Cognitive Impairment is the most common neurologic problem associated with brain tumors and is present in many people with brain tumors from the time of diagnosis. Treatment of primary brain tumors with surgery, radiation, chemotherapy, and adjunctive medications such as corticosteroids results in further adverse effects on cognitive function. To plan the best care for patients with brain tumors, healthcare providers must initiate systematic and accurate assessment of cognitive functioning at the first clinic visit and extend assessment throughout the course of illness. This article outlines the range of cognitive dysfunction that may be seen in patients with primary brain tumors and offers information for clinicians seeking to develop their skills and implement a systematic approach to cognitive screening. The use of cognitive screening to guide timely intervention, such as referral to a neuropsychologist and the provision of anticipatory guidance to people with brain tumors and their families, is discussed.

Cognitive Impairment
in Patients With Brain Tumors:
Assessment and Intervention in the Clinic Setting

Sherry W. Fox, PhD, RN, CNRN, Sandra A. Mitchell, CRNP, MScN, AOCN®, and Margaret Booth-Jones, PhD

Cognitive impairment is the most common neurologic problem associated with brain tumors (Boake & Meyers, 1993). Cognitive dysfunction results from the neoplastic process, secondarily from shift or compression of intracranial structures, and associated cerebral edema. It is evident at the time of diagnosis in 50%–80% of patients (Tucha, Smely, Preier, Lange, & Klaus, 2000). Cognitive changes reported during and after radiation and chemotherapy include memory loss, diminished information processing, reduced attention, and personality and mood changes (Weitzner, 1999). The adjunctive medications that are ubiquitous among patients with brain tumors, specifically glucocorticosteroids, anticonvulsants, and psychoactive medications, also can produce adverse effects on cognitive function (Klein et al., 2001). In addition, medical complications that frequently are encountered in patients with primary brain tumors, including endocrine dysfunction, seizures, infection, anemia, and sleep disorder, all can contribute to neurobehavioral changes.

Cognitive dysfunction negatively affects physical, psychological, social, and vocational functioning. Many patients with primary brain tumors develop behavioral, emotional, and intellectual difficulties that compromise their ability to perform their usual work and other activities and limit independent living (Meyers, Weitzner, Valentine, & Levin, 1998). Patients may be saddened and frustrated by cognitive losses, and the changes diminish the quality of individual and family life. Patients with brain tumors may have inadequate insight and self-appraisal, and they may overrate their ability to manage independently. Furthermore, problems with memory or the inability to initiate activity can negatively impact adherence to treatment regimens. Cognitive dysfunction also can limit patients’ ability to make independent treatment decisions or give informed consent.
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consent (Wichman & Sandler, 1995) because the tasks require intact reasoning, the ability to weigh risks and benefits, and an appreciation of the long-term consequences of illness and treatment. Therefore, in planning the best care for patients with brain tumors, systematic and accurate assessment of cognitive functioning must be conducted starting from the first clinic visit and extending throughout the course of illness.

Cognitive Impairment Defined

Cognitive function is the process by which sensory input is elaborated, transformed, reduced, stored, recovered, and used (Neisser, 1967). Cognitive function can be subdivided into nine domains: attention, concentration, visuospatial and constructional skills, sensory and perceptive function, language, memory, executive function, intellectual function, and mood, thought, content, personality, and behavior (Gilroy, 2000; Hickey, 2005). Table 1 describes each of the domains and summarizes the symptoms and signs of associated dysfunction. Improved knowledge and understanding of the subtleties of each of the domains are important when evaluating, describing, and documenting aspects of cognitive dysfunction. Such knowledge can facilitate anticipatory guidance to patients and families and the tailoring of specific plans for rehabilitation and support.

Prior to beginning cognitive assessment of patients with brain tumors, having an understanding of the anatomical correlates of cognition is helpful. When the location of a tumor is specified, a nurse who understands the anatomical correlates of cognition can anticipate the types of cognitive impairment that may be seen in particular patients and, thus, enhance the quality of assessments. For example, knowing a priori that a patient has a lesion in the temporoparietal cortex, as compared to the frontal lobe, might alert a clinician to assess for language dysfunction, hemispatial neglect, apraxias, or a homonymous visual deficit (Weitzen, 1999). Although a full description is beyond the scope of this article, an overview of the anatomical correlates of cognitive function and impairment is presented in Figure 1.

