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Journal of Special Operations Medicine

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THIS EDITION'S FEATURE ARTICLES:

- Adaptive Eyewear: Freeing the (Visually) Oppressed
- Battlefield Use of Human Plasma by Special Operations Forces
- Thoughts on Aid Bags Part 2
- CME -- Using Modeling to Predict Medical Requirements for Special Operations Missions
- A New Look On Civil Military Operations
- Ultrasound in Special Operations Medicine: A Proposal For Application And Training

Dedicated to the Indomitable Spirit & Sacrifices of the SOF Medic

Journal of Special Operations Medicine

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COVER

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The Fall cover is of two artist renditions of AFSOC PJs. Artists unknown.

From the Editor

The Journal of Special Operations Medicine (JSOM) is an authorized official military quarterly publication of the United States Special Operations Command (USSOCOM), MacDill Air Force Base, Florida. The JSOM is not a publication of the Special Operations Medical Association (SOMA). Our mission is to promote the professional development of Special Operations medical personnel by providing a forum for the examination of the latest advancements in medicine and the history of unconventional warfare medicine.

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Distribution: This publication is targeted to SOF medical personnel. There are several ways for you to obtain the Journal of Special Operations Medicine (JSOM). 1) USSOCOM-SG distributes the JSOM to all our SOF units and our active editorial consultants. **2) SOMA members receive the JSOM as part of membership. Please note, if you are a SOMA member and are not receiving the subscription, you can contact SOMA through http://www.trueresearch.org/soma/ or contact Jean Bordas at j.bordas@trueresearch.org.** SOMA provides a very valuable means of obtaining SOF related CME, as well as an annual gathering of SOF medical folks to share current issues. 3) For JSOM readers who do not fall into either of the above mentioned categories, the JSOM is available through paid subscription from the Superintendent of Documents, U.S. Government Printing Office (GPO), for only $30 a year. Superintendent of Documents, P.O. Box 371954, Pittsburgh, PA 15250-7954. GPO order desk -- telephone (202) 512-1800; fax (202) 512-2250; or visit http://bookstore.gpo.gov/subscriptions/alphabet.html. You may also use this link to send a email message to the GPO Order Desk — orders@gpo.gov. 4) The JSOM is online through the Joint Special Operations University's new SOF Medical Gateway; it is available to all DoD employees at https://jsoupublic.socom.mil/publications/index.php. On the left you will have several tabs; you must first "log-in" using your SS#, DOB, and name; then go to "publications." Scroll down until you get to the JSOM and click on the picture. From this site, you can link straight to the Government Printing Office to subscribe to the JSOM. We are working with the JSOU to have a SOCOM-SG medical site; we will keep you posted as that progresses. 5) The JSOM can also be emailed in PDF format; if you would like to be added to the PDF list please send your request to JSOM@socom.mil.

We need Continuing Medical Education (CME) articles!!!! In coordination with the Uniformed Services University of Health Sciences (USUHS), we offer CME/CNE to physicians, PAs, and nurses. SOCOM/SG Education and Training office offers continuing education credits for all SF Medics, PJs, and SEAL Corpsmen.

JSOM CME consists of an educational article which serves to maintain, develop, or increase the knowledge, skills, and professional performance and relationships that a physician uses to provide services for patients, the public, or the profession. The content of CME is that body of knowledge and skills generally recognized and accepted by the profession as within the basic medical sciences, the discipline of clinical medicine, and the provision of healthcare to the public. A formally planned Category 1 educational activity is one that meets all accreditation standards, covers a specific subject area that is scientifically valid, and is appropriate in depth and scope for the intended physician audience. More specifically, the activity must:

- Be based on a perceived or demonstrated educational need which is documented
- Be intended to meet the continuing education needs of an individual physician or specific group of physicians
- Have stated educational objectives for the activity
- Have content which is appropriate for the specified objectives
- Use teaching/learning methodologies and techniques which are suitable for the objectives and format of the activity
- Use evaluation mechanisms defined to assess the quality of the activity and its relevance to the stated needs and objectives

To qualify for 1 CME, it must take 60 min to both read the article and take the accompanying test. To accomplish this, your articles need to be approximately 12 - 15 pages long with a 10 - 15 question test. The JSOM continues to survive because of the generous and time-consuming contributions sent in by physicians and SOF medics, both current and retired, as well as researchers. We need your help! Get published in a peer-review journal NOW! See General Rules of Submission in the back of this journal. We are always looking for SOF-related articles from current and/or former SOF medical veterans. We need you to submit articles that deal with trauma, orthopedic injuries, infectious disease processes, and/or environment and wilderness medicine. More than anything, we need you to write CME articles. Help keep each other current in your re-licensure requirements. Don't forget to send photos to accompany the articles or alone to be included in the photo gallery associated with medical guys and/or training. If you have contributions great or small… send them our way. Our e-mail is: JSOM@socom.mil.

Lt Col Michelle DuGuay Landers

Dedication

SERGEANT FIRST CLASS
JEFFREY M. RADAMORALES

Sergeant First Class (SFC) Jeffrey M. Radamorales, 32, died as a result of a non-battle accident on June 28, Kandahar province, Afghanistan, in support of combat operations while serving with 7th Special Forces Group (Airborne).

He deployed in support of Operation Enduring Freedom in May 2008 as a member of the Combined Joint Special Operations Task Force – Afghanistan. This was his second deployment in support of the Global War on Terror and his second deployment to Afghanistan.

SFC Radamorales, a native of Naranjito, Puerto Rico, volunteered for military service and entered the Army in April 1995 as an animal care specialist. He was initially assigned as a veterinary technician at Patrick Air Force Base, FL, where he served for 14 months. In 1996 he moved to the 248th Medical Detachment at Fort Bragg, NC; in 1999 he went to Aberdeen Proving Ground for three years. He moved back to Fort Bragg in 2002, assigned to the John F. Kennedy Special Warfare Center and School, first as an animal care instructor, then as a student while training as a Special Forces medical sergeant. In 2007 he earned the coveted "Green Beret" and was assigned to 1st Bn., 7th SFG(A) at Fort Bragg as a Special Forces Operational Detachment Alpha senior medical sergeant.

SFC Radamorales' military training includes: the Basic Noncommissioned Officer Course; Survival, Evasion, Resistance, and Escape Course; Basic Airborne Course; Jumpmaster Course; Air Assault Course; Warrior Leaders Course; Basic Instructor Training Course; and Special Forces Qualification Course.

His awards and decorations include the Meritorious Service Medal, Joint Service Commendation Medal, three Army Commendation Medals, seven Army Achievement Medals, four Army Good Conduct Medals, National Defense Service Medal, Afghanistan Campaign Medal, Global War on Terrorism Service Medal, Humanitarian Service Medal, Noncommissioned Officer Professional Development Ribbon, Army Service Ribbon, NATO Medal, Senior Parachutist Badge, Air Assault Badge, and the Special Forces Tab.

SFC Radamorales is survived by his wife, stepson, daughter, and mother.

From the Command Surgeon

WARNER D. "Rocky" FARR
COLONEL, U.S. ARMY
Command Surgeon
HQ USSOCOM

Just when I thought the summer PCS season was over, I found out that COL Jose Baez, MSC, USA, our most excellent medical acquisition officer, is quickstep PCS-ing to Chicago by Christmas to run the Army's ground vehicle procurement program. Jose will be tremendously missed by both the Command Surgeon's Office and the USSOCOM Special Operations Acquisition and Logistics (SOAL). The "TCCC Acquisition Program" has done a great job of cross leveling the decks so that all Special Operations Forces Operators, Medics, and medical officers could get what they needed, as each Service is different in their ability to support SOF with Class VIII supplies and each Service's service-common stocks and abilities are different. We have fielded the new, updated individual first aid kits (SOF IFAK) and the medic kits. We are now looking at vehicle kits and what SOF forward surgical teams might need. We are about to improve the combat pill pack to a two-year shelf life with a new production process Jose got for us. Combat Gauze and Woundstat have arrived to replace Chitosan (Hemcon) and Quickclot. I recently sent out new Tactical Combat Casualty Care Committee guidelines in the Summer 08 edition, one of which is to use the "first responder card."

