Defense and Veterans Brain Injury Center Working Group on the Acute Management of Mild Traumatic Brain Injury in Military Operational Settings

Clinical Practice Guideline and Recommendations
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Working Groups:

[1]Case Definition and Natural History of mTBI
[2]Assessment of mTBI
[3]Treatment of mTBI
[4]Operational Concerns
[5]Subgroup Leaders

Introduction

During the course of the current conflicts in Afghanistan and Iraq, traumatic brain injury (TBI) has emerged as a significant cause of morbidity. Although penetrating TBI is typically identified and cared for immediately, mild TBI (mTBI) may be missed, particularly in the presence of other more obvious injuries. Due to numerous deployments and the nature of enemy tactics, troops are at risk for sustaining more than one mild brain injury or concussion in a short timeframe. The sports literature, which is highly relevant to the combat blast injury model, has published consensus documents on the assessment and management of sports related concussion (McCrory, 2005). However, due to tactical, logistical and resource considerations, it is challenging to directly apply these findings in a combat setting.

In an effort to gather best practice evidence with regards to assessment and management of mild traumatic brain injury in military settings, the Defense and Veterans Brain Injury Center (DVBIC) assembled 32 key military and civilian experts. The two day meeting was convened on 9 and 10 November 2006 in Washington DC. The purpose of this meeting was to create a literature-based clinical practice guideline (CPG). We acknowledge that more work is needed to fully support all the recommendations but recognize an acute need for guidance during this time of combat operations. To meet this need, a six week timeframe from the initiation of the meeting to the release of the CPG was created.

There are four main areas of focus within the CPG: (1) an operational definition of mTBI, (2) assessment of mTBI, (3) management of mTBI and (4) operational considerations which directly impact the feasibility of evaluating and treating mTBI within the context of the current theatres of operation.

Operational Tenets

Assessment and management of mTBI in operational settings provides a unique set of tactical challenges that must be considered when balancing patient care and mission goals. Mission completion may supersede individual service member welfare in certain operational environments. However, if a service member must be removed, the decision to evacuate that individual is best determined by the medical team caring for the service member in context with the operational risk and cost as determined by the command. There also exists a potential psychological cost when a service member is prematurely removed from duty. Conversely, returning a neurocognitively impaired individual to full duty may jeopardize operational success. Due to the limited availability of neuroimaging and neurosurgical treatment, the small risk of deterioration in patients who present with mTBI must also be considered.

Screening for mTBI

Anyone exposed to or involved in a blast, fall, vehicle crash, or direct impact who becomes dazed, confused or loses consciousness, even momentarily, should be further evaluated for a brain injury.

Operational Definition of mTBI

Mild TBI in military operational settings is defined as an injury to the brain resulting from an external force and/or acceleration/deceleration mechanism from an event such as a blast, fall, direct impact, or motor vehicle accident which causes an alteration in mental status typically resulting in the temporally related onset of symptoms such as: headache, nausea, vomiting, dizziness/balance problems, fatigue, insomnia/sleep disturbances, drowsiness, sensitivity to light/ noise, blurred vision, difficulty remembering, and/or difficulty concentrating.

This operational definition of mTBI is the result of deliberation by top experts in the field of operational medicine and traumatic brain injury. Drawing from widely-accepted definitions such as the American College of Rehabilitation Medicine (ACRM) (Kay et al, 1993), Centers for Disease Control (CDC) and Prevention (2003), World Health Organization (WHO) (Von Holst et al, 2004), National Athletic Trainers' Association position statement on management of sport-related concussion (2004) and the Prague sports concussion guidelines (McCrory et al, 2005), this definition incorporates common criterion. These established definitions endorse biomechanical forces as the cause of concussion that results in an alteration of consciousness to include: loss of consciousness (LOC), post-traumatic or retrograde amnesia (PTA or RGA) or being dazed/confused. An important aspect of this definition is that LOC is not a required characteristic of concussion, that is, a service member does not have to have a loss of consciousness to have sustained a concussion. The group acknowledged the continued usefulness of these parameters and adopted them with a few changes. Variations from the established definitions include adding combat-related mechanisms such as blast as well as a comprehensive list of TBI related symptoms.

