Acute Mild Traumatic Brain Injury Assessment and Management in the Austere Setting—A Review

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ABSTRACT

Introduction:

Traumatic brain injury (TBI) continues to be a major source of military-related morbidity and mortality. The insidious short- and long-term sequelae of mild TBIs (mTBIs) have come to light, with ongoing research influencing advances in patient care from point of injury onward. Although the DoDI 6490.11 outlines mTBI care in the deployed setting, there is currently no standardized training requirement on mTBI care in the far-forward deployed setting. As the Joint Trauma System (JTS) is considered to be one of the leaders in standard of care trauma medicine in the deployed environment and is often the go-to resource for forward-deployed medical providers, it is our goal that this review be utilized by the JTS with prominent mTBI resources to disseminate a clinical practice guideline (CPG) appropriate for the far-forward operational environment.

Materials and Methods:

The resources used for this review reflect the most current data, knowledge, and recommendations associated with research and findings from reputable sources as the Traumatic Brain Injury Center of Excellence (TBI CoE; formerly the Defense and Veterans Brain Injury Center), the Center for Disease Control and Prevention, as well as prominent journals such as Academic Emergency Medicine, British Journal of Sports Medicine, and JAMA. We searched for articles under keyword searches, limiting results to less than 5 years old, and had military relevance. About 1,740 articles were found using keywords; filters on our search yielded 707 articles, 100 of which offered free full text. The topic of far-forward deployed management of mTBI does not have a robust academic background at this time, and recommendations are derived from a combination of academic evidence in more traditional clinical settings, as well as author's direct experience in managing mTBI casualties in the austere environment.

Results:

At the time of this writing, there is no JTS CPG for management of mTBI and there is no pre-deployment training requirement for medical providers for treating mTBI casualties in the far-forward deployed setting. The TBI CoE does, however, have a multitude of resources available to medical providers to assist with post-mTBI care. In this article, we review these clinical tools, pre-planning considerations including discussions and logistical planning with medical command, appropriate evaluation and treatment for mTBI casualties based on TBI CoE recommendations, the need for uniform and consistent documentation and diagnosis in the acute period, tactical and operational considerations, and other considerations as a medical provider in an austere setting with limited resources for treating casualties with mTBIs.

Conclusions:

Given the significant morbidity and mortality associated with mTBIs, as well as operational and tactical considerations in the austere deployed setting, improved acute and subacute care, as well as standardization of care for these casualties within their area of operations is necessary. The far-forward deployed medical provider should be trained in management of mTBI, incorporate mTBI-associated injuries into medical planning with their command, and discuss the importance of mTBI management with servicemembers and their units. Proper planning, training, standardization of mTBI management in the deployed setting, and inter-unit cooperation and coordination for mTBI care will help maintain servicemember readiness and unit capability on the battlefield. Standardization in care and documentation in this austere military environment may also assist future research into mTBI management. As there is currently no JTS CPG covering this type of care, the authors recommend sharing the TBI CoE management guideline with medical providers who will be reasonably expected to evaluate and manage mTBI in the austere deployed setting.

INTRODUCTION

Traumatic brain injury (TBI) is a significant cause of morbidity and mortality in the U.S. military, and appropriate management is vital for both the servicemembers (SMs) and their units. In the past 5 years, more than 90,000 SMs were diagnosed with a first-time TBI; although the majority (approximately 86%) have been categorized as mild,[1] this group of injured SMs may have sequelae that affect their health, safety, and, as a consequence, unit readiness.[2–4] A mild TBI (mTBI) is the term used for injury in which

