Evidence-Based Diagnosis and Management of mTBI in Forward Deployed Settings: The Genesis of the USASOC Neurocognitive Testing and Post-Injury Evaluation and Treatment Program

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Case Report

A 28 year old 18-series Soldier was the driver in a vehicle which struck an improvised explosive device (IED). The vehicle was destroyed and the other occupant in the vehicle was killed instantly. The Soldier recalled hitting the roof of the vehicle a least once; however, he suffered no life-threatening injuries and was not initially evacuated to higher medical care. Immediately following the event the Soldier noticed a headache, mild dizziness, nausea, and short-term memory loss. Upon return to the forward operating base (FOB), he was evaluated by the forward surgical team physician who performed a military acute concussion exam (MACE). His score was 24 out of 30 and he was diagnosed with a mild concussion, his symptoms were treated with acetaminophen, and he was released.

On day three, he participated in another combat patrol. During the operation he suffered from dizziness and headaches. He self-medicated with acetaminophen and meclizine transdermal for his symptoms. On this patrol, he was exposed to overpressure from explosions on two separate events. Each explosion was the equivalent of approximately 27 pounds of TNT (trinitrotoluene). Following this mission, he returned to his FOB and noticed increased dizziness, nausea, and memory loss. No other members of his team who were exposed to those two explosions reported any symptoms. He continued to self medicate with acetaminophen and meclizine transdermal. He did not seek follow-up medical care. Later that same day, he participated in a third mission as part of a quick reaction force which included a high altitude helicopter assault. He was not exposed to any additional blast or injuries.

After returning from the third mission, the patient experienced significant fatigue. He went to sleep and later the same night experienced loss of consciousness after quickly standing from a lying position. Upon recovering consciousness, he experienced increased dizziness, nausea, and emesis. He was evaluated by the unit medical provider and evacuated to a Level III Theater Hospital.

Over the next three days, his nausea and dizziness improved; however, he continued to have significant issues with short term memory loss, difficulty concentrating, short-term memory recall, and headaches. His MACE scores slowly improved to 27 out of 30 over several days. He was evacuated through Landstuhl Regional Medical Center to the United States for additional evaluation and treatment.

Introduction

In the last eight years of conflict, U.S. military personnel have been exposed to a significant risk of head injury from the tactics, techniques, and procedures of our enemies. In 2007, the Defense Veterans Brain Injury Center (DVBIC) estimated that a minimum of 2,700 U.S. servicemembers suffered a traumatic brain injury (TBI). The number is not completely accurate as surveys of combat forces with at least a four-month tour of duty in Operation Iraqi Freedom (OIF)/Operation enduring Freedom (OEF) show that 30% of respondents suffered a mild TBI (mTBI) as a result of a blast wave.[1] This has resulted in mTBI being one of the "signature wounds" of the current conflicts in Iraq and Afghanistan.

The diagnosis and management of severe head injuries, to include subdural and epidural hemorrhages, open and closed skull fractures, and diffuse axonal injuries, has not been subject to the controversy surrounding the "milder" concussive injuries that have been put into the category of mTBI. The Centers for Disease Control and Prevention (CDC) defines a mTBI or a concussion as a complex pathophysiologic process affecting the brain, induced by traumatic biomechanical forces sec-

ondary to direct or indirect forces to the head, and is typically associated with normal structural neuroimaging findings.[2] For the purposes of this review, the terms mTBI and concussion are used interchangeably and are defined as physiologic changes in brain functioning resulting from trauma to the head or body without radiographic evidence, such as a computerized tomography (CT) scan or magnetic resonance imaging (MRI), of structural damage.

The neurometabolic cascade that can accompany these injuries has been well described in the Fall 2009 issue of the *Journal of Special Operations Medicine* by Delellis, Kane, and Katz. Understanding the pathophysiology on the cellular level is critical to the understanding, diagnosis, and treatment of mTBI as it is more of a metabolic injury than a structural injury.[3] The focus of this review is to explore relevant published research from the sports community and its application to the development of a program for the U.S. Army Special Operations Command (USASOC). The overarching goal of the USASOC program is to give forward deployed providers the tools to effectively diagnose and treat mTBI, while simultaneously protecting the individual Soldier from more permanent and severe injury and protecting the unit by not allowing a Soldier to return-to-duty when not 100% ready to do their job.

The specific goals are to improve the diagnosis and management of mTBI using the latest current research from the sports medicine community. The treatment of mTBI is relatively simple, centering on physical and cognitive rest and protection from further exposure until all symptoms have resolved. Therefore, improving the provider's ability to make an early and timely diagnosis as well as educating the force and the chain of command are imperative to proper treatment. Trauma during the period in which the brain is still recovering from an initial injury can result in the devastating and fatal consequences of second-impact syndrome (SIS).[4] Second-impact syndrome, although not that common in a military-aged population, is the most dramatic consequence of improperly treating a mTBI. Improper treatment of mTBI and return-to-duty before full recovery can result in or aggravate other significant long-term health complications, such as post-traumatic stress syndrome/disorder (PTSS/PTSD), post-concussive syndrome, and depression, as well as lengthening the recovery time from subsequent concussive head injuries.[5, 6] The end-state of the treatment within the USASOC program will be for the asymptomatic Soldier to participate in a graded program of increasing physical and cognitive exertion. Upon successful completion of the program the Soldier may be returned to duty. In the above case, the Soldier clearly had not completely recovered from his first injury when he was exposed to two more blasts and the end result was that he was evacuated out of theater. In addition, the discussion below will highlight the fact that "less is more" when treating mTBI. High levels of exertion by "pushing through it" or "sucking it up" while still symptomatic in the post-concussive period can prolong the patient's recovery and potentially lead to the development of chronic symptoms.

Diagnosis

The diagnosis of mTBI is a challenging clinical diagnosis and must be approached using all the tools available, including a thorough history, a focused physical exam, and a neurocognitive assessment. The history of the traumatic event must be fully explored to determine the potential for causing brain injury, as should be the symptoms that the Soldier experienced immediately post-injury and is experiencing at the time of evaluation. The physical exam should include not only looking for evidence of head injury, such as trauma above the clavicles, but should also include a neurological examination focusing on the vestibular and postural stability systems. Finally, a neurocognitive assessment should be used to evaluate neurocognitive performance. No one tool is perfect for the diagnosis of mTBI, and the clinical decisions made by medical providers should involve an assessment of all three areas.

