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Dedicated to the Indomitable Spirit and Sacrifices of the SOF Medic

A Peer-Reviewed Journal that Brings Together the Global Interests of Special Operations' First Responders

Disclosure

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USASOC Division of Science & Technology

What It Means for Special Operations Medicine

by Chris Calvano, MD, PhD; Scott Forman; Travis Osborn, 18D; William Gothard

The US Army Special Operations Command Science and Technology Division (USASOC S&T) has the mission of maximizing the use of science and technology (S&T) resources from external organizations to extend USASOC warfighters' technological and knowledge dominance in support of special warfare and surgical strike operations. Within S&T are defined area gaps covering strategic, tactical, and scientific areas. These include core warfighter functional areas such as weapons, mobility, communication, and medical, which are organized as commodity areas to include Soldier Systems (including medical), Mobility, Human Domain, Aviation, Intelligence Surveillance Reconnaissance/Intelligence Support Squadron, Target Engagement, and C4. Each commodity is assigned an experienced Operator to chaperone the process. Interested scientists, clinicians, and engineers from private industry, academia, and government/military agencies all collaborate to meet these needs of the yearly gaps. The medical gaps (some of which may be classified) are codified, keeping good faith to the guidance provided by Army Special Operations Forces (ARSOF) 2022. The gaps are fluid such that, at any time, a critical gap may be identified in the field, resulting in expedited exploration of solutions.

S&T investment is required to ensure ARSOF Operators of the future have the most advanced capabilities to conduct surgical strike operations and special warfare campaigns. This editorial aims to familiarize the Special Operations medical community with the role of the USASOC S&T and to raise awareness and encourage continued Operator-driven identification of medical gaps and development/evaluation of solutions.

Discovery of the S&T gaps comes from three sources: top-down directive (strategic), bottom-up innovation (tactical), and technology discovery (scientific). Command directives define a given gap and, therefore, the solutions often follow. Operators may have no choice but to innovate in the field; indeed, this is expected and provides a valuable "tested" solution that can be translated to a modification of an existing product versus a completely new item. Occasionally a solution is identified via technology discovery as a commercial off-the-shelf product. Such instances will still be fully vetted within USASOC, but advantages may include standing US Food and Drug Administration approval or current use within sister services or branches.

Identification of many medical gaps and development of solutions ultimately depends on and is driven by Operator input and feedback. Always observing that Special Operations medicine is Operator/Medic centric facilitates this process. The S&T division has representatives from Special Forces, Rangers, Civil Affairs, Military Information Support Operations, and other elements within USASOC to ensure a full representation of the needs of the medical community.

The Technology Assessment Unit (TAU) within the S&T division is organized by commodities, with a seasoned Operator serving as subject matter expert (SME). Commodity areas support the basic warfighter functions of shoot, move, communicate, and medicate. These operationally seasoned and technically fluent experts typically are senior 18 series noncommissioned officers and are often the entry point for new solutions into the USASOC realm. The TAU SMEs function as both a funnel and a filter for innovative ideas and products. They coordinate technology assessment events and prepare briefs for consideration at the quarterly science and technology advisory council meeting. It is at this meeting that a new technology satisfying a defined gap may receive an endorsement letter, which, in turn, is used to support further development. The TAU often assists with securing funding for promising technologies via this path. Funding may come from the USASOC or any number of other entities. The process ultimately ends with commercial product availability to SOF Medics through the USASOC medical logistics system via the G8 directorate.

USASOC S&T provides defined needs (via gaps), command approval (with endorsement letters), and a transition pathway. While many S&T lines of research are developing solutions for implementation at a multiyear distance, it is obviously critical that we remain agile and responsive to new and immediate needs of Special Operations Forces medicine (SOFMED) personnel. This editorial is intended to reach out to our SOF Medic community and provide a line of communication. Venues such as the annual Special Operations Medical Association (SOMA) Meeting and Scientific Assembly provide opportunity for Medics to present their experiences formally with peer-group discussion. Similarly, the *Journal of Special Operations Medicine* and its biweekly e-mail newsletter represent a means of gathering attention for a new problem. However, for teams actively engaged downrange, these are not timely options and they would naturally communicate through their chain of command via group surgeon, flight surgeon, and so forth.

USASOC S&T can readily facilitate identification of new gaps and associated solutions. Sometimes a commercial device or product exists that solves the problem, whereas others require evaluation and definition of a new official medical S&T gap. We know that SOFMED is Medic driven. We must actively solicit input from our medical Operators to ensure the best training, equipment, and likelihood of mission success.

