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6

Mental Status Examination

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Mental status examination is a critical part of the neuropsychiatric assessment of older patients. The examination reveals the integrity of cognitive skills, which are those intellectual abilities that facilitate thinking, perception, communication, and problem solving. Several cognitive domains are assessed, including attention, memory, language, visuospatial skills, calculation, and executive skills.

Cognitive evaluation adds an important dimension to neuropsychiatric assessment. The psychiatric examination reveals abnormal experiences, thoughts, interpersonal skills, and behavior. The neurological evaluation focuses primarily on the motor and sensory system. The cognitive mental status examination assesses the integrity of a broad range of brain structures and can reveal the presence of cerebral pathology that contributes to the expression of psychiatric symptoms or intellectual deficits. Although a trichotomy is implied, the psychiatric, cognitive, and neurological examinations overlap considerably. Together they identify a pattern of neuropsychiatric signs that the clinician uses to formulate a differential diagnosis, direct further evaluation, and monitor change over time.

Assessing cognitive skills is particularly important in older patients because the prevalence of delirium, dementia, and psychiatric symptoms related to neurological conditions increases with age. Other goals of mental status assessment in older patients include

1. Distinguishing cognitive changes of normal aging from deficits resulting from dementia;
2. Distinguishing cognitive changes of dementia from those associated with depression or delirium;
3. Promoting early recognition and treatment of dementia because even moderate cognitive decline is often not detected by family members (Ross et al. 1997) or the primary physician (Callahan et al. 1995; Eefsting et al. 1996);
4. Identifying and localizing cerebral pathology that is neurologically silent;
5. Monitoring response to treatment for dementia and other cognitive disorders; and
6. Identifying cognitive strengths in patients with mild overall impairment. Use of preserved cognitive skills can maximize a patient's functional skills.

Mental status assessment is not exclusively reserved for neuropsychologists or other subspecialists. Although complex cases may benefit from referral to a specialist, the basic

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examination can be performed efficiently by many practitioners. Thoughtful, focused evaluations can rapidly and accurately reveal the necessary information for diagnosis and treatment.

In this chapter, I review the technique of clinical mental status examination, the regional neuroanatomical pathology associated with cognitive deficits, common syndromes of cognitive impairment, and the use of rating scales for cognitive assessment. Individual neuropsychiatric syndromes in the elderly are described in Sections III and IV of this volume and an overview of the neuroanatomical and neurochemical underpinnings of human cognition and emotion is provided in Chapter 4 this volume. The role of mental status assessment in the diagnosis of dementia has been described in several recent clinical guidelines (American Psychiatric Association 1997; Costa et al. 1996; Small et al. 1997; U.S. Department of Veterans Affairs 1997).

Clinical History

The mental status examination begins with a historical review of symptoms. The patient should be invited to describe current or past difficulties with memory and thinking, such as problems concentrating, forgetting recent events, forgetting where things are located, difficulty finding the right word to say, difficulty understanding what others are saying, getting lost in previously familiar places, or difficulty with routine financial transactions or record keeping. Specific features and time course of the difficulties are diagnostically relevant and point toward those cognitive domains that should be explored in more detail during the examination. A history of head trauma, meningitis, encephalitis, seizure disorder, psychiatric symptoms, neurological symptoms, or substance abuse should be identified.

Because memory or language impairment can interfere with the patient's ability to provide an accurate history, information from a family member or close friend is useful. Family members may feel uncomfortable discussing difficulties with the patient present; if so, a separate interview should be conducted. The patient's age, educational background, cultural background, occupation, and handedness should be noted because these factors affect the interpretation of cognitive performance.

Examination Technique

The length and depth of the mental status evaluation depends on the clinical circumstances and the specific goals (e.g., screening of elderly persons without obvious neuropsychiatric illness, evaluating suspected dementia, or monitoring response to treatment for a cognitive disorder). All patients with suspected neuropsychiatric illness require at least a brief screen for competence in each cognitive domain. In some cases, the history of symptoms or the results of a screening evaluation point toward a cognitive area that needs to be investigated in detail or warrants formal neuropsychological assessment. Rating scales can be particularly useful for diagnostic screening or for following a patient's symptoms over time.

The examiner develops and tests hypotheses during the course of the examination, beginning with observations of behavior and language during the history taking. Observing how the patient behaves during the assessment and how he or she approaches cognitive challenges is essential. Throughout the examination, the *kind* of errors that occur is as important as the *presence* of errors.

A patient may become anxious or defensive during the evaluation. A brief description of the purpose and content of the examination at the beginning usually helps reduce anxiety. The patient should be reminded that "some of these questions may seem relatively easy and others may be very difficult." The evaluation is not an interrogation; an empathic approach improves the interpersonal quality of the interview and increases the reliability of the assessment. In some circumstances, completing the assessment over several brief meetings is preferable to one long examination.

The principal cognitive functions are listed in Table 6–1. These domains are not hierarchical, but competence in some domains is required for adequate performance in others. Adequate *attention* (arousal and concentration) is required for optimal performance of all other cognitive tasks. A patient who is stuporous or markedly distractible will have difficulty with other tasks. Some *executive skills* require competence in other cognitive areas because integrating several elementary cognitive abilities may be necessary. As a result of these two principles, attention is usually assessed at the beginning of the evaluation, and executive skills are often assessed at the end.

Clinical Mental Status Examination

Attention

Attention is the ability to focus, sustain, and appropriately shift mental activity. Arousal and concentration both contribute to attention. *Arousal*, alertness, and "level of consciousness" are terms that describe the patient's awareness

TABLE 6–1. Cognitive domains assessed in the mental status examination

Attention
Arousal
Concentration
Memory
Learning
Recall
Recognition
Language
Spontaneous output; fluency
Comprehension
Repetition
Naming
Visuospatial skills
Calculation
Praxis
Executive skills
Drive
Programming
Response control
Synthesis

of stimuli. Level of arousal is evident during the interview and falls along a continuum from fully alert to comatose. Intermediate levels of arousal include lethargy, obtundation, and stupor (Plum and Posner 1982), and these levels are defined by the amount of stimulus required to maintain an awake state. A patient with mild impairment of arousal appears drowsy or may fall asleep during the interview. Marked impairment of arousal can be monitored using the Glasgow Coma Scale (Teasdale and Jennett 1974).

Poor *concentration* is manifest as difficulty focusing on a conversation or task. The patient may be easily distracted by extraneous events in the room, the television, or a sound outdoors. Concentration is further assessed by testing:

1. *Digit span.* The patient is asked to repeat a string of digits that is presented by the examiner at a rate of one digit per second. A string of three digits is initially presented, followed by a string of four digits, then five digits, etc. Repeating a string of at least five digits correctly is considered normal performance.
2. *Reverse digit span.* The examiner presents a string of digits, and the patient is asked to repeat the string in reverse order. Normal aging is associated with a mild decline in the ability to perform reverse digit span, but forward digit span is relatively unaffected by age (Lezak 1995). Normal elderly can reverse a string of at least three digits.
3. *Serial 7s.* The patient is asked to subtract 7 from 100, and to continue subtracting 7 from the result. Arithmetic skills are a prerequisite for accurate performance, and the patient's educational background and occupation provide clues to the expected level of performance.
4. *Reverse sequences.* The patient is asked to state the days of the week, or the months of the year, in reverse order (e.g., "December, November, October, . . . "). These tasks may be preferable for patients who have limited education or do not routinely work with numbers.
5. *Continuous performance.* The patient is asked to tap the table "each time you hear the letter A." The examiner then presents a string of random letters that contains embedded A's. Letters are presented at a rate of one per second, and the task continues for at least 30 seconds. Errors of omission (not tapping for an A) and errors of commission (tapping for a non-A) are noted. Normally no errors occur.

