than newer ones, and those on polytherapy are often more slowed up than those only taking one drug, but the impact is different for different people and there are some notable exceptions to these rules. Whilst most AEDs are associated with a degree of cognitive slowing, Topiramate appears to have a specific impact on verbal function and significant reductions in verbal fluency and intellectual function have been reported in some patients. A recent fMRI study reported medication-specific effects (TPM vs ZNS vs LEV) on the functional neuroanatomy of language and working memory networks, with TPM and ZNS associated with dysfunction in frontal and parietal cognitive networks and associated impaired performance on associated tasks [3]. The indirect impact of AEDs on cognition should also be considered. The mood disturbance reported by some people taking Levetiracetam can also lead to poor cognitive function for some. The cognitive profile of any AED should be carefully considered by the

prescribing neurologist, particularly when they are considering changes that could have a dramatic impact on academic performance at key stages of an individual's life.

Getting the most from a Neuropsychological Assessment

The following checklist will help you get the most out of a neuropsychological assessment.

1. *Think about the clinical question you want the neuropsychological assessment to address.*

Whether it's establishing a cognitive baseline prior to medication changes, capacity to consent to treatment or advice about employment options, the more specific the questions you ask in your referral, the more tailored the subsequent assessment will be. As a rule of thumb, the more general the referral, the more general the report you will get back. Referrals do not have to be limited to just one question, often the same results can be used in a number of ways, but it is only by asking the questions, that the neuropsychologist will know what you want from the results.

2. *Give as much information in the referral as possible*

Remember that there many factors that contribute to a neuropsychological profile. If your neuropsychologist does not have ready access to the clinical history of the patient, include as much clinical information as possible in your referral. This information doesn't need to be tailored specifically to the neuropsychologist, just include copies of the most recent clinic letters. Any screening data that you have administered in the clinic (HADS, QoLIE, ACE-R, MOCA) is useful but

not essential, as most neuropsychological assessments will include measures in these domains.

3. Prepare the patient

Tell your patient why you want them to have the tests and how you think they will help. Give them some idea of what to expect. It is part of the job of a neuropsychologist to explain the nature of the tests and to establish a good rapport with the patient before they start testing them, but the neurologist can do a lot of the ground work to ensure a valid assessment by ensuring the patient is on-board, at least with the rationale behind the assessment, before they arrive. If a patient arrives with a good idea of why they have been referred and how the results of the tests will be used to help manage their condition, their motivation to complete the tests to the best of their ability will be better than if they have no idea why they have been referred. Bear in mind that if you typically have difficult clinical consultations with a patient, these difficulties will be magnified under the stressful conditions of a cognitive assessment and it may not be possible to get valid results.

4. And finally...

There are no magic bullets when it comes to cognitive dysfunction in epilepsy. Memory problems, difficulties with attention and concentration and executive dysfunction are often an integral part of the condition, because seizures and cognitive difficulties are both a manifestation of a common underlying brain pathology. To make things worse, the cognitive problems associated with the pathology are often exacerbated by the treatments aimed at reducing the seizures, be they antiepileptic medications or surgery. Clinicians often mistake this for common knowledge, but it is remarkable how many people with epilepsy report that these aspects of their condition have never been explained to them. When people with epilepsy complain of memory

problems in the clinic, education about the wider manifestations of the condition should begin there and then, to ensure realistic expectations of any further investigations you may order.

Key Points

1. Being clear about what you want from a neuropsychological assessment and how the results will affect your management of a patient before you refer will ensure that the results you get back are useful.
2. Prepare the patient. Preparation for the assessment begins in the neurology consultation, when you decide to refer. The better prepared the patient, the more valid the results will be.
3. Think carefully before you refer for a reassessment. A neuropsychological assessment should be used sparingly to maintain the sensitivity of the tests.
4. There are no magic bullets when it comes to cognitive dysfunction in epilepsy. Ensure the patient has realistic expectations of any neuropsychological investigations you may order.

Table 1. Common applications of a neuropsychological assessment in the diagnosis, treatment and management of people with epilepsy.

Determine mental capacity	Under the Mental Capacity Act (2005) mental capacity is not universal but situation specific. Data from a neuropsychological assessment can be used to determine whether some has the capacity to make decisions in a variety of situations from consent to receive/refuse treatment to the management of their affairs.
Assess and monitor medication effects	Some antiepileptic medications can have significant cognitive side effects. A neuropsychological assessment can be used to assess the cognitive cost/benefits of these medications, particularly for young people with respect to their education.
Aid in the differential diagnosis of epilepsy/Non Epileptic Attack Disorder	A very abnormal profile may indicate the presence of a functional disorder.
Provide the basis for a cognitive rehabilitation program	The results of a neuropsychological assessment can be used to create a tailor made rehabilitation program to reduce the impact of any cognitive deficits with an organic basis on everyday function.
Provide the basis for counselling regarding employment/educational options	People with epilepsy and heir carers can develop both under and over expectations regarding the likely impact of their condition on their life opportunities. A neuropsychological assessment can provide a sound basis to ensure someone is able to function at their full potential.
Specialist applications in epilepsy surgery	These include:- a. Lateralising/localising seizure focus in MR negative cases b. Preoperative prediction of postoperative cognitive changes c. Ensuring informed consent d. Implementation of prehabilitation for patients at high risk of a postoperative cognitive decline. Prehabilitation is cognitive rehabilitation implemented prior to the loss of a function. Epilepsy surgery patients are unique amongst neurological patients as we can predict both the nature and extent of the neuropsychological deficit they are likely to experience prior to the surgery that will cause it. We can utilise a patient's intact memory functions before they deteriorate to instil the routines and strategies they will need after the surgery to reduce the impact of post-operative cognitive decline.

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3. Wandschneider B, Burdett J, Townsend L, Hill A, Thompson PJ, Duncan JS, Koepp MJ. Effect of topiramate and zonisamide on fMRI cognitive networks. *Neurology*. 2017; 21;88(12):1165-1171.