INTRODUCTION

Clinical neuropsychology focuses on assessing a person’s cognitive abnormalities resulting from brain damage and dysfunction and determining how the individual’s pattern of cognitive strengths and weaknesses would likely affect his or her everyday functioning (that is, interpersonal relationships, job performance, scholastic pursuits, and the ability to carry out activities of daily living). This chapter describes neuropsychological assessment in adults living with HIV. Psychiatrists working with children who have HIV should consult with a psychologist who specializes in assessing children.

What is involved in a neuropsychological assessment?

The components of a neuropsychological assessment include:

1. a clinical interview to assess developmental and neuromedical risk factors for possible brain impairment and to document academic, educational, vocational, and psychosocial history, as well as current affective and cognitive complaints.

2. standardized psychometric tests with established reliability and validity to assess the following aspects of brain functioning:
   - sensory-perceptual functioning
     (for example, Reitan-Klove Sensory–Perceptual Exam)
   - attention, concentration, and speed of information processing
     (for example, Digit Span and Arithmetic subtests from the...
Wechsler Adult Intelligence Scale—Revised [WAIS-R], Visual Span from Wechsler Memory Scale—Revised [WMS-R], Trail Making Test [Part A], Speech Sounds Perception Test, and Seashore Rhythm from the Halstead-Reitan Battery [HRB], Paced Auditory Serial Addition Test [PASAT], simple and complex reaction time

- **verbal skills** (for example, WAIS-R verbal subtests, Reitan-Indiana Aphasia Screening Battery, Boston Diagnostic Aphasia Exam [BDAE], Boston Naming Test from BDAE, Controlled Oral Word Association Test [verbal fluency])

- **psychomotor functioning and visual–spatial processing** (for example, nonverbal subtests from WAIS-R, Rey-Osterrieth Complex Figure Test, Tactual Performance Test from HRB, Symbol Digit Modalities Test)

- **learning and memory (retention)** (for example, WMS-R, California Verbal Learning Test, Rey Auditory Verbal Learning Test, Story and Figure Learning and Memory Tests, Rey-Osterrieth Complex Figure Test)

- **abstraction, cognitive flexibility, and “executive” skills** (for example, Category Test from HRB, Trail Making Test [Part B], Wisconsin Card Sorting Test, Stroop Color–Word Test)

- **simple motor skills** (for example, Grooved Pegboard Test, Finger Tapping Test, and Hand Dynamometer Test)

3. **behavioural observations** of qualitative performance during testing to provide useful clinical information about brain functioning and behavioural syndromes (for example, how easily the person understood the test instructions; whether any language disturbance was noticed in the person’s spontaneous conversation; whether any gross sensory–motor impairments were observable; how the person approaches and attempts to solve a problem, what strategies the person employs and what kind of errors are made; how the person reacts to difficult problems or responds to feedback).

4. **mood and personality inventories** to assess emotional functioning, the presence of and response to psychosocial stressors, and the ability to cope. The assessment of emotional and psychosocial functioning is particularly important to comment on how the neuropsychological ability pattern (that is, strengths and weaknesses or deficits) would be expected to affect a person’s everyday functioning.

5. **a feedback session**. After the assessment, it is quite common for a clinical neuropsychologist to meet with the person (and with significant others or caregivers if appropriate) to give feedback on test performance, suggest possible strategies to compensate for any cognitive weaknesses or losses, and discuss treatment options.

### Which neuropsychological impairments are associated with HIV-1 infection?

Two types of neurobehavioural disorders can occur with HIV-1 disease and form part of the HIV-1–associated cognitive/motor complex (HACM). Please refer to Chapter 2 on cognitive disorders for the details on nomenclature of HACM, HIV-1–associated dementia complex (HADC), and HIV-1–associated minor cognitive/motor disorder (MCMD).

A recent study by Heaton and colleagues at the San Diego HIV Neurobehavioral Research Center (HNRC) reflects the most comprehensive neuropsychological assessment of nondemented HIV-1–infected men to date (Heaton and others 1995). In this study, all subjects were male and were screened for developmental and adverse neuromedical conditions, including dementia and recent substance use disorders that could potentially influence test results.

Neuropsychological impairments, as defined by the Centers for Disease Control and Prevention (CDC), were found in 31% of subjects in the early stages of HIV disease (CDC-A) as compared to a rate of impairment of 17% in a demographically matched group of men who were
HIV-seronegative. In addition, the rates of neuropsychological impairment were found to increase with each successive stage of HIV disease (from 44% at CDC-B stage to 56% at the CDC-C stage) (Figure 3.1).