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the casualty has a disoriented state or loss of memory which lasts <24 h and/or loss of consciousness for up to 30 min.[1] Recurrent mTBIs occurring over an extended period of time can result in cumulative neurological deficits, and if multiple mTBIs occur over a few days or weeks, the effects can be devastating and even fatal.[3,4] Despite the clinical significant of mTBI in SMs, consistent documentation has historically been rare in the deployed setting, with diagnoses being delayed.[5] The most recent update to the DoD guidelines for mTBI management in the deployed setting was on November 26, 2019 and refers providers to the Defense and Veterans Brain Injury Center (DVBIC) for additional guidance.[6] The DVBIC is now, as of 2021, the Traumatic Brain Injury Center of Excellence (TBI CoE) under the Defense Health Agency (DHA).[7] Currently, no clinical practice guideline (CPG) was found in the Joint Trauma System (JTS) for mTBIs at the time this article was written, and acute mTBI management resources such as the TBI CoE do not give many detailed recommendations regarding care in the austere operational setting.[8] Our literature search for this manuscript included articles found using combinations of applicable keywords, limiting results to less than 5 years old, and had military relevance. About 1,740 articles were found using keywords, and filters on our search yielded 707 articles, 100 of which offered free full text. This article will focus on mTBI care for SMs in the deployed, far-forward setting where larger military treatment facilities (MTFs), specialized care teams (such as the Concussion Restoration Care Center at Camp Leatherneck in Afghanistan—operational until 2014),[9] and subject matter experts (SMEs) are only available through tele-medicine consultation. The capability for medical officers to manage mTBI in the austere setting in a standardized manner has potentially tremendous value for SM health, unit readiness, and further mTBI research. It is our objective that this review be used by the JTS to assist in disseminating a CPG appropriate for the austere deployed setting, as the JTS is considered one of the leaders in standard of care in deployed trauma medicine. We also recommend sharing the TBI CoE management guideline with medical providers as part of pre-deployment training, as the majority of these providers are not TBI SMEs.

PRE-MISSION PLANNING

When preparing for mission coverage, there are several steps the medical provider can take when anticipating receiving mTBI casualties. The first action takes place before there is any injury: education. Just as the medical officer must be prepared for all types of other traumatic injuries in theater, they should complete training in preparation for managing a casualty with an mTBI. The TBI CoE offers a multitude of resources available for a medical provider, including training documents, references, pocket cards, flow charts, patient handouts, and more to provide the most up-to-date information to appropriately care for patients with TBIs.[7,8] Being able to utilize these tools, in coordination with medical judgment, tactical considerations, and the operational environment, is an important primary step in the process. Another consideration is balancing, obtaining devices potentially useful for mTBI care with the need to limit Class XIII and other supplies in a far-forward setting. Specialized devices for mTBI assessment and evaluation may be available from the medical command depending on the command surgeon and medical practice in specific areas of operation (AOs), but it is the authors' recommendation that they should not initially be embedded at the far-forward outstation primarily.

Before deployment, medical providers are educated on the location and resources available for traumatic injuries. The JTS website with the published CPGs are the first access point recommended as the CPGs offer recommendations, guidelines, and expectations based on the provider's role of care. On deployment, once the medical provider receives communication about incoming casualties with TBIs or about an event that may have caused such casualties, they must personally prepare using approved, evidence-based CPGs with consideration of the medical rules of engagement and any specific protocols to their AOs. However, currently there is no JTS CPG for mTBI. For suspected mTBIs, due to the unique clinical requirements in evaluation and treatment, the medical provider must ensure their medical command is abreast to the situation as time and the clinical scenario allows. This will help the command be prepared to send any additional resources such as personnel and supplies to assist with mTBI management depending on the number of casualties, need for assistance, and the tactical environment. The medical provider must also ensure they communicate the number of potential mTBI casualties to balance the expectations regarding post-mTBI care with the mission and tactical scenario. These initial steps will lay a solid foundation for mTBI management in the austere setting, where there are no other resources or care teams available.

EVALUATION

Evaluation and treatment of mTBIs as soon as possible after the injury improves overall recovery and symptom improvement.[2,5,10,11] The initial assessment after a potential inciting event for TBI often occurs just after POI by a medical provider available "on the X," and ideally, they will administer the Military Acute Concussion Evaluation (MACE2) once it is tactically safe to do so. The MACE2 is a screening tool recommended by the DoDI that is best used as close to the time of injury as possible, in conjunction with the rest of the clinical assessment. It can be utilized to assist the medical provider in determining who may need urgent evacuation to a higher level of care and to help guide recovery for each individual casualty based on their specific symptoms and scoring.[12] The medical provider should also be continuously evaluating for acute neurological deficits and changes in mental status.[13] The casualty with worsening neurological signs and/or symptoms requires appropriate elevated management according to local protocols and CPGs such as the severe TBI CPG from the JTS.[14] Additionally, adequate documentation regarding assessment