Arousal is maintained by the reticular activating system. This system originates with cells of the pons and midbrain and projects diffusely to cortical and subcortical regions of the brain via the thalamic projection system. Concentration requires an intact reticular activating system as well as intact cortical (particularly frontal) and limbic structures that focus and modulate attention. Specific disorders of attention are discussed later in this chapter. Patients with impaired arousal or concentration have difficulty with other cognitive tasks because attention is required to stay awake, understand directions, and maintain the mental control required for optimal performance. Thus, all cognitive deficits must be interpreted cautiously when attention is impaired. Diagnoses of dementia or amnesia cannot be reliably made when there is marked disturbance of arousal or concentration.

Memory

Recent studies have helped to clarify the neuropsychology and neurobiology of memory. The synaptic changes and neuroanatomic systems responsible for various aspects of memory function have been defined (Kupfermann 1991; Tranel and Damasio 1995), and neuropsychological constructs of memory processing and memory subtypes have been elaborated (Baddeley 1995). However, although strategies to assess specific aspects of memory function are available (Lezak 1995), such techniques may be complex

and require instruments not available in typical clinical settings.

For the purpose of routine clinical assessment, memory can be divided into the ability to learn, retain, and recall information. Learning and recall can be assessed using a *word list test.* A list of words is read aloud to the patient who is asked to immediately recall as many words as possible from the list. The process is repeated, using the same list, three or four times. This strategy assesses the patient's immediate or working memory, which requires intact attention. Immediate recall of more words on subsequent trials indicates that learning is occurring. Later in the mental status examination, the patient is asked to recall the word list. Patients with normal memory recall the majority of the words. The examiner should give the patient category clues for those words that are not recalled spontaneously (e.g., "an article of clothing"), followed by multiple choices for words that are not recalled with category clues (e.g., "Was the word 'hat,' 'belt,' or 'shoes'?"). Poor free recall of the word list and inability to recognize the words with clues indicate that the information has not been learned and retained. Poor free recall but accurate recognition of many of the words when given clues suggests dysfunction of the memory retrieval process and indicates that some learning and retention has occurred. Although a word list containing 3 words may suffice for cognitive screening, a longer list of 8–10 words can demonstrate the learning curve and can provide a more sensitive and specific test of learning and recall. *Orientation* questions to test learning and recall of the date and location also assess memory function.

Learning requires the integrity of limbic structures: the medial temporal lobes, the fornix, the dorsomedial thalamic nuclei, and the mammillary bodies (Squire 1987; Tranel and Damasio 1995). Severe memory impairment is usually a result of bilateral or midline brain dysfunction; unilateral brain pathology (often a medial temporal lobe lesion) can cause mild memory impairment. Preferential impairment of verbal memory occurs with left hemisphere dysfunction, whereas impairment in visuospatial memory often occurs with right hemisphere dysfunction (Signoret 1985). Verbal memory is assessed with the word list test. Visuospatial memory can be assessed by asking the patient to reproduce drawings, either immediately after a brief presentation (working memory) or later in the examination (learning, retention, and recall). Alternatively, visuospatial memory can be assessed by asking the patient to locate objects that were previously hidden in the room while the patient observed. Assessing visuospatial memory is particularly important in patients with significant aphasia who may fail verbal memory tests on the basis of language, not memory, deficits.

Tests of *remote memory* assess the ability to recall information that was learned in the distant past. Accurate remote memory requires the integrity of diffuse cortical systems that are required for storage and recall of data. Patients with limbic dysfunction who are unable to learn new information (as in Korsakoff's syndrome or after head trauma or herpes encephalitis) may be able to recall information that was learned before limbic disturbance. Remote memory is assessed by asking the patient to recall historical data: birthplace, family birthdays, work history, past presidents, or details of important historical events. For reliable assessment, the correct information must have clearly been learned in the past by the patient (and be known by the examiner). Therefore, it is helpful to validate remote memory loss with collateral sources.

Language

Language skills are essential for human communication. Language competence is also required for accurate performance in other cognitive domains because most of the information essential to routine cognition is verbally mediated. Right- or left-*handedness* should be noted in the examination because handedness predicts which hemisphere is dominant for language. Nearly all right-handed individuals and the majority of left-handers are left hemisphere dominant for language. Some left-handers, particularly those with a strong family history of left-handedness, have language function distributed across both hemispheres.

Language assessment explores four principal areas: spontaneous verbal output, comprehension, repetition, and naming. *Spontaneous verbal output* is evaluated during the clinical interview by listening to the linguistic features of the patient's discourse. Dysarthria, a motor disorder of speech, is distinguished from aphasia, a disorder of language. Two categories of aphasia in the patient's spontaneous verbal output are considered. In *fluent aphasia,* language output is generally effortless, with normal or increased number of words per minute, normal melody and inflection (prosody), and normal phrase length. Paraphasias, or intrusions of incorrect words or phonemes, can occur (e.g., "I was *leading* the newspaper"). The information content, or "efficiency" of language, is usually low: long sentences may contain many grammatical connecting words, nonspecific nouns ("thing," "the other one"), and limited meaning ("empty speech"). *Nonfluent aphasia,* in contrast, is characterized by effortful but reduced word output, short phrase length, and dysprosody. Dysarthria is often present and sentences efficiently convey meaning with few words. Grammar and syntax are usually abnormal.

Fluent aphasia occurs with lesions of the posterior left hemisphere, whereas nonfluent aphasia occurs with lesions of the left frontal cortex or underlying white matter.

Comprehension is assessed by asking the patient to

1. *Follow simple commands.* Single-step or multiple-step commands are given, such as "Point to your nose" or "Point to the window, then to the floor, and then to the chair."
2. *Follow commands, using objects.* Several items are placed on the table (e.g., a pen, a key, a paper clip, and a nickel). The patient is asked to follow instructions, such as "Touch the pen, then pick up the paper clip," or "With the key, touch the nickel, then point to the floor."
3. *Answer yes/no questions.* Examples are "Does a rock float on water?" and "Do you put your shoes on before your socks?"

Reading comprehension can be assessed by presenting similar commands and questions to the patient in writing. Reduced hearing in the elderly can contribute to impaired performance with spoken commands. Language comprehension deficits occur with dysfunction of the left posterior temporal or parietotemporal cortex.

Repetition is assessed by asking the patient to repeat sentences of increasing length and linguistic complexity. Abnormal repetition occurs with disruption of perisylvian structures of the left hemisphere.

A disturbance of *naming* may be evident as word-finding difficulty in the course of spontaneous speech. Naming is further assessed by asking the patient to identify objects or parts of the body. Both high-frequency names (elbow, nose, shoe, watch, pen) and low-frequency names (eyebrow, earlobe, sole of the shoe, watch crystal) are tested. Poor naming may result from focal brain lesions (usually the left inferior parietal lobule) or with diffuse hemispheric dysfunction. Other tasks, such as *verbal fluency* (asking the patient to name as many animals as possible in 1 minute), *reading skills*, and *writing ability*, can help identify specific aphasic disorders and can provide additional information on regional brain function (Strub and Black 1993). The syndromes of aphasia are discussed later in this chapter.

