Canadian Forces Health Services Advisory Panel on Management of Mild Traumatic Brain Injury in Military Operational Settings

Clinical Practice Guidelines and Recommendations

28 May 2008
EXECUTIVE SUMMARY

Mild traumatic brain injury (mTBI) in the military has gained increasing public attention and is often referred to as the “signature injury” of the Global War on Terror [1]. There is very little sound epidemiologic data about mTBI in the military operational setting, particularly as a result of exposure to blasts. Reports that we are about to see a wave of long-term disability are speculative [2] and are not substantiated by sound evidence [3]. The civilian literature on the natural history of mTBI, particularly in the sports population, shows spontaneous resolution of symptoms in the vast majority of individuals [4].

However, given the lack of epidemiologic data from well-conducted prospective studies and the theoretic potential for blast to produce mTBI with a distinct natural history, a precautionary approach is advisable.

Based on this, the panel recommends that a surveillance system be implemented to monitor the incidence, causes and natural history of mTBI in Canadian Forces members both during deployment and in the post-deployment phase.

Clinical practice guidelines have been formulated to identify and manage possible cases of mTBI both during deployment and in the post-deployment phase. The goals of clinical management differ by phase of deployment. During deployment, evaluating fitness for duty in those who may have sustained an injury is of primary importance to prevent further injury to the individual and others. In later phases, the focus is on managing those with persistent symptoms that may be attributable to mTBI.

It must be emphasized that clinical practice guidelines are provided in an endeavour to create a systematic approach. They are not meant to replace or supersede sound clinical judgment. Throughout, the panel has strived to employ an approach that is balanced, feasible and logical and based on a critical appraisal of the best available evidence.

BACKGROUND

Mild traumatic brain injury (mTBI) in soldiers returning from deployment to combat operations has received considerable attention in the United States of America to the extent that the popular press has labelled this the “signature injury” of Operation Iraqi Freedom and Operation Enduring Freedom [2]. Reports in the popular press provide information that is often confusing and frightening, making it difficult to distinguish fact from fiction. The best clinical practice must be based on sound scientific evidence and, where the evidence is lacking, guided by a precautionary approach. Towards this end, the Deputy Surgeon General of the Canadian Forces Health Services tasked an advisory panel consisting of Canadian Forces to convene to develop a systematic approach to the management of mTBI in the operational context.
MANDATE

The goal of the panel was to undertake a careful review and critical appraisal of the available evidence on mTBI in a military operational setting in order to recommend a strategy for the surveillance and management of this in Canadian Forces personnel in military operational settings that is balanced, feasible and logical given the available evidence.

COMPOSITION OF PANEL

The panel consisted of persons with expertise in emergency medicine, trauma medicine, psychiatry, internal medicine, neuropsychology, rehabilitation medicine, epidemiology and basic science. Most of the panel consisted of Canadian Forces medical personnel with operational experience. Outside experts in the fields of neuropsychology as well as international guest speakers from the United States Army and the United Kingdom Ministry of Defence also participated. Panel participants are identified in Appendix 1.

PROCEEDINGS

The panel convened for a three-day period from April 30, 2008 to May 02, 2008 at Canadian Forces Base Halifax, in Halifax Nova Scotia.

On the first day of the meeting the panel reviewed and discussed presentations that summarized evidence on the basic science of mTBI with a particular focus on mechanism of injury from blasts, the epidemiology of mTBI in the civilian literature and the military operational setting, as well as the neuropsychological testing and neuroimaging of mTBI. The panel also heard a presentation from Col Charles Engel, Director of the US Department of Defense’s Deployment Health Clinical Center at Walter Reed Army Medical Centre, who summarized his research and perspective on this issue. Finally, Surgeon Commander Neil Greenberg of the Royal Navy (UK) described the research that he considered to inform future policy approaches and also laid out the research that the UK hopes to conduct in the future on this topic. It is important to qualify that opinions expressed by both of these individuals were their own personal ones and did not represent the official positions of their parent institutions. Representation from Veterans Affairs Canada (VAC) was also included to ensure that whatever recommendations were made would be consistent with the needs of those Canadian Forces members who transition to the VAC care and benefit systems.

The remaining two days was spent developing consensus on a clinical strategy for management of mTBI both in theatre and in the post-deployment phase. Where there was disagreement on proposed recommendations, a vote was taken and the majority opinion was adopted. The international guests did not participate in this phase.
POSITION STATEMENTS

- Traumatic Brain Injury encompasses a range of severity from mild to severe. The milder forms are commonly known as a “concussion”.

- mTBI has been present in both the civilian [5] and military populations [6] for a long time.

- While there exists a vast literature on traumatic brain injuries of the severe variety, studies of mTBI are fewer in number. Critical appraisal of these studies show that a great many of these are methodologically weak [7].

- The best scientific studies in the sports literature (primarily dealing with impact injuries) suggests that in the majority of cases of mTBI, symptoms and measurable neurological deficits resolve within a week [8;9], and most other studies show resolution within a few weeks to months [4].

- A minority of cases of civilian mTBI have persistent symptoms [4]. The more common of these symptoms often occur together and have been given varying terms such as post-concussion syndrome or post-concussion disorder [10]. There is little uniformity in the identification of predictors of delayed recovery after mTBI [4]. This is because there are little consistency in the predictors studied and absence of confirmatory studies. Moreover the symptoms that may occur following concussion (e.g., headache, dizziness, fatigue, irritability, insomnia, memory or concentration difficulties) can overlap with symptoms of other conditions, further complicating the ability to attribute symptoms to a specific cause. This has been demonstrated in one recent prospective study in a civilian trauma population that showed that the prevalence of such symptoms was equivalent in trauma patients with and without head injury [11].