These findings should be interpreted with caution for two reasons:

- The rate of impairment in the control group was relatively high (17%).
- It is unclear if impairment on neuropsychological testing is associated with functional impairments.

In terms of the pattern of neuropsychological impairments associated with HIV-1 disease, the Heaton study found that attention and speed of information processing, learning efficiency, and motor functioning were the most commonly affected ability areas. Deficiencies in these areas correspond to the putative “subcortical” brain structures (that is, deep white matter and basal ganglia) and frontostriatal brain systems which have been implicated in HIV-1 disease.

Data from the San Diego HNRC study also illustrate the prevalence of impairment across specific neuropsychological ability areas with each successive stage of HIV disease. When neuropsychological abilities were comprehensively sampled, statistically significant impairments were found in five of eight ability areas: attention and speeded information processing, learning efficiency, abstraction and cognitive flexibility, psychomotor skills, and simple motor skills. No higher rate of impairment was found in sensory functioning, verbal skills, or memory (that is, the retention of information over time).

Three other points from the San Diego HNRC study should be emphasized. First, “spotty” impairments were found in the asymptomatic stage of HIV-1 disease (that is, the rate of impairment was not significantly higher in any specific ability area). Second, symptomatic subjects (that is, CDC-B) were most impaired in learning efficiency and motor skills. Third, people living with AIDS (that is, CDC-C) showed significantly higher rates of impairment in five of the eight ability areas. Motor skills, attention and speed of information processing, and learning efficiency were the most impaired; 39% to 54% of people living with AIDS had these impairments, whereas 23% showed impairments in psychomotor skills and on tests of abstraction and cognitive flexibility.

**Which neuropsychological screening instruments are used to test for HACM?**

Most office screening instruments (for example, the Folstein Mini Mental Status Examination [MMSE]) are relatively insensitive to cerebral dysfunction in persons with HACM until the late stages of HIV-1 disease (that is, HADC). The MMSE is sensitive to the impairment found in cortical dementia, but it is relatively insensitive to the pattern of dysfunction found in people with subcortical dementia.

When a screening battery is used, it must be reliable, valid, and have adequate sensitivity and
specificity relative to an established “gold standard.” Three suggested screening batteries are listed in Table 3.1.

A more comprehensive battery will usually be required if:

- the person is in the early stage of HIV disease
- there is increasing developmental, neuromedical, and psychiatric comorbidity
- information is required on the effect of neuropsychological strengths and weaknesses (that is, deficits) on a person’s everyday functioning

### In what clinical situations is neuropsychological testing appropriate or beneficial?

A psychiatrist might refer a person living with HIV for neuropsychological assessment when:

1. the person’s employer reports problems with work performance or a significant other or family member reports cognitive difficulties at home (for example, the person is more “forgetful”; the person has trouble maintaining or focusing attention, perhaps when listening to a conversation or when there is distracting noise in the background; the person has become more clumsy or slow).
2. the person reports problems with cognitive tasks, even though there are no marked neurologic signs.
3. the person reports subtle or fluctuating cognitive problems that may have functional consequences (for example, at work, while driving, or while operating potentially dangerous equipment).
4. the person is starting antiretroviral therapy, and the psychiatrist wants baseline cognitive testing for later comparison (neurologic signs may or may not be present).
5. the person is seeking disability benefits: documenting neuropsychological strengths and weaknesses (that is, deficits) may provide important information about vocational limitations.
6. the person is known to be neuropsychologically impaired, but a significant other or family member requests information on how deficits may interfere with the person’s everyday functioning and what may be some of the practical limitations associated with those deficits (for example, should the person use a stove or other electrical appliances or drive a vehicle? Is the person cognitively able to make decisions about treatment or adequately carry out activities of daily living?).
7. the person has AIDS and denies having any problems, but family, friends, and/or an employer believe that cognitive

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### Table 3.1. Screening batteries