After a concussive injury, a patient usually experiences symptoms. Common symptoms as listed above in the operational definition should be assessed and documented in medical records as they can impede occupational functioning and combat effectiveness. In addition to cognitive symptoms, a patient may experience emotional or personality changes as a result of the traumatic brain injury (Ryan & Warden, 2003). Irritability, anxiety and depression are the most common issues and usually resolve over time but should be documented because they may have operational implications. By self-report or by observations by others, a person may "not act like themselves." Clinicians and command should be aware that this may be a trigger statement to prompt an evaluation for concussion. Many times a patient will experience a combination of physical, cognitive and behavioral symptoms. Although an area of continued discussion, the majority of TBI experts agreed that symptoms associated with mTBI occur frequently but the presence of these symptoms is not mandatory in order to establish the diagnosis of mTBI.

Wide consensus among experts supports the inclusion of an alteration of consciousness in the definition of mTBI, including reports of feeling "dazed and confused" after a traumatic event. Because the primary mechanism of mTBI in the current operational settings is explosion/blast, multiple mechanisms such as the over pressurized blast wave, or heat or toxic injury, some of the experts were concerned that this definition may be too conservative. There are instances, both in the sports literature and military arena, of individuals who were involved in a traumatic event without any

alteration of consciousness, yet these patients have subsequently developed symptoms of concussion. We would suggest that those individuals involved in significant blast events and report subsequent symptoms be evaluated further. However, without supportive scientific evidence, we would not classify these patients as having sustained an mTBI. More inquiry is needed to explore this group before an objective conclusion can be formulated (Guskiewicz et al, 2004).

Physical and Neurocognitive Sequelae

The literature and clinical practice indicate that there often will be deficits for some period of time with respect to balance/motor functioning including postural instability or cognitive domains such as: attention/concentration, memory, cognitive processing speed, simple/complex reaction time, and/or executive function (Bleiberg et al, 2004; Warden et al , 2001). In one study by McCrea et al (2002), at least 84% of concussed athletes demonstrated neurocognitive deficits immediately after injury to include difficulties with orientation, immediate memory, concentration or delayed recall, as evidenced by their Standardized Assessment of Concussion (SAC) scores. The natural history of symptoms, balance problems and cognitive dysfunction following mTBI has been plotted in large-scale prospective studies of athletes demonstrating recovery in the majority of mTBI cases within one week (McCrea et al, 2003).

In military operational settings, the effect of concussion on function and judgment may cause risk to self and others. Alterations in attention/concentration, maneuverability/ flexibility/judgment, and impulse control, for example may adversely affect driving, handling firearms, establishing situational awareness, following rules of engagement or controlling aggression, and may result in adverse outcomes such as friendly fire incidents. These factors should be considered by medical personnel while making return to duty decisions.

Because of multiple deployments to theatres of combat, the risk for troops to sustain more than one mild brain injury or concussion is elevated. No literature is available to describe risks or sequelae of cumulative concussion sustained during combat operations; therefore, much of what is known about cumulative concussion has come from the sports literature. Parallels can be inferred between the sport and combat environments such as prolonged recovery time, costs of lifetime care, and decrease in troop strength/force readiness. Athletes with a history of concussion are more likely to suffer future concussive injuries than those without a history (Guskiewicz et al, 2003). A history of previous TBI is found to be associated with a poorer performance on neuropsychological tests as well (Collins et al, 1999). No difference exists, however, between the assessment and treatment of a service member with cumulative concussion and someone experiencing an initial concussion at this time. History of previous concussion alone should not prompt an evacuation to a higher echelon of care. Instead, evacuation decisions should be made based on assessment data for the particular service member.