Nursing Implications of Cognitive Screening in the Clinic

Cognitive screening is a critical tool for nurses to use to evaluate health status in patients with brain tumors and contributes to thoughtful planning for management across the course of illness. Cognitive screening on a per-visit basis provides invaluable insights into the ability of patients to make critical decisions regarding care. Nurses play key roles along with physicians, patients, and their families in dialogue about treatment decisions. In-depth knowledge of the level of cognitive impairment guides healthcare teams in deciding at what point families and significant others must share responsibility with patients for decision making.

Increased understanding of the cognitive status of patients also may provide invaluable clues in assisting interdisciplinary teams and families in improving quality of life. A clear understanding of the scope and features of cognitive impairment will help nurses to offer support, education, and anticipatory guidance to families that may help them plan for safety, maintain activities of daily living, and cope with the challenges that cognitive impairment can bring to day-to-day life (Fox & Lantz, 1998; Hickey, 2003).

Finally, one of the most important implications of cognitive screening in the clinic is the need for greater advocacy. Although many people with cancer return to gainful employment following illness, many individuals with high-grade brain tumors do not. Often, people with brain tumors appear “normal” physically and sometimes even cognitively; however, many components of brain function may be impaired subtly, including executive functions such as planning and managing multiple priorities (Meyers & Scheibel, 1990). Such impairments may prevent a return to normal work functions. Gaining the understanding of employers when people return to work, or convincing those evaluating patients for disability benefits that people cannot return to work, may be challenging. Ongoing assessment of cognitive impairment in the clinic setting can help to establish patterns of change in cognition and promote more timely referrals to neuropsychology for formal testing. Additionally, assessments may facilitate people receiving needed levels of support, including job adaptations, disability benefits, and other services.

Goals of Cognitive Screening in the Clinic

Healthcare professionals must consider the goals of cognitive screening in the clinic to choose the right instrument for the task. Assessing multiple areas of cognitive function quickly is an important goal because of limited time with patients and families in the clinic setting. Ideally, an instrument should be one that can be used by trained personnel in about 5–15 minutes; is focused on orientation, attention, concentration, executive function, language, and spatial and memory function; and has acceptable reliability and sensitivity relative to the areas of cognitive dysfunction commonly encountered by clinicians in the neuro-oncology setting (Mallory et al., 1997).

Evidence-Based Cognitive Screening Tools

For a tool to be considered valid, reliable, and sensitive for clinical use with patients with brain tumors, the parameters should have empirical support. A search of the literature revealed two instruments that have an evidence base sufficient to support their use in the clinical setting as screening tools for cognitive impairment in patients with brain tumors. The evidence is summarized in two publications, authored by the American Academy of Neurology (2001) and Patterson and Glass (2001). The evidence-based tools are the Mini-Mental State Examination (MMSE) (Folstein, Folstein & McHugh, 1975) and the Modified Mini-Mental State Examination (MMSE) (Teng & Chu, 1987) and the Neurobehavioral Cognitive Status Examination (NCSE) (Kiernan, Mueller, Langston, & Van Dyke, 1987). The MMSE addresses the following areas of mental status: orientation to person, place, time, and residence; memory and recall of three common objects; attention and calculation; language; response to commands; and ability to copy a design.
<table>
<thead>
<tr>
<th>Domain</th>
<th>Description</th>
<th>Comments</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Attention</strong></td>
<td>Spatial attention: prioritizes signals from one spatial location</td>
<td></td>
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<tr>
<td></td>
<td>Selective or focused attention: prioritizes some forms of information and suppresses others on the basis of a function goal</td>
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<td></td>
<td>Arousal or sustained attention: self-maintains an alert and ready-to-respond state</td>
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<tr>
<td><strong>Concentration</strong></td>
<td>Concentration capacity: refers to the amount of information processing a person can do in a given time</td>
<td>Distractions may be located in the environment (external) or the self (internal).</td>
</tr>
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<td></td>
<td>Concentration control: refers to an individual’s ability to direct concentration capacities</td>
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<tr>
<td></td>
<td>Concentration exists in three forms: sustained, focused (selective), and divided (alternating) attention.</td>
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<tr>
<td><strong>Visuospatial and constructional skills</strong></td>
<td>Ideational apraxia: disruptions to logical plan and basic sequence of events underlying a chain of simple actions</td>
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<tr>
<td></td>
<td>Ideomotor apraxia: dissociation between the areas of the brain that contain the ideas for movements and the motor areas that actually execute the movements</td>
<td></td>
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<td></td>
<td>Constructional apraxia: inability to accurately produce organized constructions (e.g., drawings, simple building tasks)</td>
<td>Motor apraxia generally is not reported by patients, but families often describe the dysfunction.</td>
</tr>
<tr>
<td></td>
<td>Motor apraxia: difficulty using common objects (e.g., toothbrush, eating utensils)</td>
<td>Patients and families may report illegible handwriting.</td>
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<tr>
<td></td>
<td>Loss of topographical memory: inability to find the way and tendency to get lost in familiar and unfamiliar environments</td>
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|                                | Apraxic agraphia: difficulty with writing characterized by poor letter formation and spatial distortions of letter placement | May occur as a result of an inability to perform the continuous and systematic scanning eye movements necessary for reading; alexia also may occur secondary to language deficit. May result from misplacement of digits, misalignment of columns, or aphasia for number symbols |}