and diagnosis of military mTBI in the acute period has historically been sparse,[5] and providing a MACE2 assessment together with approved, standardized medical documentation for each casualty with a possible mTBI can help fill this gap in care and knowledge. Developing a comprehensive CPG for providers that includes best practices for documentation and early diagnosis in the operational setting may aid in both acute care and preventing some of the long-term sequelae seen with a delayed mTBI diagnosis.

TREATMENT

Once the diagnosis of acute concussion or mTBI is made, the casualty should progress through a standardized process that is described by the TBI CoE.[13] Several studies in post-mTBI care have shown that early, acute management leads to faster recovery for many patients and can positively affect long-term outcomes.[2,5,10,11] Additionally, recurrent mTBIs have been correlated with elevated rates of cognitive impairment, long-term psychiatric illness, and concern for an increased incidence of chronic traumatic encephalopathy and are therefore managed very strictly.[2–4,11,15] Medical providers have access to several DHA-approved resources to carry out care,[16] such as the Concussion Management Tool,[17] the Progressive Return to Activity (PRA) guide,[13] and the Recurrent Concussion Evaluation.[15] Given the austere operational environment, the medical provider will also need to weigh several factors in deciding if and when mTBI casualties will need evacuation. Although this provider can provide primary level of care for mTBI management, they must decide if a casualty may need evacuation for specialized care teams such as those historically found at the Concussion Restoration Care Center, functional assessment by a physical or occupational therapist, and/or consultations with psychology, neuropsychology, or neurology.[13,15,16] They must also consider evacuation timelines based on other casualties, MEDEVAC capability and availability, available medical personnel and resources, availability of tele-medicine consultation, and theater-specific policies. The well-documented and significant sequelae of mTBI and recurrent mTBI must also be communicated with the casualty's unit to determine the appropriate next steps, given the tactical situation.

The next step in mTBI care in the deployed setting, after screening and a rest period, is the PRA process. This algorithmic clinical recommendation tool is consistent with current policies and medical literature and has been reviewed by SMEs within the Veterans Health Administration; the Traumatic Brain Injury Advisory Committee whose core members are the TBI CoE, service leads from the Army, Navy, and Air Force; the National Intrepid Center of Excellence; U.S. Central Command; Readiness Division of the DHA; and the U.S. Coast Guard.[13] The PRA is a standardized approach to post mTBI management that aims to direct care for acutely affected SMs, returning them to duty or directing them to a higher level of care efficiently and appropriately. The TBI CoE describes this process in detail on their website.[13] It is imperative that the medical provider educates the SM on post-TBI care.[16] This effort will help ensure SMs are forthcoming with their symptoms and concerns, assist in their understanding and approach to their injury, and help ensure they adhere to the PRA. Directly from the TBI CoE, "Education is the single most effective intervention following acute mTBI showing the greatest decrease in the number and duration of symptoms."[13] After the SM completes Stage 5 of the PRA without any significant symptoms, they perform exertion testing. If there is no exacerbation of symptoms, the medical provider can be reassured that the SM can likely return to pre-injury activity. If the patient becomes symptomatic, the medical provider should consider referral to or tele-consultation with a rehabilitation provider.[13]

For those SMs who have worsening of symptoms and/or clinically evolving or somewhat concerning findings, the medical provider has several resources to utilize in the austere setting. Any severe or "red flag" symptoms require immediate re-evaluation, as well as tele-medicine consultation and/or consideration for medical evacuation to a higher level of care based on the clinical scenario. For the clinically stable-appearing casualty who does not, upon repeat evaluation, need elevated TBI treatment or emergent evacuation, the austere medical provider should strongly consider tele-medicine consultation with neurology, primary care sports medicine, neuropsychology, and/or psychology.[13,16] If the medical provider is considering the need for head CT for this otherwise stable-appearing patient for evaluation of structural brain injury, an FDA-approved structural brain injury device may be considered.