Posttraumatic Stress Disorder (PTSD) and TBI overlay

There is an overlap of symptoms between TBI and Acute Stress Reaction (ASR) or Posttraumatic Stress Disorder (PTSD). This issue is most pertinent in the mTBI population as there are higher rates of ASR and PTSD seen in patients with mTBI than

with more severe injuries (Glaesser et al, 2004). Sustaining any kind of physical injury in theater is known to increase a service member's risk for PTSD (Hoge, 2004). There are several symptoms which are found in both PTSD and mTBI, such as deficits in attention and memory, irritability and sleep disturbance. However in the acute assessment of mTBI, some of the distinguishing symptoms such as headache, dizziness, balance problems and nausea/vomiting may help to differentiate TBI from ASR/PTSD. Another distinguishing factor is the history that is obtained from the service member about the course of events before, during and after the traumatic event. Post traumatic amnesia is less common in ASR/PTSD and is diagnostic of mTBI. Fortunately, the acute treatment for both mTBI and ASR are similar.

Neurocognitive Assessment

Neurocognitive assessment in the mild TBI patient is an important part of a comprehensive approach to care. After providing evidence outlined above as to the neurocognitive sequelae after mild TBI, utilizing neurocognitive assessment procedures can be helpful in determining cognitive deficits as well as recovery from transient cognitive deficits often associated with mTBI. The Military Acute Concussion Evaluation (MACE) tool developed by the Defense and Veterans Brain Injury Center has a history and evaluation component. The history component can confirm the diagnosis of mTBI and provide further assessment data by utilizing the Standardized Assessment of Concussion (SAC) (McCrea, 2000) to preliminarily document neurocognitive deficits. This tool can be easily used by medics and corpsmen to confirm a suspected diagnosis of concussion and can be administered within 5 minutes. The four cognitive domains tested are: orientation, immediate memory, concentration and delayed recall (Appendix A). The MACE is the recommended tool for use in theatre at Level I and II and III.

Beyond the use of the MACE, other neurocognitive measures should be used at Level III to comprehensively assess the cognitive state of the injured service member. Consensus was reached on areas to assess and the following neurocognitive domains should be assessed and documented in troops sustaining mTBI in theatre:

- Attention/concentration
- Memory
- Processing Speed
- Reaction Time
- Executive Function

There are many factors related to the applicability, utility and practicality of neurocognitive assessment procedures in the current operational environment. Some of these include:

- Reliability, Validity, Sensitivity, Specificity and Clinical Utility of test procedures
- Availability and applicability of a normative database and reliable change indexes
- Internet access and portability
- Time to administer metrics
- Ease of administration and training required
- Ease and speed of interpretation
- Ease and speed of data comparison across test administration

- Alternative forms for multiple administrations
- Flexibility of adding test modules or questions
- Ease of data transfer
- Cost per test and for maintenance and training
- Direct clinical application of results to return to duty recommendations

Among others, there were four computerized neurocognitive assessment procedures discussed:

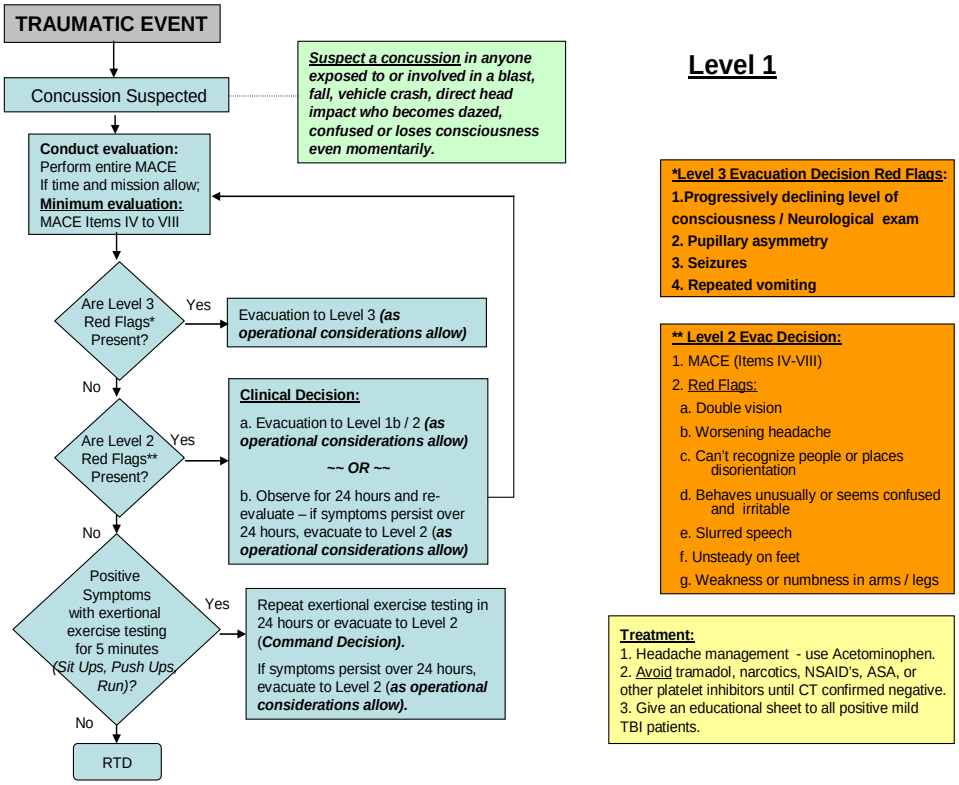
- Automated Neuropsychological Assessment Metrics (ANAM)
- Cognitive Stability Index (CSI) or Concussion Resolution Index (CRI) (Headminder)
- CogSport
- Immediate Post-concussion Assessment and Cognitive Testing (ImPACT)

None of the above computerized test batteries are in widespread use in theatre at this time. The ANAM has been used as part of clinical care and Headminder is currently being used in the context of a prospective clinical study within several combat sectors. Taking into consideration operational practicality, the group recommended a test time of under 20 minutes. In addition, in the absence of baseline neurocognitive testing, it is difficult to determine the degree of cognitive impairment, because interpretation of the scores must be based on a normative databank developed by each of the test publishers. This inherently lowers sensitivity and specificity in injury detection. The group reached broad consensus on recommending that baseline testing be considered in all service members in an effort to enhance the clinical interpretation and overall utility of post – injury neuropsychological testing. Prior to making a formal recommendation for use in the assessment of acute mTBI occurring in theatre, more evaluative work needs to be done by analyzing each tool regarding the variables listed above.

Assessment and Treatment of Acute Mild TBI

The following three algorithms, offered as clinical practice guidelines, should not be interpreted as a substitute for sound clinical judgment. Operational and tactical considerations may in some instances override the CPG.

Level I Algorithm (See Appendix B for a larger version)



Level 1

***Level 3 Evacuation Decision Red Flags:**
1.Progressively declining level of consciousness / Neurological exam
2. Pupillary asymmetry
3. Seizures
4. Repeated vomiting

**** Level 2 Evac Decision:**
1. MACE (Items IV-VIII)
2. Red Flags:
   a. Double vision
   b. Worsening headache
   c. Can't recognize people or places disorientation
   d. Behaves unusually or seems confused and irritable
   e. Slurred speech
   f. Unsteady on feet
   g. Weakness or numbness in arms / legs

Treatment:
1. Headache management - use Acetominophen.
2. Avoid tramadol, narcotics, NSAID's, ASA, or other platelet inhibitors until CT confirmed negative.
3. Give an educational sheet to all positive mild TBI patients.