- A critical appraisal of the literature shows that the majority of interventional studies employed weak methodologies [12;13]. There is some evidence that early educational interventions that include reassuring information about the high probability of a good recovery and advice and encouragement on gradual return to regular activities helps improve symptoms in patients with mTBI.

- Discussion surrounding mTBI in the military setting has focussed on mTBI as a consequence of exposure to blasts [6;14]. While it is known that blasts can produce TBI of all severity, there has been increasing speculation that TBI in general and mTBI in particular may result from exposure to the primary blast wave without any other associated injury. To date, the supporting evidence for this largely comes from animal studies and small case series [15-19].

- There are currently few well-described, methodologically sound, peer-reviewed studies on the epidemiology of mTBI in the military operational environment [3;20-23]. There are no such epidemiologic studies that show a clear cause and effect relationship between exposure to blasts and development of mTBI. The
limited available studies are retrospective and cross sectional in nature with no control for confounding. In addition, reporting of exposure to blasts or other forms of head trauma is prone to recall bias.

• There are a variety of quotes as to the prevalence/incidence of mTBI in the military operational setting ranging from 15% [3] to 28% [22]. Few of these are population based and those that are have methodologic weaknesses [21]. The widely quoted belief that there will be a sharp rise in the number of military personnel with mTBI is not based on solid evidence [2]. A recent report from the U.S. Defense Medical Surveillance System shows that while there has been a 10 fold increase in hospitalizations for TBI of all severity levels secondary to battle injuries since September 2001, the total number of cases of all TBI medical encounters, both in an ambulatory setting (presumably encompassing Mild TBI cases) and hospitalizations has remained relatively constant because battle related TBI only accounts for 3.2% of all causes of TBI in the US Armed Forces [23].

• The strongest epidemiologic study of mTBI performed to date was recently published in a peer-reviewed journal [3]. This study showed that in those with a history of mTBI and persistent symptoms, there was a strong association with post-traumatic stress disorder (PTSD). Studies in the civilian literature also document associations between mTBI and co-morbid psychiatric diagnoses such as PTSD and depression [24]. It is unclear whether this represents co-morbid illness or overlapping symptoms between two diagnostic symptom constructs. However, it highlights the importance of identifying and treating psychiatric illnesses in those with a history of mTBI and persistent symptoms particularly given that effective, illness-specific treatments exist for mental health problems but not for mTBI.

• Promulgation of a more systematic approach to the identification and management of suspected cases of mTBI has different goals depending on the deployment phase. During deployment the primary objective is to identify those with symptoms and/or impairments that may be attributable to mTBI in order to evaluate fitness for duty. Identification and management of mTBI in those who have sustained other injuries is an important consideration as this may have an impact on the clinical course of their recovery. Modification of post-deployment screening would provide surveillance data on mTBI in those who have returned from deployment and allow for a more systematic approach in management of persistent symptoms regardless of whether they are attributable to mTBI or other causes. Finally, in all phases of deployment, documentation of a history of mTBI, whether caused by blast or other mechanisms, is an important element for those who at some point transition into the care of Veteran’s Affairs Canada.

• The value of neurocognitive testing to assess fitness for duty in a military operational setting has not been adequately studied. A broad range of neurocognitive tests are available [25]. Such tools can identify impairments in the domains of memory, attention, concentration and reaction time in those with mTBI. However, the interpretation of such findings in any given individual is
limited for several reasons: There exist no normative values for comparison in a military operational setting where individuals are exposed to multiple stressors that can influence cognitive performance, such as sleep deprivation [26]. Baseline testing may control for this but comparison of baseline tests done in an ideal environment to tests done on individuals who have been exposed to stressors such as sleep deprivation still presents problems. Finally, without studies that validate neurocognitive tests as a predictor of fitness for duty in a military operational setting, it is not possible to apply these results in a meaningful way. So while such tests can be done, the findings should not replace good clinical judgement in assessing fitness for duty. Much more work needs to be done to validate such tools in this population in this environment.

- There is a critical need to educate all stakeholders about the facts and myths regarding mTBI in the military operational setting.

- There is an urgent need for well done prospective epidemiologic studies to determine the incidence, prognosis and risk factors for persistent symptoms in mTBI occurring in a military operational setting. Treatment strategies must be assessed in well-designed randomized clinical trials. Incorporation of surveillance on the incidence of mTBI both through the recently adopted US Joint Theatre Trauma System (JTTS) and modification of the Enhanced Post-Deployment Screening Program will be an important initial step in better understanding the impact of mTBI in the Canadian Forces.

RECOMMENDATIONS

1. The US Defense Veteran’s and Brain Injury Center (DVBIC) Working Group Definition of mTBI [26] should be adopted by the Canadian Forces. The definition is as follows:

   **Mild TBI in military operational setting 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 definition was adapted from other existing definitions derived in a civilian setting including, the American College of Rehabilitation Medicine (1993) [27]; Centers for Disease Control and Prevention (CDC, 2003) [5]; World Health Organization (2004) [7]; National Athletic Trainer’s Assn (2004) [28]; and, Prague Sports Concussion Guidelines (2005) [29]. It endorses biomechanical forces as a cause of concussion that results in an acute alteration of consciousness to include: loss of consciousness (LOC), post-traumatic amnesia or retrograde amnesia (PTA or RGA) or being dazed and confused.
Loss of consciousness is not a required characteristic. As such this definition is intentionally broad and applies a lower threshold for detection than DSM-IV [30]. The panel recognizes that further research may be necessary to refine this definition but chose to adopt it to allow comparison with future research coming out of DVBIC.

