Darcy Cox, PsyD, RPsych, ABPP

The role of neuropsychological testing in the care of older adults

The standardized administration of cognitive tests and the individualized interpretation of results can reveal much about brain-behavior relationships and brain function.

ABSTRACT: Neuropsychological testing is recommended for the assessment and diagnosis of cognitive impairment and dementia in older adults. Practice guidelines support neuropsychological testing in this population to identify mild cognitive impairment and to differentiate between types of dementia. Physicians have easy access to a number of brief in-clinic and bedside screening tools. Of these, the most useful and commonly used screening instruments are the Montreal Cognitive Assessment and the Mini-Mental State Exam. In BC, more in-depth neuropsychological assessment can be obtained at all the larger hospitals in the Metro Vancouver area and at those hospitals affiliated with the University of Victoria.

This article has been peer reviewed.

An estimated half a million Canadians are currently suffering from dementia and this number is expected to double within the next 15 years.[1] Currently, 70 000 patients with dementia are living in British Columbia.[2] As the population ages, the need for accurate diagnosis and effective treatment of patients with dementia will increase.

Neuropsychological assessment can aid in the diagnosis and management of patients with dementia or other psychiatric and neurological disorders.[3-6] Neuropsychological assessment is the standardized administration of cognitive tests and the individualized interpretation of the results of these tests to form conclusions about brain-behavior relationships and brain function.

Neuropsychologists are psychologists who have usually completed a 2-year fellowship to obtain further training in neuroanatomy, neuropathology, and behavioral neurology following the completion of their doctorate in psychology. Neuropsychologists are trained to interpret the results obtained from standardized neuropsychological assessment measures in the context of a patient's psychiatric and medical history and to compare that patient's performance with others of similar age and life experience. A typical neuropsychological evaluation for a patient with dementia will last 2 or 3 hours, depending on the patient's tolerance, and will involve standardized testing of memory, attention, processing speed, language, visual-spatial skills, executive functioning, and motor skills. By examining the patient's pattern of performance on these tests, neuropsychologists can help specify both the type of dementia experienced by the patient and the prognosis. Neuropsychological testing can help develop individualized strategies that the patient and caregivers can use to manage specific deficits. Repeated neuropsychological testing can track the progression of the dementia and can also assess the effectiveness of medications or other rehabilitative strategies. Neuropsychologists practise in many settings, including departments of neurology and psychiatry; rehabilitation clinics; inpatient neurology, psychiatry, medical, and geriatric services; and spe-

Dr Cox is an assistant clinical professor in the Department of Psychiatry at the University of British Columbia and the staff neuropsychologist for the Geriatric Psychiatry Outpatient Team at Vancouver General Hospital.

cialized rehabilitation and long-term care hospitals and facilities.

Neuropsychological testing has been recommended by the American Academy of Neurology since 1996 for patients who may have experienced a traumatic brain injury, a stroke, Parkinson disease, multiple sclerosis, a neurotoxic exposure, or dementia. Guidelines published by the American Academy of Neurology note that neuropsychological testing "is particularly valuable in distinguishing between normal aging and mild dementias."[4]

Diagnostic system review

The current *DSM-IV-TR* diagnostic criteria for the dementias are widely recognized to be inadequately specific when describing both the symptoms and the course of any given dementia. Most geriatricians, neurologists, and geriatric psychiatrists use diagnostic systems and tools other than those found in the *DSM-IV-TR*.[7] The manual is currently under revision and the authors completing the revision are likely to incorporate a number of these well-validated tools into the new diagnostic system.

Mild cognitive impairment (MCI), as described by the Mayo Clinic criteria, is a recently defined condition characterized by cognitive impairments that are apparent on clinical exam or formal cognitive testing, but that are not yet producing a clinically significant impairment in daily functioning.[8,9] Neuropsychological testing is thus the most common way to diagnose MCI. MCI has been shown to be the strongest predictor for developing dementia. While the strength of this relationship varies somewhat based on setting, patients with MCI seen in specialized settings convert to dementia within 3 years at a rate of 50%.[10] In community settings, both MCI and dementia are quite common and the prevalence of these conditions increases significantly as people age.[11]

Performance on specific types of neuropsychological tests has been found to have strong sensitivity and specificity when predicting which patients with MCI will go on to develop a dementia. For example, patients with amnestic MCI who demonstrate impairments on delayed word-list recall tasks, category-based verbal fluency tasks, and processing speed tasks are at high risk to convert from MCI to Alzheimer disease.[12]

The most commonly used diagnostic criteria for diagnosing Alzheimer disease are those developed by the National Institute of Neurological and Communicative Disorders and Stroke and the Alzheimer's Disease and Related Disorders Association (NINCDS-ADRDA). The NINCDS-ADRDA criteria require that impairment be confirmed by neuropsychological testing.[5,6]

Although the NINCDS-ADRDA criteria are commonly used, they are specific to Alzheimer disease. The Global Deterioration Scale (GDS) is another dementia diagnosis and rating system that is often used to specify the stage of mild cognitive impairment or dementia experienced by a given patient, regardless of cause.[13] While neuropsychological testing is not necessary when using the GDS, results from neuropsychological tests can be incorporated into a GDS rating.