History

The history of the injury has been considered extremely important in the initial evaluation of the Soldier. Attempts have been made to specifically define what injury history requires an evaluation. Such criteria as being near an explosion (within "x" meters) or being in a vehicle hit by an IED are starting points, but research has shown that there are no specific thresholds for injury. In a prospective study using accelerometers in the helmets of 88 National Collegiate Athletic Association (NCAA) football players, all head impacts over the course of the 2004 – 2006 football seasons were recorded. In the 88 players, 13 concussions were documented. Comparing clinical measures (baseline and post-injury changes) to the linear and rotational accelerations of the head revealed no significant relationships between the magnitude, direction (linear or rotational), or impact location, and symptom severity, postural stability, and neurocognitive function. The authors reached the following conclusion: "Our findings suggest that football players are concussed by impacts to the head that occur at a wide range of magnitudes and that clinical measures of acute symptoms severity, postural stability, and neuropsychological function all appear to be independent of impact magnitude and location."[7] Based on this study, establishing a threshold for concussive injury may not be as clear cut as being in specific proximity to an IED explosion, and medical providers should not minimize reported exposures that seem "too small" to cause injury. In an effort to provide some guidance for the de-

ployed provider the DVBIC is in the progress of publishing incident based screening guidance. The intent of this guidance is to lower the screening threshold and maximize the number of servicemembers screened to minimize the number of servicemembers who suffer an undiagnosed mTBI. The guidelines will state that anyone in a damaged vehicle, dismounted personnel within 50 meters of a blast, within a structure hit by an explosive device, anyone who sustains a blow to the head, or who is command directed should be evaluated with at least a MACE examination and then managed appropriately based on the results.[8] Guidelines should never supersede clinical judgment and, keeping in consideration that injury severity is not directly related to the impact magnitude and location, providers should maintain an index of suspicion for mTBI when conducting post-incident evaluations.

Symptom history has also been considered an important part of the initial evaluation of the Soldier, but it should be noted that the absence of symptoms does not mean that no injury has been sustained. A study that evaluated the symptoms of concussed athletes and their neurocognitive performance revealed that asymptomatic concussed athletes performed more poorly in neurocognitive testing 48 hours post-injury than did matched control subjects. Of note, the group of symptomatic concussed athletes had significantly poorer performance on neurocognitive testing than did the asymptomatic concussed athletes.[9] The results of this study show that the absence of symptoms 48 hours post-injury are not indicative of full recovery, but should be considered in the context of a full evaluation (history, physical exam, and neurocognitive assessment). Though one must consider the caveat that many Soldiers and athletes will under-report or minimize symptoms in order to stay in the "fight" or "game," some symptoms have been shown to be a discriminator as to the severity of the injury. The presence of and duration of loss of consciousness (LOC) is often a focus of providers when gathering the patients' history, as it is felt to be a prognostic indicator of the severity of the injury. Research has shown that it is the amount and extent of amnesia (retrograde or anterograde) is a much better predictor of the severity of injury and not LOC.[10] Another study looking at symptoms found significant relationships between "feeling foggy" one week post-concussion and persistence of other post-concussive symptoms as well as performance on neurocognitive testing. The study showed that regardless of the degree of fogginess on a 6-point scale, athletes experienced a larger number of post-concussive symptoms and significantly slower reaction times, reduced memory performance, and slower processing speed than those athletes that reported no fogginess.[11] These studies indicate a complex relationship between symptoms and injury. On one hand, the absence of symptoms at 48 hours is not indicative of full recovery, and on the other hand, the presence of a specific symptom (amnesia or fogginess) can indicate a more severe injury.

Physical Exam

The physical exam is also an important aspect of the comprehensive evaluation of a Soldier with suspected mTBI and should include assessments of the vestibular system and postural stability. Traditional focus has been on looking for evidence of trauma above the clavicles, such as bruising, lacerations, skull or facial deformities, and ruptured tympanic membranes. These injuries need to be addressed in addition to the potential for mTBI, but another focus of the exam should be the function of the neurologic system, particularly the balance and vestibular systems. Research has shown that in addition to symptom severity and neurocognitive function, postural stability is often affected initially post concussion. It has been shown that in addition to the standard Romberg test, the Balance Error Scoring System (BESS) is a useful adjunct in the evaluation of the motor domain of the neurocognitive system. Evaluation of athletes post-concussion has shown that the greatest deficits are apparent on post-injury day one, and resolution of these deficits should also be considered in any return-to-play (return-to-duty in our population) decisions.[12] It has also been shown that postural stability may not be affected in every case of head injury, nor does it appear to be related to the severity of post-injury symptoms or deficits in neurocognitive function.[13] This is an important aspect of the physical exam for the evaluation of the post-injury Soldier, because many of the tasks that USASOC Soldiers do in combat require postural stability and a fully functioning vestibular system to be conducted effectively. Close-quarter battle (CQB) and the piloting of Special Operations aviation aircraft are two tasks that can be seriously hindered by deficits in these body systems.

Neurocognitive Testing

Neurocognitive testing is the final leg of the evaluation triad, and is important for multiple reasons. Neurocognitive testing can serve as a screening test for injury, as an assessment tool during follow-up care, and an indicator of physiologic brain function. As discussed earlier, neurocognitive deficits can be present post injury even in the absence of symptoms.[14] The MACE is a military version of the standardized assessment of concussion (SAC) which has been shown to be useful in the initial screening of athletes suspected of head injury. Studies of the SAC have shown that concussed athletes score significantly below non-concussed controls, and that follow-up testing can document a return to pre-injury baseline within 48 hours of the injury. Clearly the MACE or the SAC is effective in the initial evaluation; however, for serial testing and documentation, its limitations become apparent. A 1998 study of the SAC by McCrea and colleagues showed 100% return to baseline

within 48 hours, while a 2006 study by Van Kampen showed that with more sensitive neurocognitive testing, 83% of concussed athletes continued to demonstrate neurocognitive deficits 48 hours after injury.[15, 16] Granted, these are different studies, with different patient populations, but they suggest that either the SAC is not sensitive enough to pick up residual neurologic deficits, or there is a significant practice effect involved.