2. **Baseline neurocognitive testing should not be done until more rigorous research has validated the use of these tools in a military operational setting.**

   Until such time, clinicians may use neurocognitive testing to determine the presence and magnitude of any impairment and to follow the clinical course of any impairment identified.

3. **The DVBIC clinical practice guidelines and algorithms for mTBI in theatre should be adopted [26], with some modification, for the purpose of evaluating fitness for duty in those who may have sustained a mTBI in an operational setting (Appendix 2).**

   A major modification was the removal of the recommendation for detailed neurocognitive testing in the algorithm applicable to the Role 3 facility. While such testing may be available, the panel was sceptical about its utility in assessing fitness for duty in the absence of validation studies performed in the military operational setting. As stated previously in this document, while baseline testing provides some reference frame for interpretation of subsequent tests, they are done in an ideal setting. There is little validation work that identifies how to interpret deviations from baseline that may occur in a military operational setting that might be due to factors such as stress and sleep deprivation. If such tests are employed, they should be interpreted cautiously and good clinical judgement should be exercised when incorporating these into the clinical picture.

   The algorithm for the Role 3 Clinical Practice Guideline begins with a recommendation for CT scan of the head. The panel recognized that guidelines exist to suggest when a CT scan is indicated [31]. However, these guidelines were developed in a civilian population and may not readily extrapolate to injured personnel in a military operational setting. For this reason, a precautionary approach may warrant a more liberal application of diagnostic neuroimaging.

   Additional minor modifications were made to reflect terminology used in the Canadian Forces Health Services.

4. **The Military Acute Concussion Evaluation (MACE, Appendix 3) screening tool should be adopted and used as outlined in the preceding guidelines [26].**

   The MACE is a two-staged test. The first stage is oriented towards describing the injury event and current symptoms while the second stage is oriented towards pragmatic bedside testing of attention, concentration and memory. While it is acknowledged that there is limited validation data on the MACE, it is derived
from a well-validated assessment of concussion in the sports population, the Standardized Assessment of Concussion (SAC) [32], and use of it by the Canadian Forces will allow for comparison to research findings from the United States where it is currently used.

5. **mTBI should be considered in all injured personnel evacuated to a Role 4 medical facility.** This is particularly important since many injured personnel may end up in civilian hospital settings in Canada where there may not be sufficient awareness of this issue. A screening MACE (Items IV-VIII) should be performed. If screening MACE is positive then the entire MACE should be performed. All patients with current symptoms and/or a MACE Score under 25 on Items IX-XIII should undergo a comprehensive clinical examination and managed in accordance with post-deployment guidelines (delineated in Recommendation # 7). Patients with a positive history but who are asymptomatic and have a MACE Score 25 or over require no further intervention unless indicated by changes in their clinical course.

6. **The Enhanced Post-Deployment Screening Program should be amended to provide surveillance data on any history of mTBI during the deployment, mechanisms of injury, presence of symptoms at the time of injury and presence of symptoms at the time of post-deployment assessment.**

7. **A systematic approach should be adopted for the management of those with a history of mTBI identified in the post-deployment period.** (An algorithm developed by the panel is provided in Appendix 4). The recommended approach follows several key guiding principles which are outlined as follows:

   - Provide education and appropriate reassurance to patients with a history of head trauma;
   - Consider chronic subdural haematoma in patients with chronic headache after head trauma;
   - Post-traumatic headache responds to the usual approach for chronic headache disorders;
   - Other somatic symptoms (e.g., dizziness) should also be approached in a conventional fashion;
   - Cognitive Behavioural Therapy (CBT) and graded exercise are the most consistently helpful treatments for unexplained symptoms;
   - Common non-specific mTBI symptoms are more likely to be attributable to mental health problems or to distress than to mTBI per se;
   - In the presence of a mental health problem, treat the problem and follow non-specific symptoms expectantly—evaluate those with persistent
symptoms or symptoms that are inconsistent with (or out of proportion to) mental health problems;

- Consider somatoform disorders or atypical presentations of mental health problems in patients with multiple unexplained symptoms;
- Patients with documented cognitive deficits or persistent concerns should have neuropsychological evaluation to document and quantify deficits;
- Cognitive Behavioural Therapy (CBT) may help if there are persistent concerns without documented deficits; and
- Consider medical employment limitations (MEL’s) in all patients with concerns about cognitive deficits.

8. **An educational package needs to be created for all stakeholders.** A sub-working group should be tasked for this. At a minimum this needs 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 clinical judgement;
   - Standardized lecture outlining the CPG aimed at medical units;
   - Standardized lecture on the facts and myths of TBI as well as the importance of identifying personnel in theatre aimed at the non-medically trained members

9. **The Canadian Forces, where possible, should actively facilitate research to better understand mTBI in the operational setting.** In particular, the following questions were viewed by the panel as being particularly important to the CF:

   - What is the true incidence of varying degrees of head injury on CF operations, and what are the common causes, contributing factors, and mechanisms of injury?
   - How does the pathophysiology of blast-induced mTBI differ (if at all) from conventional mechanisms?
   - What is the natural history of mTBI, particularly with respect to the resolution or persistence of neurocognitive symptoms? What factors appear to influence the natural history? Do blast victims have a higher risk for long-term consequences than other mechanisms of injury?
   - How do neurocognitive symptoms, findings on neuropsychological exams, and specialized studies correlate with operationally significant deficits in those who have experienced head trauma? In particular, do asymptomatic
individuals have hidden deficits that will interfere with operational safety or effectiveness?

- Role of imaging in later phases of mTBI (i.e., post-deployment) needs to be better defined.