I am eagerly awaiting the second edition of the SOF Medic Handbook rolling off the presses in November, and I hope to have some at the Special Operations Medical Association (SOMA) Conference in December. Bob Clayton and Gay Thompson have done a great job of updating it. A large "thank you" to all the docs, physician assistants, and many SOF Medics who contributed time and effort to redoing what has become a classic work that is used by many more than just our community. It was a major accomplishment to get it out as soon as we have.

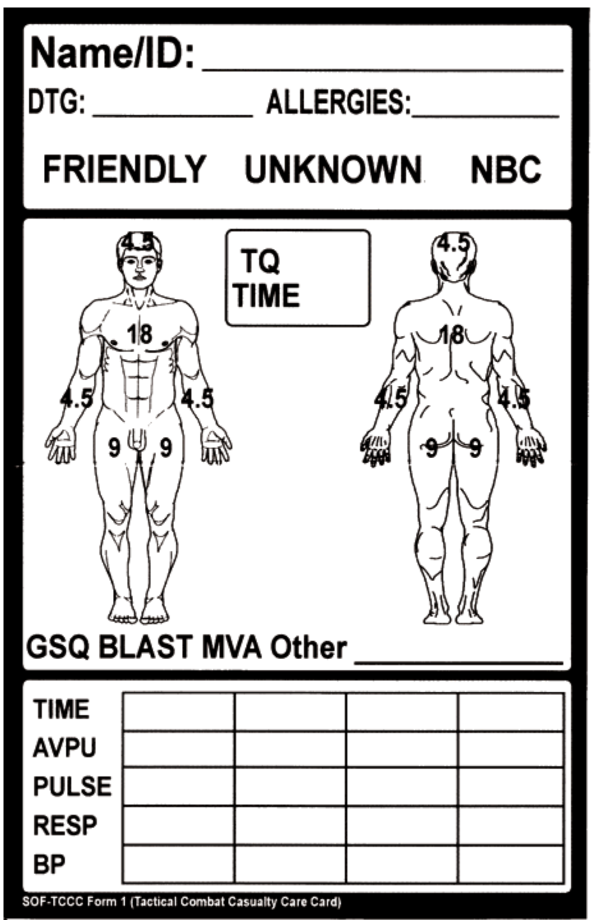
LTC Craig Myatt, MSC, USA, has arrived in my office. He is a research psychologist and will help us explore the issue of stress in the force, the long war, and what to do about it. SOF is actually doing quite well, and I want to keep it that way. You may see him as he makes the rounds getting smartened up on the issues at each command or at SOMA. As you have probably seen, the Services are experiencing more suicides than in past years and SOF is no exception. We all need to work at seeing what we can do to support the warfighters in all phases of the life cycle: pre-deployment, deployment, and post-deployment. We are blessed with stress-hearty, resilient Soldiers, Sailors, Airmen, and Marines, but they all have ultimate limits; time to explore such.

As for SOMA, I cannot wait. It is the one time a year that we get to see a large portion of the force and hear how things are going at the war. The meeting continues to grow and develop; attend if at all possible and say hello. I am bad with both names and faces. I stay in the Army (42 years next April) just for the nametags.

I am flying down to SOCSOUTH shortly to see their commanding general, BG Pagan (I believe the flight was canceled for this Friday but I believe he intends to meet with BG Pagan here at SOCOM or via VTC in the short term – FYI) . When SOCSOUTH gets their Theater Special Operations Command (TSOC) Surgeon, a U.S. Navy billet, by the end of November we will at last have TSOC Surgeons in all geographic combatant command TSOCs.

The *Journal of Special Operations Medicine* is still growing. I stand by my statement that I have NEVER turned down a submission by an enlisted Medic. So if you are tired of reading things written by physicians and PAs, act accordingly and write! Thanks to all of you who have taken the time to write and submit to the JSOM. You will notice that the page count is steadily going up.

The war continues, my wife, LTC Kathleen Farr, MC, USAR, deployed to OEF last week. My oldest son, LTC David Farr, JAG, TXANG, will be heading over next year. The youngest, Maj Timothy Farr, USAF, got back this year. We will all see what 2009 holds in store for each of us; the new administration gets a vote but so does the enemy!



Name/ID: ______________________

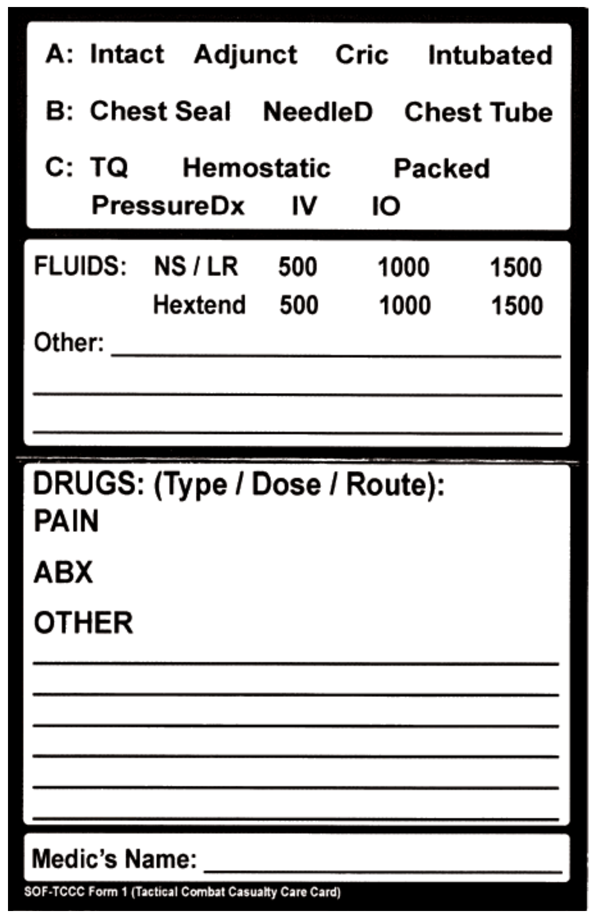
DTG: ____________ ALLERGIES: ____________

FRIENDLY UNKNOWN NBC

GSQ BLAST MVA Other ______________

TIME				
AVPU				
PULSE				
RESP				
BP				

SOF-TCCC Form 1 (Tactical Combat Casualty Care Card)



A: Intact Adjunct Cric Intubated

B: Chest Seal NeedleD Chest Tube

C: TQ Hemostatic Packed PressureDx IV IO

FLUIDS: NS / LR 500 1000 1500
Hextend 500 1000 1500
Other: ______________________

DRUGS: (Type / Dose / Route):
PAIN
ABX
OTHER

Medic's Name: ______________________

SOF-TCCC Form 1 (Tactical Combat Casualty Care Card)

Our trainings section has been working on various plans for ATP card reciprocity with the civilian world. See the letter from the BCCTPC printed below. We plan to move forward with other ways to take our ATP federal certification and get it recognized by others in the civilian pre-hospital community.

BCCTPC
Board For Critical Care Transport Paramedic Certification

BOARD FOR CRITICAL CARE
TRANSPORT PARAMEDIC CERTIFICATION

GRAHAM PIERCE, CHAIRMAN OF THE BOARD — JOHN COLE MEDICAL DIRECTOR

October 30, 2008

COL Warner D. Farr, M.D., MPH
United States Special Operations Command
Office of the Command Surgeon
7701 Tampa Point Blvd
MacDill Air Force Base, Florida 33621-5323

COL Farr:

This letter is in regards to our October 20th, 2008 meeting, at the Air Medical Transport Conference in Minneapolis.

We thank you for the very informative presentation on the background and education of the Advanced Tactical Practioner (ATP), within the Special Operations Forces of the United States Military.

