

Mild Traumatic Brain Injury Update: Forensic Neuropsychiatric Implications

Hal S. Wortzel, MD, and Robert P. Granacher, Jr, MD, MBA

Traumatic brain injury (TBI) involves a wide range of potential neuropsychiatric outcomes, from death or profound impairment to full and fast recovery. This circumstance has contributed to an atmosphere with considerable potential for both clinical confusion and unjustified medicolegal outcomes. Given that mild (m)TBI accounts for most (~80%) TBI events and is generally associated with an excellent prognosis, the risk for erroneous clinical formulations and unmerited legal outcomes seems particularly high in cases involving mTBI. In this article, we summarize the recent results published by the International Collaboration on Mild Traumatic Brain Injury Prognosis (ICMTBIP) and the new approach of the Diagnostic and Statistical Manual of Mental Disorders, Fifth Edition, to TBI, and we explore the clinical and medicolegal implications. Symptoms that emerge after mTBI remain nonspecific, and potential etiologies are diverse. Clinicians and medicolegal experts should be familiar with the natural history of mTBI, able to recognize atypical outcomes, and willing to search for alternative explanations when confronted with persistent or severe impairment.

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Traumatic brain injury (TBI) can represent a life-altering injury for survivors and their families, profoundly affecting the patient's neuropsychiatric status. Mild (m)TBI, or what we used to call concussion, is a very common injury that is most often inconsequential to the individual's neuropsychiatric status after recovery. Either scenario may be true of any given individual with TBI, with a broad spectrum of intermediate outcomes lying between. This reality perhaps explains why some controversies remain in the medical literature on TBI, especially mTBI, and its prognosis. It also explains in part why the evaluation of cognitive, emotional, and behavioral impairment in persons with history of TBI can be so clinically challenging.

Dr. Wortzel is Director of Neuropsychiatric Consultation Services for the Rocky Mountain Mental Illness Research, Education and Clinical Center (MIRECC), Denver Veterans Medical Center, Denver CO, and the Michael K. Cooper Professor of Neurocognitive Disease, Associate Professor of Psychiatry, Neurology, and Physical Medicine and Rehabilitation, University of Colorado School of Medicine, Denver, CO. Dr. Granacher is Clinical Professor of Psychiatry, University of Kentucky College of Medicine, Lexington, KY. Support for this work was provided in part by the Veterans Health Administration's VISN-19 MIRECC (to H.S.W.). The content is solely the responsibility of the authors and does not necessarily represent the official views of the Department of Veterans Affairs. Address correspondence to: Hal S. Wortzel, MD, Rocky Mountain MIRECC, Denver Veterans Hospital, 1055 Clermont Street, Denver, CO 80220. E-mail: hal.wortzel@ucdenver.edu.

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From the medicolegal perspective, this reality combines with the occurrence of millions of TBI events annually and a litigious environment to yield frequent claims surrounding TBI in both civil and criminal matters. Litigants, attorneys, and medical experts can take advantage of the legitimate but widely disparate potential outcomes of TBI to misrepresent the implications of any given injury event, conflating the very favorable prognosis associated with concussive injuries with the potentially debilitating sequelae of TBI more generally. Given that mTBI accounts for the majority of TBI events (nearly 80%) and is typically associated with full and relatively fast recovery, the risk of erroneous clinical formulations and unmerited legal outcomes seems particularly high for cases involving such injuries. In fact, claims suggesting severe and permanent neuropsychiatric impairment and resultant disability from mTBI are regularly encountered in civil litigation. Claims suggesting that a remote mTBI explains violent criminal acts are sometimes encountered in criminal cases.