- Do baseline neuropsychological exams significantly improve the predictive value of post-trauma tests?

- Can brief, automated neuropsychological exams substitute for more detailed testing under some circumstances? Are there simple, functionally oriented tests, procedures, or examinations that can be used to assess fitness for duty after a head injury?

- Which patients need neuropsychological evaluation?

- What are the performance characteristics of the MACE and other instruments used for assessment of head trauma patients?

- How can post-concussive symptoms and those of mental health problems be separated clinically? And does doing so make a difference therapeutically or prognostically?

- How effective are treatments for mTBI symptoms? Are these treatment effects specific to TBI or would they be seen in others with the same symptoms with different etiologies?

- Is education of head trauma patients effective?

- Which strategies are most promising when it comes to prevention of brain injury?
APPENDIX 1: PANEL PARTICIPANTS

Canadian Forces Health Services

Dr Bryan G Garber (Chair)
Dr Markus Besseman
Maj Paul B Charlebois
LCdr Peter J Clifford
Maj Colleen A Forestier
LCol Rakesh Jetly
Maj Alexandra Heber
Maj Nicholas J Withers
Dr Mark A Zamorski

Defence Research and Development Canada

Dr Bob Cheung

Veterans Affairs Canada

Dr Jim Thompson

McGill University

Dr Alain Ptito

International Guest Speakers

Col Charles C Engel, Dir DoD Deployment Health Clinical Center at Walter Reed Army Medical Center (WRAIR), U.S.A.

Surgeon Commander Neil Greenberg, Royal Navy, U.K.
APPENDIX 2: IN-THEATRE CLINICAL PRACTICE GUIDELINES

(ADAPTED FROM US DVBIC GUIDELINES [26])

NOTE ADDED IN PROOF:

Several days after the meeting of this CF Advisory Panel on mTBI, the US Department of Defense (DoD) released a new set of mTBI management guidelines for their deployed operations in Iraq [33;34], which have replaced the DVBIC guidelines [26] originally endorsed by this panel. The three major differences between these guidelines are as follows:

- The new guideline collapses the three levels of evaluation (labeled Role 1, Role 2, and Role 3 in the guidelines that follow) into two levels, one for the primary care setting and one for remote settings where a credentialed health provider is not available.

- The new guideline de-emphasizes the role of neurocognitive testing in the evaluation of head-injured service members in the deployed setting.

- The new guideline provides additional useful detail in some areas.

If anything, these changes make this new US guideline *more* consistent with the guiding principles and recommendations of the CF Advisory Panel.

This report had already been finalized by the CF Advisory Panel at the time this new US guideline was released; the report was accepted on 28 May 2008 by BGen Hilary Jaeger, the CF Surgeon General, in its original form. On that same date, however, the Surgeon General approved a minimally modified version of the new US guideline to replace the in-theatre guidelines endorsed by the CF Advisory Panel. For the sake of convenience and clarity, these are included as Appendix 6.
TRAUMATIC EVENT

Concussion Suspected

Conduct evaluation:
- Perform entire MACE if time and mission allow;
- Minimum evaluation: MACE Items IV to VIII

Are Role 3 Red Flags Present?

YES Evacuation to Role 3 (as operational considerations allow)

NO Clinical Decision:
- Repeat exertional exercise testing in 24 hours or evacuate to role 2 (Command decision)
  - If symptoms persist over 24 hours, Evacuate to role 2 (as operational Consideration allows).

Are Role 2 Red Flags Present?

YES Role 2 Evac Decision:
- MACE (Items IV-VIII)
- Red Flags:
  1. Double vision
  2. Worsening headache
  3. Can’t recognize people or places, disorientation
  4. Behaves unusually or seems confused and irritable
  5. Sturred speech
  6. Unsteady on feet
  7. Weakness or numbness in arms / legs

NO Role 1

Suspect a concussion in anyone exposed to or involved in a blast, fall, vehicle crash, direct head impact who becomes dazed, confused or loses consciousness even momentarily.

Concussion Suspected

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

Conduct evaluation:
- Perform entire MACE if time and mission allow;
- Minimum evaluation: MACE Items IV to VIII

RTD

Role 1

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

From Role 1

Conduct evaluation:
Perform entire MACE
Evaluate for Red Flags

Are Role 3 Red Flags* Present?

YES
Evacuation to Role 3 (as operational considerations allow)

NO

Is MACE Score for Items IX to XII Under 25 or are there Any symptoms from Item VII?

YES
Observe up to 7 days (Command decision)

NO

Repeat testing in 24 hours or evacuate to Role 3 (Command decision)

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

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

RTD

Guideline Superceded
(See Appendix 6)
Role 3 Algorithm

From Role 1 or 2

Perform CT Scan and Comprehensive Evaluation*

Positive Findings on CT Scan or Comprehensive Evaluation?

YES

a. Physician Decision: Evacuate or Observe up to 2 weeks
   b. Evacuate if symptoms persist for 2 weeks
      (Command Decision – evacuation policy)

NO

Positive Symptoms with exertional exercise testing for 5 minutes?

