Single Isolated Concussion Part II: Diagnosis, Recovery Assessment, and Treatment

Providing sound advice after a single isolated concussion.

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This article is a continuation of one published in the previous issue of Practical Neurology, which focused on definitions, classification, and prognosis of a single isolated concussion, or mild traumatic brain injury (mTBI). Here in part II, diagnosis, treatment, and recovery assessment are addressed. The focus of this article is a single mTBI occurring in a patient without a history of previous mTBI.

**Diagnosis**

Diagnosis of mTBI is clinical, and the diagnostic criteria are:

1. Any immediate alteration in the level of consciousness of <30 minutes
2. Posttraumatic amnesia lasting from minutes to a few hours but <24 hours
3. Normal structural imaging studies (CT scan or MRI)
4. A nonfocal neurologic examination

If all 4 are present, the patient meets the criteria for having mTBI.

**Recovery Assessment**

There are many assessment tools to help physicians monitor a patient’s recovery from mTBI that aid the physician in following the patient’s somatic, behavioral, and cognitive complaints during the recovery period. Examples include symptoms scales, (eg, the standardized assessment of concussion [SAC] and the sport concussion assessment tool-5 [SCAT-5]), balance tests, computerized neurocognitive tests, and formal neuropsychological testing. It is of note that these are not validated as diagnostic tools but rather are tools for assessing recovery from the initial injury. If these scales show that patients have symptoms lasting longer than expected based on a typical natural history of recovery within approximately 1 to 3 months, suspicion of postconcussion syndrome (PCS) or a neurocognitive disorder (NCD) due to a traumatic brain injury (TBI) may arise.

**Symptom Scales**

The most commonly used mTBI symptoms questionnaire is the Rivermead Post-Concussion Symptoms Questionnaire, a 16-item self-report during the first 24 hours following an mTBI and comparing status in that period to status prior to injury. Symptoms are reported by severity on a scale from 0 to 4: not experienced, no more of a problem, mild problem, moderate problem, and severe problem.

A second commonly used assessment tool is the graded symptom checklist (GCS), another self-report measure of mTBI symptoms derived from the Head Injury Scale. The Post-Concussion Symptom Inventory and the Post-Concussion Symptoms Scale are 2 other mTBI symptoms scales used primarily in school-age children and adolescents.

The SAC was formulated at the request of the American Academy of Neurology (AAN). It is a standardized protocol used to evaluate athletes within minutes of having sustained an mTBI. The SAC evaluates cognition: orientation, immediate memory, concentration, and delayed recall. The total possible score is 30, and in a control population without mTBI, the mean score was 26.6. The test assesses a patient's orientation, immediate and delayed memory, concentration (ie, ability to repeat 3 to 6 numbers in reverse sequence and recite the months of the year in reverse), neurologic assessment (ie, consciousness, amnesia, strength, sensation, and coordination), and optional exertional maneuvers when indicated. The reliability, sensitivity, and specificity of the SAC as a measure of cognitive function during the initial 1 to 2 days following mTBI has been validated; however, another study found that it was only valid in the first 6 hours after recovery.
The SCAT-5 \( ^9 \) is intended for the use of health care professionals trained in assessing and managing sports-related mTBIs in children age >13 years. The SCAT-5 was not designed to be used in isolation or to make or exclude the diagnosis of mTBI. It consists of a symptom checklist, immediate and delayed word recall and reverse order number list recall; and a rapid neurologic screening examination that includes evaluation of the cervical spine, speech, ability to read, balance, gait, visual tracking, and finger-to-nose coordination. The SCAT-5 mandates a written clearance by a health care professional prior to returning to play or sport.

**Balance Tests**

The ability to maintain postural stability has been evaluated as an objective measure of mTBI recovery. Balance requires multiple sensory inputs and outputs to the muscles. A clinical, practical, and cost-effective method, the Balance Error Scoring System (BESS), has been developed as a standardized, quick sideline measurement of postural stability. \( ^10 \) The patient holds 3 different stances (double leg, single leg, tandem) on a firm surface and a medium-density foam pad, each for 20 seconds, with hands on hips and eyes closed. Errors are counted and summed to a maximum error score of 10 per trial.