In addition to these diagnostic tools, there are specific diagnostic criteria for frontal-temporal dementias,[14] and various proposed diagnostic considerations for vascular dementia, Lewy body dementia, and dementia due to Parkinson disease. Many of these diagnostic schemes incorporate neuropsychological test data to at least some degree.

Neuropsychological testing has been recommended by the American Academy of Neurology since 1996 for patients who may have experienced a traumatic brain injury, a stroke, Parkinson disease, multiple sclerosis, a neurotoxic exposure, or dementia.

Patterns of test performance

Cognitive function peaks in our 20s or early 30s and then slowly declines with age, with the greatest changes in speed of processing, memory, and attention. These changes progress across the lifespan with rate of decline beginning to increase in our 60s. Therefore, most individuals will experience a perceivable change in their cognitive function as they age.

Normal aging, mild cognitive impairment, and depression

Cognitive function changes are bothersome and worrisome for many patients,

who fear that these changes may represent the start of a dementing illness. For anxious patients, neuropsychological testing can very often help reassure them that the changes they are experiencing are normal for their age and that there are no indications of impairment or a possible dementing illness. For patients who may have experienced a stroke or brain injury that leads to a localized cognitive impairment, neuropsychological testing can help assure them that the cognitive impairment is stable or improving.

In cases of MCI, a patient experiences greater cognitive impairment than would be expected based on age or other localized factors alone. The impairment is apparent on neuropsychological testing but is not yet of sufficient severity that the cognitive deficits are producing impairment in the patient's ability to function independently. MCI is generally diagnosed with a GDS score of 3.[13] MCI can be diagnosed when a patient has any number of subtle cognitive impairments. The diagnosis of MCI does not require that the patient demonstrate a specific impairment in memory. For example, one patient with MCI may have difficulties with word-finding and processing speed but intact memory, and a second patient may have difficulty with memory alone. In addition, MCI can arise from any cause.

As well as complicating assessment, depressive symptoms are a significant risk factor for MCI and dementia. Individuals with depressive symptoms are significantly more likely to develop MCI than individuals who do not have mood or anxiety symptoms.[15] While individuals with vascular disease are also at increased risk for MCI, the association between depression and MCI is not a result of vascular disease.[15] It appears that for many patients, symptoms of depression or anxiety (or both) develop prior to MCI. It is unknown whether effectively treating depression in older adults reduces the risk of MCI or dementia.

In addition to the possibility that depression represents an early symptom of MCI or dementia, depression alone can produce significant impairments in a given patient's day-to-day functioning. Individuals who are clinically depressed may become apathetic about basic activities, and may demonstrate significant functional impairment. Neuropsychological testing can reliably differentiate between true MCI or dementia and the functional impairments seen in depression.

Alzheimer disease and vascular dementia

Alzheimer disease is the most common type of dementia, accounting for between 50% and 70% of cases.[16] Early Alzheimer disease is characterized on neuropsychological testing by initial difficulties with learning and remembering new information, while the patient's long-term memories and fund of knowledge remain intact. This finding occurs as a result of bilateral medial temporal lobe (hippocampal) damage, which severely impairs the patient's ability to learn new information. For example, a patient with early Alzheimer disease may be able to easily and accurately repeat a brief list of words right after hearing them, but be completely unable to recall or even recognize any of those words after a delay of a few minutes. As the disease progresses, patients begin to have difficulty with language, particularly problems with anomia and generating words to category, and then more global cognitive impairments, including impaired executive functioning, significant language impairment, and impaired spatial processing.

Neuropsychological testing can be used to differentiate between early Alzheimer disease and early vascular dementia, as well as to identify patients who are experiencing both conditions. In general, patients with Alzheimer disease perform better on measures of executive functioning than patients with vascular dementia. Patients with vascular dementia perform better on measures of verbal learning and memory than patients with Alzheimer disease.[17] Patients with Alzheimer disease may have more difficulty generating words of a category than patients with vascular dementia, and patients with vascular dementia may have more difficulty generating words to a given letter than patients with Alzheimer disease.[16]

When considering the possibility of a vascular dementia, it is important to keep in mind that diffuse white matter changes seen on CT or MRI do not necessarily indicate that the patient will present with symptoms of dementia, or that if the patient does develop symptoms of dementia, that those symptoms will reflect a vascular pattern.