YES

Perform CT Scan and Comprehensive Evaluation

*Comprehensive Evaluation

a. Neuro examination
b. ENT exam
c. Opti exam
d. Psych exam

NOTE: All patients evacuated to Role 3 for other trauma:
   a. Perform a screening MACE (items 4 – 8) and check for red flags
   b. If Positive – Do a full MACE evaluation

Guideline superseded (see Appendix G)

Patients presenting directly to Role 3 without referral are to be evaluated and managed as per Role 1 and Role 2 Guidelines.

a. Perform a screening MACE (items 4 – 8) and check for red flags
b. If Positive – Do a full MACE evaluation
APPENDIX 3: MILITARY ACUTE CONCUSSION EVALUATION TOOL

Patient Name: ________________________________
SS#: ___________________________ Unit: ___________________________
Date of Injury: __/__/____ Time of Injury: ___________________________
Examiner: ________________________________________________
Date of Evaluation: ______/____/____ Time of Evaluation: __________

History: (I – VIII)

I. Description of Incident
   a) What happened?
   b) Tell me what you remember.
   c) Were you dazed, confused, "see stars?" Yes ☐ No ☐
   d) Did you hit your head? Yes ☐ No ☐

II. Cause of Injury (Circle all that apply):
1) Explosion/Blast
2) Blunt object
3) Motor Vehicle Crash
4) Gunshot wound
5) Fall
7) Other ____________________________

III. Was a helmet worn? Yes ☐ No ☐ Type ____________________________

IV. Amnesia Before: Are there any events just BEFORE the injury that are not remembered? Assess for continuous memory prior to injury.
   ☐ Yes ☐ No If yes, how long ____________________________

V. Amnesia After: Are there any events just AFTER the injury that are not remembered? Assess time until continuous memory after the injury.
   ☐ Yes ☐ No If yes, how long ____________________________

VI. Did anyone observe a period of loss of consciousness or "blacking out?" Yes ☐ No ☐ If yes, how long ____________________________

VII. Symptoms (circle all that apply):
1) Headache
2) Dizziness
3) Memory Problems
4) Balance problems
5) Nausea/ vomiting
6) Difficulty Concentrating
7) Irritability
8) Visual Disturbances
9) Ringing in the ears
10) Other ____________________________

Examination: (IX – XIII)

Evaluate each domain. Total possible score is 30.

IX. Orientation: (1 point each)
   Date: 0 ☐ 1 ☐
   Day of Week: 0 ☐ 1 ☐
   Year: 0 ☐ 1 ☐
   Time: 0 ☐ 1 ☐
   Orientation Total Score _______/

X. Immediate Memory:
   Read at 5 words and ask the patient to recall them in any order. Repeat two more times for a total of three trials. (1 point for each correct, total over 3 trials)

   Elbow 2 1 0 0 0 0
   Apple 2 1 0 0 0 0
   Carpet 2 1 0 0 0 0
   Drain 2 1 0 0 0 0
   Score 2 1 0 0 0 0
   Immediate Memory Total Score _______/

XI. Neurological Screening
   As the clinical condition permits, check:
   Eyes: pupillary response and tracking
   Speech: slurred or word finding
   Motor: pronator drift, gait coordination
   Record any abnormalities. No points are given for this.
XII. Concentration
Reverse Digits: (go to next string length if correct on first trial. Stop if incorrect or both trials) 1 pt. for each string length.

<table>
<thead>
<tr>
<th>2-5-1</th>
<th>4-2-6</th>
<th>0</th>
<th>1</th>
</tr>
</thead>
<tbody>
<tr>
<td>3-8-1</td>
<td>3-9-2</td>
<td>0</td>
<td>1</td>
</tr>
<tr>
<td>6-2-9-7</td>
<td>5-0-8-6</td>
<td>0</td>
<td>1</td>
</tr>
<tr>
<td>7-6-0-5</td>
<td>5-3-1-4</td>
<td>0</td>
<td>1</td>
</tr>
</tbody>
</table>

Months in reverse order: (1 pt. for entire sequence correct)
Dec-Nov-Oct-Sep-Aug-Jul-Jun-May-Apr-Mar-Feb-Jan

Concentration Total Score: ______/6

XIII. Delayed Recall (1 pt. each)
Ask the patient to recall the 5 words from the earlier memory test
(Do NOT reread the word list.)

<table>
<thead>
<tr>
<th>Elbow</th>
<th>0</th>
<th>1</th>
</tr>
</thead>
<tbody>
<tr>
<td>Napie</td>
<td>0</td>
<td>1</td>
</tr>
<tr>
<td>Carpet</td>
<td>0</td>
<td>1</td>
</tr>
<tr>
<td>Saddle</td>
<td>0</td>
<td>1</td>
</tr>
<tr>
<td>Sunline</td>
<td>0</td>
<td>1</td>
</tr>
</tbody>
</table>

Delayed Recall Total Score: ______/6
TOTAL SCORE: ______/30

Notes: __________________________________________

________________________________________________

Diagnosis: (circle one or write in diagnosis)
No concussion
860.0 Concussion without Loss of Consciousness (LOC)
860.1 Concussion with Loss of Consciousness (LOC)
Other diagnoses

________________________________________________

Defense & Veterans Brain Injury Center
1-888-870-8244 or DBH: 866-4646

07/2007 DVBI.org 800-870-8244
This form may be duplicated for clinical use. Page 3 of 8

Instruction Sheet

Purpose and Use of the MACE
A concussion is a mild traumatic brain injury (mTBI). The purpose of the MACE is to evaluate a person in whom a concussion is suspected. The MACE is used to confirm the diagnosis and assess the current clinical status.

Tool Development
The MACE has been extensively reviewed by leading civilian and military experts in the field of concussion assessment and management. While the MACE is not a validated test, the examination section is derived from the Standardized Assessment of Concussion (SAC) (McCrea, M., Kelly, J. & Randolph, C. [2000]. Standardized Assessment of Concussion (SAC): Manual for Administration, Scoring, and Interpretation. 2nd ed.) Wackee, W. (Author), which is validated, widely used tool in sports medicine. Abnormalities on the SAC correlate with formal comprehensive neuropsychological testing during the first 24 hours following a concussion.