In contrast, the use of computerized neurocognitive testing has shown a 19% increase in sensitivity over self-reported symptoms. In this study, which used the immediate post-concussion assessment and cognitive testing (ImPACT) computerized neurocognitive assessment, the use of symptom and neurocognitive test results demonstrated a 29% increase in sensitivity compared to the use of symptoms alone. Of note, the control (non-concussed group) had no subjects with both symptoms and abnormal neurocognitive assessment scores.[17] Another study that used the ImPACT exam demonstrated a sensitivity of 81.9% and a specificity of 89.4% for concussion. The ImPACT exam is the only computerized neurocognitive assessment tool with documented sensitivity and specificity for concussion.[18]

Finally, a recent study found that brain abnormalities noted on post-concussion functional MRI scans correlated with neuropsychological and symptom data. Athletes who demonstrated areas of hyperactivation on functional MRI scans had a more prolonged recovery than athletes without those findings. In addition, resolution of the hyperactivation correlated with recovery as measured by the ImPACT exam.[19] The linking of physiologic brain abnormalities and results of neuropsychological testing further validates the use of computerized neurocognitive assessments in the evaluation of concussion and mTBI.

The 2008 International Symposia on Concussion in Sport released a consensus statement that supports the use of neuropsychological testing, but also points out that it should not be the sole basis for management decisions.[20] As the third leg of the evaluation triad, which includes a history and physical exam, neurocognitive testing is an important part of the comprehensive evaluation. It can serve both as an initial screening tool and as a method of tracking recovery with increase sensitivity over symptoms alone, and has been correlated with abnormal findings of brain physiology.

Classification of Injury

Over the last 35 years, multiple grading systems have been proposed in the classification of head injury. The consensus statement released following the Second International Conference on Concussion in Sport in 2005 proposed a new classification for sports concussions, introducing the concept of simple (taking less than 10 days to recover) vs. complex (taking greater than ten days to recover) concussions.[21] Subsequently, following the latest International Conference on Concussion in Sport, this terminology was abandoned.[22] Despite its abandonment by consensus from the latest international conference, there is evidence that in the first few days after an injury, the combination of symptoms and computerized neurocognitive testing can discriminate between simple and complex concussions. A study of 114 concussed football players revealed that when compared to those with simple concussions, players with complex concussions performed more poorly on neurocognitive testing and reported more symptoms. This study used the ImPACT exam as its neurocognitive test and showed that athletes with complex concussions were 18 times more likely to have three unusually low test scores on the exam. Further analysis revealed that the positive predictive value of this finding is 0.94. Symptom scores were also significantly different and those players with a symptom score of 40 or more were seven times more likely to have a complex concussion.[23] The ability to use a neurocognitive assessment tool to give prognostic information for military providers is an important aspect of the simple and complex classifications. Because the simple and complex classification system is correlated with recovery time, the authors recommend the use of this system in a forward deployed environment. Military commanders can more effectively manage personnel and plan combat operations armed with more accurate prognostic data than is currently available through the use of the MACE.

Treatment of mTBI

The focus of mTBI treatment encompasses several areas: management of symptoms, prevention of further injury, graduated increase in physical and cognitive exertion, and patient education. The evidence for effective treatments of mTBI is indirect and is related to what is known to worsen symptoms and prolong recovery. Symptom management in the acute phase is mainly focused on the treatment of headache. Sleep disorders, attention disorders, and anxiety can also be consequences of mTBI, but will not be discussed because those Soldiers suffering these symptoms to the extent that pharmacologic therapy is necessary should be evacuated to a higher level of care for management.

A 2009 MEDLINE search found no good clinical studies on effective treatment of headache in the mTBI patient.[24] One recent review states, "pharmaceutical treatment strategies with proven clinical benefits are still lacking."[25] An earlier review came to the same conclusion, stating that "at the present time the clinician has no evidence based pharmacological treatment to offer the concussed athlete."[26] Currently, acetaminophen and/or non-steroidal anti-inflammatory drugs (NSAIDs) are considered first line treatments, though there is a theoretical consideration that treatment with NSAIDs could worsen undiagnosed intracerebral hemorrhage.

Evidence for prevention of further injury is much clearer. Protection from the potential for second-

impact syndrome has already been discussed. The pathophysiology of this disorder appears to be related to the loss of the brain's auto-regulatory mechanisms for a period of time after an initial injury, making the brain more vulnerable to low-level impacts.[27] Limiting the duties of Soldiers recovering from mTBI serves to reduce their risk of sustaining a second impact during the recovery period. Given the devastating clinical effects that can result from a low-level second impact, it is clearly a prudent course of action.

Another important aspect of prevention of further injury is revealed through research that shows high levels of physical and cognitive activity after injury are related to poorer neurocognitive performance in follow-up testing. The athletes who had the best symptom scores and neurocognitive performance were those who did moderate levels of exercise after the injury.[28] Though more research is clearly needed, this study supports the recommendation for a graded return-to-play (or duty) protocol, which can be individualized based on the complete evaluation of the athlete or Soldier. The 2008 International Symposia on Concussion in Sport and the 2006 CDC "Heads Up: Brain Injury in Your Practice" physicians tool kit both support return-to-play plans for the athlete that involve graduated increases in functional exercise.[29, 30]

Patient education has also been shown to decrease the anxiety and symptom prevalence after injury. A 2002 study looked at 202 adults with mild head injury and divided them into two groups; one received a one week follow-up visit and information booklet, as well as a three month follow-up visit, and one that only received follow-up at three months. The group that received an information booklet outlining the symptoms associated with head injury and coping strategies demonstrated fewer overall symptoms and were significantly less stressed at their three month follow-up visit.[31]

These areas of mTBI treatment discussed involve treatments (headache management) and interventions (protection from injury exposure, use of a step-wise rehabilitation protocol, and patient education) that can be accomplished by primary providers in a forward deployed setting with minimal resources. Soldiers with evidence of more severe injuries or those that are unresponsive to the conservative therapies discussed should be evacuated to a higher level of care for specialty evaluation and treatment.