Following this meeting, the Board met to specifically discuss the question of whether the ATP meets the educational requirements, and qualifications to be a candidate for the "Certified Flight Paramedic Exam" (FP-C).

We are very pleased to inform you that the Board unanimously approved your request. Therefore, all Special Operations Forces medics who obtain the certification of ATP are now eligible to sit for the Certified Flight Paramedic exam.

We look forward to working with you in the future. Please contact me directly if we can be of any further assistance, or if you have any questions regarding the process.

GRAHAM W PIERCE BS, MICP, FP-C
Chairman of the Board

ENLISTED CORNER

Senior Enlisted Medical Advisor (SEMA)
SOCM Glenn Mercer

As this edition is predictably mailed just prior to the Special Operations Medical Association (SOMA) Conference, I take the opportunity to discuss our new *Training Directive*. We expect the new *TR 350-29* to make its final approaches through the staffing channels this month. By the time we assemble at SOMA in December, we should be able to quote, manage, and refer responsibilities from the final document. As the component leaders are aware, this directive solves a 10-year track record of vague training policies that were exempted, waived, ignored, and bypassed more times than stop signs in California. My litmus test for a policy document is simple: does it help or hinder leaders doing their jobs. In the case of this *350*, this document is binding. It closes the "by exception" and decision of the year atmospherics that have been the hallmarks of SOCOM 40-series polices. I am pleased to say we finally have some rules and strong policies that are enforceable in a point-to-point capacity between HHQ and the force we are supposed to be governing and subsequently providing Quality Assurance for.

While this directive is centric to the Advanced Tactical Practitioner (ATP), it also delineates and validates our high yield, formally internal boards like the CEB. Actions such as these are critical to our legitimacy as a specialized force supporting the Commanders' strategic missions. We are sufficiently diverse in our technical applications and employment doctrine that having a Line legitimatized standards baseline in 2008 is paramount to our future.

Newcomers, transients, or personnel stepping back into in the SOF medical force may have difficulty with the strict construction of this *350* and that is to be expected. Education as to the why may be necessary. Medics and the Medical Corps have shown adaptability with HHQ being far too obtuse in the past about who we are and what we do. It is that same adaptability that will set the foundation for correct critical decisions in the future. In 15 years, culminating with seven years of sustained conflict, we have driven a complete circle in regards to mission-driven standards. At one point we allowed ourselves to believe that a civilian for-profit organization set our standards for us. With this directive in place we will orient correctly. Mission requirements set by the Line and a response chain aligned with this practice is the correct posture.

Significant credit for initial actions that allowed this *350* to mature goes to MSG Sam Rodriguez of USASOC who in early 2004 had the foresight and maturity to define us by our common mission and warfare specialty first. While contrarian at the time, it was the necessary thing to do. The ATP is the most accurate descriptor for what we do right now, since the skills and capabilities conferred by the title ATP are unique and proprietary to SOF. It was MSG Rodriguez's initiatives and experience that allowed Chapter 4 to establish simple, direct qualifiers for who is, and who is not, eligible to receive a certification within this architecture.

In conclusion, it is appropriate to advertise that this SOCOM Senior Medic position is in need of a new Technical Leader. I have served our Command Surgeon for the last 24 months and due to the successes in Human Performance I will likely begin full-time efforts in that venue. This position has evolved substantially since its first fill over a decade ago and is more appropriately titled “Force Medical Advisor” as it requires equal time unifying efforts both up and down the joint chain of command. This position serves at the convenience of the Surgeon, so candidates will need to gain concurrence from the Component COC / Branch Managers and the present SOCOM Surgeon. This position is appropriate for all Army or Navy SOF Enlisted Classifications at pay grade E9, but E8 will be considered. Having Enlisted Advisor and line leadership experience are advantageous but not prerequisites. This position primarily provides technical leadership for a force of 1400, chairs the Enlisted Advisory Council, influences the Requirements process and is a voting representative in the SOAL-T selection processes. Candidates should contact the SOCOM Deputy Surgeon no earlier than APR 2009. Permanent station is MacDill, AFB and a PCS move would be required in the summer of 2009.

COMPONENT SURGEON

USASOC

Virgil Deal, MD
COL, USA
Command Surgeon

Let me start by saying "Thanks" to the Surgeons who let their folks attend our recent Special Operations Medical Indoctrination Course or intro course for new, or sorta new, medical personnel to ARSOF. As I look over the credentials of the typical newcomer to the USASOC world, I continue to be impressed by the fact that we do indeed attract the best and brightest of our medical departments. While welcoming Docs who were new not only to Special Forces, but brand new to the Army, may have been the norm a couple of decades ago, that is not the case today. Never before has the Army fielded as competent and as well trained a medical force in support of the SOF fight.

Kudos to all for your continued and expert care of our combat wounded. We're staying in touch with the traumatic brain injury task forces and anticipate their release very soon on what will amount to clinical practice guidelines for the complete spectrum of brain injury at the first responder and unit level. A lot of research is being directed at the diagnosis and management of brain injury nationwide. Hopefully some better diagnostic tools will soon be in the inventory.

Our efforts to continue to update the medical equipment of the force and to outfit our new battalions are ongoing. We certainly appreciate the work you are all doing to keep the Lessons Learned (and the Lessons Not Quite Learned) coming back to us so that we can indeed learn from the experiences down range. One only has to compare the medical kit at an Operational Detachment – Alpha's disposal today to what we had in 2001 to realize that much work has been done. Everyone's work in the new CASEVAC equipment is just one example of the SOCOM medical machine at work. Complacency however, doesn't appear in any of our mission statements and we'll keep hunting for the lighter, better, faster stuff in every category. We'll be looking forward again to the SOMA get together as a great forum to exchange information from forward to CONUS and unit to unit. See you there!

COMPONENT SURGEON

AFSOC

Timothy McCormick, MD
Col, USAF
Command Surgeon

I just returned from 180-day deployment in Kandahar, Afghanistan, where I was the Senior Mentor to the Afghan Commander at the newly built and just opened 50-bed Afghan National Army Hospital about four miles outside the wire from Kandahar Air Base. I had 14 Air Force Medics working with me to mentor 175 Afghan medics. The deployment was an opportunity I highly recommend to anyone. Prior to the deployment, I spent 60 days at Combat Skills Training at Fort Riley, Kansas. The Army trainers, most just returning from either Afghanistan or Iraq, did a great job of preparing troops from all Services. My welcome back included saying goodbye to our Surgeon, Col Tim Jex and preparing for our new Surgeon, Col Bart Iddins.

In August, Col Jex departed and joined the Air Staff as Deputy Assistant Surgeon General, Health Care Operations. Congratulations Col Jex and thanks for the outstanding leadership you provided the command! As is the tradition with filling the AFSOC/SG position, in November, Col Bart Iddins, another great leader, will replace Col Jex.

Col Iddins brings a wealth of operational and SOF experience with him as the next AFSOC/SG. He is a veteran within the SOF world with assignments that include being an Operational Flight Surgeon with the 67 Special Operations Squadron (SOS), the Special Tactics Squadron Medical Director for the 321 Special Tactics Squadron (STS), and Operational Medical Flight Commander with the 352 Special Operations Group (SOG). He also has held a number of key leadership positions in the Global War on Terror (GWOT) fight with the most recent being the Commander, Joint Task Force MED, Bagram Airfield, Afghanistan and the Vice Commander, 59 Medical Wing (MDW). Welcome, Col Iddins!

As we go into the final quarter of the calendar year, the topic around the command seems to be change. We continue to build-up our west coast AFSOC wing, retire aircraft that have served Special Operations Forces so well, and bring on new aircraft to support the GWOT as well as future wars.

Clovis, NM, continues to see different aircraft flying their skies and the new faces of the Airmen that fly, maintain, and support them. The 27 Special Operations Wing (SOW) is well on their way to being a fully operational organization with the ability to support SOF. As a matter of fact, this quarter will mark the first deployment for the wing in support of SOF. Congratulations to the men and women of the 27 SOW; rest assured, this is just the beginning.