Who to Evaluate
Any one who was dazed, confused, "saw stars" or lost consciousness even momentarily, as a result of an explosion, blast, fall, motor vehicle crash, or other event involving abrupt head movement, a direct blow to the head, or other head injury is an appropriate person for evaluation using the MACE.

Evaluation of Concussion

History: (II – VIII)
I. Ask for a description of the incident that resulted in the injury; how the injury occurred, type of force. Ask questions A – D.
II. Ask about the cause or injury
III. Assess for helmet use: Military, Keizer or ACH (Advanced Combat Helmet), Sports helmet, motorcycle helmet, etc.
IV – V Determine whether and length of time that the person was asymptomatic, such as sleeping or being unconscious, then approximate the amount of time in seconds, minutes or hours, whichever time increment is most appropriate. For example, if the assessment of the patient yields a possible time of 20 minutes, then 20 minutes should be documented in the "how long" section.
VI – VII Determine whether and length of time self reported loss of consciousness (LOC) or witnessed loss of LOC. Again, approximate the amount of time in seconds, minutes or hours, whichever time increment is most appropriate.
VIII Ask the person to report their experience of each specific symptom since injury.

07/2007 DVBI.org 800-870-8244
This form may be duplicated for clinical use. Page 4 of 8
Examination: IX – XII

Standardized Assessment of Concussion (SAC):
Total possible score = 30
Orientation = 5
Immediate Memory = 15
Concentration = 5
Memory Recall = 5

IX Orientation: Assess patients awareness of the accurate time
Ask: WHAT MONTH IS THIS?
WHAT IS THE DATE OR DAY OF THE MONTH?
WHAT DAY OF THE WEEK IS IT?
WHAT YEAR IS IT?
WHAT TIME DO YOU THINK IT IS?
One point for each correct response for a total of 5 possible points. It should be noted that a correct response on time of day must be within 1 hour of the actual time.

X Immediate Memory is assessed using a brief repeated list learning test. Read the patient the list of 5 words once and then ask them to repeat it back to you, as many as they can recall in any order. Repeat this procedure 2 more times for a total of 3 trials, even if the patient scores perfectly on the first trial.

Trial 1: I am going to test your memory. I will read you a list of words and when I am done, repeat back as many words as you can remember, in any order.
Trial 2: I am going to repeat that list again, again, repeat back as many as you can remember in any order, even if you said them before.
One point is given for each correct answer for a total of 15 possible points.

XI Neurological assessment

Eyes: check pupil size and reactivity.
Vertebral: notice speech fluency and word finding.
Motor: pronator test – ask patient to lift arms with palms up, ask patient to then close their eyes, assess for either arm to "shift" down. Assess gait and coordination if possible. Document any abnormalities.
No points are given for this section.

XII Concentration: Inform the patient:
I'M GOING TO READ YOU A STRING OF NUMBERS AND WHEN I AM FINISHED, REPEAT THEM BACK TO ME BACKWARDS. THAT IS, IN REVERSE ORDER. I'M GOING TO READ THEM TO YOU. FOR EXAMPLE, IF I SAY 7-1-9, YOU WOULD SAY 9-1-7.
If the patient is correct on the first trial of each string length, proceed to the next string length. If incorrect, administer the second trial of the same string length. Proceed to the next string length if correct on the second trial. Discontinue after failure on both trials of the same string length. Total of 4 different string lengths; 1 point for each string length for a total of 4 points.
NOW TELL ME THE MONTHS IN REVERSE ORDER, THAT IS, START WITH DECEMBER AND END IN JANUARY.
One point if able to recite all months in reverse order, 0 points if not able to recite all of them in reverse order. Total possible score for concentration portion: 6.

XIII Delayed Recall
Assess the patient's ability to retain previously learned information by asking him to recall as many words as possible from the initial word list, without having the word list read again for this trial. DO YOU REMEMBER THAT LIST OF WORDS? I READ A FEW MINUTES EARLIER? I WANT YOU TO TELL ME AS MANY WORDS FROM THE LIST AS YOU CAN REMEMBER IN ANY ORDER.
One point for each word remembered for a total of 5 possible points.
Total scores: Add up from the 4 assessed domains: Immediate memory, orientation, concentration and memory recall.

Significance of scoring
In studies of non-concussed patients, the mean total score was 25. Therefore, a score less than 25 does not imply that a concussion has occurred. Definitive normative data for a "cut-off" score are not available. However, scores below 25 may represent clinically relevant neurocognitive impairment and require further evaluation for the possibility of a more serious brain injury. The scoring system also takes on particular clinical significance during serial assessment where it can be used to document either a decline or an improvement in cognitive functioning.

Diagnosis
Circle the ICD-9 code that corresponds to the evaluation. If loss of consciousness was present, then circle 850.1. If no LOC, then document 6533. If another diagnosis is made, write it in.

07/2007
DVHIC.org 800-870-8244
This form may be copied for oilsole use.
Page 6 of 8
MACE Form B

Due to test retest issues (e.g., service members memorizing words and numbers) validated, alternative versions B or C should be used.

Immediate Memory
Read all 5 words and ask the patient to recall them in any order. Repeat two more times for a total of three trials. (1 point for each correct, total over 3 trials.)