Given these circumstances, it is essential that the forensic psychiatrist be well informed regarding the medical science surrounding TBI more generally, and mTBI in particular. Some recent additions to the medical literature are particularly relevant in this regard and are of considerable import for both clinical

and medicolegal practice. The article that follows offers a summary spanning the recent results published by the International Collaboration on Mild Traumatic Brain Injury Prognosis (ICMTBIP; the series of articles is described below) and the new approach to TBI in the Diagnostic and Statistical Manual of Mental Disorders, Fifth Edition (DSM-5)¹ and explores the clinical and medicolegal implications of these important updates of the literature.

Defining TBI

Neuropsychiatric formulations surrounding the prognosis or development of physical, cognitive, emotional, or behavioral symptoms in the postacute recovery phase are informed by the severity of TBI, thus highlighting the importance of clinically determining the severity of an injury event. It is particularly important that mTBI be distinguished from more substantial (moderate-severe) injuries. Among the most widely accepted of definitions of mTBI is that offered by the American Congress of Rehabilitation Medicine (ACRM),² as a mechanically induced physiologic disruption of brain function featuring any of the following: loss of consciousness (LOC); loss of memory for events immediately preceding or following the injury, the phenomenon termed posttraumatic amnesia (PTA); alteration in mental state (feeling dazed, stunned, confused or disoriented) at the time of injury; and focal neurological signs that may or may not be transient. To meet the criteria for mTBI, any associated LOC must be briefer than 30 minutes in duration, PTA must not exceed 24 hours, and the Glasgow Coma Score (GCS) must be 13 or better by 30 minutes after injury. If any of these criteria is exceeded, the injury breaks into the moderate-severe range.

An important addition to ACRM criteria is the concept of complicated mTBI.³ Most injuries involving a phenomenologically defined mTBI will not be accompanied by early (i.e., day of injury) computed tomographic (CT) or magnetic resonance imaging (MRI) findings consistent with acute neurotrauma (i.e., hematoma, hemorrhage, contusion, axonal injury, or edema). An injury meeting ACRM criteria for mTBI and associated with such intracranial abnormalities on conventional structural neuroimaging is termed a complicated mTBI and may be associated with outcomes more akin to moderate TBI, though not invariably so.^{3,4}

International Collaboration on mTBI Prognosis

Uncomplicated mTBI features a very favorable long-term prognosis in most cases.^{5–11} The systematic review conducted by the World Health Organization (WHO) Collaborating Center Task Force on Mild TBI⁶ reported that complete recovery within weeks or months of injury is the norm for both children and adults. That body of work was very recently updated by the ICMTBIP in a comprehensive search and critical review of the mTBI literature spanning 2001 through 2012. Results are offered in a series of publications describing: methodological deficits and research recommendations for prognosis after mTBI¹²; cognitive, psychiatric, and mortality outcomes of mTBI¹³; self-reported prognosis in adults after mTBI¹⁴; clinical course, natural history, and prognosis for pediatric mTBI¹⁵; risk of dementia and chronic cognitive impairment after mTBI¹⁶; risk of Parkinson's disease after mTBI¹⁷; return to work after mTBI¹⁸; prognosis and return to play after sports concussion¹⁹; and prognosis after mTBI in the military.²⁰ The ICMTBIP systematic search and review procedures are described in detail in a separate publication.²¹

Methodological Deficits and Research Recommendations

Despite nearly an additional decade of time and a substantial upswing in public interest and funded research, the body of literature reporting on mTBI and its prognosis has demonstrated very modest progress. In 2014, Kristman *et al.*¹² reported that only 34 percent of eligible studies met criteria for ICMTBIP inclusion, a small increase over the 28 percent accepted by the WHO task force in 2002. "Despite the proliferation of mTBI research over the past decade, virtually no improvement was seen in study quality. These low acceptance rates indicate a literature plagued with poorly designed studies and as a result, many unanswered important clinical and research questions" (Ref. 12, p S266). In addition to problems surrounding risk of bias (i.e., lack of control of confounding factors, information bias, and selection and attrition bias), study design (i.e., lack of true comparison groups and use of small samples), unclear reporting regarding methods and results, inappropriate data analysis techniques, and methodological shortcomings, the literature also continues

to feature a lack of uniformity in the definitions used to describe mTBI.