**Computerized Neurocognitive Tests**

Several proprietary tests have been developed to monitor concussed individuals. Computerized neuropsychological test batteries are objective methods for testing large groups, are generally brief, and can be used in follow-up for tracking recovery. In these populations, the test can be administered at baseline so that in the case of injury, there is a standard to which postinjury results can be compared. The proposed advantages over traditional neuropsychological testing include ease of administration and alternate test forms to reduce the possibility of practice effects. The most commonly encountered computerized neuropsychological tests include Immediate Post Concussion Assessment and Cognitive Testing (ImPACT), \(^11\) CogState/Axon, \(^12\) CNS Vital Signs, \(^13\) and Automated Neuropsychological Assessment Metrics (ANAM). \(^14\) To date, all current evidence- and consensus-based sports mTBI recommendations advise against using a single computerized neurocognitive test to diagnose or manage mTBI and recommend that these tests be used in conjunction with other evaluation modalities to make management decisions. Factors limiting the use of computerized neurocognitive tests include premorbid learning disabilities that are not discernable on computerized testing, underreporting of prior mTBIs, language issues, administration of testing in a suboptimal environment (including an unsupervised condition), and potential inappropriateness of the test for the age of the injured individual. \(^15\)

**Neuropsychological Testing**

Neuropsychological testing provides a scientifically validated and objective method to evaluate certain brain functions. It is important to understand the purpose behind a neuropsychological evaluation: what it may and may not reveal about an individual. A neuropsychological profile will demonstrate the presence of cognitive and behavioral strengths and weaknesses but is unable to identify what caused a problem. As there is no neuropsychological profile that precisely correlates to a specific area of brain and no specific area of the brain that precisely correlates to a neuropsychological function, neuropsychological studies cannot localize the findings to a specific area of the brain or to a specific injury. As reported by the Therapeutics and Technology Assessment Subcommittee of the AAN, “Neuropsychological assessment is not intended to provide a diagnosis or to indicate the precise localization of a focal brain lesion.” \(^16\)

A neuropsychological evaluation is the only mTBI assessment tool to include validity testing, which is subject to responder biases. This is of particular note because there is an inverse relationship between financial incentives and the pace of recovery from closed head trauma. \(^17-21\) The 2016 Consensus Statement on Concussion in Sport reported, “It must be emphasized, however, that NP (neuropsychological) testing should not be the sole basis of management decisions. Rather, it provides an aid to the clinical-management process in conjunction with a range of assessments of different clinical domains and investigative results.” \(^22\)

**Treatment**

**Physical and/or Cognitive Rest**

There is controversy regarding whether physical and/or cognitive rest is beneficial in patients recovering from an mTBI. The conference recommended complete cognitive and physical rest until recovery. Although physical and cognitive rest is often recommended, \(^23-25\) several recent systematic reviews and meta-analyses of controlled randomized studies have concluded it may have no benefit and may even be detrimental. \(^26-30\)

**Education and Cognitive or Psychologic Rehabilitation**

Meta-analysis has shown patient education (eg, an informational booklet and follow-up phone call) to be efficacious in reducing mTBI symptomatology. \(^31-33\) Anticipatory guidance with reassurance and education has been shown to be effective as a preventive measure against the development of prolonged mTBI symptomatology. \(^24\)

Some meta-analyses of controlled studies provides little evidence to support active psychological treatment for patients with mTBIs, although patient education is beneficial if initiated in the early period following injury. \(^34-36\) In contrast, other meta-analyses suggest that there is some positive effect of cognitive behavioral therapy for adults who sus-
tained an mTBI, whereas education, information, or assurance may not be as beneficial as previously thought.37,38

Medication

There is no approved pharmacologic intervention for the treatment of postconcussive symptomatology, and the 2016 Consensus Statement on Concussion in Sport concluded there was limited evidence supporting the use of pharmacotherapy.22 Off-label use of medications approved for the treatment of Alzheimer’s dementia, attention-deficit/hyperactivity disorders, generalized anxiety disorders, depressive disorders, and dysthymia for treating patients with mTBI is based primarily on anecdotal evidence and/or personal opinion. Meta-analyses have shown that there is insufficient evidence to determine whether pharmacological treatment is effective or that there is no effective pharmacologic treatment that speeds recovery from an mTBI.39-41

Treating the symptomatology following an mTBI is analogous to treating the symptomatology following a flu-like illness. Antipyretics to reduce temperature, antihistamines to combat nasal and conjunctival discharge, decongestants and/or nasal spray to relieve a stuffy nose, analgesics to relieve the aches and pains, and sleeping pills to facilitate rest may alleviate some of the flu-related symptomatology but have no effect on the duration of the illness. The side effects of polypharmacy may be worse than the illness itself. Not only does polypharmacy produce frequent and substantial side effects, it also acts as a nocebo.