The USASOC S&T Division is eager to communicate with SOFMED personnel who have identified both new gaps and solutions to existing problems. Although the annual SOMA conference is an ideal venue for face-to-face discussions and long-term planning, please contact us directly for more immediate concerns or visit us at Ft. Bragg, North Carolina: US Army Special Operations Command, Division of S&T; telephone: 910-432-2723.

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Mr Forman spent the last 35 years in the Army Special Operations Community, having spent his first 10 years in the Rangers starting in the 1st Ranger Battalion, as well as working in the Mountain Ranger Camp as a Ranger Instructor. He subsequently spent 11 years in 5th Special Forces Group (Airborne) and the 3rd Special Forces Group (Airborne). In 1999, he retired from the US John F. Kennedy Special Warfare Center and School. In 1999, Mr Forman was one of two Americans in charge of Humanitarian Demining Operations in Namibia, South Africa, for the State Department. In 2000, Mr Forman went to work for US Army Special Operations Command as a contractor doing project management as well as instructing in the Special Forces Advanced Special Operations Course. In 2004, he started working in the USASOC Science and Technology Division, where he currently is Deputy Division Chief. E-mail: formans@soc.mil.

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Mr Gothard was commissioned as a Second Lieutenant in the Infantry upon graduation from the University of Dayton in 1978. His first assignment was with the 82nd Airborne Division, where he served as a Rifle Platoon Leader. He subsequently served as a Special Forces Officer in a variety of command and staff positions in the 5th and 7th Special Forces Groups, the John F. Kennedy Special Warfare Center and School, and classified assignments. BG Gothard served as the Chief, Training and Mobilization Division, for the US Army Civil Affairs and Psychological Operations Command. He subsequently commanded the 2d Battalion, 321st Regiment, of the 108th Training Division. In January 2006, BG Gothard deployed to Iraq as the Chief, Division Military Training Team, 5th Division, Iraqi Assistance Group, Multi-National Corps-Iraq, where he was the Senior US Advisor. He assumed command of the 353d Civil Affairs Command in 2007. In April 2010, BG Gothard assumed the duties as the Deputy Commanding General (Support) and Chief of Staff, US Army Reserve Command. BG Gothard assumed duties as the Deputy Commanding General, 81st Regional Support Command on 1 November 2011 where he served until his retirement on 17 May 2014. In his civilian capacity, Mr Gothard has served the US Army Special Operations Command (USASOC) as a G8 Combat Developments Officer, Chief of the G8 Advanced Technology Branch, and the G9 Science and Technology Manager. He currently serves as the G9 Chief of the Science and Technology Division responsible for all aspects of the USASOC Science and Technology Program. E-mail: gothardw@soc.mil.

Keywords: *US Army Special Operations Command Science and Technology Division; USASOC S&T; science and technology; special warfare; surgical strike operations*

Traumatic Brain Injury

Its Outcomes and High Altitude

by Rovshan M. Ismailov, MD, PhD; Judith M. Lytle, PhD

Traumatic brain injury (TBI) has been frequently called a hallmark of military conflicts in Iraq and Afghanistan. In addition, the Armed Forces Health Surveillance Center reports an increasing rate of TBI in US Armed Forces that is greatest in the US Army. The Congressional Research Service reports a total of 253,300 TBI cases between 1 January 2000 and 20 August 2012, with the Army averaging about 20,000 TBIs per year from 2007 to 2011.[1]

Posttraumatic headache (PTH) remains the most frequent symptom after TBI and will continue to be a problem in the military healthcare system. One study showed that 19% of Soldiers returning from combat duty in 2005 had symptoms consistent with migraine and that, for migraine-like PTH, individuals who had the most severe headache pain had the highest headache frequencies.[2] However, TBI can also lead to a number of other negative outcomes, such as stroke, depression, various cognitive dysfunctions, posttraumatic stress disorder (PTSD), anxiety disorder, sleep disorders, epilepsy, visual disturbance, hearing loss, tinnitus, and memory loss.[3,4] For example, injured active-duty Operation Iraqi Freedom personnel presented with a substantially higher prevalence of PTSD than did uninjured personnel (32% versus 14%).[5] Population-based research evidence suggests that TBI may increase risk of stroke by 10-fold, even after adjusting for the most important confounders.[6]

Among other sequelae, TBI triggers neuroinflammation and activates microglia. While inflammation is reparative acutely, chronic persistence may lead to secondary injuries, causing neurological symptoms such as headache.[7] Further, mechanical trauma from TBI and resulting neuroinflammation can alter blood–brain barrier (BBB) function, allowing entry of substances from circulating blood into the brain's interstitial space, both protective and harmful. TBI induces a myriad other responses, including involvement of the peripheral immune system and influx of potentially cytotoxic bloodborne proteins and pathogens. This causes neuronal damage and glial activation that can further contribute to BBB permeability. Leukocytes, cytokines, and other inflammatory mediators cross the BBB after TBI, contributing to chronic pathology. Many of these sequelae persist for days, months, or years.