<table>
<thead>
<tr>
<th>List</th>
<th>Trial 1</th>
<th>Trial 2</th>
<th>Trial 3</th>
</tr>
</thead>
<tbody>
<tr>
<td>Candle</td>
<td>0</td>
<td>1</td>
<td>0</td>
</tr>
<tr>
<td>Paper</td>
<td>0</td>
<td>1</td>
<td>0</td>
</tr>
<tr>
<td>Sugar</td>
<td>0</td>
<td>1</td>
<td>0</td>
</tr>
<tr>
<td>Sandwich</td>
<td>0</td>
<td>1</td>
<td>0</td>
</tr>
<tr>
<td>Wagon</td>
<td>0</td>
<td>1</td>
<td>0</td>
</tr>
<tr>
<td>Total</td>
<td>1</td>
<td>2</td>
<td>0</td>
</tr>
</tbody>
</table>

Concentration
Reverse digits (go to next string length if correct on first trial. Stop if incorrect on both trials.) 1 pt. for each string length.

5-2-6     4-1-5   0   1
1-7-9-5   4-9-6-8 0   1
4-9-5-2-7 6-1-8-4-3 0   1
2-5-1-9-6-4 7-2-4-8-6-6 0   1

Delayed Recall (1 pt each)
Ask the patient to recall the 5 words from the earlier memory test (DO NOT reread the word list.)

<table>
<thead>
<tr>
<th>List</th>
<th>Score</th>
</tr>
</thead>
<tbody>
<tr>
<td>Candle</td>
<td>0</td>
</tr>
<tr>
<td>Paper</td>
<td>0</td>
</tr>
<tr>
<td>Sugar</td>
<td>0</td>
</tr>
<tr>
<td>Sandwich</td>
<td>0</td>
</tr>
<tr>
<td>Wagon</td>
<td>0</td>
</tr>
</tbody>
</table>

07/2007
DVbic.org
800-870-8244
This form may be copied for olitinal use.
Page 7 of 8

MACE Form C

Due to test retest issues (e.g., service members memorizing words and numbers) validated, alternative versions B or C should be used.

Immediate Memory
Read all 5 words and ask the patient to recall them in any order. Repeat two more times for a total of three trials. (1 point for each correct, total over 3 trials.)

<table>
<thead>
<tr>
<th>List</th>
<th>Trial 1</th>
<th>Trial 2</th>
<th>Trial 3</th>
</tr>
</thead>
<tbody>
<tr>
<td>Baby</td>
<td>2</td>
<td>1</td>
<td>0</td>
</tr>
<tr>
<td>Monkey</td>
<td>1</td>
<td>1</td>
<td>0</td>
</tr>
<tr>
<td>Perfume</td>
<td>1</td>
<td>1</td>
<td>0</td>
</tr>
<tr>
<td>Sunset</td>
<td>1</td>
<td>1</td>
<td>0</td>
</tr>
<tr>
<td>Iron</td>
<td>1</td>
<td>1</td>
<td>0</td>
</tr>
<tr>
<td>Total</td>
<td>2</td>
<td>3</td>
<td>1</td>
</tr>
</tbody>
</table>

Concentration
Reverse digits (go to next string length if correct on first trial. Stop if incorrect on both trials.) 1 pt. for each string length.

1-4-2     2-6-9   0   1
6-9-3-1   3-4-6-1 0   1
4-9-1-5-3 6-9-2-5-1 0   1
3-7-6-5-1-9 9-2-6-5-1 0   1

Delayed Recall (1 pt each)
Ask the patient to recall the 5 words from the earlier memory test (DO NOT reread the word list.)

<table>
<thead>
<tr>
<th>List</th>
<th>Score</th>
</tr>
</thead>
<tbody>
<tr>
<td>Baby</td>
<td>0</td>
</tr>
<tr>
<td>Monkey</td>
<td>0</td>
</tr>
<tr>
<td>Perfume</td>
<td>0</td>
</tr>
<tr>
<td>Sunset</td>
<td>0</td>
</tr>
<tr>
<td>Iron</td>
<td>0</td>
</tr>
</tbody>
</table>

07/2007
DVbic.org
800-870-8244
This form may be copied for olitinal use.
Page 8 of 8
APPENDIX 4: POST-DEPLOYMENT GUIDELINE

Post-Deployment Surveillance & Management of mTBI

Enhanced Post-deployment Screening Process (3 – 6 months after return) 

- Enhanced Post-deployment Screening will include questions (and guidance on interpretation) for:
  - Head trauma while deployed
  - Alteration in consciousness at the time of trauma
  - Cause of trauma while deployed (e.g., blast)
  - Current symptoms
  - Interviewer concerns on mTBI

Data automatically recorded in 2034 and captured for surveillance purposes

Primary care assessment:
- Provide education and appropriate reassurance to patients with a history of head trauma
- Consider chronic subdural haematoma in patients with chronic headache after head trauma
- Post-traumatic headache responds to the usual approach for chronic headache disorders
- Other somatic symptoms (e.g., dizziness) should also be approached in a conventional fashion
- Cognitive Behavioural Therapy (CBT) and graded exercise are the most consistently helpful treatments for unexplained symptoms

Assessment of MH problems in accordance with symptoms, local practice, and resources

Cognitive deficits documented?
- Patients with documented cognitive deficits or persistent concerns should have neuropsychological evaluation to document and quantify deficits
- Cognitive Behavioural Therapy (CBT) may help if there are persistent concerns without documented deficits
- Consider MEL’s in all patients with concerns about cognitive deficits

C cognitive deficits in mTBI:

Guideline only—not a substitute for clinical judgment
APPENDIX 5: REFERENCE LIST


Primary Care Management of Concussion (mTBI) in a Deployed Setting

**TRAUMATIC EVENT OCCURS**

1. **Concussion Suspected**
   - Administer MACE HISTORY only—Questions I-VIII (page 1)
   - Confirm concussion (Assessed by med or higher) must meet both criteria:
     a. Head Injury Event (blast, fall, motor vehicle accident, head impact)
     b. Alteration of Consciousness (dazed, confused, or loss of consciousness)
   - Ask unit if they’ve noticed any post concussive problems in the individual