Clearly, there remain significant problems regarding study and publication quality in the mTBI literature. This circumstance has important implications for clinical care and medicolegal matters. Needless to say, clinicians may erroneously draw conclusions from peer-reviewed literature, wrongly assuming that definitions are accurate and methodologies suitable to the study's objectives. Take for example a recent publication featured in *JAMA Neurology* entitled "Imaging Correlates of Memory and Concussion History in Retired National Football League Athletes." The authors report that "prior concussion that results in loss of consciousness is a risk factor for increased hippocampal atrophy and the development of mild cognitive impairment (MCI)" (Ref. 22, p 773). Readers might assume (or retained experts might claim) that this is a study of mTBI, and that it is applicable to patients who have sustained such an injury. Review of the Methods, however, reveals some problematic nomenclature; concussion, for example, is not used in a fashion consistent with accepted mTBI definitions: "Concussion severity ranged from brief periods of confusion to loss of consciousness for several hours" (Ref. 22, p 774).

In legal matters, one of the four criteria (under *Daubert*²³) used to determine the admissibility of scientific evidence includes the existence of peer-reviewed publications, but critical analysis of the peer-review process has caused some authors to make serious inquiries into its value.²⁴ Such concerns seem applicable to a body of literature that remains plagued by various methodological and reporting shortcomings. This very same body of literature is often co-opted by experts and attorneys in an effort to substantiate grossly atypical outcomes of concussive injuries. It is not uncommon to encounter situations where only certain articles in the TBI literature are referenced by medical experts to insinuate that a remarkably improbable neuropsychiatric presentation is compatible with the natural history of mTBI, with no meaningful reference to large-scale meta-analysis suggesting otherwise. Take the aforementioned example from the medical literature: it is not difficult to imagine how that publication, featured in a highly respected peer-reviewed journal, might be presented in support of claims that an mTBI has led to significant cognitive impairment or substantial risk of developing such. Literature reviews suggesting

more grim prognoses and contained within medicolegal reports and running contrary to the available best medical evidence ought to be greeted with skepticism, with close attention paid to the individual publications cited and the methodological and reporting rigor surrounding those investigations.

The ICMTBIP also identifies a paucity of good data regarding litigation and compensation factors and how these may influence the outcome of mTBI. There is also no additional information available on compensation and litigation factors in mTBI recovery. Given the consistent evidence that litigation and compensation are associated with recovery after mTBI, further examination is needed to understand motivations behind this association and suggest policies that promote recovery (Ref. 12, p S276).

There does appear to be some relationship between litigation/compensation and atypical outcomes, and it seems likely that there are bidirectional components, meaning some atypical outcomes are driven by litigation/compensation, and some compensation/litigation is driven by atypical recoveries. In other words, some people remain symptomatic because they are suing, and some people sue because they are not getting better. Research exploring temporal relationships between injury event and transition to plaintiff status may shed light on such associations. A worthwhile investigation could involve testing the hypothesis that earlier legal engagement after an injury event that would typically be associated with full and fast recovery is associated with an increase in or maintenance of symptoms.

Cognitive, Psychiatric, and Mortality Outcomes of mTBI

The ICMTBIP presents findings based on 21 accepted studies and offers results generally in keeping with prior meta-analyses portending full and relatively fast recovery for most persons who sustain concussive injuries.¹³ In the first 48 hours to two weeks after injury, mTBI is consistently associated with cognitive deficits, although the nature and magnitude of identified neurocognitive deficits has varied across investigations. Recovery often occurs early, during the first month after injury, but results also suggest the potential for residual cognitive deficits, which may be associated with positive loss of consciousness. The ICMTBIP identifies limited evidence that complete recovery may take as long as six months or a year for some. There does not appear to

have been any quality medical evidence to support long-standing severe neurocognitive impairment as a consequence of a single, uncomplicated mTBI. The ICMTBIP does report that “a limited number of exploratory studies suggest that certain cognitive deficits may last longer than 3 months in some populations, although there was no consistency on the exact deficits that were persistent. In some cases, the observed deficits were of questionable clinical importance” (Ref. 13, p S171). The ICMTBIP reports limited evidence that mTBI is a risk factor for affective disorders, psychotic disorders, and suicide, but cautions that such findings should be considered hypothesis-generating at this point. There was limited evidence that certain oculomotor and upper limb visuomotor functions may be affected negatively for up to one year after injury.