We also recently saw the end of an era. The Special Operations' workhorse for 41 years, MH-53 Pave Low helicopter, was retired in October. And with its retirement came the deactivation of the decorated 20 SOS. The Pave Low served the command extraordinarily over its lifespan. Whether infilling or exfilling SOF personnel, conducting Combat Search and Rescue (CSAR) missions, or being utilized as a CASEVAC platform, the Pave Low and its crews lived up to their motto, "Any Time, Any Place." In fitting manner, the last mission flown by the 20 SOS and the Pave Low occurred over the skies of Iraq on 26 August. The MH-53 was retired and the unit deactivated on 17 October.

But, as the Pave Low is given a much deserved rest, the command is bringing on many new and exciting aircraft. From the much-anticipated CV-22 to the non-standard aircraft, the command's fleet is changing nearly by the day. And with the addition of these aircraft, the surgeon's office is working hard to integrate "medical" into each airframe and its mission, whether from the human performance perspective or ensuring CASEVAC planning is included.

COMPONENT SURGEON

NAVSPECWARCOM

Jay Sourbeer, MD
CAPT, USN
Command Surgeon

The men of Naval Special Warfare (NSW) are often held to be examples of strength and tenacity, steadfast and immutable. In identification of our men as SEAL and SWCC warriors we recognize that they have the capacity to fight and win in circumstances where most men quit. Because personality is in large part either inherited or developed by early adulthood, our men are often considered a rare breed distinct from lesser men, but this simple perception is not the entire story.

It is true that some of the strength of our personnel is inherent in the personality traits they bring to the community through the selection process. Only the men that nature or nurture has bestowed with a certain degree of determination elect to persevere, but that process itself reveals that character strength, like physical strength, grows under stress. Rather than having merely static strength, which, our warriors are better characterized as having resilience, the ability to make positive adaptation to stress.

The stresses of extended war have reinforced the premise that resilience can be taught. Whether in SEAL/SWCC basic training or in the crucible of combat, it becomes apparent that determination and resilience are infectious; a resilient leader can inspire determination in others.

Inspired by the twin premises that even the toughest individuals can further develop resilience and that individual resilience can extend to others, NSW has embarked upon a concerted effort to develop mental resilience for our warriors and their families. The tasks of defining resilience factors and mapping a measurable way to build them in individuals and families is within the NSW Combat Stress program. We have implemented research into many factors, including neuropsychiatric baseline testing to allow us to recognize and manage sometimes subtle changes in function, including traumatic brain injury (TBI).

The recent completion of post combat decompression training allows us to objectively validate the ancient practice of "blowing off steam" with a band of brothers. Through family resilience retreats in the future we hope to integrate our families to be resilient together. Through expansion of our practice of embedding psychologists in our units and the use of surveys, we hope to build a database to support improvements in family resilience building. Through initiatives to improve access to medical care and child care we will improve the lives on the home front. It is hoped that teaching resilience across areas as diverse as family communication, healthy living, and finance, we will allow the NSW community to strengthen during war.

The Naval Special Warfare community cannot afford weakness that can be hammered into defeat. For the long run; therefore, we must impart resilience to have the dynamic strength to meet every challenge and grow stronger.

COMPONENT SURGEON

MARSOC

Stephen F. McCartney, MD
CAPT, USN
Command Surgeon

MARSOC's third birthday approaches. USSOCOM became fully joint with the assumption of MARSOC fully under their operational control 24 February 2006. At the time of this writing our second commander, Major General Mastin M. Robeson, USMC, has taken the helm and is fully engaged in meeting the challenges of USSOCOM's newest Component.

Major General Robeson is a graduate of the Basic School, the Amphibious Warfare School, the Command and Staff College, and a U.S. Army Advanced Operational Art Studies Fellowship. He has held numerous infantry command assignments both ashore and afloat with USS John F. Kennedy (CV 67) and the 22nd MEU. Recent assignments included Commander, Joint Task Force - Horn of Africa, Commanding General (CG) of the 3rd Marine Division, Deputy CG of III Marine Expeditionary Force and lastly, Director, CJ5 of Multinational Forces - Iraq. As 4th Marine Expeditionary Brigade Commander (Anti-terrorism), MG Robeson was instrumental in standing up the future MARSOC.

Priorities are unchanged. "People are more important than hardware," and MG Robeson makes taking care of the war fighter his number one priority. This past October 6th, our Marine Special Operations School (Stone Bay, NC) stepped off with its first 60 USMC Class in our Individual Training Course (ITC). As we train our own MARSOF Operators to the highest of standards we will continue to refine and formalize our assessment and selection process to allow us to access, not always the best Marine but the "right" Marine. We will continue to operationally refine the right balance of kinetic and non-kinetic missions.

By publishing time MSOC Hotel and Charlie will have returned from OEF. India and Delta Companies will be engaged as part of CJSOTF. Our traditional relationship with the MEU exists and will continue to be evaluated to determine if that is the best way for the MSOC to be employed.

At this time MARSOC Medical has reached 95% of its officers and 90% of its enlisted authorized strength. Since we don't have "SOF for Life" seven of our original plank owner medical officers, myself included, are slated to depart MARSOC in 2009. We continue to attract many Navy physicians from across the fleet to come to MARSOC Medical.

Of note, MARSOC has leaned ahead early with four interim facilities where we can begin to institute many of the principles inherent to the Warfighters Performance and Rehabilitation Center (WRPRC) program. Our WRPC team has looked at programs from both the military and civilian sector. Just recently, at the Baltimore Raven's training facility, our own Chief Petty Officer Anthony "Tony" Shattuck (DV/PJ), USN, coached an impromptu moving testimony to health, family, sacrifice, and healing. Tony was grievously wounded in Afghanistan in June of 2008. There wasn't a dry eye in the crowd as he spoke. When a three hundred pound linebacker weeps, you must have made an impression. Thanks, Tony for your service, even in adversity. Thank you to the 18Ds who came to his aid.

MARSOC thanks our Component Surgeons as well as for the phenomenal support we get from the Joint Special Operations Medical Training Center at Fort Bragg. MARSOC will continue to approach older paradigms as we grow and engage the enemy both on the battlefields and also in the hearts and minds of those who see America as a force for good. God Bless America.

CPO Shattuck, an outpatient from Bethesda Naval Hospital, is addressing the Baltimore Ravens football team, Sept 10, 2008 at their training facility. He spoke to them about the importance of health and fitness, specifically that he feels that his survival from combat related thoracoabdominal injuries and the subsequent surgeries to repair his injuries was due to his excellent state of health and fitness beforehand.

Major General Mastin M. Robeson
Commander, U.S. Marine Corps Forces Special Operations Command

SOCPAC

Frank J. Newton, MD
COL USA
Command Surgeon

Since the beginning of the Global War on Terrorism, SOF medical planners have been forward-thinking to ensure that advanced surgical capabilities are in the right place at the right time to save lives and decrease morbidity. Air Force Special Operations Command did an excellent job in refining the capabilities of Big Blue's 5-man Mobile Field Surgical Team (MFST) to meet the needs of SOF. Renaming it the Special Operations Surgical Team (SOST), members are volunteers who are hand-picked, motivated, and equipped with the tactics, techniques, and procedures that Commanders have come to rely on in SOF Medicine. The SOST is manned with a general surgeon, an orthopedic surgeon, a nurse anesthetist, an OR technician, and an emergency medicine physician.

Because the SOST is a high-demand resource in very limited supply, it must be deployed appropriately at the Tip of the Spear in support of our SOF. The Joint Special Operations Task Force – Philippines has been engaged in the Global War on Terrorism since 2002. Given the austerity of operations in the Southern Philippines, with long CASEVAC flight times and the non-availability of local medical treatment facilities, the need for forward resuscitative surgical capability continues. To balance the need for forward surgical capabilities in this area of operation and provide USSOCOM with SOSTs for emerging operations, the decision was made to replace the SOST with a conventional 5-man MFST after two years of continuous deployments.