FURTHER CONSIDERATIONS

Another consideration for post-injury evaluation in the deployed environment is the use of neurocognitive assessment tool (NCAT) testing. The Automated Neuropsychological Assessment Metrics (ANAM) is the chosen instrument for NCAT testing by DoD SMEs, and medical providers should consider including this tool for SMs with prolonged symptoms.[18] Baseline testing is performed within 12 months before deployment and can serve as a comparison after a TBI-inciting event. Given the far-forward setting in which this testing would be taking place, it is recommended by the TBI CoE that the medical provider have tele-consultation available with neuropsychology for assistance in determining if NCAT testing is appropriate, as well as for evaluation and interpretation of testing. Details about testing are available in the DoDI 6490.13 and on the TBI CoE website.[18,19] The austere medical provider may not have ANAM capability embedded at their site but can coordinate logistics with their command, as testing software may be available on laptops for deployed providers. Although not always indicated, NCAT testing can assist with the rest of the evaluation and treatment for a subset of SMs with prolonged symptoms after a TBI-inciting event.

Given that the medical provider is serving in the austere setting with limited resources and heightened tactical considerations, there are several factors to consider other than the clinical picture for the SM with an mTBI. The considerations regarding the tactical situation are already mentioned in this article. Ideally, an SM who has suffered an mTBI should be able to rest, avoid any situation that may lead to another inciting event causing TBI, and not perform any other duties, including administrative.[3,4,11,13,15–17] In the far-forward setting, however, this is not always an option due to factors such as ongoing operations, urgent security needs, and not having personnel who can perform that SM's duties. Further complicating the scenario is that recent evidence shows that SMs who have had recurrent occupational overpressure exposure (i.e., firing heavy caliber weapons, breaching charges, etc.) have a higher risk for mTBI, both independently from a blast injury and more so if both blast injury and overpressure exposure are experienced on the same deployment.[20] Conversations with the SM and their command are absolutely vital to determining the appropriate next steps to mitigate as much risk as possible to both the affected SM and all the other personnel in a far-forward operational environment.

Another challenge in the overall management of SMs who are exposed to a possible TBI-inciting event in the austere setting is the possibility that their symptoms are not directly caused by acute TBI. Given the PRA process depends on subjective symptom reporting, if the SM has significant insomnia, anxiety, nightmares, or other symptoms of psychological trauma based on the events surrounding the TBI-inciting event, as well as other symptoms such as physical pain, this may complicate symptom reporting and the clinical picture.[5,13] These issues can also confound results of NCAT testing.[18] The medical provider should err on the side of caution in treating these patients as possible mTBIs, considering the possible sequelae from such injuries, and seek tele-consultation with SMEs for assistance in management.

A final additional consideration for the medical provider caring for these SMs as well as those looking to improve mTBI care from POI onward is documentation. Historically, military documentation in the deployed setting regarding assessment and diagnosis of mTBI has been wanting.[5] A recent systematic review of 106 studies on military blast-related mTBIs revealed little regulation regarding how mTBI was being diagnosed and assessed, showing inconsistencies and varying approaches.[21] Having standardized training and use of documentation and practice patterns from a consolidative source such the MACE2 would help streamline the process, benefitting SM health and well-being, faster recoveries influencing unit readiness, and assist in further mTBI research focusing on acute care and its effects in the long term.

CONCLUSION

The appropriate assessment and management of casualties with acute mTBIs by medical providers in an austere deployed setting can be challenging, but it is crucial for the safety and readiness of both the SM and their unit. Pre-deployment education on mTBI management, thoughtful planning on the part of the medical provider and their command, consideration for the operational environment and its limitations in appropriate management for mTBIs, and the availability of mTBI-management resources all affect the capability to treat mTBI in the far-forward setting. Thoughtful steps taken in theater may also have positive downstream effects on long-term mTBI care and research. We recommend this review be utilized to develop standardized training for deploying medical providers who will likely encounter mTBI casualties, ensure they have access to mTBI management resources in the austere operational setting, and provide recommendations from the leaders in deployed TBI medicine.

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None declared.

AUTHOR CONTRIBUTORSHIP STATEMENT

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