2. **MACE**
   - Evaluate for red flags
   - Perform neuro exam, evaluate for amber flags

3. **Concussion Examination**
   - Primary Care Management:
     1. Give educational sheet to all mTBI patients
     2. Headache management—use Acetaminophen
     3. Avoid tramadol, narcotics, NSAID's, ASA, or other platelet inhibitors until cleared for RTD
     4. Consider Neurology referral or evacuate to higher level if clinically indicated
     5. Screen for anxiety and depression
     6. Document concussion diagnosis in 2034

4. **Amber Flags**
   - Perform neuro exam, evaluate for amber flags
     1. Confusion
     2. Slurred speech
     3. Unusual behavior
     4. Unsteady on feet
     5. Weakness
     6. Vertigo/Dizziness
     7. Headache

5. **Red Flags**
   - Progressive declining level of consciousness
   - Progressive declining neurological exam
   - Pupillary asymmetry
   - Seizures
   - Repeated vomiting
   - LOC greater than 5 minutes
   - Double vision
   - Worsening headache
   - Neurological deficit: motor or sensory
   - Neurological ataxia

6. **Red flags**
   - Present?

7. **Amber flags**
   - Present?

8. **Evac to Role 4**
   - More than 7 days post-injury?

9. **Consult**
   - with psychiatry, neurology, or psychology for disposition

10. **Evac to designated Role 3**
    - for specialty evaluation and rest away from unit

11. **Complete MACE Evaluation**
    - (Quest. IX – XII)
    - (MD, PA, or NP)

12. **ICD-9 Codes**
    - 850.0 concussion w/o LOC
    - 850.11 Concussion w/ LOC < 30 min
    - 850.12 Concussion w/ LOC 31-59 min
    - E979.2 Injury from terrorist explosion blast

13. **Exertional Testing Protocol**
    - 65-85% Target Heart Rate (THR = 220-age), using push-up, step aerobic, treadmill, hand crank
    - Assess for symptoms (headache, vertigo, photophobia, balance, dizziness, nausea, tinnitus, visual ch., response to bright light or loud noise)

14. **Psychiatry, neurology, or psychology consult**
    - Goals are assessment of fitness and exclusion of other causes for deficits (including psych. prob.)

15. **Neurocognitive testing may be done**, provided that:
    - Trained staff is available to administer testing and to interpret results
    - The results will influence clinical decision-making
    - The functional impact of any abnormalities is considered in determining fitness for duty

16. **The consultant (in conjunction with the primary care provider) will weigh the costs and benefits of transporting the patient for further testing versus further rest in place.**

**Head Injury Severity Grading**

<table>
<thead>
<tr>
<th>Severity</th>
<th>GCS</th>
<th>LOC</th>
<th>PTA</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mild</td>
<td>13 – 15</td>
<td>&lt; 1 hr.</td>
<td>&lt; 24 hrs.</td>
</tr>
<tr>
<td>Moderate</td>
<td>9 – 12</td>
<td>1 – 24 hr.</td>
<td>24 hrs. – 7 d.</td>
</tr>
<tr>
<td>Severe</td>
<td>3 – 8</td>
<td>&gt; 24 hr.</td>
<td>&gt; 7 d.</td>
</tr>
</tbody>
</table>

**GCS = Glasgow Coma Scale; LOC = Loss of consciousness; PTA = Post-traumatic amnesia**

Guideline only—not a substitute for clinical judgment
Medic's Management of Concussions (mTBI) in a Remote Setting

**Red Flags**
1. Progressively declining level of consciousness
2. Progressive declining neurological exam
3. Pupillary asymmetry
4. Seizures
5. Repeated vomiting
6. Clinician verified Glasgow Coma Scale < 15
7. LOC greater than 5 minutes
8. Double vision
9. Worsening headache
10. Neurological deficit: motor or sensory
11. Cannot recognize people or disoriented to place
12. Neurological ataxia

**Amber Flags**
 Persisting beyond initial traumatic event:
1. Confusion
2. Slurred speech
3. Unusual behavior
4. Unsteady on feet
5. Weakness
6. Vertigo/Dizziness
7. Headache

**Exertional Testing Protocol**
1. 65-85% Target Heart Rate (THR = 220-age), using push-up, step aerobic, treadmill, hand crank
2. Assess for symptoms (headache, vertigo, photophobia, balance, dizziness, nausea, tinnitus, visual ch., response to bright light or loud noise)

**Concussion Examination**
(MO, PA, or NP)
1. Evaluate for "red flags"
2. Perform neuro exam, evaluate for "amber flags"

**Evacuate to higher level of care**

---

**Head Injury Severity Grading**

<table>
<thead>
<tr>
<th>Severity</th>
<th>GCS</th>
<th>LOC</th>
<th>PTA</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mild</td>
<td>13 – 15</td>
<td>&lt; 1 hr</td>
<td>&lt; 24 hrs</td>
</tr>
<tr>
<td>Moderate</td>
<td>9 – 12</td>
<td>1 – 24 hr</td>
<td>24 hrs – 7 d</td>
</tr>
<tr>
<td>Severe</td>
<td>3 – 8</td>
<td>&gt; 24 hr</td>
<td>&gt; 7 d</td>
</tr>
</tbody>
</table>

GCS = Glasgow Coma Scale; LOC = Loss of consciousness; PTA = Post-Traumatic amnesia

**Guideline only—not a substitute for clinical judgment**

CF Version 3.2
June 2008