Three investigations offer evidence in support of the notion that expectations may influence outcomes from mTBI. “There were consistent findings that having negative expectations about head injuries is associated with poorer cognitive test performance” (Ref. 13, p S166). Such results lend support to the idea that iatrogenic injuries may result when patients or plaintiffs are directed toward evaluators with poorly informed opinions regarding mTBI and are offered discouraging prognostic predictions. Early transition from patient to patient–plaintiff status may foster such circumstances, blurring lines between clinical care and legal agendas, with needlessly grim predictions potentially morphing into self-fulfilling prophecies. Also notable are findings suggesting that health care visits occurring in the wake of mTBI may result in the identification of other, previously unknown health conditions. Of course, the discovery of such health conditions subsequent to mTBI does not establish a causal relationship with TBI, indicating the need for careful consideration before temporal relationships are accepted as evidence of injury. Overly reductionistic formulations risk missing other relevant conditions, yielding lost treatment opportunities and potentially perpetuating functional impairment.

Self-Reported Prognosis After mTBI

Although the best scientific evidence indicates a full and fast recovery for most persons who sustain uncomplicated mTBI, it is also well established that there remains a subset of individuals who experience persistent symptoms. Such atypical recovery

probably occurs in roughly 10 percent of cases, and such outcomes are significantly influenced by factors unrelated to injury.^{25,26} Recent findings by the ICMTBIP, described by Cassidy *et al.*,¹⁴ extend the body of evidence indicating that symptoms experienced subsequent to mTBI are nonspecific and very often relate to factors other than brain injury. Investigations comparing individuals with mTBI to persons with orthopedic injury “indicate that postconcussive symptoms, pain, and mental health are similar across acute injuries and not unique or specific to mTBI” (Ref. 14, p S134). Also noted are findings suggesting that patients with mTBI may misperceive their preinjury status, having a bias toward recalling it in an overly positive manner and a tendency to misattribute symptoms to injury. “The weight of this evidence suggests that postconcussion symptoms are nonspecific to mTBI, and clinicians should be cautious about attributing common postinjury symptoms to mTBI. This calls into question the validity of diagnosing postconcussion syndrome” (Ref. 14, pp S134–5). Results suggesting that expectations influence outcomes after mTBI are again identified.

Cassidy *et al.* report that:

... most of the postconcussion symptoms could be viewed as common reactions to the stress of injury, or other mental or physical health stressors These symptoms are common in the general population, in patients with chronic pain, and after whiplash injury to the neck Thus, we recommend that the term postconcussion syndrome be replaced with posttraumatic symptoms because they are common to all injuries” (Ref. 14, p S149).

Persistent symptoms are associated with a variety of psychosocial factors, including things such as depression, posttraumatic stress, negative injury perceptions, poor expectations for recovery, mental health status, anxiety, or litigation involvement. “In fact, the psychosocial factors are more strongly associated with outcomes than the traditional biomedical factors thought to determine recovery” (Ref. 14, p S149).