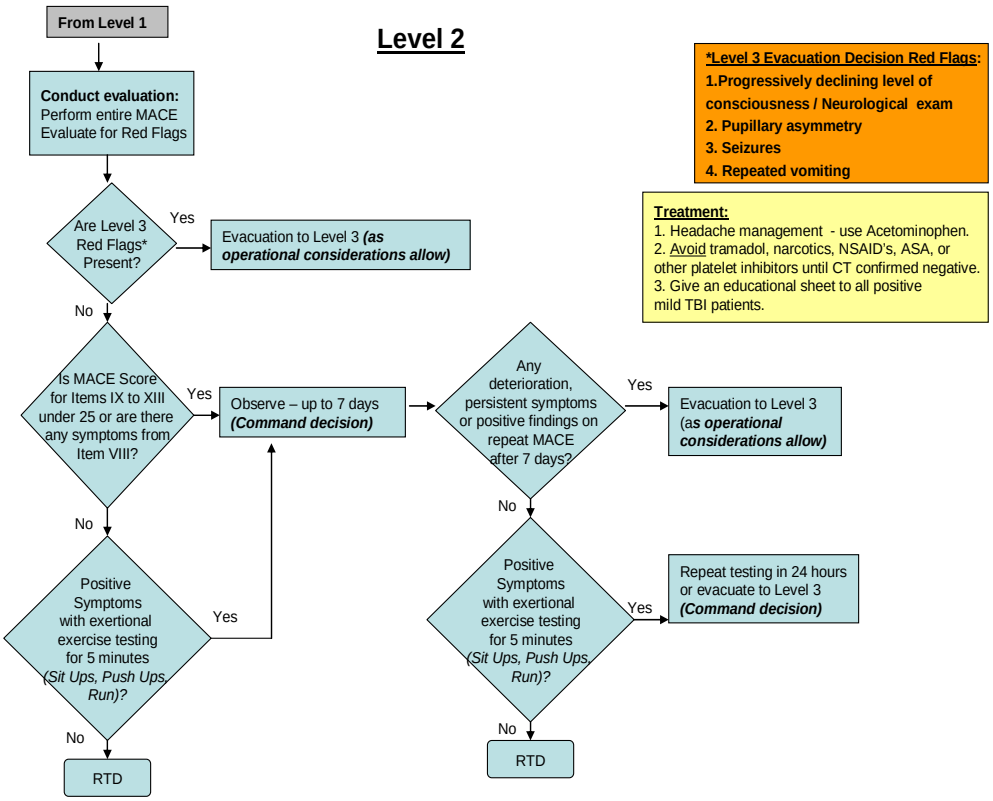
Priorities:

- Evacuate if Red Flags are present.
- Evacuate for a full medical evaluation or neuroimaging.

Capabilities:

- History taking and assessment of symptoms (MACE # IV-VIII) and TBI screening.
- Exertional testing may be required prior to return to duty.

Level II Algorithm (See Appendix C for a larger algorithm)