Current Department of Defense (DoD) and DVBIC Recommendations:

The DoD and DVBIC mTBI guidance (www.dvbic.org) has been regularly reviewed and updated, but in light of the above discussion, there are two areas where improvements can be made: The use of the automated neuropsychological assessment metrics (ANAM) as a computerized neurocognitive assessment tool and the formalization of a graduated return-to-duty protocol. The ANAM has been extensively used as a pre-deployment baseline neurocognitive test as directed by the Assistant Secretary of Defense for Health Affairs.[32] Normative data for the military population has been studied and generated.[33] However, as a tool that military providers can use in the assessment of patients with known or suspected mTBI, a MEDLINE search of relevant topics failed to return any published studies that look at its use in mTBI diagnosis and management. The only published study to look at ANAM data and Soldiers with a history mTBI or postconcussive symptoms showed no association between poor ANAM performance and history of TBI, injury severity, or presence of problematic postconcussive symptoms.[34] In addition, it is not easily accessible in the deployed theaters of operations, and generally requires evacuation to the level of a theater hospital (Level III) for testing. Medical providers forward of the theater hospitals have no tool other than the MACE, which has been shown to have reliability problems with repetitive use in the same patient. The latest updated mTBI clinical guidance from the DVBIC encourages progressive physical activity to the maximum extent (without symptoms) by Soldiers with mTBI. A more formalized approach as recommended by the International Symposia on Concussion in Sport and the CDC Physician's Toolkit may be beneficial in applying a standardized method across the military population. Improvements need to be made in the existing DoD and DVBIC clinical guidance in order to give providers forward of the theater hospitals the best and most relevant tools to diagnose and manage Soldiers with known or suspected mTBI.

The USASOC Neurocognitive Testing and Post-Injury Evaluation and Treatment Program

Premature return-to-duty not only can result in an increased risk of re-injury and long term complications for the patient but it can also put other team members at increased risk of danger due to the suboptimal performance of the injured individual. Further complicating the issue is the fact that return-to-duty decisions often are made in a chaotic environment with limited resources.[35] Recognizing the limitations of the DoD and DVBIC recommendations noted above, USASOC has developed an evidence-based program for use by providers at the lowest levels (i.e., by Battalion and Group or Regimental medical providers). This program incorporates the standards of care used in the sports medicine community: Asymptomatic at rest prior to returning to activity, asymptomatic with both physical and cognitive exertion, and a return to baseline neurocognitive testing.[36] The USASOC program uses the ImPACT computerized neurocognitive assessment exam as a tool in the evaluation of Soldiers with suspected mTBI. The ImPACT exam was chosen because it has documented sensitivity and specificity

for concussion diagnosis, it is easily accessible for both baseline and post-injury testing, and can easily be used by USASOC medical providers. In addition, this program incorporates a formal graduated rehabilitation protocol to get Soldiers back to full duty. At this time the USASOC program does not include a formalized assessment of postural stability such as the BESS, but that is under consideration.

Case Discussion

The lack of a quantitative measurement tool for evaluation and monitoring of suspected mTBI casualties has been a concern for military medical providers throughout the duration of OIF and OEF. This concern is amplified among the forward deployed medical providers of Special Operations Forces (SOF) units, primarily due to the vast distances often experienced between the operational teams and higher levels of medical care. The case report described at the beginning of this article is an excellent example of the challenges faced by medical providers throughout the SOF environment. The need for clinical practice guidelines supported by an accurate, readily available, objective test for evaluation of mTBI is demonstrated in this case report.

In this case, the injured Solider was stationed at a FOB which was co-located with a Forward Surgical Team (FST). This facilitated the Soldier being evaluated by the FST physician after his initial injury; however, despite the completion of the ANAM prior to his deployment, the ANAM score was unavailable to the FST physician or the battalion surgeon for comparative analysis. Additionally, due to the constraints of the ANAM testing process, even if pre-injury scores were available, no published data is available to guide the medical treatment or support the evacuation of this Soldier. Using existing DVBIC guidelines, his score of 24 out of 30 on the MACE should have triggered 24 hours of rest and a re-evaluation, which he did not receive. Later in his course he was able to score 27 out of 30 on the MACE (a score of <25 is considered abnormal) while continuing to have significant symptoms, further revealing the limitations of this tool in consecutive evaluations. The location of the FST relative to higher U.S. medical care was an issue as well. Due to distances, medical evacuation was not possible using rotary wing assets without aerial refueling capabilities. As a result, a "routine" evacuation of this Soldier would feasibly require two to three days to accomplish and would likely require the same if not more time to return him to his unit once medically cleared.

Additionally, this Soldier possessed a specific skill set which was not redundant on his operational detachment, and his evacuation to higher medical care would negatively impact the capabilities of his unit. The Soldier was aware of the need for his skills and the challenges in evacuating him from his location. Therefore, as is frequently observed in SOF Soldiers, the individual minimized his symptoms in order to remain with his detachment. Specifically, he did not seek follow-up medical care until he became incapacitated following his third mission.

Deployed medical providers are often forced to make decisions in reference to evacuation which have implications for the well-being of the Soldier as well as impact to the unit. However, these decisions are frequently simplified due to the nature of the injuries and the clear need for medical evacuation in order to prevent further injury or disability to the patient. Due to the broad spectrum of TBI and the difficulty of making a well informed decision in the absence of "solid" data, these generally straight forward decisions become blurry in the face of potential head injuries. Furthermore, convincing arguments to commanders are difficult in the absence of solid, tangible, medical data which support the medical evacuation or duty limitations for the injured Soldier.

If available at the time, the USASOC neurocognitive testing CPG would have directed this individual to be screened following the initial injury based on his "significant mechanism of injury." If presented with an objective assessment, which could potentially clear the patient for return-to-duty or validate the need for medical evacuation, the stigma of seeking medical care for a potential mTBI would be minimized. This Soldier clearly had mTBI, and demonstrated worsening of his symptoms with the physical stresses of multiple missions, as well as second-impact syndrome. This hypothesis is supported by the fact that he was the only Soldier to suffer symptoms following exposure to the second and third blasts despite other team members being in the same proximity to the blasts. The availability of a neurocognitive test like the ImPACT exam at the FOB, used in conjunction with a focused history and physical exam, clear patient education, and an individualized rehabilitation program would have prevented this Soldier from suffering the complications described, and likely would have prevented his evacuation from the theater. Computerized neurocognitive testing alone will not resolve the complexities surrounding the management of mTBI. However, the use of a computerized neurocognitive assessment in conjunction with clear guidelines and supported by substantiated medical data is a powerful tool in the aid bag of the forward deployment provider.

Conclusion

USASOC is currently in the process of implementing this program. Provider education began in November 2009 and baseline testing of a select unit started in December 2009. Baseline testing and educational initiatives will be expanded to the rest of the deploying force over the next several months.

Current research initiatives will undoubtedly lead to further refinements of the USASOC, DoD, and

DVBIC programs. As USASOC gains experience with the ImPACT, the prognostic accuracy will continue to be refined along with further development of criteria that will differentiate between simple and complex mTBI early in the clinical course. With the incorporation of new strategies based on the latest evidence and clinical research, improvements in mTBI diagnosis and management will continue to be made.