Visuospatial Skills

Visuospatial impairment is one of the most sensitive indicators of brain dysfunction. Patients with mild delirium or with posterior brain lesions that are otherwise neurologically silent may have marked visuospatial deficits. In contrast, patients with primary psychiatric illness usually have minimal difficulty with visuospatial tasks.

Visuospatial skills include visually guided attention, perception, use of internal visual images, visuospatial memory, and constructional abilities. The history can reveal important evidence of visuospatial impairment: getting lost in previously familiar environments, difficulty estimating distance, or difficulty orienting objects to complete a task. Visuospatial skills can be clinically assessed by asking the patient to copy drawings provided by the examiner or by asking the patient to spontaneously draw a clockface, a house, or a person. Drawings to be copied should include a simple geometric shape, a design that is not easily verbally described, and a complex drawing with three-dimensional perspective. Examples are shown in Figure 6–1. The patient's drawings may reveal a variety of visuospatial errors: poor use of the space available to draw, hemineglect, unusual drawing strategy (focusing on detail while missing overall layout), overlapping or "closing in" on the stimulus drawing, loss of details, loss of three-dimensionality, or poor spatial relationships among elements of the drawing (reversals, rotations, inaccurate angles). Examples of inaccurate reproduction drawings are shown in Figure 6–2. Asking the patient to draw a clockface and put hands on the clock to indicate a particular time may rapidly reveal a visuoconstructive deficit (Mendez et al. 1992) and may reveal impaired executive skills (Royall et al. 1998). Visual acuity and motor skills are obviously required for accurate drawing. Complete understanding of visuospatial deficits may require formal neuropsychological assessment using standardized tests of block design, object assembly, and line orientation (Lezak 1995).

Visuospatial impairment is more common and usually more severe among patients with a focal brain lesion in the posterior hemisphere (Black and Strub 1976). Patients with right hemisphere lesions more often have visuospatial deficits than those with left hemisphere lesions. Characteristic visuoconstructive deficits that depend on the laterality of brain injury have been identified, although the specificity of these findings is limited (Benson and Barton 1970). Features of the deficits associated with lateralized lesions are shown in Table 6–2. Executive skills, in addition to visuospatial abilities, are apparent in the organizational strategy used by the patient to draw a figure (e.g., Figure 6–2, *panel B*).

Among the elderly, visuospatial disturbance is a sensitive indicator of *delirium* and can occur in any *dementia* syndrome. Patients with *Alzheimer's disease* typically have visuospatial impairment early in the course of illness. Visuospatial impairment may also occur with a *focal brain lesion* resulting from cortical infarction or tumor.

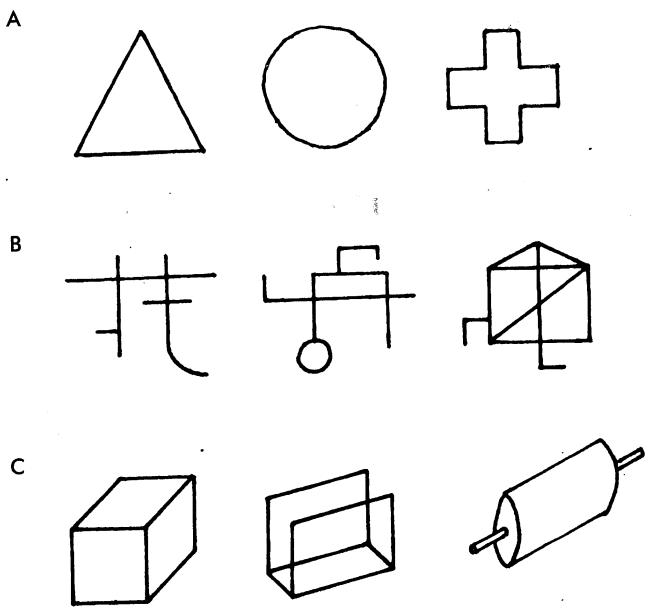

FIGURE 6–1. Examples of designs to be reproduced to assess visuospatial skill. *Panel A:* Simple geometric shapes. *Panel B:* Designs that are not easily verbally described. *Panel C:* Three-dimensional designs.

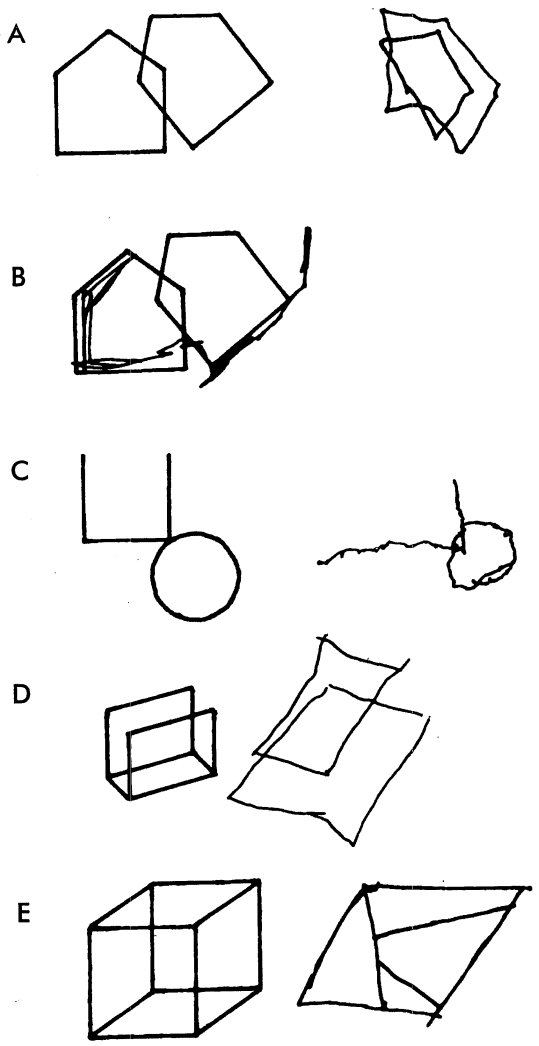

FIGURE 6–2. Examples of inaccurate reproduction drawings. The design to be reproduced is shown on the left; the patient's reproduction is to the right. *Panel A:* Inaccurate angles and rotation of one of the pentagons; patient with delirium. *Panel B:* Stimulus boundedness; the patient's drawing overlaps the stimulus figure; patient with Alzheimer's disease. *Panel C:* Missing parts of the design and evidence of tremor; patient with Alzheimer's disease. *Panel D:* Missing parts of the design and loss of three-dimensionality; patient with vascular dementia. *Panel E:* Simplified drawing with loss of three-dimensionality; patient after resection of a left occipital astrocytoma.

Calculation

Calculation skill is assessed by asking the patient to perform simple addition and multiplication (e.g., 7 + 6, 5 × 7, 8 × 9) and then more difficult arithmetic (e.g., 18 + 29, 15 × 7) without using paper and pencil. Calculation is further assessed by asking the patient to answer arithmetic questions with paper and pencil (e.g., 129 + 87, 423 × 18). The ability to perform calculations requires attention, an understanding of mathematic operations (addition, subtraction, multiplication, division), memorized knowledge of simple sums and the "times table," and the visuospatial ability to maintain number alignment. The patient's educational background and premorbid arithmetic skills must be considered in assessing current performance.

Dyscalculia may result from a variety of neurological conditions. Patients with impaired concentration as a result of delirium usually perform poorly, as do patients with diffuse degenerative brain conditions such as Alzheimer's disease. Dyscalculia has been demonstrated in patients with focal involvement of a wide range of brain regions, although it often occurs in association with aphasia and is most common with lesions of the dominant parietal lobe (Luria 1980).