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<tr>
<th>Organization</th>
<th>Description</th>
<th>Tests</th>
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| National Institute of Mental Health (NIMH) Workgroup | Recommended by a group of clinicians and researchers attending a workshop sponsored by the NIMH in 1989 (See Butters and others 1990) | WAIS-R Vocabulary  
WMS-R Visual Span  
Paced Auditory Serial Addition Test  
California Verbal Learning Test  
Hamilton Depression Scale  
Speilberger State-Trait Anxiety Scale |
| San Diego HIV Neurobehavioral Research Center (HNRC) | These seven tests were part of a seven- to nine-hour comprehensive battery that was found to discriminate well between HIV-seronegative and HIV-seropositive participants (See Heaton and others 1996) | Paced Auditory Serial Addition Test  
Boston Naming Test  
Thurstone Written Fluency  
Story Learning and Memory  
Finger Tapping Test  
Grooved Pegboard Test |
| Multicenter AIDS Cohort Study (MACS) | The MACS screening battery is the most widely used to date, although it is better suited for detecting impairment when patients are in the symptomatic phases of HIV disease (that is, CDC-B and CDC-C) (See Miller and others 1990) | WAIS-R Digit Span  
Controlled Oral Word Association Test  
Rey Auditory Verbal Learning Test  
Trail Making Test  
Symbol Digit Modalities Test  
Grooved Pegboard Test  
CES Depression Scale |
Problems are developing. Testing is worthwhile in this situation because, according to a 1996 study by Hinkin and colleagues, a significant subgroup of HIV-infected people, primarily those living with AIDS, underreported or denied neuropsychological impairments despite documented deficits on objective neuropsychological testing.

What information should a psychiatrist provide when referring someone for neuropsychological testing?

The psychiatrist should provide:
- Identifying information
- General medical status, including disease stage and any HIV-related medical conditions
- Any known neurologic or medical conditions that may potentially affect brain functioning
- A list of medications, specifically those that may influence cognition (for example, benzodiazepines, codeine, sedating neuroleptics, and antidepressants with anticholinergic side effects)
- Any subjective cognitive or affective complaints reported by the patient
- Current and past psychiatric diagnoses, including substance use
- Any cognitive impairments noted on mental status examination or information from prior neuropsychological testing

What information should psychiatrists consider requesting from a neuropsychological assessment?

The psychiatrist should consider requesting information and findings on:
- The presence, nature, and etiology of neuropsychological deficits
- What to expect, if deficits are present, in terms of time course (that is, will deficits improve, remain static, or progress?)
- The nature of subjective cognitive complaints (that is, organic versus functional)
- Implications of deficits for everyday functioning, including possible effects on job, academic pursuits, and interpersonal relationships
- Concerns regarding competency or safety (for example, ability to drive an automobile and make informed decisions about treatment, care, and everyday functioning)
- Whether the person’s psychiatric condition can be expected to influence neuropsychological performance, and if so, what the specific implications for the person’s everyday functioning are

CASE STUDY

HIV-SEROPOSITIVE MAN WITH COGNITIVE AND AFFECTIVE SYMPTOMATOLOGY

Ravi, a 50-year-old gay male employed as a vice-president of a large company, has been HIV-seropositive for nine years. He was diagnosed with AIDS one year ago after a bout of Pneumocystis carinii pneumonia (PCP). His CD4 lymphocyte count is currently 90, but he is medically stable. He presents with both cognitive and affective symptomatology and is currently being evaluated for a mood and/or anxiety disorder. His clinical picture is complicated by heavy alcohol use. (For more detail on Ravi’s medical, psychiatric, and neurologic assessments, see Chapter 2 on cognitive disorders.)

The psychiatrist referred Ravi for a neuropsychological assessment and requested the following information:
- Is there any evidence of brain impairment? If so, in which ability areas?
- Does Ravi meet criteria for HACM (that is, MCMD or HADC)?
- How might his deficits affect his job functioning and other aspects of his everyday life?
- If neuropsychological deficits are found, what is their nature or etiology (that is, are they HIV-related, caused by his affective status, or related to substance use)?
- Will Ravi’s neuropsychological deficits get worse?
- What is the nature of his subjective cognitive complaints?
- Does the psychologist have suggestions for management?
appointments and agendas, and focusing and maintaining concentration during meetings and when reading. He also has word-finding problems and pronounced slowness in his thinking. These problems have become worse over the past six months. Both his administrative assistant and his partner have noticed changes in his cognitive efficiency at work and at home. His partner has also noticed that he is slower and more clumsy. Ravi denies any personal or family history of psychiatric illness. He does, however, report long-standing affective symptomatology, but it is unclear whether these symptoms persist when he is not drinking heavily.

Ravi has smoked a pack of cigarettes daily for the past 30 years. He admits to drinking between four and six drinks of hard liquor in the evenings to “calm his nerves.” He has used alcohol at this level for the past 20 years, although there were periods when he drank more. He has not had any significant periods of sobriety (that is, lasting for several months). He denied any past or current illicit drug use.