References

1. Tanielian T. and Jaycox L.H. (2008). Invisible wounds of war psychological and cognitive injuries, their consequences, and services to assist recovery. RAND Center for Military Health Policy Research; page 4.
2. Reddy C.C. and Collins M.W. (2009). Sports concussion: Management and predictors of outcome. *Current Sports Medicine Report*; 8(1): 10-15.
3. Lovell M., Collins M.W., Pardini J.E., et al. (2005). Management of cerebral concussion in military personnel: Lessons learned from sports medicine. *Operative Techniques in Sports Medicine*; 13:212-221.
4. Bey T. and Ostick B. (2009). Second-impact syndrome. *Western Journal of Emergency Medicine*; X(1): 6-10.
5. Langlois J.A., Rutland-Brown W. and Wald M.M. (2006). The epidemiology and impact of traumatic brain injury: A brief overview. *The Journal of Head Trauma Rehabilitation*; 5: 375-378.
6. Gardetto N.J., Gibbons W., LaZarre-Miller J. and Watts D.D. (2009). Mild traumatic brain injury assessment and manage ment in the outpatient setting, *Federal Practitioner*; Nov: 40-48.
7. Guskiewicz K.M., Mihalik J.P., Shankar V., et al. (2007). Measurement of head impacts in collegiate football players: Relationship between head impact biomechanics and acute clinical outcome after concussion, *Neurosurgery*; 61(6): 1244-1252.
8. 2008 Consensus Conference on the acute management of concussion/mild traumatic brain injury in the deployed setting. 30 Nov 2009 Draft Revision. Retrieved from http://dvbic.gkdev.com/Providers/TBI-Screening.
9. Fazio V.C., Lovell M.R., Pardini J.E., and Collins M.W. (2007).The relation between post concussion symptoms and neurocognitive performance in concussed athletes, *NeuroRehabilition*; 22(3): 207-216.
10. Collins M.W., Iverson G.L., Lovell M.R., et al. (2003). On-field predictors of neuropsychological and symptom deficit following sports-related concussion, *Clinical Journal of Sport Medicine*; 13: 222-229.
11. Iverson G.L., Gaetz M., Lovell M.R., and Collins M.W. (2004). Relation between subjective fogginess and neuropsychological testing following concussion, *Journal of International Neuropsychology Society*; 10(6): 904-906.
12. Guskiewicz K.M. (2002). Balance and mild head injury in athletes, *Orthopaedic Physical Therapy Clinics of North America*; 11(1): 143-158.
13. Guskiewicz K.M. (2001). Postural stability assessment following concussion: One piece of the puzzle, *Clinical Journal of Sport Medicine*; 11:182-189.
14. Fazio V.C., Lovell M.R,. Pardini J.E., and Collins M.W. (2007).The relation between post concussion symptoms and neurocognitive performance in concussed athletes, *Neuro-Rehabilition*; 22(3): 207-216.
15. McCrea M., Kelly J.P., Randolph C., et al. (1998) Standardized assessment of concussion (SAC): On-site mental status evaluation of the athlete, *Journal of Head Trauma Rehabilitation*; 13(2): 27-35.
16. Van Kampen D.A., Lovell M.R., Pardini, J.E., Collins M.W., and Fu F.H. (2006). The "value added" of neurocognitive testing after sports-related concussion, *American Journal of Sports Medicine*; 34(10): 1630-1635.
17. Van Kampen D.A., Lovell M.R., Pardini, J.E., Collins M.W., and Fu F.H. (2006). The "value added" of neurocognitive testing after sports-related concussion, *American Journal of Sports Medicine*; 34(10): 1630-1635.
18. Schatz P., Pardini J.E., Lovell M.R., Collins M.W., and Podell K. (2006). Sensitivity and specificity of the impact test battery for concussion in athletes, *Archives of Clinical Neuropsychology*; 21(1): 91-99.
19. Lovell M.R., Pardini J.E., Welling, J., et al. (2007). Functional brain abnormalities are related to clinical recovery and time to return-to-play in athletes, *Neurosurgery*; 61(2) 352-359.
20. McCrory P., Meeuwisse W., Johnston K., et al. (2009). Consensus Statement on Concussion in Sport, 3rd International Conference on Concussion in Sport held in Zurich, November 2008, *Clinical Journal of Sport Medicine*; 19: 185-200.
21. McCrory P., Johnston K., Meeuwisse W., et al. (2005). Summary and agreement statement of the 2nd International Conference on Concussion in Sport, Prague 2004, *British Journal of Sports Medicine*; 39(Suppl 1); i78-i86.
22. McCrory P,. Meeuwisse W., Johnston K., et al. (2009). Consensus Statement on Concussion in Sport, 3rd International Conference on Concussion in Sport held in Zurich, November 2008, *Clinical Journal of Sport Medicine*; 19: 185-200.
23. Iverson G. (2007). Predicting slow recovery from sport-related concussion: The new simple-complex distinction, *Clin ical Journal of Sport Medicine*; 17(1): 31-7.
24. Dobscha S.K., Clark M.E., Morasco B.J., et al. (2009). Systematic review of the literature on pain in patients with polytrauma including traumatic brain injury, *Pain Medicine*; 10(7): 1200-1217.
25. Marklund, N., Bakshi A., Castelbuono D.J., et al. (2006). Evaluation of pharmacological treatment strategies in traumatic brain injury, *Current Pharmaceutical Design*; 12(13): 1645-1680.
26. McCrory P. (2002). Should we treat concussion pharmacologically? *British Journal of Sports Medicine*; 36:3-5.
27. Bey T. and Ostick B. (2009). Second-impact syndrome. *Western Journal of Emergency Medicine*; X(1): 6-10.
28. Majerske C.W., Mihalik J.P., Ren D., et al. (2008). Concussion in sports: Postconcussive activity levels, symptoms, and neurocognitive performance, *Journal of Athletic Training*; 43(3): 265-274.
29. McCrory P., Meeuwisse W., Johnston K., et al. (2009). Consensus Statement on Concussion in Sport, 3rd International Conference on Concussion in Sport held in Zurich, November 2008, *Clinical Journal of Sport Medicine*; 19: 185-200.
30. National Center for Injury Prevention and Control, Division of Injury Response. (2008). Heads Up: Brain Injury in Your Practice, a Tool Kit for Physicians. Retrieved from http://www.cdc.gov/NCIPC/tbi/physicians_tool_kit.htm; accessed 30 December 2009.
31. Ponsford J.,Willmott C., Rothwell A, et al. (2002) Impact of early intervention on outcome following mild head injury in adults, *Journal of Neurology, Neurosurgery, and Psychiatry*; 73(3): 330-332.