Alzheimer disease and the frontal-temporal dementias

The frontal-temporal dementias are a cluster of early-onset dementias characterized by significant dysfunction and atrophy in the frontal and temporal lobes. These disorders usually manifest early in the aging process, in the late 50s or 60s, and produce profound impairments in language in the case of the primary progressive aphasias (semantic dementia, non-fluent progressive aphasia) and behavior (frontal-temporal dementia). Individuals with an early frontal-temporal dementia may have an entirely intact ability to learn and remember new material on neuropsychological testing, but may demonstrate significant impairment in speech and language,

or significant behavioral change and impairment in executive functioning. As frontal-temporal dementias progress, formal neuropsychological testing of these patients can become challenging because of the severity of their language and behavioral impairments. Consultation with a neuropsychologist about behavior management strategies that family and other caregivers can use to improve care can be useful.

Alzheimer disease, Lewy body dementia, and Parkinson disease

Lewy body dementia is characterized by significant fluctuations in cognition, particularly attention and alertness, in the context of recurrent well-formed visual hallucinations and parkinsonism. Cognitively, patients with Lewy body dementia typically have significant impairments in visual-spatial processing and form discrimination early in the course of the disease, including problems with constructional apraxia and agnosia. In patients with Alzheimer disease, these visual-spatial cognitive functions are usually relatively well preserved until later in the course of the disease. Patients with Lewy body dementia may demonstrate fluctuations in attention if assessed across multiple sessions or even one long session, and at times, their fluctuations in consciousness may be of sufficient severity to preclude neuropsychological assessment.

However, it is crucial to note that the risk factors for Alzheimer disease and Lewy body dementia overlap significantly and cases are often comorbid.[18] Alzheimer disease can produce psychotic symptoms, including hallucinations, suspiciousness, and paranoia. Both disorders can also produce significant disruption in mood and clinically significant anxiety and depression. Differentiating between these conditions can be challenging. The differential diagnosis of these conditions is further complicated because Parkinson disease also produces a dementia syndrome. Perhaps as many as 40% of patients with Parkinson disease have some cognitive impairment, and perhaps as many as 70% of patients with advanced Parkinson disease have significant cognitive impairment.[18]

For anxious patients, neuropsychological testing can very often help reassure them that the changes they are experiencing are normal for their age and that there are no indications of impairment or a possible dementing illness.

Other conditions

Neuropsychological testing can be useful for diagnosis and treatment planning for other common causes of cognitive impairment, such as stroke or brain injury, and less common forms of dementia, such as normal pressure hydrocephalus, substance-induced persisting dementia, cortico-basal degeneration, and Creutzfeld-Jacob disease.

Screening tools for general practice

A number of screening tools are available for bedside and clinic use. While these screening tools cannot reliably differentiate between types of dementia, they can help establish a diagnosis of MCI and identify patients who may benefit from a more extensive neuropsychological exam. Of these instruments, the strongest is the Montreal Cognitive Assessment (MoCA).

The MoCA is a one-page test that can be easily administered in a clinic or at the bedside. The MoCA briefly assesses patient ability in a variety of cognitive domains, including problem solving and sequencing (trails, similarities), attention (digit span, letter vigilance), memory (word list, orientation), visual-spatial construction and reasoning (cube, clock), and language (naming, repetition, word generation). The MoCA, available without cost at www.mocatest.org, has been translated into 30 languages, including Arabic, Chinese, French, Russian, and Spanish. Numerous studies show that the MoCA is superior to the Folstein Mini-Mental State Exam (MMSE) when screening for mild cognitive impairment or dementia in patients with Alzheimer disease or Parkinson disease.[19-21]

A number of commercially available software programs are marketed to physicians to assess cognition. While a computerized program designed to monitor cognition after sport-related concussion (the ImPACT program) has shown good reliability and validity, the makers of computerized programs designed to diagnose MCI or dementia have yet to publish sufficient reliability and validity data in the peer-reviewed literature to recommend their use.[22] At this time, physicians

are probably best served by relying on the MoCA and MMSE to screen for dementia in their practices.

Physicians who feel a given patient would benefit from more in-depth neuropsychological assessment can refer their patients to the neuropsychology services available at all of the larger hospitals in the Metro Vancouver area and those affiliated with the University of Victoria. While there is currently a shortage of neuropsychologists in the province, it is to be hoped that additional training and recruitment programs will be able to expand the reach of neuropsychological services throughout British Columbia.