Severity and duration of postconcussion syndrome (including PTH) are not related to the severity of TBI. There must be other factors at play. Wartime theaters of operation have occurred in various parts of the world and very often much above the sea level. Altitude was a factor in recent military operations in Iraq (Operation Iraqi Freedom and Operation New Dawn) and Afghanistan (Operation Enduring Freedom). Iraq has an upper elevation of approximately 12,000 ft (3,600m), and Afghanistan has an upper elevation of approximately 24,000 ft (7,200m). High altitude (4,900–11,500 ft) brings the onset of physiological effects of diminished oxygen pressure. At very high altitude (11,500–18,000 ft), maximum arterial oxygen saturation falls below 90%.[8]

On one hand, cellular hypoxia is caused by decreased barometric pressure, predisposing to various negative post-TBI outcomes. Hypoxic injuries are closely associated with disturbed BBB function,[9] allowing substances to cross the BBB. In addition, high elevation results in lowered partial pressure of oxygen and the human brain responds to it by changing the responsiveness of cerebral circulation.[10] Exposure to hypoxia has been also shown to result in multiple changes to the central nervous system, such as verbal working and short-term memory impairment, hippocampal atrophy, and neurodegeneration, as well as a significant difference in the middle, posterior cerebral, and basilar artery flow velocity.[10]

On the other hand, hypoxia can also trigger some potentially beneficial physiological reactions to protect the human body from damage. One potentially beneficial reaction is the higher production of erythropoietin (EPO) by human kidneys. Previous research evidence suggests that subtle hypoxia can result in moderate production of

EPO, whereas presence at 3,000m above sea level may result in a sharp, almost twofold renal EPO production.[11] EPO has been shown to possess multiple neuroprotective properties.[12] EPO was also shown to protect the astroglial space by reducing the concentration of extracellular glutamate.[12] In addition, EPO was shown to be an effective agent protecting and repairing many important processes in the nervous system. Furthermore, synthesis of EPO in astrocytes could protect them against apoptogenic chemicals or even low oxygen pressure.[12] Overall, EPO is currently viewed as a substance that can sustain antiapoptotic responses in many tissues where it can be regarded as a general tissue-protective cytokine.

TBI is a complex process with several stages, the initial stage being the impact itself (i.e., blunt object or blast) followed by several complex physiologic and biochemical reactions, such as accumulation of free radicals, direct trauma to cell membranes by free radicals, and a cascade of inflammatory reactions following by cell apoptosis.[13–15] Cumulatively, these reactions are likely to cause neurodegeneration and subsequent PTH[7] and potentially other adverse outcomes such as depression, PTSD, or sleeping disorders. An alteration or elimination of one or more of these posttrauma reactions is likely to result in fewer adverse outcomes as well as a better prognosis for TBI. If head trauma has occurred at high altitude, both profound cellular hypoxia and higher EPO production by the kidneys are likely to affect many complex physiologic and biochemical reactions following injury and, therefore, all post-TBI outcomes. Thus, it is unclear whether high altitude is an additional risk factor for all negative outcomes associated with TBI such as PTH, depression, or PTSD acutely or chronically post-TBI, and there is a need to conduct further research in the area. It is likely that high altitude can trigger many negative post-TBI outcomes; however, some of them could be more affected than others due to the protective role of EPO.

Knowledge that high altitude may trigger various post-TBI outcomes may help justify additional screening, diagnostic, preventive, and treatment procedures among Warfighters returning from military duties at high altitude. This is particularly important because, for example, untreated headaches are known to cause various mental issues, ranging from mental anguish and substance abuse to suicide. Moreover, PTSD and depression are the leading causes of medical visits and missed workdays among Soldiers with TBI. Thus, proper diagnosis of post-TBI outcomes among Soldiers returning from military duties at high altitude would be essential and could include not only additional diagnostic procedures but also detailed evaluation for conditions such as PTSD, depression, epilepsy, visual disturbance, cognitive functions, hearing loss, tinnitus, memory loss, anxiety, and insomnia. This could improve return-to-duty times and bolster performance. In addition, it will help establish new research directions in this area, such as those focusing on a better classification or a new treatment for PTH, PTSD, or depression.