**Note:** Based on information from Anderson, 1994; Burgess, 2000; Cammermeyer, 2001; Feinberg & Farah, 2003; Gilroy, 2000; Greenberg et al., 2002; Groth-Marnat, 2003; Halligan et al., 2003; Heilman & Valenstein, 2003; Hickey, 2003; Unsworth, 1999; Walsh & Darby, 1999.

(Continued on next page)
### Table 1. Domains of Cognitive Function (Continued)

<table>
<thead>
<tr>
<th>DOMAIN</th>
<th>DESCRIPTION</th>
<th>COMMENTS</th>
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</table>
| Language                      | • Aphasia and dysphasia  
  - Language production (expressive aphasia and dysphasia)  
  - Language comprehension (receptive aphasia and dysphasia)  
  Dysarthria: sensorimotor disorder affecting the respiratory and articulatory functions involved in speech sound production; speech may be garbled, slurred, or muffled, whereas grammar, comprehension, and word choice are intact.  
  Dysprosody: interruption of speech inflections and rhythm (i.e., speech melody), resulting in monotone or halting speech | Evaluation of spontaneous speech:  
  - Can communication be established?  
  - Does the patient produce speech at all?  
  - Is the patient’s speech comprehensible? If not, is it because of semantic errors or because of dysarthria?  
  - Is the patient’s speech fluent or nonfluent?  
  - Are semantic errors occurring?  
  - Are repetitive speech patterns occurring (e.g., automatisms, perseveration, stereotypy)?  
  Language production difficulties:  
  - Pauses, hesitancy, restricted range of vocabulary  
  - Use of circumlocutions  
  - Discontinuation of a phrase  
  - Substitution of a presumably intended word for another word (i.e., verbal paraphasia)  
  - Substitution of a presumably intended word for a meaning-related word (i.e., semantic paraphasia)  
  - Difficulty with grammatical construction  
  - Telegraphic speech style  
  Language comprehension difficulties:  
  - Difficulty following multistage commands  
  - Problems comprehending television or movies; difficulties reading, working on a computer, or participating in conversation  
  - May be difficult to differentiate from problems with attention and can overlap with stress and fatigue |
| Memory                        | Remote memory usually is preserved. Examples of short-term memory loss include forgetting a message, losing track of a conversation, forgetting to do things, forgetting what has been read or events in movies or television programs, and being unable to navigate in familiar places | Examples of executive dysfunction:  
  - Difficulties with abstract thinking, planning, decision making, goal formulation, and multistage tasks  
  - Poor temporal sequencing  
  - Difficulty with reasoning and problem solving  
  - Difficulty carrying out everyday, routine activities (e.g., making tea, brushing teeth, dressing)  
  - Lack of insight  
  - Distractibility  
  - Marked reduction in spontaneous purposeful activity  
  - Confabulation  
  - Perseveration  
  - Lack of concern  
  - Shallow affect, impulsiveness, disinhibition, aggression, and lack of concern for social rules |
| Executive function            | Executive functions are the adaptive abilities that enable people to analyze what they want and develop and carry out plans to achieve the goals. Executive function also includes understanding of complex social behavior such as understanding how others see them and reflecting on and modifying their own behaviors. | –                                                                                                   |
| Intellectual function         | Evaluation of intellectual function may be affected by problems with attention and concentration, receptive and expressive language problems, difficulties with calculations or reading, and short-term memory problems. Aspects of intellectual function include orientation, fund of common knowledge, insight and judgment, abstract thought, and problem solving. | –                                                                                                   |
| Mood, thought content, personal- | Evaluation of mood, thought content, personality, and behavior should be considered in the context of baseline personality, coping style, adjustment difficulties, and neurocognitive sequelae of disease or treatment. | –                                                                                                   |