To date, multiple meta-analytical studies and systematic reviews have failed to identify a significant benefit of bed rest, cognitive rest, cognitive rehabilitation, or medications in the treatment of concussed individuals. As with most illnesses, there appears to be a benefit to patient education.42

Postconcussion Syndrome

Following mTBI, individuals often complain of a mixture of somatic, behavioral, and cognitive difficulties. In the past, such patients have been given the diagnosis of PCS. A syndrome is defined as a group of symptoms that collectively indicate or characterize a disease, psychological disorder, or other abnormal condition. In 1992, the 10th revision of the International Classification of Diseases (ICD-10) proposed diagnostic criteria for a PCS as shown in the Table.43

Neuroimaging findings are often cited as evidence that prolonged symptomatology following mTBI results from brain damage. To date, SPECT, PET, and functional MRI studies have yielded conflicting results, as many of the neuroimaging findings are not specific to head injury and have been identified in individuals with other neurologic conditions.44-56 There is no proven relationship between neuroimaging findings and subjective findings or objective postconcussion findings.58,59 Finally, most studies do not utilize a control population, and there is no consensus opinion or definition of mTBI across studies.60

Psychogenic contribution to PCS is suggested by many empiric clinical observations. The symptom complex of PCS is similar to the somatization found with various psychiatric diagnoses, such as anxiety disorders, depressive and bipolar disorders, somatization disorders, and posttraumatic stress disorders. In addition, anxiety and depression can produce both subjective complaints and objective cognitive deficits that are similar to those identified in PCS and that improve with antidepressant treatment.61,62 Several studies have shown that both psychiatric predispositions (poor coping skills, limited social support, and negative perceptions) and psychiatric comorbidity (depression, anxiety, panic attacks, and posttraumatic stress disorder) are more prevalent in patients with PCS compared with general population controls or head-injured individuals who do not develop a PCS.63-73 The 2016 Consensus Statement on Concussion in Sport reported, “There is a growing body of literature that psychological factors play a significant role in symptom recovery and contribute to the persistence of symptoms in some cases.”22

TABLE. INTERNATIONAL CLASSIFICATION OF DISEASES-10 (ICD-10) DIAGNOSTIC CRITERIA FOR POSTCONCUSSIVE SYNDROME

<table>
<thead>
<tr>
<th>History of head trauma preceding symptom onset by &lt; 4 weeks (objective EEG, brain imaging, or oculonystagmographic evidence for brain damage may be lacking)</th>
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<tr>
<td>And 3 of the following:</td>
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<td>Complaints of unpleasant sensations and pains, such as headache, dizziness (usually lacking the features of true vertigo), general malaise, excessive fatigue, or noise intolerance</td>
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<td>Emotional changes, such as irritability, emotional lability, both easily provoked or exacerbated by emotional excitement or stress, or some degree of depression and/or anxiety</td>
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<tr>
<td>Subjective complaints of difficulty in concentration and in performing mental tasks and of memory complaints, without clear objective evidence (eg, psychological tests) of marked impairment</td>
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<tr>
<td>Insomnia</td>
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<tr>
<td>Reduced tolerance to alcohol</td>
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<tr>
<td>Preoccupation with the above symptoms and fear of permanent brain damage, to the extent of hypochondriacal overvalued ideas and adoption of a sick role</td>
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Other factors that appear to play a role in the pathogenesis of PCS symptomatology include misattribution, litigation, and chronic pain. The very low, even absent, rate of postconcussive symptomatology in certain countries and in children suggests a prominent role for misattribution in the pathogenesis of PCS. Patients without a history of head trauma often expect PCS symptomatology following a concussion and their physicians may mistakenly attribute their complaints to the head injury when they are actually unrelated.24 Pending litigation also contributes to the presence and duration of PCS symptomatology.25 Furthermore, failure of patients to recover after their claims are settled does not invalidate this observation, as a financial settlement may serve to reinforce the illness behavior. Patients with chronic pain have cognitive, behavioral, and somatic symptoms at a rate similar to a brain-injured cohort.76,77 Other possible influences on the pathogenesis of PCS include advanced age, preinjury unemployment, low educational level, substance abuse, misinterpretation of normal variation in neuropsychological test results, secondary gain, and nocebo expectations.78

