

Evaluation After Traumatic Brain Injury

By Tina M. Trudel, PhD; James Halper, MD; Hayley Pines; and Lorraine Cancro, MSW

The following article is the third in a multi-part series on traumatic brain injury (TBI).

This series is being published by the Traumatic Brain Injury-Resource Optimization Center (TBI-ROC) and its Advisory Group, which is facilitated by JBS International, Inc. The TBI-ROC is a recognized source and leader for advancing national attention to the myriad of policy, research, practice, and service needs supporting both civilian and military individuals who incur TBI and their families.

It is important to determine if a traumatic brain injury (TBI) has occurred when an individual is assessed in a hospital emergency room after a car accident, fall or other injury that affects the head. This determination influences decisions about treatment. It is essential to screen for the injury, because those who may have sustained a TBI have an increasingly higher chance of reaching their maximum potential of post-injury functioning and independence, the sooner they begin appropriate medical stabilization and treatment interventions such as rehabilitation.

Some head traumas can lead to death, while others appear to have virtually no immediate effect. A large number are classified as Mild Traumatic Brain Injuries, (MTBI). The word “mild” is somewhat of a misnomer, as those initially assessed as having a MTBI may experience post concussive syndromes and other neurobehavioral disturbances such as disturbances of memory, attention, and mood. These symptoms can be troublesome and long lasting. The following Center for Disease Control and Prevention’s (CDC) self-reported criteria for Mild Traumatic Brain Injury (MTBI) include:

- Transient confusion, disorientation, or impaired consciousness;
- Dysfunction of memory around the time of injury; or
- Loss of consciousness lasting less than 30 minutes.

When a patient with isolated head trauma presents at an emergency room they are asked about confusion, disorientation and other criteria for MTBI and given a focused neurological exam that assesses strength, balance, sensation (e.g. ability to feel things including pain), and thinking ability. Particular focus is given on three

parts of the examination: 1) Ability to move, 2) Ability to open eyes and 3) Ability to speak in a coherent fashion. The individual’s functioning in these three areas support the use of the Glasgow Coma Scale (GCS), a TBI assessment tool that calculates a score highly predictive of the chance of a TBI, especially in the more moderate to severe range.

The GCS is based on a 15-point scale for estimating and categorizing the outcomes of TBI based on overall social capability or dependence on others. The number helps the emergency room medical provider classify potential levels for survival and directs a course of action. A lower number signifies a more severe TBI. Patients with low scores on this scale typically identify the need for hospital admission and/or the necessity for further diagnostic testing to assess hospitalization need/other interventions. A CT scan may be done (CT scan visualizes the brain to check for block-

ages, masses or problems in blood vessels). For patients with high GCS scores (13-15 indicating mild confusion and/or disorientation) the necessity of further diagnostic tests or hospitalization is not obvious. For these individuals, the question is whether a CT scan should be performed to assess next medical steps.

CT scans are expensive and involve exposure to radiation. It would be useful to have guidance to support decision making when these scans are necessary. To help with deciding if a CT scan is necessary, two guidelines are often used. One is the New Orleans Criteria (NOC), and the second is the Canadian CT Head Rule (CCHR). Both use the GCS score and a variety of input from the patient or onlooker who provide information on headache, vomiting, age, drug or alcohol intoxication, decreased short-term

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memory, evidence on exam of skull fracture, and/or injury above the collarbones.

The NOC and CCHR are each generally effective in identifying the need for a CT scan when the injury appears significant enough to warrant surgery. The NOC, however, is more likely to identify other brain injuries, not requiring surgery, than the CCHR. However, the NOC leads to many more people getting CT scans that present no supporting symptoms. Attention is needed to reduce unnecessary CT scans. One such method may involve increased education/training of emergency room medical staff to help them integrate alternative methods of assessment. This training would reduce patient radiation exposure and health care expenses.

CT scans do not detect more inconspicuous abnormalities that could interfere with future health and functioning. Such abnormalities are commonly found with other imaging techniques including Magnetic Resonance Imaging (MRI). MRIs differ in ability to identify brain damage, although in general they are an improvement over CT. One advanced type of MRI is Diffusion Tensor Imaging (DTI). DTI allows identification of abnormalities of nerve pathways, which transport messages from one part of the brain to another.