Further refinement of the force structure for this MFST is under way. The orthopedic surgeon is being replaced with an orthopedic physician assistant. The goal of forward resuscitative surgical stabilization is unchanged and will not be degraded. The PA will serve the team as the surgical first assistant and provide orthopedic subject matter expertise to the trauma team and to our host nation military and civilian orthopedic counterparts. The decision to modify the team composition was based on the assessment that risk of extremity wounds to U.S. SOF in this AOR was low, and that orthopedic injuries could be stabilized with surgical treatment deferred to a more conducive setting for orthopedic surgery. Lastly, it is recognized that there is a greater demand for orthopedic surgeons at combat support hospitals supporting Operation Iraqi Freedom and Operation Enduring Freedom – Afghanistan.

Forward resuscitative surgical stabilization has proven to be a vital Forward Resuscitative Care (Level II) capability that gives commanders and SOF Operators greater confidence in conducting high-risk missions. I believe that tailoring the medical skill sets of this MFST was the right decision for this area of operation. An orthopedic surgeon may provide important additional capabilities to the SOST and MFST supporting SOF in other operations.

TSOC SURGEON

SOCAFRICA

Frank Anders, MD
COL USA
Command Surgeon

SOCAFRICA became a sub-unified Command under AFRICOM on 1 Oct 2008. This occurred six months prior to the planned date and thus caused us all some significant growing pains. The good news is that the medical shop is fully capable of supporting AFRICOM in medical planning for all operations on the African continent. We now have myself, MAJ Mike Nack (USA) as our very talented and capable Environmental Science Officer, and Capt John Lane (USAF) as our Medical Planner and the officer who started the development of our section last summer. I would be remiss if I did not mention the significant contributions of LTC Dieter DuPont (USAR), who assisted with the development of this office and is now Mr. DuPont and serving as the Chief of Staff of the AFRICOM Medical Division and Surgeon's Office.

We recently made a donation of over 6,000 pounds of durable medical equipment to the hospital in Ouagadougou, Burkina Faso. This was done through the AFRICOM Excess Property Program (EPP) in response to a request from the U.S. Ambassador to Burkina Faso to show our appreciation for medical care previously provided to one of our injured Soldiers. We were able to coordinate the air transport through the diligent efforts of MAJ Tim Switaj (USA), the Battalion Surgeon of the 1st Battalion, 10th Special Forces Group (Abn). 1st Bn had a previously scheduled MEDCAP in Ouagadougou, and MAJ Switaj was able to take the equipment with him on a "space available" basis.

This donation was so well received that we are currently planning other donations to several African partner nations. If the equipment is technical in nature the donation can, and should, be coordinated in conjunction with a MEDCAP and/or DENTCAP. Future excess property will also be donated for dedicated training programs intended to instruct Partner Nation medical personnel aimed at capacity building. Follow-on visits will allow us to evaluate measures of effectiveness, provide continued training opportunities and proficiency training, and provide medical maintenance support to our African partners. This "capacity building" effort is made possible because of the excess property generated by the Base Realignment and Closure (BRAC) program in Germany. Mr. DuPont used his numerous contacts in Europe to identify and acquire the equipment as the hospitals and clinics closed.

The challenges which lie ahead for us are numerous and complex but so are the opportunities. The tyranny of distance has been and will remain our greatest obstacle for aero-medical evacuation. Establishing the first Theater Special Operations Command (TSOC) in over two decades has meant taking different approaches to sourcing personnel and staff development. On the surface this might appear as a normal growing pain associated with establishing a new unit, but when one takes into account the force structure becoming a greater mixture of civilian vs. military members, the problems grow exponentially. A case in point is that aero-medical evacuations on the Continent of Africa for non-active duty personnel and dependants require Secretary of Defense designee status for military air lift supporting patient movement. This is because the primary means of movement, which is International SOS, is currently not an option. This is a major planning nightmare when considering distances between point of injury and available Level II care. The time required to reach definitive care is markedly lengthened due to the inability of traditional evac assets to land on unimproved surfaces, areas denying overflight, night operations, etc… These illustrations are just a few of the challenges that planning staffs are facing in this new era of mixing joint SOF, civilians, and IA partners at the TSOC level as well as the COCOM.

Special Forces Surgeon

USASFC

Peter J. Benson, MD
LTC (P), USA
Command Surgeon

In this new fiscal year, the U.S. Army Special Forces Command (Airborne) Surgeon's Office is already working on the summer 2009 turnover of medical personnel. As residents graduate and conventional units return from deployment, interested candidates will become available to fill openings. The proposed replacements for summer 2009 are currently being finalized. The need to continually fill openings and "grow" Special Forces experienced medical personnel has highlighted several issues.

The need to maintain a thoughtful and coherent plan to fill medical positions in Special Forces is vital. Recruitment of a balanced mix of physicians, veterinarians, dentists, planners, logisticians, physician assistants, psychologists, and medical technicians is an important goal of the Surgeon's Office. To this end, it is important to recruit personnel, who in the aggregate have: a mix of clinical specialties, cultural and language skills, and prior military or Special Operations Service. The Regiment needs younger personnel as a cadre for longevity as well as prior service individuals to provide ready expertise. Additionally, Special Forces Group professional medical assignments will normally be limited to three years to maintain a development process for trained and experienced Special Forces medical personnel.

There is no official program by which information regarding medical careers and enlisted opportunities in Special Forces is circulated. The "marketing" of Special Forces' operational medical assignments and recruitment of medical personnel is haphazard and largely word of mouth. A specific Special Forces/Special Operations career track needs to be recognized by the medical branch and career managers. This is the only way experienced and expert medical personnel will be managed and returned to Special Forces. The Army Medical Department (AMEDD) and the career branches must be made cognizant of their responsibility to provide capable and experienced medical staff to Special Forces, other USASOC units, and the Theater Special Operations Commands (TSOCs).

A related area requiring emphasis is the need for a comprehensive training and indoctrination program for non-18 series Special Forces medical personnel. There is very little training available to prepare incoming non-18 series personnel for a Special Forces assignment except the Special Operations Medical Indoctrination Course (SOMIC). It is vital that medical personnel understand the role of the Special Forces Group operationally and strategically, and their tactical function within it. A conventional AMEDD and Army background provide little understanding of the role of and the prosecution of health service support operations in an unconventional or irregular warfare environment.

These are some of the issues that have surfaced recently. It is understood that there are many issues "out there" in the Groups. MSG Ware and I will hopefully see many of you at the SOMA Conference and be able to discuss the issues in person.

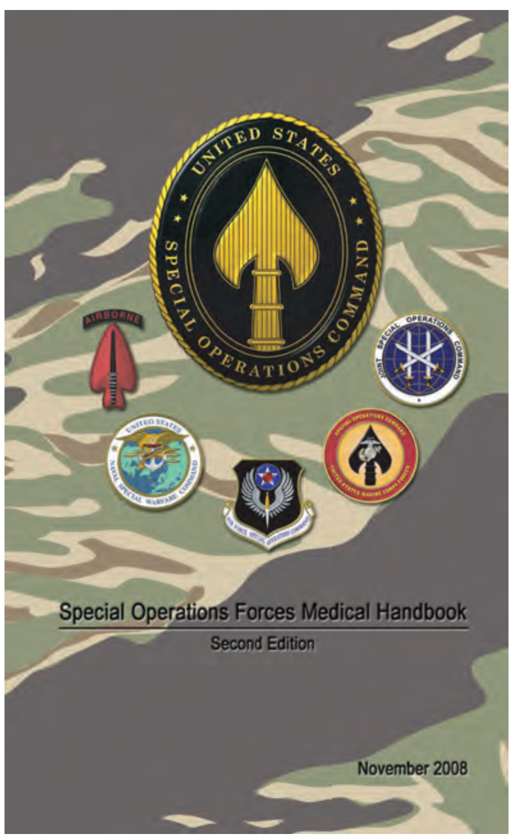
USSOCOM Research and Development Update

Mr. Robert Clayton, Biomedical R&D Coordinator

JSOM Biomedical Research and Development

Recently the 2008 version of the Special Operations Computer Assisted Medical Reference (SOCAMRS) was released in a DVD format. The SOCAMRS consists of medical references that have been acquired from the Component Surgeons. The content is based upon an identified need for providers to have quick references, regulations, journal articles, reports, and other literature. SOCAMRS is published each year and includes a survey imbedded on the DVD in order to improve the quality and content of the next version. Please take time to review the SOCAMRS and fill out the survey. If there are additional references or other literature that you would like to see included in the next release, please use the survey to let us know.