The best evidence indicates that although atypical recovery is a reality and that some individuals will go on to experience persistent symptoms subsequent to mTBI, such complaints may not be related at all to neuronal injury *per se*, but instead may result from a variety of non–brain-injury neuropsychiatric and psychosocial factors. Hence, atypical recoveries mandate a search for alternative explanations for persisting symptoms in terms of both competent clinical

practice and objective medicolegal analysis. Arguably, the more dramatically atypical an mTBI outcome is, the more likely that alternative explanations exist and account for a substantial burden of impairment. Although the best clinical evidence may allow for some persistent symptoms directly stemming from neuronal injury in rare instances, there is a remarkable paucity of medical evidence to support the contention that neuropsychiatric impairment yielding severe functional disability (i.e., permanent inability to work and inability to live independently) results from a single, uncomplicated mTBI. The question of return to work after mTBI is specifically addressed in an ICMTBIP report by Cancelliere *et al.*¹⁸ They noted a very modest number of methodologically sound investigations, but they concluded that the best medical evidence indicates that mTBI does not appear to be a significant risk factor for long-term work disability.

For the most part, the previously described data regarding outcomes from mTBI are extended to pediatric cases in the ICMTBIP report by Hung *et al.*¹⁵ However, the pediatric mTBI literature has a relative paucity of acceptable studies investigating prognosis. That said, the best medical evidence suggests that pediatric uncomplicated mTBI is typically associated with full and relatively fast recovery and that, as in adults, common postconcussive symptoms are non-specific to mTBI.

Risk of Dementia, Chronic Cognitive Impairment, and Parkinson's Disease After mTBI

Concern surrounding the long-term implications of concussive injuries has become widespread, in part because of the dramatic media attention paid to sports-related injuries. Much of this surrounds the controversial topic of chronic traumatic encephalopathy (CTE). Godbolt *et al.*¹⁶ specifically note that there are no established clinical criteria for CTE and that the relationship between brain injury and dementia remains uncertain, especially in cases involving mTBI. Nevertheless, clinical encounters in the present authors' TBI clinics often feature inquiries and anxiety surrounding the long-term risk of dementia. Medicolegal cases involving mTBI sometimes feature claims of increased risk for dementing illness, damages predicated upon such outcomes, and allusions using the CTE literature in efforts to substantiate otherwise grossly atypical outcomes.

Godbolt *et al.* identified no evidence in support of increased risk of dementia following single or repetitive mTBI. They noted very limited methodologically sound investigations addressing this important topic. "Taken together, there is insufficient evidence to draw any conclusions about a potential risk of dementia after mTBI (either single or repetitive injury). Clinicians and policy makers should be cautious about attempting to address this issue until more evidence is available" (Ref. 16, p S253). They identify objective evidence for chronic cognitive impairment at 12 months after injury only in pediatric cases of complicated mTBI. Once again, the potential for negative expectations to yield worse outcomes is noted. The ICMTBIP report by Marras *et al.*¹⁷ extends findings to Parkinson's disease, where once again the best available medical evidence argues against an important causal relationship with mTBI. In light of this body of work and the need to offer testimony within a reasonable degree of medical certainty or probability, expert opinions portending increased risk of neurodegenerative illness after concussive injury are not in keeping with the state of the science and the best available medical literature.

The DSM-5 and TBI

The DSM-5¹ approach to TBI is described in detail in a prior publication by Wortzel and Arciniegas.²⁷ However, aspects of the new manual's treatment of TBI are highly germane to the present discussion and warrant some elaboration. Prior editions of the DSM failed to feature either well-accepted diagnostic criteria or clinically useful material pertaining to TBI, and all prior DSM versions were seldom used in either clinical or medicolegal matters involving such injuries. The DSM-5 has brought that circumstance to an abrupt end by incorporating both definitions and clinical information pertaining to the development and course of TBI that is in keeping with the TBI literature more generally. These changes may help mental health professionals to become more adept at identifying TBI, to distinguish between mild and moderate-severe injuries, and to recognize cognitive, emotional, and behavioral conditions resulting (or not) from these injuries. With increased clinical familiarity and confidence, the role played by mental health professionals in TBI litigation may also increase.