Positron Emission Tomography (PET) identifies abnormalities of metabolism and blood flow in the brain. This tool helps locate abnormalities occurring in mild TBI. With the PET, the individual is injected with radioactive material. As the PET is elaborate and difficult to perform, emergency room medical provides may refrain from using it.

In some instances of TBI, individuals may be at risk for increasing symptoms, because of unsuspected building intracranial pressure (ICP), or rise in the pressure inside the skull. If left untreated, too high ICP levels can result in permanent brain damage or even death. To identify and counteract dangerous ICP fluctuations, providers monitor ICP by using a device placed through the skull that senses intracranial pressure and sends its measurements to a recording device. This helps providers regulate ICP levels and treat the trauma issues before their effects are irreversible.

Throughout the acute hospital course, evaluations are performed by a wide variety of medical specialists. Once beyond the acute medical crisis, individuals with a TBI are again often evaluated by an entire team of professionals beyond their primary physician and whatever medical specialties are needed. Nurses review health systems and develop nursing care plans. Case managers assess care needs, funding sources and discharge planning options. Social work staff reach out to the person's circle of support and assess their needs, family functioning and return to community issues. Various counselors and psychologists may be involved, examining concerns related to adjustment, behavioral health and the risk of substance abuse after TBI.

Allied health professionals play a prominent role on the rehabilitation team. These include occupational therapy, physical therapy, speech therapy, recreation therapy and vocational rehabilitation. Depending on the approach of the particular rehabilitation setting and the individual therapist's background and training, overlap may occur in various ways across the team. Occupational therapists (OT) typically focus on functional skills, examining the person's ability to perform activities of daily living, both personal

(bathing, dressing, cooking, eating, toileting, etc.) as well as community (shopping, banking, accessing transportation). OTs often determine home safety issues, adaptive equipment needs and assistive technology recommendations. They may be very involved in upper extremity functioning, and evaluation of practical problem solving. In some settings, OTs, along with neuro-optometrists, may focus on post-brain injury vision rehabilitation. Their evaluations include interview, paper and pencil tasks and actual performance of various functions in different settings.

Physical therapists (PT) are usually involved with assessment of strength, conditioning, flexibility, coordination, balance and safety. Assessments involve range of motion of various limbs, strength testing, and use of machines to examine movement, walking gait and balance, along with demonstrating these skills on various surfaces, stairs and in functional tasks. PTs are also very involved in selection of adaptive equipment and training for use of canes, wheelchairs, etc., as well as working closely with orthotists and prosthetists for ensuring proper fit and use of braces and artificial limbs. Some physical therapists specialize in balance problems, which can occur after TBI, and have specialized evaluations for vestibular (inner ear) balance functions.

Speech therapists address not only language, but also are involved in the full assessment of the oral mechanism, working together with the medical team to address swallowing disorders that may occur after incurring a TBI. This evaluation (video fluoroscopy/modified barium swallow) is done in the medical setting and involves the person ingesting various substances containing barium (liquids, cookie), while an x-ray type video is made to visualize the swallowing function to ensure food and liquids are not entering the airway. Along with language evaluation (listening, speaking, repeating and paper & pencil tests), many speech therapists also assess cognitive functions and are involved in the selection of adaptive communication equipment and assistive technology.

Recreation therapists assess leisure skills, interests, community access and available resources in order to assist the person with TBI to have greater quality of life and motivation. Leisure interest inventories (paper & pencil), interview and contacts with the local community are often included in the evaluation. The recreation therapist may also introduce new activities in this process.

Vocational rehabilitation involves a number of evaluation processes. A vocational assessment compiles information from all of the records of other healthcare providers, and reviews such in terms of returning to work. Additionally, vocational interest and work aptitude testing is also administered, along with interviews about work history and future career goals. Functional Capacity Testing (usually via an OT or PT) can clarify physical parameters for return to work. Situational assessments are also available, wherein a person tries out a specific job in a designated situation, and receives structured feedback.

One of the common assessments after TBI less familiar to most consumers is the neuropsychological evaluation, which provides a functional overview of the brain. Neuropsychologists are doctoral level psychologists with additional specialty training in brain-behavior relationships. They utilize a variety of tests that are administered

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in a standardized manner and allow each person's test data to be compared to the test performance of others without TBI, often using comparison data ('norms') that are organized by age, gender and/or level of education. The comparisons are often expressed in the form of percentiles, similar to the typical achievement tests administered in school, ranging from 1 to 99, with 50 as the midpoint and higher numbers indicating a better score. Aside from comparing one person's test scores against appropriate norms to assess current level of functioning, periodic neuropsychological evaluation after TBI can evaluate recovery of functions and provide information useful for educational and vocational planning.