32. Casscells S.W., Assistant Secretary of Defense (Health Affairs). Memorandum for the Assistant Secretaries of the Army, Navy, and Air Force; Subject: Baseline pre-deployment neurocognitive functional assessment – interim guidance; May 28, 2008.
33. Vincent A.S., Bleiberg J., Yan S., et al. (2008). Reference data from the automated neuropsychological assessment metrics for use in traumatic brain injury in an active duty military sample, *Military Medicine*; 173(9): 836-852.
34. Ivins B.J., Kane R., Schwab K.A. (2009). Performance on the automated neuropsychological assessment metrics in a nonclinical sample of Soldiers screened for mild TBI after returning from Iraq and Afghanistan: A descriptive analysis, *Journal of Head Trauma Rehabilitation*; 24(1): 24-31.
35. Lovell M., Collins M.W., Pardini J.E., et al. (2005). Management of cerebral concussion in military personnel: Lessons learned from sports medicine. *Operative Techniques in Sports Medicine*; 13:212-221.
36. Reddy C.C. and Collins M.W. (2009). Sports concussion: Management and predictors of outcome. *Current Sports Medicine Report*; 8(1): 10-15.

APPENDICES

1st CPG
2nd Rehab Guidelines
3rd Patient Information Sheet

USASOC Neurocognitive Testing and Post – Injury Evaluation and Treatment Clinical Practice Guideline (CPG)

Note: *The intent of this CPG is to serve as general guidance for medics and medical officers. It should not supplant good clinical judgment and experience. In addition, providers should be familiar with the Joint Theater Trauma System CPG for "Management of Mild Traumatic Brain Injury (mTBI)/Concussion in the Deployed Setting." Operational and tactical considerations may, in some instances, override the CPG. This is a working document, and as we gain experience with the test and the procedures it will be modified. Send comments and suggestions to:* robert.h.lutz@ahqb.soc.mil .

1. Recognition of Injury Potential and General Principles:

A. All Soldiers who receive a head injury should be evaluated for evidence of mild traumatic brain injury (mTBI). The initial evaluation should consist of a focused history and physical exam. All Soldiers with clinical signs of head trauma, symptoms of head injury, or a significant mechanism should receive a more detailed evaluation. Consider using the Military Acute Concussion Exam (MACE) as an initial screening tool as part of the decision making process.

B. The goal of this program is early identification of Soldiers with a mild injury that initially may not be readily apparent. These mild TBI injuries if not treated appropriately put the Soldier at risk for developing chronic problems or "second-impact syndrome."

C. Those Soldiers with severe or potentially severe head-injuries are beyond the scope of this CPG. This group of Soldiers needs evacuation to a higher level of care where imaging (non-contrast head CT) and surgical capability are available. After evaluation at a higher level of care and structural brain trauma has been ruled out, these Soldiers may be returned to the unit through the medical system. At that time it is appropriate for them to be revaluated through this CPG.

1) **Criteria for imaging:** The American College of Emergency Physicians published a Clinical Policy in December, 2008, titled, " Neuroimaging and Decisionmaking in Adult Mild Traumatic Brain Injury in the Acute Setting." A thorough review of the available literature was examined to answer the question "which patients with mild TBI should have a noncontrast head CT scan in the ED?" The recommendations are as follows:

2) Level A recommendations (generally accepted principles for patient management that reflect a high degree of clinical certainty): A noncontrast head CT is indicated in head trauma **patients with loss of consciousness or posttraumatic amnesia** only if one or more of the following is present: headache, vomiting, age greater than 60 years, drug or alcohol intoxication, deficits in short term memory, physical evidence of trauma above the clavicle, posttraumatic seizure, GCS score of less than 15, focal neurologic deficit, or coagulopathy.

3) Level B recommendations (recommendations for patient management that may identify a particular strategy or range of management strategies that reflect moderate clinical certainty): A noncontrast head CT should be considered in head trauma patients **with no loss of consciousness or posttraumatic amnesia** if there is a focal neuologic deficit, vomiting, severe headache, age 65 years or greater, physical signs of basilar skull fracture, GCS less than 15, coagulopathy, or a dangerous mechanism of injury (including ejection from a motor vehicle, pedestrian struck, fall from height of more than three feet or five stairs)

4) Keep in mind that these recommendations are based on studies from the civilian population. There are no studies that look at head injuries from blasts and explosions. Providers will need to maintain an index of suspicion based on the described nature of the mechanism of injury, and use that in their determination of the need for noncontrast CT of the head.

D. The "PIE's" principle is an important framework within which to work. Keep the Soldier in "Proximity" to his unit and support network. Recognize and begin evaluation and treatment "Immediately" as soon as potential for TBI is considered. Treat the Soldier with the "Expectancy" that they are going to get better and return-to-duty fully recovered.

E. Education is a **very important** component of treatment. Many of the symptoms of mTBI are concerning for our Soldiers. They should be educated to understand that they are normal symptoms and the majority of them will improve with time and rest.

2. **Evaluation and disposition of Soldiers with suspected mTBI:**

A. **Initial field evaluation:** The purpose of the initial evaluation in the field is to determine the need for urgent evacuation. Urgent evacuation is required for those Soldiers that are exhibiting signs/symptoms of a potentially severe head injury. Signs or symptoms that indicate the presence of diffuse axonal injury, intracranial bleeding with mass effect, or penetrating head injuries include, but are not limited to:

Prolonged loss of consciousness
Progressively declining level of consciousness
Progressively declining neurological exam
Seizures
Repeated vomiting
Sensory or motor neurological deficit

B. Evaluation in clinical setting (Army Health Clinic, Aid Station, or Forward Operating Base [FOB] Clinic): Once the Soldier is removed from the field setting, a more thorough evaluation can be conducted. The goal of this evaluation is to determine the extent (or potential extent) of the injury and establish diagnostic and treatment priorities. This evaluation should consist of a detailed history, physical exam, and if indicated, imaging studies and/or neurocognitive testing. The MACE may also be used in the initial evaluation to aid in the decision making process.