On 1 November the Second Edition of the Special Operations Forces Medical Handbook (SOFMHB) will be published. The format, as well as the cover, has changed a bit from the First Edition. The content has been updated and expanded to include ENT, Pediatrics, Trauma, and other specialties. Over 130 authors volunteered their time to update this edition and over 70 reviewers checked the content for accuracy and operational relevance. The SOFMHB will be printed on a synthetic, waterproof, rugged, light weight paper stock. Inside the front cover is a 9-line MEDEVAC request and on the inside of the back cover are the norms for common laboratory values. You can obtain copies through the medical chain of command. Additional copies can be acquired from the Government Printing Office (GPO) website at http://bookstore.gpo.gov/actions/GetPublication.do?stocknumber=008-070-00810-6.



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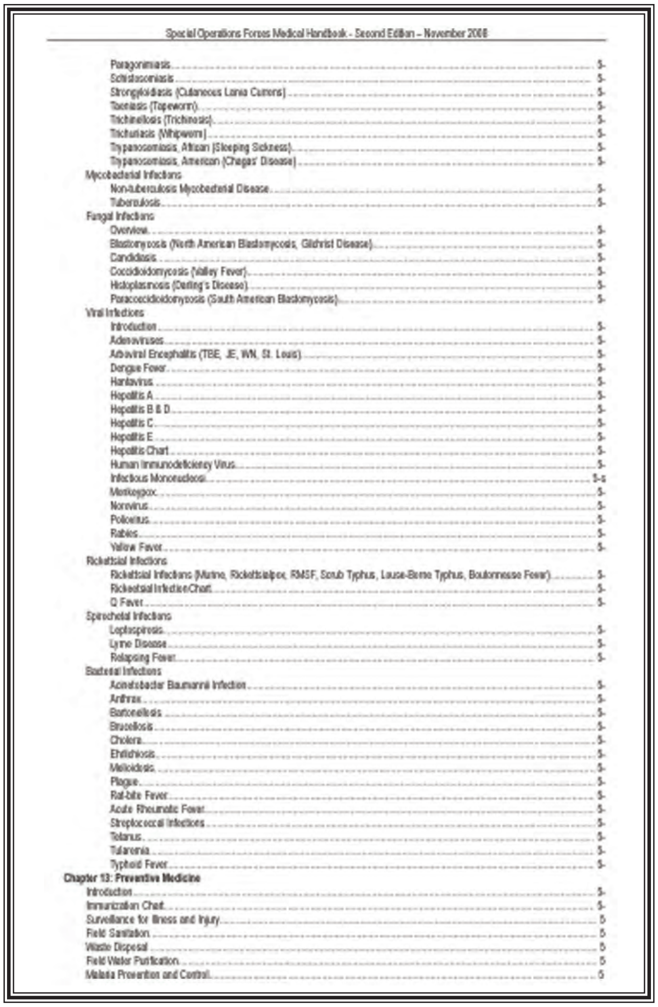

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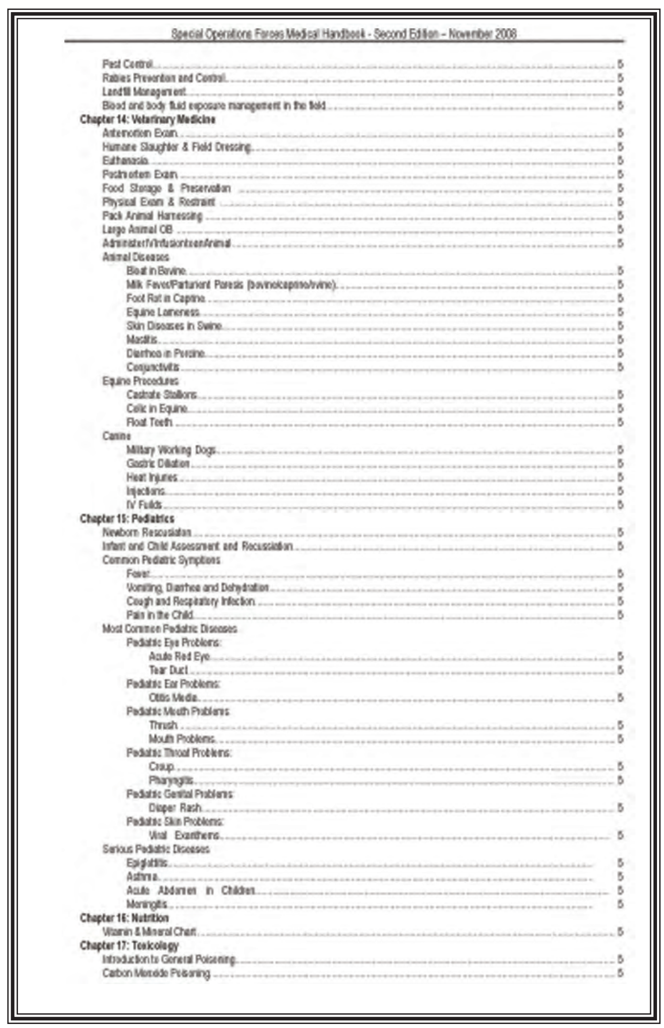

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Introduction

The Office of the Surgeon, John F. Kennedy Center for Military Assistance published the first *Special Forces Medical Specialist Handbook* in January 1969. It has a red cover and I have the only copy that I have seen in years. In 1982, the John F. Kennedy Special Warfare Center published the second edition. It was green covered and titled *ST 31-91B US Army Special Forces Medical Handbook*. This office, the Command Surgeon, United States Special Operations Command, under Colonel Steve Yevich, a Special Forces qualified Army medical officer, published the first edition of the familiar black covered *Special Operations Forces Medical Handbook* 1 June 2001. This "single-source" reference provided many nontraditional approaches to accessing medical information, such as a treatment hierarchy based on available resources and mission parameters commonly facing Special Operations Forces (SOF) Medics. Our handbook continues to be an innovation in military medicine, organized into a problem-oriented template for reference to diagnoses and treatments with contributions by over 118 authors, 42 reviewers, and 4 editors.

As a Special Forces medic in Vietnam with the Studies and Observations Group, I used the "red book" to do my utmost to care for our wounded and sick. Current Global War On Terror SOF medics, called "Doc" by the men they serve, rely on the medical resources at their disposal-what supplies they brought on their backs to the war along with ingenuity, and courage. I am profoundly grateful for the time and effort put forth by the authors, editors, and production staff of the Special Operations Forces Medical Handbook's second edition, especially, Mr. Bob Clayton, USSF(Ret.); CDR Les Fenton, USN (Ret), and Mrs. Gay Thompson, RN. I recognize with heartfelt appreciation the time sacrificed by all contributors from their busy schedules, deployments, families and friends, in order to meet our requirements. The rules of employment were stringent, the template a struggle, and the salary was none. They are listed in this introductory section.