Ravi is on zidovudine and didanosine. His neuromedical history is positive for a mild traumatic brain injury with a loss of consciousness for 10 minutes when he was 20 years of age, but there were no reported sequelae. He had one episode of PCP one year ago and mild oral candidiasis. On the Folstein MMSE, Ravi scored 28 out of a possible 30 (he recalled only two of three items after a short delay and made one error in serial subtraction).

In this case, a comprehensive neuropsychological assessment is indicated based on:

- subjective cognitive complaints and observed problems by others at work and at home
- concurrent affective and anxiety symptomatology
- neuromedical risk factors (history of mild traumatic brain injury and 20-year history of heavy alcohol use, including current heavy use)
- immunocompromised condition (CD4 lymphocyte count of 90) and diagnosis of AIDS
- a score on MMSE within normal range but below the expected level for a highly educated person
- possible implications of cognitive deficits for everyday functioning, including the ability to continue working full-time as a vice-president of a large company

Findings from the Neuropsychological Assessment

Is there any evidence of brain impairment? In which ability areas?

Ravi’s overall level and pattern of test performance showed clear evidence of at least mild neuropsychological impairment. The assessment revealed that he had specific impairments in speed of information processing, complex attention, learning efficiency, psychomotor skills, abstract reasoning and cognitive flexibility, and on tests of simple motor skills. In contrast, his verbal intellectual skills were well developed, and there was no evidence of impairments in visual–spatial functioning or disturbance in language (that is, receptive or expressive aphasia). His basic attention skills and concentration ability were within normal limits. He did not have any difficulty retaining verbal or visual information over time (that is, his retention was normal). No sensory abnormalities were detected.

Does Ravi meet the criteria for MCMD or HADC?

Yes. Ravi meets the American Academy of Neurology criteria for HACM (MCMD subtype), as experience some problems with multistage commands. He was cooperative, put forth adequate effort, and demonstrated a normal tolerance for frustration. As a result, the neuropsychologist was able to obtain valid results that reflected Ravi’s current neuropsychological functioning.
shown in Table 3.2 (Working Group 1991).

In Ravi’s case, personality change (irritability and emotional lability) was not considered to be clinically significant.

Ravi does not meet the criteria for HADC because his deficits and the impairments in his activities of daily living are not severe enough. If his neurocognitive status worsens, however, he might later meet criteria for HADC.

How might Ravi’s neuropsychological deficits affect his job functioning and other aspects of everyday life?

In Ravi’s case, his neuropsychological deficits, although mild, will likely affect his ability to function as a vice-president of a large company. In addition, his current level of alcohol use and affective symptomatology will likely interact with his neuropsychological deficits to cause a poorer overall adjustment than would be predicted based on neuropsychological test results alone.

Ravi has above average verbal intellectual skills, and he knows enough to conduct himself appropriately in any routine, everyday situation he is likely to encounter. His mild impairment on tests of abstraction and cognitive flexibility would not be expected to prevent him from exercising good judgement in basic day-to-day activities, but it would likely influence his performance at work (for example, with making “big picture” plans or complicated business decisions). His mild deficit in attention and slowness in information processing speed will also likely affect his ability to do his job (for example, he will not be as quick in his decision making and will likely not be able to perform as many tasks at one time).

Although Ravi has occasional difficulty finding words to express himself, he has an excellent basic vocabulary, and he communicates

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<th>Table 3.2. American Academy of Neurology criteria for HACM</th>
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<td><strong>Criteria</strong></td>
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<tr>
<td>Acquired abnormality in at least two of the following cognitive abilities (present for one month or longer):</td>
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<tr>
<td>Attention/concentration</td>
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<td>Abstraction/reasoning</td>
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<td>Memory learning</td>
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<tr>
<td>Speed of processing</td>
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<tr>
<td>Visuospatial skills</td>
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<td>Speech/language</td>
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<td>At least one of the following:</td>
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<td>Acquired abnormality in motor function or performance verified by physical examination, neuropsychological tests, or both.</td>
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<td>Decline in motivation or emotional control or change in social behaviour characterized by apathy, inertia, irritability, emotional lability, or new-onset impaired judgement characterized by socially inappropriate behaviour or disinhibition.</td>
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*Mild impairment at work and in activities of daily living was verified by two informants: secretary and partner.
well enough for everyday social and job interaction. He does not have an auditory comprehension deficit per se, but he does have trouble learning new information (that is, he does not assimilate new information as quickly or as efficiently as he had in the past). As a result, when talking to him, people should speak simply and be prepared to repeat or explain things when necessary.