Executive Skills

Executive skills are those mental abilities that facilitate performance of complex cognitive tasks or behaviors. A constellation of skills that extend beyond memory, language, and visuospatial competence is included: planning strategies to accomplish tasks, implementing strategies, adjusting strategies as needed, monitoring performance, recognizing patterns, appreciating time sequence, and formulating abstract ideas (Duffy and Campbell 1994; Tranel et al. 1994). Such skills are critical for routine daily activities. Executive deficits are associated with disruptive

TABLE 6–2. Visuoconstructive deficits characteristic of left-hemisphere versus right-hemisphere brain lesions

Left-hemisphere lesions
Few lines in drawings
"Simplified" drawings with few details
Preserved symmetry of drawings
Drawing is done slowly
Drawing skill improves with practice
Right-hemisphere lesions
Complicated structure and elaborate details
Extra lines in drawings; extraneous scribbling
"Piecemeal" approach to drawing
Particular impairment of three-dimensional drawings
Left hemineglect
Drawing is done rapidly
Drawing skill does not improve with visual cues or

behaviors and self-care limitations among patients with Alzheimer's disease (Chen et al. 1998) and among heterogeneous groups of community-dwelling and institutionalized elderly (Royall et al. 1992).

Executive skills can be divided into four categories: drive, programming, response control, and synthesis (Table 6–3). These categories provide a useful framework for assessing executive function, although there is overlap among the categories. Executive skills can be adequately assessed in the clinic, although an informant's description of the patient's ability to accomplish tasks, negotiate social situations, and respond to environmental contingencies can be particularly revealing (Malloy and Richardson 1994).

Drive includes the initiation of cognitive activity and sustained motivation to perform tasks. Drive is subjectively assessed during the mental status examination. Reduced drive usually has a marked impact on performance in other cognitive domains.

Programming is the ability to recognize patterns and to generate motor programs to perform motor sequences. Two ways that programming skill can be assessed include

1. *Alternating programs.* The examiner provides the patient with an alternating pattern. The patient is asked to copy the pattern and continue the pattern across the page. Examples of inability to generate or maintain a pattern are shown in Figure 6–3.
2. *Hand sequences.* The patient is asked to perform a three-step hand sequence: "slap" (palm down on the table), "fist" (hand in a fist on the table), and "cut" (side of the hand on the table) (Christensen 1975). The examiner demonstrates the sequence, and then the patient attempts to produce the sequence. Normally, a subject will learn to perform the pattern smoothly after about five trials. If there is difficulty, the patient is encouraged to "say the words out loud as you do each step" ("slap," "fist," "cut"). Inability to produce smooth three-step sequences and verbal-manual dissociation (saying "fist," while doing "slap") are noted.

Response control is the ability to plan and efficiently execute a strategy to complete a complex cognitive task. Mental flexibility and a balance between independent thought and use of environmental cues are required for response control. Tasks that assess response control at the bedside include

TABLE 6–3. Categories of executive skills

Category	Executive skills
Drive	Spontaneous initiation of activity
	Motivation
	Sustained performance
Programming	Recognizing patterns
	Recognizing timing sequence
	Fluid output of alternating or rhythmic patterns
Response control	Divided attention
	Inhibition of incorrect responses
	Nonperseverative responses
	Cognitive speed and fluency
	Planning; ordering the steps to accomplish a task
	Mental flexibility: changing strategies, as required
	Use of memory to adjust performance
	Use of feedback to adjust performance
	Freedom from environmental dependence: ability to resist imitation, utilization, or stimulus-bound behavior
Synthesis	Abstraction
	Similarities
	Proverb interpretation
	Monitoring cognitive performance
	Anticipation

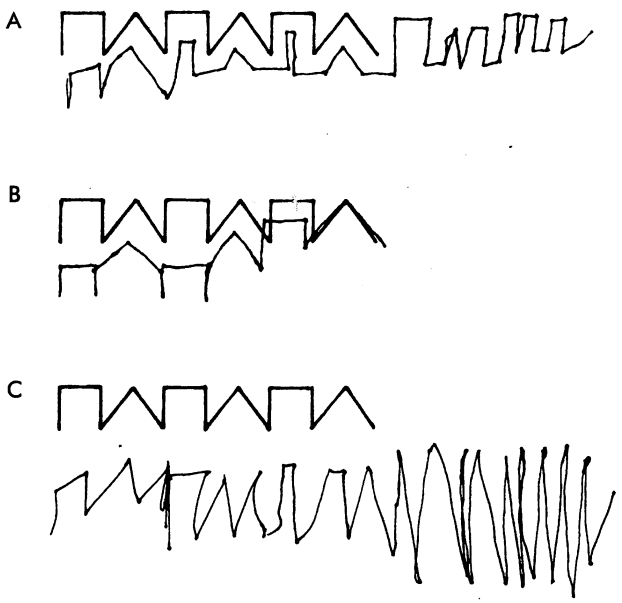

FIGURE 6–3. Alternating patterns. The patient is asked to copy the pattern (shown at the top of each example) and to continue the pattern across the page. *Panel A:* The patient's drawing initially moves toward the stimulus and the alternating pattern deteriorates as it continues across the page. *Panel B:* The patient's drawing "closes in" on the stimulus and is not continued after the stimulus ends. The patient, with mild dementia and severe bifrontal hypoperfusion on SPECT scan, was able to understand and repeat the instructions. *Panel C:* Marked inability to maintain the alternating pattern.

1. *Divided attention.* The patient is asked to continue the sequence, "1-A, 2-B, 3-C, . . ."
2. *Verbal fluency.* The patient is asked to name as many animals as possible in 1 minute. Alternatively, the patient is asked to name as many words as possible that begin with the letter "F." Initiation, strategy, and perseveration are noted. Normal performance is at least 12 animals or 10 "F" words in 1 minute.
3. *Reciprocal programs and "go/no-go."* The patient is asked to tap the table twice if the examiner taps the table once and to tap once if the examiner taps twice (reciprocal programs). The examiner then randomly taps once or twice and notes the patient's response. When this task is mastered (usually after only a few presentations), the patient is told, "Now I am going to change the rule. If I tap once, you tap twice, but if I tap twice, you should not tap at all" (go/no-go). The patient's ability to respond to the rule change and to resist the impulse to tap is noted.
4. *Multiple loops.* The patient is asked to draw a set of loop figures with the same number of loops as drawn by the examiner. Perseveration of loop drawing is noted, as shown in Figure 6–4.
5. *Clock drawing strategy.* The patient is asked to draw a clockface. The spontaneous reproduction reveals executive function, as well as visuospatial ability. Planning and organization are observed. Poor spacing of clockface numbers or perseveration can occur (Figure 6–5), as well as incorrect representations on the clockface (Figure 6–6).
6. *Stimulus boundedness.* The patient is asked to draw the hands on a clockface as they would appear when the time is 11:10. The patient may be unable to resist placing the hands on the stimulus numbers (11 and 10) (Figure 6–7). In another task, the examiner writes the word "brown" in large black letters. The patient is asked to name the *color* that the word is written in. The patient may be unable to ignore the *word* "brown." Stimulus boundedness may also appear in a patient's reproduction drawings with overdrawing of the stimulus figure (Figure 6–2, *panel B*).
7. *Imitation behavior.* The examiner rapidly flexes and extends her or his thumb, while pointing to it with the other hand. The patient is asked, "What is this finger called?" Spontaneous movement of the patient's thumb is noted.