*Note: Based on information from Anderson, 1994; Burgess, 2000; Cammermeyer, 2001; Feinberg & Farah, 2003; Gilroy, 2000; Greenberg et al., 2002; Groth-Marnat, 2003; Halligan et al., 2003; Heilman & Valenstein, 2003; Hickey, 2003; Unsworth, 1999; Walsh & Darby, 1999.*
Scores of 1 are given for each correct patient response. The maximum score for the MMSE is 30. Scores higher than 24 indicate no impairment, and patients with scores of 20–24 need additional testing. Patients who score below 20 are likely to be cognitively impaired (Buttaro, Trybulski, Bailey, & Sandberg-Cook, 2003; Schwartz, 2002). Administration time for the MMSE is about 5–10 minutes.

The MMSE has several methodologic issues that are important to consider prior to its use in the clinical setting. The MMSE has been reported to have limited sensitivity and specificity in patients with mild cognitive impairment (McDowell & Newell, 1996). This does not mean that the tool should not be used as a screening instrument but rather that patient interviews should be used to validate findings from the instrument. The MMSE may be insensitive to impairments from lesions in the right hemisphere (Mallory et al., 1997). It also has no measurement of visual perceptual deficits. Finally and most importantly, the MMSE has proven to be less sensitive with patients of advanced age and those with lower educational attainment (McDowell & Newell). However, standards of interpretation can be used to adjust for the problems (Mallory et al.). The modified MMSE, known as 3MS, also can be used to offset the problems with age and educational biases; however, the modified version is slightly longer (Teng & Chui, 1987).

In summary, the goals of cognitive screening in the clinic setting are to accurately and efficiently identify areas of cognitive dysfunction for the purposes of establishing a baseline against which to compare future progress of patients and to identify areas in which patients and families may require assistance in dealing with cognitive dysfunction. If screening reveals cognitive dysfunction, interventions must be planned by the health-care team to address areas of dysfunction.

**Interdisciplinary Interventions for Cognitive Dysfunction**

Interventions for people with cognitive dysfunction are directed to three areas: restoration, substitution, and restructuring. Restoration encompasses cognitive training and exercises that strengthen and restore function, such as memory rehearsal, timed reading, and verbal mediation. Substitution involves using compensatory devices and strategies to substitute for loss of function, such as the use of a calendar or memory book in which to record important information to remember. Finally,
Restructuring is focused on adjusting the demands placed on the cognitive function of individuals with brain tumors, such as changing environmental settings or expectations and involving the people in activities in which they can be successful. In the above framework, interventions also include systematically evaluating cognitive function at regular intervals (Meyers, Hess, Yung, & Levin, 2000) and setting specific goals for restoration, substitution, or restructuring of environment with periodic reevaluation of progress toward the goals. The rehabilitative disciplines, such as physical and occupational therapy, speech therapy, and cognitive vocational rehabilitation, are an important part of the supportive therapy of individuals with brain tumors. Evaluating the effects of fatigue, depression, anxiety, insomnia, and physiologic discomfort on cognitive functioning and remediating the contributing factors may be an invaluable intervention for many patients. Although no placebo-controlled, randomized trials have supported the use of psychostimulants, data from case reports and small, single-arm trials have shown that methylphenidate (5–10 mg by mouth twice daily and titrated to effect) or modafinil (100–200 mg per day) may offer symptom relief from fatigue, diminished alertness and attention, and problems with mental concentration and psychomotor slowing (Barton & Loprinzi, 2002; Meyers et al., 1998; Morrow, Shelke, Roscoe, Hickok, & Mustian, 2005). Choice of agent and dosing considerations should incorporate knowledge of the potential adverse effects (e.g., irritability, anorexia, insomnia, mood lability, nausea, tachycardia) of individual agents. Perhaps most importantly, providing anticipatory guidance to patients and families may be one of the most helpful interventions that nurses can contribute to the care of cognitively impaired patients with brain tumors. Recommendations for anticipatory guidance are offered in Figure 2.

The healthcare team, particularly nurses, can provide many interventions for patients with brain tumors and their families. However, additional intervention may be required at times. Such assistance can be provided by referral to a neuropsychologist.

Figure 3 provides an overview of the indications for referral to a neuropsychologist.