Summary

Neuropsychological assessment is a useful tool for identifying patients with mild cognitive impairment and for differentiating between types of dementia. The use of neuropsychological assessment for these purposes is well supported by current practice guidelines. As the population of BC ages, physicians will benefit from expanding their expertise with established and developing neuropsychological screening tools, as well as by identifying referral networks which will allow them to access neuropsychologists in their own communities when more comprehensive evaluations are needed.

Competing interests

None declared.

References

1. Hill G, Forbes W, Berthelot J-M, et al. Dementia among seniors. Health Rep 1996;8:1-10.
2. Alzheimer Society of British Columbia. Put your mind to it. 5 January 2009. Accessed 17 July 2011. www.alzheimerbc.org/News-and-Events/News-Archives/2009/Put-Your-Mind-To-It----make-change-happen-for-thos.aspx.
3. Knopman D, DeKosky S, Cummings J, et al. Practice parameter: Diagnosis of dementia (an evidence-based review). Report of the Quality Standards Subcommitte of the American Academy of Neurology. Neurology 2001;56:1143-1153.
4. Assessment: Neuropsychological testing of adults. Considerations for neurologists. Report of the Therapeutics and Technology Assessment Subcommittee of the American Academy of Neurology. Neurology 1996;47:592-599.
5. Blacker D, Albert M, Bassett S, et al. Reliability and validity of NINCDS-ARDA criteria for Alzheimer's disease. The National Institute of Mental Health Genetics Initiative. Arch Neurol 1994;51:1198-1204.
6. McKhann G, Drachman D, Folstein M, et al. Clinical diagnosis of Alzheimer's disease: Report of the NINCDS-ADRDA Work Group under the auspices of Department of Health and Human Services Task Force on Alzheimer's Disease. Neurology 1984;34:939-944.
7. Jeste DV, Meeks TW, Kim DS, et al. Research agenda for DSM-V: Diagnostic categories and criteria for neuropsychiatric syndromes in dementia. J Geriatr Psychiatry Neurol 2006;19:160-171.
8. Petersen RC, Smith GE, Waring SC, et al. Mild cognitive impairment: Clinical characterization and outcome. Arch Neurol 1999;56:303-308.
9. Grundman M, Petersen RC, Ferris SH, et al. Mild cognitive impairment can be distinguished from Alzheimer disease and normal aging for clinical trials. Arch Neurol 2004;61:59-66.
10. Gauthier S, Reisberg B, Zaudig M, et al. Mild cognitive impairment. Lancet 2006; 267(9518):1262-1270.
11. Caracciolo B, Palmer K, Monastero R, et al. Occurance of cognitive impairment and dementia in the community: A 9-year long prospective study. Neurology 2008; 70:1778-1785.
12. Chong MS, Sahadevan S. Preclinical Alzheimer's disease: Diagnosis and prediction of progression. Lancet Neurol 2005;4:576-579.
13. Reisberg B, Ferris S, de Leon M, et al. The Global Deterioration Scale for assessment of primary degenerative dementia. Am J Psychiatry 1982;139:1136-1139.
14. Neary D, Snowden J, Gustafson L, et al. Frontotemporal lobar degneration: A consensus of clinical diagnostic criteria. Neurology 1998;51:1546-1554.
15. Barnes DE, Alexopoulos GS, Lopez OL, et al. Depressive symptoms, vascular disease, and mild cognitive impairment. Arch Gen Psychiatry 2006;63:273-280.
16. Levy JA, Chelune GJ. Cognitive-behavioral profiles of neurodegenerative dementias: Beyond Alzheimer's disease. J Geriatr Psychiatry Neurol 2007;20:227-238.
17. Looi JC, Sachdev PS. Differentiation of vascular dementia from AD on neuropsychological tests. Neurology 1999;53: 670-678.
18. Galvin JE. Cognitive change in Parkinson disease. Alzheimer Dis Assoc Disord 2006;20:302-310.
19. Smith T, Gildeh N, Holmes C. The Montreal Cognitive Assessment: Validity and utility in a memory clinic setting. Can J Psychiatry. 2007;52:329-332.
20. Luis CA, Keegan AP, Mullan M. Cross validiation of the Montreal Cognitive Assessment in community dwelling older adults residing in the Southeastern US. Int J Geriatr Psychiatry 2008;24:197-201.
21. Hoops S, Nazem S, Siderowf A, et al. Validity of the MoCA and MMSE in the detection of MCI and dementia in Parkinson disease. Neurology 2009;73:1738-1745.
22. Schatz P, Pardini JE, Lovell MR, et al. Sensitivity and specificity of the ImPACT Test Battery for concussion in athletes. Arch Clin Neuropsychol 2006;21:91-99. BCMJ