The major themes and clinical implications elaborated by the ICMTBIP are also found in the

DSM-5. Outcome expectations are explicitly addressed. The manual informs readers that initial TBI severity does not necessarily correspond to the severity of subsequent neuropsychiatric deficits. At the same time, an important caveat surrounding outcome from mTBI is offered, indicating that complete and relatively rapid recovery is the norm. Outcomes subsequent to moderate or severe injuries are more variable. The DSM-5 thus enables providers to distinguish between typical and atypical recoveries from mTBI, and encourages a search for alternative explanations when postconcussive symptoms and related functional impairment extend beyond the anticipated course of recovery or exceed reasonable expectations in terms of severity. Other relevant considerations are offered, including the individual's preinjury neuropsychiatric status and comorbid conditions and the postinjury psychosocial environment. Any combination of such factors has the potential to influence the development and resolution of common postconcussive symptoms. Furthermore, the identification of such factors presents the opportunity to deploy evidence-based interventions for treatable neuropsychiatric conditions or amenable psychosocial factors, thereby restoring function and enhancing quality of life. Providers are cautioned to be mindful of possible somatic or factitious symptoms when the severity of neuropsychiatric symptoms appears to be incompatible with the initial injury severity and when other neuropsychiatric conditions (e.g., depression, posttraumatic stress disorder, or substance abuse or dependence) are excluded. Finally, the new manual usefully describes the natural history of TBI, emphasizing that late-emerging neuropsychiatric symptoms have a more tenuous relationship and ought to prompt exploration for more tenable explanations.

Neurobehavioral symptoms tend to be most severe in the immediate aftermath of the TBI. Except in cases of severe TBI, the typical course is that of complete or substantial improvement in associated neurocognitive, neurological, and psychiatric symptoms and signs. Neurocognitive symptoms associated with mTBI tend to resolve within days to weeks after the injury with complete resolution typical by 3 months. Other symptoms that may potentially co-occur with the neurological symptoms (e.g., depression, irritability, fatigue, headache, photosensitivity, sleep disturbance) also tend to resolve in the weeks following mTBI. Substantial subsequent deterioration in these areas should trigger consideration of additional diagnoses [Ref. 1, p 626].

The thoughtful approach to TBI featured in the DSM-5 clearly seeks to enable the identification of TBI-related neuropsychiatric impairment while simultaneously discouraging overly reductionistic or catastrophized formulations in the wake of concussive injuries.

Conclusions

Much remains to be learned about mTBI, but the best available medical evidence supports that full and fast recovery is expected for most individuals who experience such injuries. There is no compelling scientific evidence to suggest that a single, uncomplicated mTBI constitutes a devastating neurological injury. A fairly predictable clinical course follows mTBI, wherein impairment is most pronounced immediately after injury, with subsequent improvement and eventual resolution. Presentations that deviate from this anticipated course of recovery should prompt the search for alternative explanations, in both clinical and medicolegal settings. Although atypical outcomes are a real phenomenon, such occurrences may have little to do with neuronal injury and are frequently predicated upon non-brain-injury neuropsychiatric conditions and psychosocial factors. It appears that expectations can influence outcomes subsequent to mTBI, suggesting that idiosyncratic beliefs portending poor outcomes can result in iatrogenic injuries. The risk of such misguided expectations seems particularly high in medicolegal contexts, wherein lines separating clinical and forensic agendas are frequently blurred.

Although mTBI is seldom associated with severe or persistent neuropsychiatric impairment, injuries of greater severity are frequently associated with substantial long-term impairment and disability. It is important that limited resources remain available for legitimately injured persons and that they not be wrongly diverted. Claims involving falsified or exaggerated outcomes positing severe impairment and disability as a consequence of mTBI potentially make recovery of deserved compensation and benefits more difficult for those in legitimate need. Ethical medicolegal practice mandates that we preserve the integrity of (and science in) TBI litigation by defending against inflated or manufactured claims stemming from objectively mild injuries and facilitate recovery for those who have sustained a truly life-altering injury.

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