A neuropsychological evaluation usually takes four to eight hours and addresses referral questions. These can range from a general overview of brain functioning, diagnosing mild TBI, determining cognitive aides needed for return to work, to assessing if someone is competent to make medical and financial decisions. In order to answer the referral question, the neuropsychologist takes a thorough history and reviews medical records and when available, records from prior to the brain injury, such as school records or work evaluations. The neuropsychologist also records behavioral observations to ensure that the person is giving a consistent effort, and to note any symptoms apparent during the testing sessions. The battery of tests administered is thorough and designed to answer the referral question. Tests typically include:

- **Orientation** - does the person know who they are, where they are and the date.
- **General Intellect** - often referred to as 'IQ', these tests provide a general overview of a person's cognitive status and intellectual background. However, because TBI often impacts very specific functions (attention, memory and executive skills - see below), measures of general intellect can be well within or above normal limits, even after significant TBI.
- **Attention & Concentration** - refers to tests of the ability to manage, shift and sustain one's focus, and can involve various modalities, such as repeating or adding strings of numbers presented orally, or concentrating on computerized information for an extended period.
- **Learning & Memory** - refers to tests that primarily assess memory for new learning, as memory for remote events is typically not affected by TBI, except in the more severe cases. Memory is examined using both verbal and non-verbal information, and determining short term and then long term (over 30 minutes) recall of new information. Recognition memory (such as in multiple choice formats) is also checked. For example, if someone cannot recall the newly learned information presented during testing, but is able to recognize the correct answers on a multiple-choice question, their ability to store information is working, only their recall is not. Such findings have implications for rehabilitation, education, assistive technology and return to work.
- **Executive Functions** - refer to cognitive abilities involved in the initiation, planning, sequencing, organization and control of behavior. They incorporate basic abilities, such as working mem-

ory (having two things going on at the same time) and inhibitory control (being able to block responses), as well as complex overarching abilities, such as coming up with solutions to new problems and being able to evaluate your own performance, strengths and weaknesses. Tests for executive functions are varied and complex, as these are the highest level of brain function, and the most often affected after incurring a TBI.

- **Sensory and Perceptual Functions** - refer to tests that determine if the senses (especially vision and hearing) are accurately receiving information and then processing that input in the brain. For example, in the case of post-TBI cortical blindness, the eyes are unaffected, but the part of the brain responsible for interpreting visual messages from the eyes is affected. If problems are noted in these areas, referral to other specialists for detailed examination occurs (i.e., optometry, audiology, etc.).
- **Psychomotor Functions** - refer to tests of motor speed and dexterity and involve tasks such as a high-speed finger tapping, engaging in complex motor patterns and manipulating small objects. These functions are also often assessed in detail by the Occupational Therapist.
- **Language** - refer to both the expressive (talking) and receptive (listening) elements of communication, as well as written language. These functions are also often assessed in detail by the Speech Therapist.
- **Visual Spatial Skills** - refer to the abilities to process non-verbal information and to be able to construct drawings, analyze visual scenarios and use visual information for abstract reasoning. Assessment of these functions may involve assembling puzzles, examining patterns and matching block patterns.
- **Academic Skills** - refer to assessment of achievement across the basic skills taught in school, such as reading, writing and arithmetic. Examining this set of skills can also assist the neuropsychologist in confirming pre-injury level of functioning, as often basic vocabulary and academic skills are unaffected by TBI.
- **Personality & Psychological Functioning** - neuropsychological evaluations often screen for psychological issues. Depression, for example, is very common after TBI and not only has a negative impact on recovery, but also can reduce cognitive performance in areas such as attention, concentration and memory.

TBI rehabilitation can be an extended process for individuals with more complex or severe impairments, extending across the continuum of care from hospital to home. Throughout this period, thorough evaluation and timely re-evaluation are keys to better treatment and enhanced outcomes. All evaluations hinge on interpretation of data, be that CT scans or mental tests. A person with TBI and their family should be informed about the interpretations of the data and ensure that professionals making these interpretations have accurate records and history to provide an accurate foundation for their judgments—and as always, never be afraid to ask questions. •

Lead writer Tina M. Trudel, PhD, is the COO of Lakeview Neurorehabilitation Center and Specialty Hospital.