Thirteen years passed between the first and second SF Medic handbooks and a further nineteen years before the first SOF Medic handbook. It has been only eight years to this second SOF edition. The world has changed dramatically; we are at war and we have new weapons, enemies, friends and threats. New diseases and new types of injuries have emerged, and as always in war, new treatments and therapies have been developed. Advancing technology and an explosive proliferation of medical information on the Internet have revolutionized medicine. The mission of SOF medics has not changed; unaided, medics provide care with limited resources in austere, hostile, stressful, and isolated environments, without the capability of timely patient evacuation. The scope and standards of SOF medical missions are radically different from those found in a fixed, fully equipped, and staffed hospital in a peaceful America. Few in civilian (or even conventional military) medicine ever are challenged with the conditions in which SOF medics practice daily. Despite the proliferation of medical information, no other single reference source has emerged addressing the varied and complicated needs of SOF Medics. Prior to the last edition, conflicting information and even misinformation had created confusion over the most basic medical questions, possibly endangering the lives of those we are committed to help. The SOF medical community mitigated this danger by creating the SOF Medical Handbook. This Handbook is part of an evolving system, taking advantage of new information technology. I deliberately limited the printed version in size. The system includes a CD that is in exhaustive detail. It provides guidance to medics in our special environment, answering the hard diagnostic and treatment questions as best as possible. These answers are based on the best possible knowledge and tailored to the austere mission — in plain, straightforward language, without excuses, conditions, or academic musings. This is not a trauma manual; this is a primary care medicine manual. We developed the Tactical Combat Casualty Care (TCCC) guidelines under Captain Frank Butler, a SEAL, qualified medical officer and my predecessor, and it has its own manual. Some will view the advice in this handbook as dangerous, outrageous in traditional, conservative, hospital-based medical settings. Only someone struggling with life and death decisions in the difficult environment of SOF medics can appreciate the need for this advice. Some will view it as inappropriate, possibly even bordering on malpractice.

Be well advised that the Handbook has limited application outside of SOF and we did not intend it for anything other than use by highly trained SOF medics in deployed situations.

All the authors have experience with SOF and its environment. We charged all with the same question: "*How would you diagnose and treat this patient if it was your wife, child, or parent and you were alone, with no assistance, evacuation, or consultation, in an isolated environment, armed only with the most basic of medical tools?*" These authors struggled answering this difficult question, knowing they had to break with the conservative paradigms of medicine, possibly facing the censure of their peers in doing so. The SOF community and I salute their efforts. We offer this handbook in remembrance of noble deeds and honorable intentions of all SOF medic warriors and all those who have served so ably and well since inception, from World War II OSS to GWOT USSOCOM, so that those SOF medics who follow can serve at an even higher level of medical skill and knowledge.

"Unconventional Warfare - Unconventional Medicine!"

Colonel Warner D. ("Rocky") Farr, M.D., M.P.H.
USSOCOM Command Surgeon

Chief Editor
Special Operations Forces Medical Handbook
Second Edition 2008

Current Events

SF Soldier earns Frederick Award

Sergeant 1st Class Sean Howie

Sergeant 1st Class Sean Howie, 10th Special Forces Group, was awarded the 2008 First Special Service Force Frederick Award (FSSF) for his professional excellence and courage under fire during a deployment to Samarra, Iraq, in 2007.

The Special Forces medical sergeant conducted 215 consecutive days of continuous combat operations as the operations sergeant in an area deemed one of the most hostile in Iraq at the time.

The Frederick Award is presented by the First Special Service Force to a Special Forces Operator who exhibits the highest degree of professionalism. The FSSF was a one-of-a-kind joint Canadian and American unit that fought side-by-side throughout the Italian Campaign and southern France during World War II. The award is named after Lieutenant Colonel Robert T. Frederick, the first commander of the FSSF.

"Sean Howie is like the vast majority of Green Berets in that they do not seek the spotlight," said Sergeant Major Gregory Hayes. "Sean just comes to work every day and tries to do his best. He loves what he does, and he takes enormous pride in his medical duties."

At any given time during his deployment, Howie could be found manning the .50-caliber machine gun in the turret of a tactical vehicle, leading assault elements, establishing casualty-collection points, treating patients in the compound clinic, supervising mass-casualty events, conducting tribal engagements, and training Iraqi counterparts in close- quarters battle and combat-casualty care.

Howie, a 17-year veteran of Special Forces, said, "I've worked with top-notch guys my entire career. They strive to be the best. Danger is inherent with our jobs. You hope for the best and prepare for the worst."

His deployment had its share of danger. Howie and his team were returning from a mission when his vehicle was struck by an improvised explosive device. Exposed to the elements and sitting in the gunner's turret of the lead vehicle on the convoy, the medical sergeant took shrapnel to the face.

Samarra further tested his team's resilience and his medical expertise during four mass-casualty events involving lED attacks on the Iraqi Army and the Iraqi National Police. During his eight months, he made more than 200 medical contacts with coalition and Iraqi casualties.

With the attacks happening around them, Howie and his team were not immune to attacks during their missions. During an operation, his team came under intense enemy fire, and three members of the team were hit during the exchange. Being the only Medic on the team, he immediately assessed and called for a medical evacuation. While en route to the medical facility, Howie treated his wounded teammates, saving their lives.

During an attack on the Askariya Shrine, Howie and his team stepped into action without orders and were the first to arrive on scene. They secured the site and established a casualty-collection point, preventing a follow-on attack at the mosque. - *USASOC PAO.*

Adaptive Eyewear: Freeing the (Visually) Oppressed

Gerald D. DePold, PA-C, MPAS

Abstract

It is difficult for Special Operations Forces (SOF) to provide meaningful long-term medical solutions for the indigenous population in their area of operation (AO). Limited time, equipment, supplies, the inability to follow-up, and re-exposure to disease are common obstacles to effective local national patient care.[1] Poor vision due to uncorrected refractive errors has a significant negative impact on quality of life in under-developed countries.[2] New eyewear technology will give SOF Medics the ability to provide definitive care for this chronic, burdensome condition which will benefit both patient and mission.

Introduction

There are an estimated 153 million people around the world aged five-years and older with visual impairedment due to uncorrected refractive errors.[3] Based on World Health Organization data, uncorrected refractive errors affect 6.4 million (1%) indigenous people in AFRICOM's area of operations, 3.2 million (1.19%) in CENTCOM, 7.2 million (1.4%) in SOUTHCOM, 15.5 million (1.58%) in EUCOM, and 115.5 million (3.6%) in PACOM.[4] Actual rates of visual impairment caused by unrefracted errors in your area of operations may be higher. Most of these people live in third-world countries where optometry services are located only in urban areas and basic eyeglasses are cost-prohibitive.

Impact

In any culture, uncorrected vision impairment hinders societal development and has a negative effect on quality of life. Students are unable to read and drop out of school. Adults are unable to work.[5,6] Without education and economic security, individuals are unable to participate in the process that moves a population toward democracy. Uncorrected refractive errors are a burden on family, community, health and social services, and society.

For SOF personnel, the focus of any Medical Civic Action Program (MEDCAP) is patient care and interaction with the population to forge new relationships. Previously, MEDCAPs that incorporated vision services were time and resource intensive and required a specialist (refractionist, optometrist, or ophthalmologist), specialized testing equipment, and donated prescription eyeglasses. Individuals were examined and fitted with the pair of glasses that best corrected their vision. If their prescription was not matched, they went without – not a win-win situation.[7]

The Solution

Adaptive eyewear has revolutionized vision correction and is simple, quick, and inexpensive. One-size-fits-all glasses with adjustable lenses allow the wearer to dial in the refraction to fit his or her needs without the assistance of an eyecare professional. The power range is +6 to -6 diopters, which is effective for over 90% of patients and corrects hyperopia (farsightedness), myopia (nearsightedness), and presbyopia (limited accommodation).[8]

Adjustment is simple; seat the person in an area with good light and have him look at a distant object to relax the eyes. Set both lenses to +6 diopters using the adjustment wheels. Have the person put on the eyewear, cover the left eye and adjust the right lens using the adjustment wheel until they can clearly see an object that is 20 feet away, and repeat with the other eye. Then have the person look at the same object with both eyes, adjust the focus until the object blurs, and then bring the object back into focus again. Seal the lenses by turning two sealing valves (crosshead screws) clockwise, cut the tubing and remove the adjustment wheels and pumps. The adjustment wheels, pumps, and tubing are left intact for people who have a bifocal requirement. This self-prescription results in an improvement in vision almost identical to that provided by a trained professional.[9]

Adaptive eyewear doesn't work for everyone. For those with poor results, perform an eye exam. Refer people with pathology, common after age 50, to an eye care professional if available, or send a SOAP note to eye.consult@us.army.mil if you can follow up with the patient. Correcting refractive error in children may be challenging due to an increased range of accommodation, difficulty following directions, and language barriers.