Disclosures

The authors have nothing to disclose.

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Dr Ismailov is a medical doctor who earned his PhD in injury and cardiovascular epidemiology from the University of Pittsburgh. Together with his collaborators from Pacific Institute for Research and Evaluation and University of Pittsburgh, he conducted the first population-based studies that examined the role of trauma in many important and serious cardiac events which was an important step from an epidemiological point of view. Dr Ismailov was a recipient of the Dean's Endowment Scholarship, a finalist for the Student Research Achievement Award Competition at the 47th Annual Biophysical Society Meeting, and featured student in *Public Health,* the official magazine of Graduate School of Public Health University of Pittsburgh. His publications appeared in such prestigious scientific journals as *American Heart Journal, Annals of Neurology, Journal of Trauma, Alzheimer Disease & Associated Disorders,* and others. He currently heads the nonprofit Complex Mechanisms of Disease, Aging and Trauma Research Foundation in Glendale, CO. E-mail: dr.ismailov@cmdat.org.

Dr Lytle earned her PhD in interdisciplinary neuroscience from Georgetown University Medical Center in Washington DC. In 2007, she was awarded a National Defense and Global Security Fellowship with the American Association for the Advancement of Science and served at the Office of Naval Research, managing biomedical research and development programs. She has also served as a programmatic reviewer for the US Department of Defense Congressionally Directed Medical Research Program. In 2009, Dr Lytle joined AVIAN LLC as their Science and Technology Division Director and went on to become a director of Business Development and chair of AVIAN's Science and Technology Center of Excellence. In 2009, she was awarded the Chief of Naval Research Gold Coin for her contributions to the US Naval Science and Technology Strategic Plan. In 2012, Dr Lytle was awarded the Commander Naval Air Forces Force Surgeon Gold Coin for her efforts associated with their hypoxia mitigation program. She is currently a Director at the Pacific Northwest Research Institute (www.pnri.org), Seattle, Washington.

KEYWORDS: *high altitude; traumatic brain injury; Editorials; Posttraumatic headache*

Power to the People

by Steven Schauer, DO; Cord Cunningham, MD; Robert DeLorenzo, MD

You are about to start golf season with a limited budget to get you through the summer. Where do you sink your budget: a new driver, a new putter, or lessons from the clubhouse professional? Like a misguided golfer who repeatedly seeks the panacea of yet another piece of fancy equipment that will achieve Jack Nicholas–like performance, the military medical establishment sidesteps better training in the hope of a technology solution to the challenges of far-forward combat casualty care.[1]

Since 1990, the US Army Medical and Materials Command has executed more than $9.6 billion in appropriations,[2] much of which is in search of a supposed technology game changer. This elusive device or drug would save lives, replacing Combat Medic skills with technology. Despite repeated calls for more than a quarter of a century, a proportional amount of resources has not been aligned with training.[3–6] Aside from some pharmaceutical agents, there is no equipment in the Medic's aid bag that was not there several decades ago. Even with the addition of drugs to that aid bag, recent data demonstrate poor adherence to Tactical Combat Casualty Care-recommended use; lack of training with these agents is almost certainly a contributing factor.[7]

To be sure, two important advances in combat medical training must be highlighted: the Army 68W revolution spearheaded at the turn of the century and the more recent program to train Army Flight Medics to the Paramedic level. But, in reality, both initiatives were mere catch-up moves to align Army Medic training with a far more advanced and effective civilian trauma standard. With the experience of the two recent wars and a pause in the action allowing for retraining and refitting, now is the time for the Army and the entire military medical establishment to lead, and not lag, in combat casualty training.

At a strength of approximately 20,000, the 68W Combat Medic military occupational specialty (MOS) is the second largest MOS in the Army and the largest group of battlefield medical providers. The literature has shown both the significant level of preventable deaths that occur in the prehospital setting before reaching the fixed facility, as well as a clearly demonstrable improvement in mortality with the properly trained prehospital providers.[8,9] However, the 68W advancement model is starkly contrasted with the rest of the Soldiers they serve next to in combat.

The 11-MOS (infantry) and 18-MOS (Special Forces) series Soldiers make up the considerable percentage Warfighters where advancement in combat skills is requisite for advancement in rank. The 11- and 18-MOS Soldiers must seek schools and MOS-related advanced training as well as noncommissioned officer (NCO) education system classes to move up in rank.

The 68W training model is disappointingly different. The average Soldier entering basic training is 20.7 years old, rapidly moving from basic training through 16 weeks of advanced individual training, where they are trained to a skill level roughly equivalent to that of the civilian advanced emergency medical technician (AEMT;