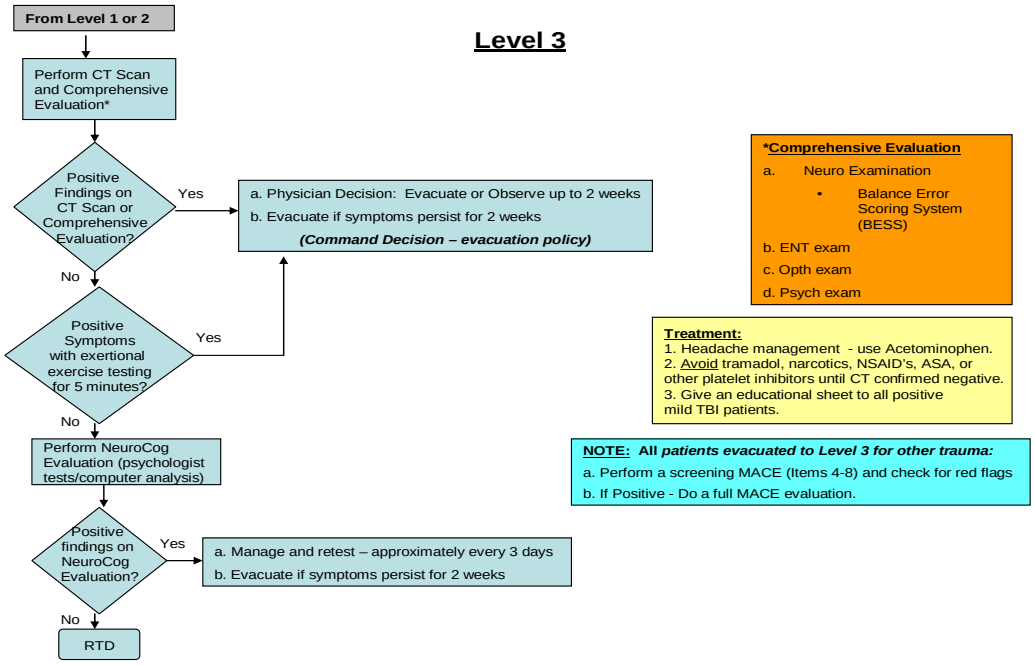
Priorities:
Evacuate to Level III for

- Progressively declining loss of consciousness/neuro exam
- Pupillary asymmetry
- Seizures
- Repeated vomiting

Capabilities:

- Observe/holding capacity up to 7 days
- Trained on MACE tool

Level III Algorithm (See Appendix D for larger version)



Priorities:
Evacuate if symptoms persist for two weeks

Capabilities:

- Neuroimaging
- Full medical evaluation, to include a neurological, ear/nose/throat , ophthalmological, psychological exam
    - As part of the neurological exam, the Balance Error Scoring System (BESS) should be considered for evaluation of postural instability (Guskiewicz et al, 2001; Guskiewicz, 2001)
- More comprehensive neurocognitive tool
- Holding capacity for observation

Treatment of mTBI occurring in theatre

Treatment can be organized into four different areas: symptom management, rest/return to duty guidance, educational initiatives and supportive therapies. There are no clear randomized-controlled trials supporting therapy for mTBI, furthermore specific treatments have not been evidence-supported (Comper et al, 2005). However the following are recommendations based on clinical experience in the management of mTBI in theatre:

- In the acute environment, for headache management, use acetaminophen.
- Avoid the use of tramadol, narcotics, NSAIDS , ASA, or other platelet inhibitors until neuroimaging can confirm the absence of intracranial pathology.

Providing an educational intervention has demonstrated a reduction of symptoms in the civilian population with mTBI (Von Holst et al, 2004; Ponsford et al, 2002). An education sheet with instructions specific to combat environments should be distributed to all mTBI patients. The same model used for battle fatigue treatment highlighting that recovery is expected should be offered in this education process. Educational sheets should be distributed with one copy to the patient and one copy to the commander/squad leader. The command sheet should outline specific duty recommendations and restrictions to assist in duty assignments. An mTBI patient should not return to full duty until they are asymptomatic. Patients who are asymptomatic should be exertionally tested before returning to duty, as outlined in the algorithms. Exertional testing may include sit ups, push ups or running in place for 5 minutes. If TBI symptoms return after exertion, then continued observation and retesting in 24-48 hours is indicated.

Recommendations

- Incorporate Level 1,2,3 algorithms in theatre
- Create mechanism to collect operational data on the use and efficacy of the CPG in theatre and report on recommended changes
    - Standardize documentation of concussion occurring in theatre to enhance individual patient care as well as to provide operational reporting as to the frequency of concussion and treatment patterns.
- Initiate a focused educational package to include:
    - Written background and explanation of the MACE tool, how it is used, how to interpret the scores and how the tool fits with clinician judgment.
    - A video with taped lectures outlining this CPG to include the MACE components, aimed at medical units training for impending deployment.
    - A shorter video, one hour or less, that is developed for the non-medically trained service member to be delivered during a medical threat briefing or similar venue.
    - Discussion of Acute Stress Reaction and TBI overlay as well as dissimilarities of symptoms
    - All pre deployed personnel, including non-medical assets, be briefed on TBI, with a focus on the importance of identification.

- Institute baseline neurocognitive testing
    - High Risk Units (EOD, SOF, ABN)

    - Military-wide
- Incorporate different versions of the Standardized Assessment of Concussion (SAC) into the MACE to minimize practice effects on retesting
- Add a Red Flag section to the MACE tool
- Convene subgroup to address comprehensive neuropsychological testing to occur in theatre at Level III
- Further guidance on exertional testing and the use of the Balance Error Scoring System (BESS) is needed.

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