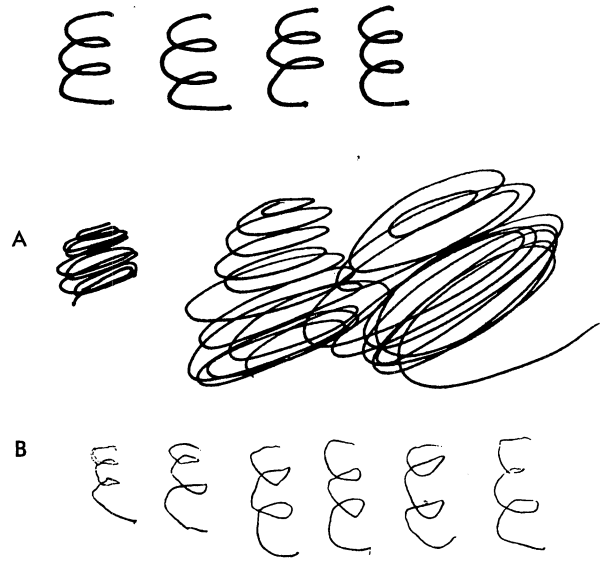

FIGURE 6–4. Multiple loops. The patient is asked to draw loop figures that contain the same number of loops as the examples provided by the examiner (*top*). The patient, who had recently undergone resection of a left frontal astrocytoma, had great difficulty terminating each loop figure drawn with her right hand, which felt "out of control" (*panel A*). She was able to draw the correct number of loops with her left (nondominant) hand (*panel B*).

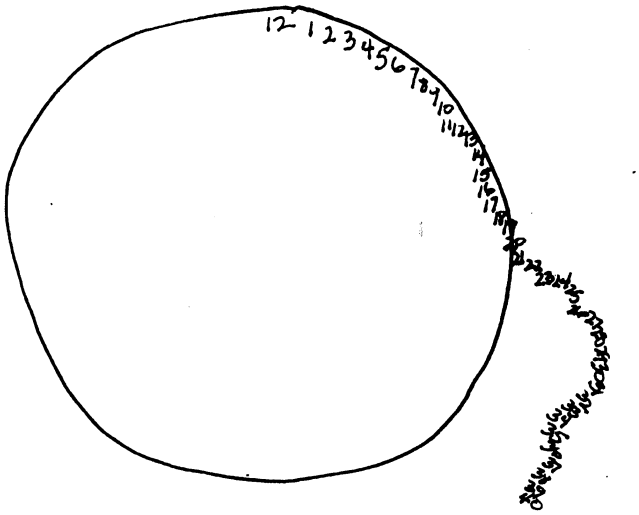

FIGURE 6–5. Poor planning and perseveration on the clockface drawing. The patient, with moderate subcortical dementia and parkinsonism, was asked to put numbers on the clockface in their appropriate places. The spacing between numbers on the patient's drawing is not correct for 12 evenly spaced numbers, and there is perseveration of micrographic number writing up to 40. The patient was able to correctly state that a clock has 12 numbers on it and was able to put all 12 numbers in correct position on a clockface (not shown), when the examiner dictated the numbers to him one by one in random order.

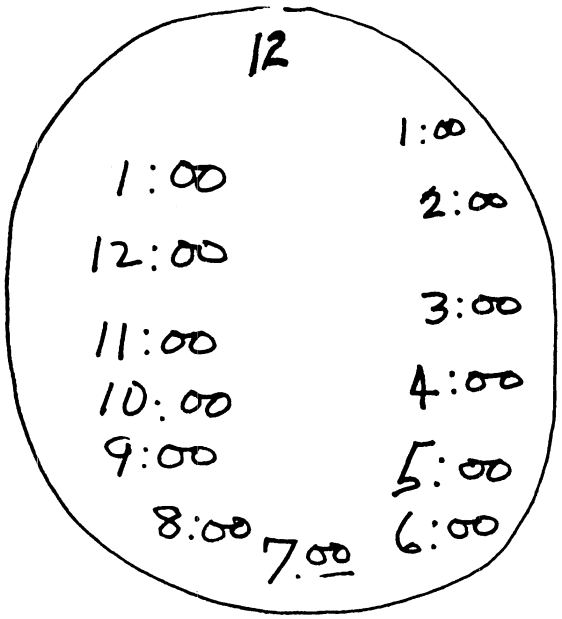

FIGURE 6–6. Intrusion on the clockface drawing. The patient's clockface has a "12" at the top but then includes representations of time in digital format. The intrusion of digital time and the mismatch between time as conventionally written and the true appearance of a clockface reflect the executive deficit. Numbers are also incorrectly located on the clockface and the sequence continues beyond 12:00. The patient has a history of heavy alcohol use and moderate dementia.

Synthesis is the ability to appreciate metaphoric meaning, form an intellectual gestalt, and monitor cognitive performance. These skills are influenced by educational background. Clinical assessment includes evaluation of

1. *Similarities.* The patient is asked to describe how a pair of words are alike. Examples are: rabbit/elephant, bicycle/train, watch/ruler.
2. *Proverbs.* The patient is asked to describe the meaning of a proverb, such as "Don't change horses in the middle of a stream." The patient's appreciation of the abstract meaning is noted.
3. *Monitoring.* The patient's ability to learn from errors and to self-correct while performing cognitive tasks is observed during the examination.

Executive skills require the integrity of diffuse or multifocal neuronal systems. Drive, programming, and response control depend on intact function of discrete circuits that include the frontal cortex, basal ganglia, thalamus, and connecting white matter tracts (Malloy and Richardson 1994; Mega and Cummings 1994). These skills are often impaired with frontal lobe damage (Grafman 1994; Mesulam 1986; Shallice and Burgess 1991; Stuss and Benson 1986; Stuss et al. 1994), although they may occur in patients with focal lesions or degenerative processes distant from the frontal cortex (Cripe 1996; Stuss et al. 1994; Tranel et al. 1994).

Performance on some structured tests of executive skills declines in psychiatrically healthy people after age 60 (Tranel et al. 1994). More extensive impairment of executive skills can result from a variety of conditions: toxic/metabolic disturbance, cerebrovascular disease, head trauma, cerebral neoplasm, cerebral or systemic infection, and degenerative brain diseases such as Alzheimer's disease, frontotemporal dementias, and Parkinson's disease (Duffy and Campbell 1994; Royall and Polk 1998). Older patients with schizophrenia can also exhibit deficits in executive skills (Almeida et al. 1995) (Figure 6–7). Drive, programming, and response control may be particularly impaired in older patients with dysfunction of frontal cortex, as in Pick's disease, frontal lobe degeneration, and some cases of Alzheimer's disease, or with disruption of frontal-subcortical circuits that occurs in basal ganglia disorders such as Parkinson's disease or Huntington's disease. Patients with vascular dementia as a result of cerebrovascular