The popularity of PCS as a diagnostic entity stems from a review by Alexander,79 who reported, “at one year after injury approximately 15% of patients with mTBI still have disabling symptoms.” Of the references cited for this claim,80,81 one study gathered data for only 1 month. In the other, of the 19 symptomatic individuals identified as having disabling symptoms after 1 year, 42% were involved in litigation, and 50% endorsed a symptom at 1 year that was not present at 6 weeks. The incidence of symptoms reported was lower than that reported in normal cohorts.

Persistent Symptoms
According to the 2016 Consensus Statement on Concussion in Sport, persistent symptoms is the preferred term to identify mTBI symptomatology that persists beyond the expected recovery time frame of 10 to 14 days in adults and 4 weeks in children.22 Persistent symptoms reflect the nonspecific posttraumatic symptoms that may be linked to coexisting or confounding factors and do not necessarily reflect ongoing physiologic injury to the brain.

Patients who had mTBI may develop signs and symptoms of anxiety and/or depression due to an anticipated prolonged work absence, job security, having to repeat a grade or semester at school, or loss of income with inability to pay the rent. Such complaints may be unrelated to physiologic brain injury.

Neurocognitive Disorder Due to a Traumatic Brain Injury
Since the 1990s, there have been significant advances in understanding the pathophysiology of mTBIs and thus complaints following. In 2015, the fifth edition of the Diagnostic and Statistical Manual of Mental Disorders (DSM-5), published by the American Psychiatric Association, provided a much-needed update.82 The DSM-5 no longer contains a specific entry for a PCS, but instead uses the term neurocognitive disorder (NCD) due to traumatic brain injury (TBI) to describe patients with cognitive complaints following a TBI. According to the DSM-5, an NCD due to TBI can be further classified as major or mild, depending on whether the cognitive difficulties interfere with activities of daily living. Of note, this diagnosis cannot be made after a concussion, but only after a more severe TBI.

When postconcussive symptoms continue longer than expected, an alternative explanation must be considered. The recovery timetable following a concussion as well as the frequency in which concussive complaints are identified in normal control populations, psychological diagnoses, and nonconcussive injuries (sprains and strains) reinforce the necessity of a search for an alternative explanation.

Conclusion
When an individual sustains a single isolated mTBI, whether at home, in the athletic arena, at the job site, or because of a motor vehicle accident, a physician can confidently advise the patient, spouse, family, attorney, or any other interested party that the somatic, behavioral, and cognitive complaints resolve in approximately 3 months. During the recovery phase, various assessment tools assist the physician in monitoring the patient’s recovery. To date, multiple meta-analytic studies and systematic reviews have failed to identify a statistically significant benefit to bed rest, cognitive rest, cognitive rehabilitation, or medications in the treatment of patients after an mTBI. Only patient education with anticipatory guidance has been shown to hasten recovery and reduces the incidence of prolonged postconcussion complaints.

PCS describes the presence of subjective complaints during a patient’s recovery period. As multiple prospective and controlled studies with baseline evaluations have demonstrated, concussion symptomatology dissipates in approximately 3 months, its use represents a temporary phenomenon. It is analogous to giving a label (eg, post-flu syndrome) to a patient who demonstrates symptoms (cough, sore throat) during her or his approximately 2-week recovery from a flu-like illness. A neurocognitive disorder due to a TBI reflects a permanent condition in which the cognitive deficits following a TBI persist. When encountering a patient who has sustained a single and isolated mTBI, whose complaints have persisted for substantially longer than expected based on the natural history of the diagnosis, an alternative explanation for the symptom complex must be explored.