1) **Injury history:** A thorough review of the history of the injury, with a focus on symptoms consistent with head injury. Some of these symptoms may be not apparent to the Soldier, but clearly recognized by teammates or other Soldiers. Consider talking with friends, supervisors, and subordinates in order to get their assessment of the Soldier's behavior. Such symptoms include:

Headache
Amnesia (retrograde or anterograde)
Confusion
Unusual behavior or emotional changes
Irritability
Balance problems
Vertigo and dizziness
Photophobia
Decreased tolerance to noise
Vision changes
Lethargy
Nausea/vomiting

2) **Physical exam:** A thorough physical exam and neurologic exam is required when a Soldier is being evaluated for the presence of mTBI. Indications of the potential for mTBI include:

Ruptured tympanic membranes
Trauma to the head/neck (penetrating and non-penetrating
Cranial nerve deficits
Sensory deficits
Motor deficits
Inability to do rapid alternating movements
Visual field deficits
Abnormal mini mental status evaluation
Abnormal vestibular screening exam:
    Inability to maintain balance
    Persistent nystagmus
    Tracking/convergence problems with extraocular movements

3) **Neurocognitive testing:** USASOC Soldiers with any of the above indicators of mTBI should be evaluated using the Immediate Post-Concussion Testing and Cognitive Assessment (ImPACT) Exam. This evaluation should take place no earlier than the day after the injury, and after that can be conducted at any time post-injury. Testing can be done by any trained medical officer or medic. Ideally, the Soldier will have a baseline test to compare against. If no baseline is available, comparison will be made against normative population data. Test interpretation is only to be done by a trained licensed provider. Indicators of mTBI include:

a) **If baseline test available:** Test results that show deviation outside of the reliable change index (RCI) in one or more areas of the test.

b) **If no baseline test available:** Test results with two or more scores that fall below the 25th percentile in either the verbal memory, visual memory, reaction time, or processing speed components of the test. This finding occurs in less than 13% of a normal population.

C. **Diagnosis of mTBI:** Based on the complete evaluation (history, physical exam, and neurocognitive testing), the Soldier can be placed in one of four diagnostic categories: No evidence of mTBI, simple mTBI, complex mTBI, severe or potentially severe head injury. In addition to the clinical impression from the history and physical exam, neurocognitive testing can aid in placing the Soldier in a diagnostic category. Use the ImPACT scoring and diagnostic category criteria below as general guidance.

1) **No evidence of mTBI:** No ImPACT subcomponent scores outside of the RCI, minimal symptoms at most.

2) **Simple mTBI:** ImPACT symptom score range below 30 and/or only one ImPACT subcomponent score outside of the RCI or two subcomponent scores below the 25th percentile (if no baseline available). These Soldiers will likely get better quickly with full resolution of symptoms in less than 10 days. Early return-to-duty before meeting criteria may exacerbate the injury and worsen the length and scope of symptoms.

3) **Complex mTBI:** ImPACT symptom score above 30 and two or more ImPACT subcomponent scores outside of the RCI or below the 16th percentile (if no baseline available). These Soldiers will likely take longer to recover and full resolution of symptoms may take longer than 10 days. As with low-risk mTBI, early return-to-duty before meeting criteria may exacerbate the injury and worsen the length and scope of symptoms. However, these Soldiers will take longer to heal and providers should resist efforts to push through symptoms as this may delay recovery and increase the risk for the development of chronic post-concussive symptoms.

4) **Severe or potentially severe head injury:** Evidence of more severe injury requiring imaging (if not available at your location), potential need for neurosurgical intervention, or potential for further deterioration and need for supportive care such as airway control.

3. **Treatment and Disposition of Soldiers with mTBI:**

Disposition of Soldiers diagnosed with mTBI: Based on the complete evaluation (history, physical exam, and neurocognitive testing), the Soldier can be placed in one of four categories: Return-to-duty, light duty, quarters, or evacuate to higher level of care. The importance of light duty and quarters cannot be overstated. Recovery time from mTBI can be delayed if not treated properly, and the cornerstones of treatment are physical and cognitive rest. Commanders need to be educated that "light duty" includes both physical and mental light duty.

A. **No evidence of mTBI:** Return-to-duty, no treatment indicated

B. **Simple mTBI:**

1) **Treatment**:

Rest: 72 hour light duty profile.
Headache: Treat with acetaminophen (may use naproxen if no suspicion of intracranial hemorrhage); do not use narcotics.
Post-concussion rehab: After 72 hours rest, begin at Stage 1, if tolerated. May advance rapidly as tolerated (no symptoms at completion of exercise protocol) to Stage 5. If symptoms develop during any stage, then stop exercise, and restart at pre vious asymptomatic stage once symptoms resolve. Balance exercises as indicated by screening.

2) **Disposition**: Light duty profile for at least 72 hours, with restrictions on both physical and cognitive work.

3) **Follow-up**: Focused provider re-evaluation every 24 hours, repeat ImPACT in five to seven days, earlier if symptoms resolve.

C. **Complex mTBI:**

1) **Treatment**:

Rest: 72 hours quarters.
Headache: Treat with acetaminophen (may use naproxen if no suspicion of intracranial hemorrhage); do not use narcotics.
Post-concussion rehab: After 72 hours rest, begin Stage 1, if tolerated. Advance slowly, no more than one stage per day, and only if symptom free. 95% of Soldiers with 3 or more ImPACT scores outside of the RCI will not be able to return-to-duty within 10 days. Accelerating the rehab protocol only has the potential to worsen the injury – so advance with caution. Balance exercises as indicated by screening.

2) **Disposition**: Quarters for at least 72 hours, with both physical and cognitive rest. Soldier should maintain normal sleep/wake cycles. Follow with light duty profile until cleared to return-to-duty.

3) **Follow-up**: Focused provider re-evaluation every 24 hours, repeat ImPACT in 7 to 10 days, earlier if symptoms resolve.

D. **Severe or potentially severe head injury:**

1). **Treatment**: As indicated by trauma protocols.
2). **Disposition**: Evacuate per protocol to higher level of care.

4. **Return-to-Duty Criteria:**

Recommended return-to-duty criteria are as follows:

A. Resolution of symptoms (off medications) with standard cognitive activities required of position.
B. Tolerance of Stage 5 full exertion physical activity without symptoms (off medications).
C. Return of ImPACT score to within the RCI for each subcomponent, if a baseline test is available for comparison. If no baseline test available, then follow the trend of the examination results as the Soldiers symptoms improve. Based on normative data, 33% of the population will have at least one score less than the 25th percentile. Two scores less than the 25th percentile occurs in less than 13% of the population.