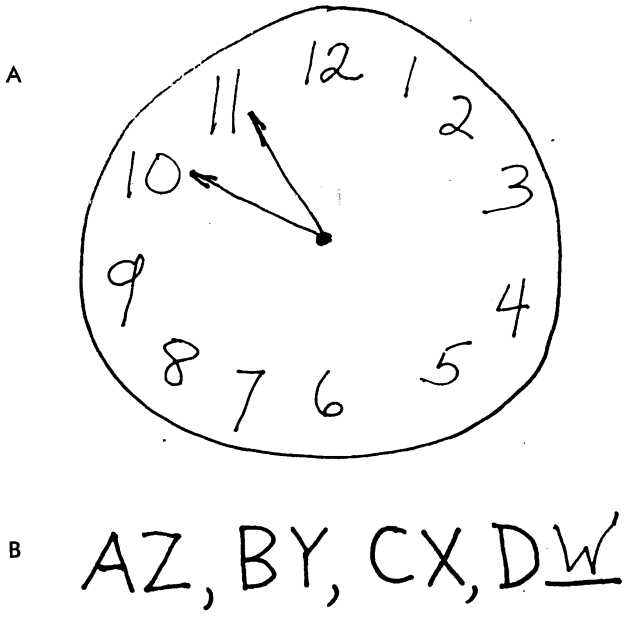

FIGURE 6–7. Stimulus boundedness. The patient is asked to put the hands on the clock as they would appear when the time is 11:10. *Panel A:* The hands are placed on the "11" and the "10," as the patient is unable to resist the stimulus numbers. This example was drawn by a 73-year-old man with schizophrenia, who showed no evidence of memory, language, calculation, or visuospatial deficits. Other executive skills were intact; he was able to correctly identify the letter that follows the "D" in the sequence of letters shown in *panel B.*

disease in subcortical nuclei or white matter tracts that link frontal cortex to other brain regions frequently demonstrate executive deficits (Duffy and Campbell 1994; Ishii et al. 1986).

Other Cognitive Skills

Apraxia. The term "apraxia" is used with variable meaning. Generally, it refers to the inability of a patient with normal elementary motor function to execute the required sequence of skilled movements to complete a complex motor task (Luria 1980). In "dressing apraxia," for example, the coordinated sequence of movements required to put on clothes is disrupted: the steps are out of order or coordinated simultaneous movements do not occur. This type of apraxia (*ideational apraxia*) usually reflects right parietal or bilateral diffuse brain dysfunction.

In *ideomotor apraxia*, the patient is unable to pantomime a motor task on command that can be performed spontaneously (Geschwind 1975). Ideomotor apraxia is revealed by asking the patient to briefly pantomime a motor act that involves muscle groups of the face, trunk, or limbs. Examples include, "Show me how you blow out a match, . . . suck through a straw, . . . hold a baseball bat, . . . wave good-bye, . . . brush your teeth." Ideomotor apraxia is an inability to smoothly perform the movement altogether or the substitution of a part of the body for the imitated object (e.g., substituting a finger for the toothbrush). Ideomotor apraxia reflects left hemisphere dysfunction or lesion of the anterior corpus callosum.

Agnosia. Patients with agnosia have intact primary sensation and normal perception but lack the ability to recognize or associate meaning to the sensory perception. In *visual agnosia*, the patient can "see" the outline, color, and lighting of an object but is unable to recognize what the object is or what it is used for (Benson and Greenberg 1969). Visual agnosia occurs with bilateral lesions of visual association cortex. Patients with *prosopagnosia* have normal visual perception and do not have visual agnosia, except for impaired recognition of familiar faces. In *environmental agnosia*, the patient can describe details of a familiar environment, but the scene lacks any sense of familiarity (Landis et al. 1986). In *astereognosis*, the patient with normal somatosensory perception is unable to recognize an object by tactile exploration with eyes closed (Adams et al. 1997). Agnosia in an elderly patient is usually caused by a discrete cortical infarction.

Syndromes of Cognitive Impairment

Disorders of Attention

Abnormal attention is the hallmark of *delirium*, or acute confusional state, which is one of the most common causes of behavioral disturbance among hospitalized elderly (see Chapter 19 in this volume). Poor attention is also an important clinical feature that distinguishes delirium from dementia (see Chapters 23 and 24 in this volume).

Reduced arousal occurs on a spectrum: drowsiness, obtundation, stupor, or coma. These states occur with impairment of the reticular activating system or widespread cortical dysfunction. Conditions that cause reduced arousal in older patients include: brainstem infarction or compression, metabolic disturbances, drug intoxication, bilateral cortical infarction, brain infection, and head trauma. *Increased arousal* with anxiety, hypervigilance, and signs of autonomic activation can occur with drug intoxication (stimulants), drug withdrawal (alcohol, benzodiazepine, opioid, or barbiturate), or metabolic disturbances.

Akinetic mutism and catatonia resemble the syndrome

of reduced arousal. Patients with *akinetic mutism* appear alert and may follow stimuli with their eyes. However, spontaneous movement and speech are rare and tend to occur in brief episodes in response to vigorous stimulation (Benson 1990; Mega and Cummings 1994; Plum and Posner 1982). Akinetic mutism is caused by lesions of the midbrain, bilateral cingulate gyri, or septal area. Patients with *catatonia* can present with a variety of motor signs and alterations of attention, including reduced response to stimuli, mutism, posturing, waxy flexibility, and repetitive stereotypic movements (Taylor 1990). Catatonia may occur in patients with schizophrenia, mood disorders, diffuse neurological illness, or metabolic disorders. Focal brain lesions can also cause catatonia. Lesions of the frontal lobes or subcortical structures are most often implicated.

Unilateral *neglect* is a syndrome of inattention to half the body or half the external space. In sensory neglect, sensory input from one hemispace is neglected or extinguished. Sensory neglect can occur in a single sensory modality (e.g., somatosensory, visual) or can be multimodal. In motor neglect, movement in or toward one hemispace is reduced. Neglect of the left hemispace occurs more frequently than neglect of the right hemispace. The extent of neglect does not depend on the extent of primary sensory or motor impairment. With either sensory or motor neglect, the patient is strikingly unaware of the neglected half-space. Sensory neglect usually occurs with right parietal dysfunction, and motor neglect can occur with frontal lesions, although the neuroanatomic specificity of the sensory versus motor components of neglect syndromes is limited (Mesulam 1985).

Patients with normal arousal but poor *concentration* appear awake and alert, but they are easily distracted and have difficulty focusing on cognitive tasks. Poor concentration can result from dysfunction of the brainstem, midbrain, limbic system, or diffuse cortical systems that modulate and focus mental activity. Poor concentration can occur either with metabolic, toxic, or infectious conditions that affect brain function diffusely or with bilateral cortical lesions, as in head trauma or bilateral infarction. The prefrontal cortex and anterior cingulate appear to play important roles in modulating concentration (Knight 1991; Stuss et al. 1995). Older patients with primary psychiatric disorders such as schizophrenia, mania, major depression, and dissociative states may also have reduced ability to concentrate.

Memory Disorders

Amnesia is the inability to learn new information. Patients with amnesia are often able to recall information that was learned before the onset of the memory disorder. *Anterograde amnesia* is the inability to learn during the time that begins with cerebral insult and extends forward in time. *Retrograde amnesia* refers to the lack of recall for events that occurred during the period preceding the cerebral insult. Amnesia occurs with bilateral damage to the medial temporal lobes or midline limbic structures. Conditions that cause amnesia in the elderly include dementia, head trauma, posterior cerebral artery occlusion, anoxia, neoplasms involving midline limbic structures, herpes encephalitis, and Korsakoff's syndrome. Many of these conditions cause cognitive deficits in addition to amnesia, although those affecting only medial temporal or midline limbic structures, such as Korsakoff's syndrome, may result in isolated memory impairment. With stable neurological lesions, anterograde amnesia can improve over time and there can be concomitant shrinkage of the period of retrograde amnesia.