**How to Present the Idea of a Neuropsychological Examination**

Some patients associate psychology or psychiatry with “being crazy” and resist referral, whereas others are concerned that they will appear stupid or be emotionally traumatized in some way. Patients should be informed that neuropsychological evaluation is a practical, noninvasive assessment of brain function that allows for more comprehensive treatment planning. A neuropsychological examination starts with a clinical interview with the patient and a family member or loved one when possible. Behavioral observations include social interaction, awareness of social norms, and the patient’s awareness of his or her impact on others. Gait, posture, and overall motor movement are observed, as are expressive and receptive language. The ability of the patient to act as his or her own historian is determined further with the assistance of the family member. Testing typically includes an estimate of premorbid function either through a brief reading test or review of academic and occupational achievement, thus allowing for proper comparison of current function in other cognitive areas. For example, an average performance on a memory test may be consistent with premorbid function of someone with average estimated premorbid intellect but may represent a relative decline for someone with superior premorbid intellect.

Ideally, neuropsychological testing consists of a brief, repeatable, well-validated battery of tests assessing the cognitive domains of attention, language, verbal memory, nonverbal memory, visuospatial perception, and psychomotor speed. When assessing attention, concentration and vigilance should be measured, as well as susceptibility to interference. With language, verbal fluency and confrontational naming are important. With verbal memory, memory for newly learned information usually is more vulnerable; remote memory usually remains intact. Nonverbal memory and visuospatial perception are essential functions for negotiating one’s environment and can be assessed by asking a patient to copy and recall drawings. Executive function is a higher-level function encompassing a broad category of abilities that usually are associated with the frontal lobe. Executive functions include problem solving, judgment, reasoning, and the ability to multitask. Psychomotor speed and stamina are assessed on specific tests and with observation across tests. Testing considerations include determination of the patient’s sensory limitations, such as visual field cuts, hearing loss, peripheral neuropathy, and hemiplegia, and should be limited to one or two hours to minimize fatigue. Therefore, completion of a full neuropsychological evaluation may require two or three visits (Lezak, 1995).

**Providing Feedback**

Whenever possible, feedback from neuropsychological examinations should be provided to patients and family members at the end of evaluations in a compassionate, supportive manner with emphasis on strengths and weaknesses. Feedback should be provided in an educational manner, with test findings explained in

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**Figure 2. Anticipatory Guidance for People With Brain Tumors and Cognitive Impairment**

*Note.* Based on information from Sherwood et al., 2004.

- Consider support groups, online support, counseling resources available through the National Brain Tumor Foundation and the American Brain Tumor Association, and individual and family counseling.
- Make a list of things that others can do to help the caregiver, and keep the list by the phone to consult when friends call to ask how they can help.
- Expect that mood disorder, particularly depression, is present and contributing to cognitive difficulties (Litoffsky et al., 2004).
- Provide explanations and information that help link emotions and changes in behavior and functioning to the tumor site and treatment.
- Help patients and families anticipate the trajectory of the illness and plan for the next phases—end-of-life decision making, articulating wishes, and fulfilling desired short-term goals.
- Help patients maintain who they are and the roles that are important by suggesting alternatives, adaptations, accommodations, and problem solving.
- Maintain patients’ involvement and dignity despite limitations.
When a patient requests assessment or expresses concerns
When family members express concern
When a physician or other healthcare provider needs a baseline assessment or notices cognitive changes
When a rehabilitation counselor or therapist needs a comprehensive baseline
When documentation of disability or accommodation is required
When competency is an issue
When issues of placement in a rehabilitation or adult-living facility exist

**Figure 3. Reasons for Referral to a Neuropsychologist**

The art of the possible.

Conclusions

Assessing the cognitive function of patients with brain tumors accurately, efficiently, and longitudinally is paramount to quality care. Nurses can use the information provided in this article to refine their ability to evaluate and describe cognitive function in this patient population and should become skilled in deliberately intervening to provide remediation and support. Furthermore, they should engage in interdisciplinary care planning and referral to other healthcare team members, including neuropsychologists and rehabilitation specialists, early in the course of illness. As programs develop to care for patients with brain tumors, plans must be set forth to provide education and conduct research related to cognitive impairment in such patients. Part of program planning involves systematically evaluating patients at regularly scheduled intervals with mechanisms to document progress and adjust plans of care. Education must be provided to clinicians to strengthen skills in assessing and intervening to address cognitive dysfunction. Research is urgently needed to develop and refine brief, clinically relevant, valid, and reliable measurements of cognitive function for use in clinical practice and to evaluate the effectiveness of innovative interventions to improve outcomes for patients with brain tumors experiencing cognitive dysfunction and the family members and friends who care for them.

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