5. **Failure to improve or progress:**

Providers should strongly consider evacuating Soldiers who fail to progress within 14 days, or exhibit worsening symptoms despite conservative management and should consult with the nearest neurologist for management recommendations. In addition, the potential for an acute combat stress reaction or pre-existing illness (i.e. sleep apnea) as a component of the Soldier's symptom complex should be considered.

6. **Special Situations:**

Soldiers who perform complex tasks including (but not limited to) close quarter battle, room clearing, piloting an aircraft, or any other job/position that requires split second timing and rapid visual recognition/reaction, may require further evaluation prior to being returned to duty. Check rides for pilots and shoot/no shoot decision simulations (CQB range) should be considered prior to return to full duty, particularly if there are indications from neurocognitive testing that reaction time and visual motor speed are not back to baseline (but still within the RCI).

USASOC GUIDELINES FOR POST-CONCUSSION REHABILITATION

Rehabilitation Stage	Physical Therapy Program	Recommended Exercises
Stage 1 Target Heart Rate: **30-40%** of maximum exertion Recommendations: exercise in quiet area; no impact activities; balance and vestibular exercises as needed; limit head movement/position changes; limit concentration activities; 10-15 minutes light cardio	- Very light aerobic conditioning - Sub-max isometric strengthening - ROM/Stretching - Low-level balance activities	Stationary Bike; seated elliptical; treadmill walking (10-15 minutes) Quad sets; Ham sets; light hand weights; resistive band rowing; SLR's; resistive bands ankle strengthening Cervical ROM exercise; trap/LS stretching, pec stretch; hamstring stretching, quad stretching, calf stretching Romberg exercises, single leg balance
Stage 2 Target Heart Rate: **40-60%** of maximum exertion Recommendations: exercise in gym areas; use various exercise equipment; allow some positional changes in head movement; low level concentration activities; 20-30 minutes of cardio	- Light to moderate aerobic conditioning - Light weight - Active stretching - Moderate balance activities; initiate activities with head position changes	Treadmill; stationary bike; elliptical (20-30 minutes) Light weight strength exercises, resistive band exercises; wall squats; lunges; step up/downs Any stage 1 stretching; active stretching as tolerated Romberg exercises, VOR exercise (walking with eyes focused and head turns); Swiss ball exercises; single leg balance exercises
Stage 3 Target Heart Rate: **60-80%** of maximum exertion Recommendations: any environment ok; integrate strength, conditioning, and balance/proprioceptive exercises; can incorporate concentration challenges; 25-30 minutes of cardio	- Moderately aggressive aerobic exercise - All forms of strength exercise - Active stretching exercise - Impact activities (running, plyometrics) - Challenging proprioceptive and dynamic balance; challenging positional changes	Treadmill (jogging); stationary bike; elliptical (25-30 min) Resistive weight training including free weights; functional squat; dynamic strength activities Active stretching (lunge walks, side to side groin stretching, walking hamstring stretch Initiate agility drills (zig-zag runs, side shuffle), jumping on blocks Higher level balance activities: ball toss on plyo floor, balance discs, squats and lunges on BOSU ball
Stage 4 Target Heart Rate: **80%** of maximum exertion Recommendations: resume aggressive training in all environments	- Non-contact physical training - Aggressive strength training - Impact activities/plyometrics - Job-specific physical training	Program to be designed by unit physical therapist Interval training Job-specific drills/training
Stage 5 Target Heart Rate: Full exertion Recommendations: Full activities and combat training	- Resume full physical training with contact - Continue aggressive strength and conditioning exercises - Job-specific activities (shooting, CQB training, fast-roping)	Program to be designed by unit physical therapist Train at full combat intensity

USASOC Concussion Patient Information Sheet

1. What is a Concussion?

A concussion, sometimes called a mild traumatic brain injury (mTBI), is an injury that is caused by a blow or jolt to the head that briefly knocks you out (lose consciousness) or makes you confused or "see stars." In combat, concussions are usually caused by an explosion, fall, direct impact, or motor vehicle accident. Some, but not all, people with a concussion lose consciousness.

2. Why is this important?

Often after a concussion Soldiers think they are OK, yet a concussion may affect your ability to perform at your best. You should seek medical treatment from the nearest medic or medical officer as soon as possible after any injury where there may be a chance of a concussion. Your medic or medical officer will evaluate your injury and decide if it is safe for you to return-to-duty. Returning to duty too early from an injury can put you at greater risk for a more serious injury, and in addition, can cause a mild injury to become more serious.

3. What are the symptoms associated with concussion?

There are many symptoms associated with concussion. These are normal symptoms that can be very disturbing, but will resolve with time, rest, and treatment. These symptoms include:

Headache	Nausea/Vomiting	Dizziness
Fatigue	Sleep Disturbances	Difficulty Remembering
Noise Sensitivity	Light Sensitivity	Blurry Vision
Loss of Balance	Trouble with Concentration	Ringing in the Ears
Irritability	Excessive Tiredness	

4. How is concussion diagnosed?

A concussion diagnosis is based on the specific circumstances of your injury, your symptoms at the time of injury, and an examination. Tests of your memory and concentration may be done on the computer or with a series of questions.

5. Does medicine help?

The treatment for concussion is limited duty and rest. Rest includes both physical and mental rest. You should refrain from doing mentally taxing activities such as reading, playing video games, or watching excessive amounts of TV. If you have a headache, you can usually take acetaminophen (brand name: Tylenol). Other medications like ibuprofen and aspirin should only be taken upon the advice of a medical provider. Narcotics (strong pain relievers) should be avoided.

6. When can I return-to-duty?

After your evaluation, you will be given a plan to follow with the assistance of your unit medical personnel. This plan will involve rest, and a gradual return to normal duties. As you increase your activity level, you need to back off if symptoms return. This means you still need more time to heal. You should not return-to-duty until your symptoms are completely gone and you are able to resume full activities without their recurrence. You also may be asked to take a computer test to help evaluate your ability to return to full duty.

7. Are there any lasting effects to a concussion?

Almost all people recover completely following a concussion. Multiple concussions without letting you fully heal in between can cause prolonged symptoms that will increase your recovery time.

8. What else should I know about my recovery?

<u>Do:</u>
Get plenty of rest
Return to activities according to the plan developed by your medic or medical officer
Stay hydrated

<u>Don't:</u>
Overexert yourself
Participate in contact sports or high-risk activities until cleared by your unit medic or medical officer
Drink alcohol

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