Age-associated memory impairment is the term applied to subtle alterations in recent memory that occur with normal aging (see Chapter 8 in this volume). The elderly often describe a subjective sense of poor memory, may require more trials to learn a word list, and may be less efficient in memory retrieval.

Memory impairment along with other cognitive deficits occurs in patients with dementia. Patients with *Alzheimer's disease* have difficulty learning new information (anterograde amnesia) as well as difficulty recalling information that was learned before onset of the dementia. The recall deficit is a result of widespread impairment of diffuse cortical systems that are required for continued storage and recall of memory and may be mild in the early stage of illness. In *frontotemporal dementias* including Pick's disease, memory impairment often occurs after the onset of behavioral changes, whereas in Alzheimer's disease, memory or language impairment is often the first indication of illness. In *subcortical dementias*, such as those associated with Parkinson's disease or Huntington's disease, memory impairment usually occurs early in the course of dementia, as in Alzheimer's disease. However, the memory impairment of subcortical dementia is characterized by improvement in recall when clues are given, spared recognition memory, and relatively spared declarative memory (facts, knowledge) compared with procedural memory (acquisition of motor skills or cognitive strategies) (Huber and Shuttleworth 1990; Tranel and Damasio 1995). The memory impairment of patients with Alzheimer's disease does not markedly improve when clues are given and deficits in declarative memory are greater than deficits in procedural memory (Cummings and Benson 1992).

Aphasia

Syndromes of aphasia are distinguished by the pattern of specific language skills that are impaired: fluency, comprehension, repetition, or naming (Cummings 1985; Goodglass and Kaplan 1983). The principal aphasia syndromes, the specific language skills that are impaired in each syndrome, and the region of the brain involved are shown in Table 6–4. The disorders of language provide relatively sensitive and specific indications of regional brain dysfunction.

Among elderly patients with language impairment and no other cognitive deficits, the aphasia syndromes usually occur as a result of *infarction*, *hemorrhage*, or *tumor* that affects the brain regions identified in Table 6–4. Occlusion of the left middle cerebral artery causes global aphasia and right hemiparesis, if the occlusion disrupts perfusion of a wide area of the left hemisphere. If the occlusion is more distal, Broca's aphasia, conduction aphasia, or Wernicke's aphasia may occur, depending on the vascular territory that is compromised. Border zone infarctions, resulting from anoxia, hypotension, or carotid stenosis, affect the watershed regions between the vascular territories served by the anterior, middle, and posterior cerebral arteries and produce transcortical motor or transcortical sensory aphasia.

Elderly patients with dementia often have aphasia along with other cognitive deficits. The involvement of language skills depends on the distribution of brain lesions that cause the dementia. In *Alzheimer's disease*, a characteristic pattern of language disturbance occurs. Very early in the illness, word-finding difficulty and mild anomia are usually present. Subsequently, "empty speech" (language output that contains little information), mild comprehension deficit, and reduced fluency (e.g., measured as number of animals named per minute) occur. Paraphasias may be apparent in spontaneous speech. Elements of transcortical sensory aphasia occur during the course of Alzheimer's disease, reflecting the concentration of neuropathological changes of Alzheimer's disease in the inferior parietal lobe.

In *vascular dementia*, speech abnormalities are more common than in Alzheimer's disease (Sultzer et al. 1993). Language disturbance also occurs. The characteristics of language impairment depend on the brain regions affected by cerebrovascular disease. In general, patients with vascular dementia are more likely to have nonfluent aphasia than are patients with Alzheimer's disease and less likely to have naming impairments (Cummings and Mahler 1991). Marked impairment of language does not occur in patients with dementia associated with *subcortical extrapyramidal disorders* (Huber and Shuttleworth 1990).

TABLE 6–4. Principal syndromes of aphasia

	Language skills				
Aphasia syndrome	**Fluency**	**Comprehension**	**Repetition**	**Naming**	**Regional brain dysfunction[a]**
Broca's	Nonfluent	Intact	Impaired	Impaired	Left frontal operculum, left insular cortex, and adjacent white matter
Transcortical motor	Nonfluent	Intact	Intact	Impaired	Left supplementary motor area
Global	Nonfluent	Impaired	Impaired	Impaired	Wide area of left hemisphere convexity
Wernicke's	Fluent	Impaired	Impaired	Impaired	Posterior, superior left temporal lobe; left inferior parietal lobe may also be involved
Transcortical sensory	Fluent	Impaired	Intact	Impaired	Left inferior parietal lobule
Conduction	Fluent	Intact	Impaired	Impaired	Left arcuate fasciculus (usually in the left parietal operculum) or left insula and adjacent white matter
Anomic	Fluent	Intact	Intact	Impaired	Left angular gyrus or left posterior middle temporal gyrus

[a]In patients with left hemisphere dominance for language.

Frontal Lobe Disorders

The frontal lobe disorders are particularly important in neuropsychiatric evaluation of the elderly because the brain lesions that are responsible are often not detected by the traditional neurological examination and the psychiatric symptoms that occur do not usually fit the characteristic pattern of common psychiatric disorders. Patients with frontal lobe disorders often present with unusual combinations of cognitive, psychiatric, and behavioral symptoms. Neuropsychiatric symptoms that occur in each of the three principal frontal lobe syndromes and those symptoms that are not well localized to specific frontal subregions are shown in Table 6–5 (Malloy and Richardson 1994; Mega and Cummings 1994; Salloway 1994; Stuss and Benson 1986). Symptoms may occur with a lesion in specific regions of the frontal cortex or in linked cortical or subcortical structures. Lesions in subcortical nuclei or white matter tracts may have marked effects on frontal function (Sultzer et al. 1995a). The relationship between anatomy and symptomatology is incomplete: patients with extensive frontal dysfunction may not manifest the full spectrum of "frontal" symptoms, and these symptoms may occur following lesions outside the frontal circuits.

The *medial frontal syndrome* is primarily a disturbance of motivation and includes a range of symptoms from mild disinterest to akinetic mutism (Stuss and Benson 1986). Aspontaneity, blunted affect, and reduced spontaneous movement may occur. The syndrome occurs with lesions of the anterior cingulate gyrus, ventral striatum, medial dorsal thalamus, or tracts that connect these structures. More severe symptoms usually occur with bilateral lesions. Conditions that cause the medial frontal syndrome in the elderly include anterior cerebral artery occlusion, thalamic infarction, hydrocephalus, and tumors of the diencephalon or third ventricle.

Lesions of the *dorsolateral frontal convexity* produce a syndrome of disorganized cognitive performance (Fuster 1997; Malloy and Richardson 1994). Executive dysfunction often appears on the mental status examination, including perseveration (e.g., extra loops on the multiple loops, intrusion of a prior response in a new task), impaired motor programming, stimulus-bound behavior, difficulty with alternating programs or changing mental set, or reduced verbal or design fluency. Dorsolateral frontal convexity insults include head trauma, frontal infarction, frontal lobe tumor, and degenerative dementias, particularly those that preferentially affect frontal structures. Lesion of the dorsolateral caudate nucleus may produce a similar pattern of executive deficits.