Once Ravi has learned information, he is able to retain it normally. Because of his learning efficiency problem, however, he may misplace things or forget to follow through with intentions and obligations. Most patients with this mild level of impairment compensate quite well by relying on written notes, schedules, and checklists. If he is not doing so already, Ravi should make use of such written reminders. He should also try to routinize his life as much as possible (for example, sticking to familiar schedules, activities, procedures, and areas whenever he can) and avoid situations that require quick learning of new information.

Ravi’s handwriting is legible, his spelling skills average, and his writing fluent. He should be able to complete any writing tasks required of him at work and in his personal life. He should also be able to understand any reading material he encounters. Because his math skills are above average, he would not be expected to have difficulty with everyday calculating requirements. There were no sensory–perceptual deficits that would be expected to interfere with his day-to-day functioning. Although he is quite slow and weak with his hands and may need help with heavy manual tasks, he should be able to perform basic tasks.

What is the etiology of Ravi’s neuropsychological deficits?

Ravi’s neuropsychological deficits are consistent with symptomatic HIV infection and AIDS and likely reflect damage and/or dysfunction primarily to putative “subcortical” brain structures (that is, deep white matter and the basal ganglia) and frontostriatal systems. While it is possible that his heavy alcohol use may be contributing to his deficits in learning efficiency, psychomotor skills, and abstraction and cognitive flexibility, the abrupt onset of these problems would be more consistent with the HIV disease process. Ravi’s history of a mild traumatic brain injury is unlikely to have had any influence on his current results, especially given that there were no sequelae following the injury. While his affective status may have contributed to some of his deficits (for example, with attention and learning efficiency), the clinical impression was that this did not play a major role. A number of research studies have clearly shown that, while affective status has some relationship to neuropsychological performance, it does not account for the neuropsychological deficits found in people living with HIV.

What is the nature of Ravi’s subjective cognitive complaints?

Ravi tended to report more severe problems than were actually documented on formal testing. This discrepancy is quite common in people living with HIV, even in those who do not meet the criteria for a DSM-IV axis I disorder (American Psychiatric Association 1994). In general, subjective cognitive complaints tend to be positively correlated with subjective depressive and anxiety symptoms and with concurrent substance use. When someone presents with a myriad of affective and cognitive complaints, it is often difficult to determine the nature of the cognitive symptoms without formal neuropsychological testing. People living with HIV tend to be accurate in their assessment of their motor abnormalities, however, even if they exhibit elevated levels of affective symptomatology.

CONCLUSION

Neuropsychological impairments increase with each successive stage of HIV disease. According to a 1995 study by Heaton and colleagues, global impairments of 31%, 44%, and 56% were found in asymptomatic (CDC-A), symptomatic (CDC-B), and AIDS (CDC-C) patients, respectively.
The study also found that, in terms of the pattern of neuropsychological impairments associated with HIV-1 disease, attention and speed of information processing, learning efficiency, and motor functioning were the most commonly affected ability areas. Deficiencies in these areas correspond to the putative “subcortical” brain structures and frontostriatal brain systems that have been implicated in HIV-1 disease.

Recent studies have shown that even mild neuropsychological deficits can have significant effects on the ability of people living with HIV to function in vocational situations. For example, according to a 1994 study by Heaton and colleagues, people living with HIV who were rated as neuropsychologically impaired were two to three times more likely to be unemployed than nonimpaired HIV-seropositive control subjects; those who were neuropsychologically impaired but remained working were five times more likely to report problems with work functioning than the control subjects.

Neuropsychological impairments can also affect people’s ability to manage their everyday lives. A neuropsychological assessment can help psychiatrists determine the severity of cognitive abnormalities or impairment in people living with HIV and the extent to which their cognitive strengths and weaknesses will affect their everyday functioning. That information can be used to help patients make decisions about maintaining or modifying a job, applying for long-term disability, or managing other aspects of their lives.

RESOURCES


MULTIPLE-CHOICE QUESTIONS

1. Of the following neuropsychological abilities, which one is not typically affected in HACM?
   a) Attention
   b) Learning efficiency
   c) Language
   d) Motor skills
   e) Speed of information processing
   d) Clinical interview
   e) All of the above

2. Which one of the following is part of a neuropsychological assessment?
   a) Behavioural observation
   b) Feedback session
   c) Mood and personality inventories
   d) Clinical interview
   e) All of the above

3. Which one of the following screening tests is the “gold standard” for evaluating HACM?
   a) NIMH screening battery
   b) HNRC screening battery
   c) MACS screening battery
   d) Folstein MMSE
   e) None of the above

Answers on page 151