The *orbitofrontal syndrome* occurs with lesions of the inferior aspect of the frontal lobe. This region of the frontal lobe is intimately associated with the limbic system, and dysfunction often appears as a striking change of personality (Duffy and Campbell 1994). Disinhibition and aggression are common, and patients may show a marked inability to conform behavior to social customs (Salloway 1994). Mood is often expansive or irritable, affect is labile, and impulsive outbursts of jocularity can occur. When lesions are confined to the orbitofrontal cortex, there may be no formal neurological deficits or other cognitive deficits. Orbitofrontal damage occurs with head trauma, inferior

TABLE 6–5. Neuropsychiatric symptoms that occur with lesions of the frontal lobe or related subcortical structures

Site of lesion	Symptoms
Medial frontal	Low motivation
	Blunted affect
	Motor retardation
	Reduced verbal output
	Grasp reflex
Dorsolateral frontal convexity	Poor selective attention
	Deficits in working memory
	Perseveration
	Excessive stimulus dependence
	Impaired motor programming
	Motor impersistence
	Reduced verbal or design fluency
Orbitofrontal	Disinhibition
	Failure to appreciate social customs
	Childlike jocularity
	Labile affect
	Expansive mood
	Irritability
	Lack of empathy
Heterogeneous frontal cortical regions	Apathy
	Impulsivity
	Poor directed attention
	Poor sustained attention
	Difficulty with temporal sequencing
	Inability to change rules

frontal meningiomas, rupture of anterior cerebral artery aneurysms, and frontal dementias.

Screening for Cognitive Impairment

My focus in this chapter is on comprehensive cognitive assessment, but some clinical settings may not be ideally structured to complete a thorough evaluation. Detection rate for dementia in some care settings is low (Callahan et al. 1995; Eefsting et al. 1996). Screening can improve case detection and is most important when the prevalence of cases in the clinic population is high.

Efficient screening can be accomplished by asking questions related to cognitive decline in the patient's history or by very brief mental status testing. A complaint of cognitive difficulty may emerge spontaneously or the clinician can ask if the patient has difficulty learning new information, handling complex tasks, finding his or her way, or using words correctly. Functional abilities can be rapidly assessed using tools such as the Functional Activities Questionnaire (Pfeffer et al. 1982), which has good discriminant ability (Costa et al. 1996). Brief tests such as the Blessed Orientation-Memory-Concentration Test (Katzman et al. 1983) can quickly measure a patient's overall cognitive abilities and are described in the next section of this chapter. Screening techniques will not reveal all cases with cognitive impairment, particularly when deficits are mild, and do not substitute for a complete assessment, but they can facilitate recognition of cases that might otherwise be missed. When screening reveals possible impairment, the patient should undergo more thorough diagnostic assessment to determine the extent and etiology of cognitive deficits.

Rating Scales for Cognitive Assessment

Rating scales can be used to screen for cognitive impairment, provide a framework for more thorough clinical assessment, or quantify the results of a mental status examination. Measurement of cognitive deficits allows the clinician to identify changes over time or to determine the response to treatment. Structured assessment also facilitates reliable communication among clinicians.

Many different rating scales are available, and reviews of their use have been published (Camicioli and Wild 1997; Kluger and Ferris 1991; Raskin and Niederehe 1988; Siu 1991; Weiner et al. 1996). Rating scales differ in the time required for administration and the spectrum of symptoms assessed (cognition, functional skills, psychiatric symptoms, behavior disturbance). Some scales are screening instruments; others are more comprehensive. Some scales provide subscores for individual cognitive domains, whereas others generate only an overall score. Each rating scale accomplishes a different clinical goal:

1. *Blessed Orientation-Memory-Concentration Test*, a six-item screening instrument that assesses concentration and memory (Katzman et al. 1983). Sensitivity, specificity, and diagnostic value of this brief instrument are acceptable and comparable to those of longer instruments (Stuss et al. 1996).
2. *Short Test of Mental Status*, a brief screening instrument (Kokmen et al. 1987). The eight items assess attention, orientation, memory, calculation, and visuoconstructive skill. Sensitivity has been shown to be acceptable.
3. *Mini-Mental State Examination (MMSE)*, a 30-item instrument that is widely used to screen for cognitive impairment and to assess the severity of impairment (Folstein et al. 1975). The examination takes about 10 minutes and provides a reliable overall cognitive score. Sensitivity for mild impairment is limited (Tombaugh and McIntyre 1992), and older individuals with low "normal" scores are at high risk for developing dementia over subsequent years (Braekhus et al. 1995). Age and educational level must be considered in interpreting the MMSE score (Crum et al. 1993).
4. *Neurobehavioral Cognitive Status Examination*, which assesses attention, memory, calculation, visuoconstructive skills, language, and abstraction. A subscore for each of these cognitive domains is generated (Kiernan et al. 1987). The examination requires specific testing materials and takes about 20 minutes to complete with an impaired patient.
5. *Mattis Dementia Rating Scale*, which assesses a wider range of cognitive skills, including executive abilities (Mattis 1976). The instrument requires about 30–45 minutes to complete with an impaired patient. It provides an overall cognitive score, with a maximum of 144 points.
6. *Neurobehavioral Rating Scale*, a 28-item instrument that measures psychiatric and behavioral disturbances, in addition to cognitive impairment (Levin et al. 1987). The evaluation takes about 40 minutes to complete. The instrument provides six factor scores that measure the cognitive and noncognitive symptoms (Sultzer et al. 1992); reliability and validity are acceptable (Sultzer et al. 1995b).

7. *Global Deterioration Scale*, a seven-point scale that measures the overall severity of dementia (Reisberg et al. 1988). Cognitive deficits, psychiatric symptoms, and functional impairment are all considered by the clinician in assigning the global severity score.
8. *Executive Interview*, a brief measure of executive skills (Royall et al. 1992). Measures of executive skills may help to clarify diagnosis (Royall and Polk 1998) and suggest risk for impairment in activities of daily living or behavioral disturbance (Chen et al. 1998).

Functional Assessment

The ability to accomplish functional activities at home is important information that complements the assessment of cognitive skills in the mental status examination. Reduced functional skills can be a sensitive indicator of dementia (Barberger-Gateau et al. 1992; Costa et al. 1996). Functional assessment also reveals the impact of medical problems and cognitive deficits on living skills and indicates the need for assistance with activities, which are both of prime importance to the patient and family.

At least a brief review of functional skills should be included in the assessment of each geriatric patient, and whether the patient currently drives a car should be noted. Two groups of activities are considered in functional assessment: physical activities of daily living (ADLs) and instrumental activities of daily living (IADLs) (Lawton and Brody 1969). Physical ADLs include the basic skills required for self-maintenance: dressing, bathing, toileting, transferring, and feeding. IADLs include more complex skills required for independent living: shopping, cooking, housekeeping, laundry, using the telephone, using transportation, managing money, and managing medications. An observer determines whether the patient is independently able to perform each of these activities. Rating scales such as the IADL Scale (Lawton 1988) or the Functional Activities Questionnaire (Pfeffer et al. 1982) can be used to improve the reliability of functional assessment or to screen for cognitive disorders.

Summary

The mental status examination is a fundamental part of the neuropsychiatric assessment of older patients. The examination focuses on cognitive abilities, which include perception, "thinking," intellect, and problem-solving skills. Several cognitive domains are explored: attention, memory, language, visuospatial skills, calculation, praxis, and executive skills. The extent of cognitive assessment depends on the particular clinical circumstances and the goals of the evaluation; at least a screening evaluation is recommended for all geriatric patients. Rating scales can be used to help screen for cognitive impairment or to quantify the extent of impairment in patients with known deficits.

The pattern of deficits is used to identify syndromes of cognitive impairment, such as delirium, other disorders of attention, dementia, aphasia, amnesia, and frontal lobe disorders. The results of the mental status examination can also reveal the contribution of regional brain dysfunction to the expression of psychiatric symptoms in older patients.

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