The sole manufacturer of adaptive eyewear is Adaptive Eyecare Limited, a United Kingdom company.

Figure 1

Costs range from $15 to $21.50 per pair depending on use (humanitarian vs non-humanitarian) and order size. A new, lighter version is in development and will be available on a limited basis in the first quarter of 2009.[10] For sales information contact sales@adaptive-eyecare.com.

Operational Benefits and Concerns

Visual impairment presents a significant barrier for the military trainer – there's not much you can teach someone who can't see hand signals, his fellow trainees, or the target over the sights on his rifle. The same holds true for indigenous medic trainees in a guerilla hospital; it's hard to manage a bleed if you can't see it.[11] Adaptive eyewear turns an individual who cannot contribute into someone who can learn how to shoot, move, communicate, and render aid.

Adaptive eyewear can even serve as replacement eyewear for members of your unit. However, it does not substitute for protective eyewear since its performance when subjected to blast overpressure is unknown.

Restoring vision may have unintended effects. When operating in a hostile environment you should be aware that new glasses readily identify those people who have interacted and benefited from a SOF presence. There is also the potential to improve the enemy's vision (read "aim") if they obtain such adaptive eyewear either by posing as patients or by taking the eyewear from someone you treated. You can minimize this if you seal the lenses and remove the wheels and pumps to prevent adjustment for multiple users.

Conclusion

The socioeconomic impact of uncorrected refractive error is surely underestimated, when you consider the positive second- and third-order effects on family and community when a person regains their sight.[12,13] SOF personnel should educate key personnel in country health systems and encourage programs that provide eye exams and adaptive eyewear for the population. About 30,000 pairs of adaptive eyewear have been delivered in over 15 countries, the majority by U.S. government humanitarian assistance programs.[14]

What is the potential impact of adaptive eyewear for SOF operations? Having 153 million new friends in under-developed countries around the world could only be considered positive.

Adaptive eyewear were provided free of charge to the author for evaluation. The author has no financial, R&D, or other relationship with the manufacturer. Images are used with permission. .

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Battlefield Use of Human Plasma by Special Operations Forces

MSG Christopher Murphy

Abstract

Recently a select group of Special Operations medical providers have carried fresh thawed human plasma as a resuscitative fluid on the battlefield at the evacuation phase of Tactical Combat Casualty Care (TCCC) and in rare occasions at the tactical field care phase of TCCC. Plasma in certain circumstances should be considered as an adjunct to treatment of coagulapathic battlefield casualties. Plasma does however have limitations due to logistical constraints. The long term solution is to develop a field stable variant of plasma which would make this life-saving fluid available to a broader range of care providers. Recent studies have shown that the development of lyophilized plasma is feasible.

Special Operations Forces employed the use of fresh-thawed human plasma for hypotensive resuscitation of combat casualties in August of 2007. Plasma use in the treatment of casualties in the Global War on Terrorism (GWOT) had been limited mostly to the Combat Support Hospitals (CSH) in both Baghdad and Balad during Operation Iraqi Freedom (OIF) and CSHs in Operation Enduring Freedom (OEF). Recently a select group of Special Operations Forces (SOF) medical providers have been carrying fresh-thawed human plasma as a resuscitative fluid on the battlefield, at the evacuation phase of Tactical Combat Casualty Care (TCCC), and on rare occasions, at the tactical field care phase of TCCC. This solution has been reserved for operations that are high-risk and have extended evacuation times.

Patients with an abbreviated injury score (AIS) of four to six usually arrive at the CSH with an acquired coagulopathy. This patient population represents five to seven percent of combat trauma patients. Acquired coagulopathy is known to occur in patients with multiple injuries. Conventional resuscitation practice focuses on rapid reversal of acidosis, prevention of hypothermia, and control of hemorrhage; however, recent studies have shown that early attention to coagulopathy may improve patient outcome.[1,2]

Medical intervention may also then augment this coagulopathy by hemodilution with large fluid volumes, the administration of colloids, massive transfusion with stored blood, and the subsequent development of hypothermia. However, there is an acute coagulopathy before significant fluid administration that may be attributable to the injury itself. This derangement reflects the severity of tissue damage and carries a worse prognosis. The presence of an early coagulation abnormality has implications for both management and outcome.[3-6]

Plasma not only raises acidotic pH levels in trauma patients, but also contains all viable clotting factors. Early coagulopathy could be reversed by administering plasma before arrival to the CSH and thus reduce overall use of other resuscitative fluids on trauma patients. Operational medical providers with access to plasma could have a dramatic impact on patient survival.

"We hypothesize that the early, increased use of plasma in these severely injured patients helped control the coagulopathy of trauma more efficiently and, as a result, required less crystalloid and red blood cells (RBCs) per hour during the first 24 hours of resuscitation. Additionally, the use of plasma instead of crystalloids and RBCs helped prevent or limit the development of dilutional coagulopathy.[7] Conversely, we believe that patients who received less plasma and more crystalloid and RBCs in the low and medium plasma to RBC ratio groups entered the "bloody vicious cycle," and died significantly sooner from uncontrolled hemorrhagic shock. The rate of blood products and crystalloid may have also been reduced for the survivors in the high plasma to RBC ratio group as a result of not requiring active resuscitation during the entire 24 hours after initiating a massive transfusion. We suspect that both improved hemostasis and survival, and the lack of need to be actively resuscitated, contributed to the decreased rate of products and crystalloid transfused in the high plasma to RBC ratio group."[8]

Current TCCC guidelines recommend the use of Hextend® as the primary resuscitative fluid of choice during the tactical field care phase of combat casualty care and, when possible, the use of whole blood during the evacuation phase. Hextend's® mechanism of action is to pull fluid from the interstital space and bring it into the vascular system therefore increasing blood pressure and hopefully increasing tissue perfusion. Fluids such as Hextend® and hetastarch only provide vascular volume and some electrolyte replacement. They do nothing to reverse coagulopathy and lowered pH in trauma patients.

Studies by U.S. Army Institute of Surgical Research (USAISR) have suggested that dilution of clotting factors with colloids such as Hextend® and hetastarch could have negative effects on patient outcome. Hextend's® effect on coagulation and induced coagulopathy have been widely demonstrated in clinical and experimental studies and has been attributed to the inhibitory effect of this colloid on clotting factors, platelet function, and fibrin polymerization.[9-17]

Therefore, Hextend® may be a less than optimal fluid of choice for casualties in shock. Hextend® is, however, the fluid of choice for TCCC due to it being the best FDA approved field stable fluid available today.

Whole blood is the fluid of choice for resuscitation. The logistics of whole blood is similar to that of plasma and blood should be made available forward in some instances. Pushing blood far forward has inherent problems due to transfusion reactions, lack of training, and age of available war stock.

Transfusion reactions in the field are difficult to manage. Plasma has a lower threshold for transfusion reactions. Blood also requires a filtered administration set and must be primed prior to use with normal saline. This can be difficult and in some instances has been unsuccessful due to lack of training and the stresses of combat. Even the simplest tasks become difficult in combat. Also, blood older than 30 days may be a less than optimal resuscitative fluid, since "old blood is bad blood."[18] Current theatre blood stocks average 30 days in age. Buddy transfusions are also an option for TCCC but buddy transfusions are extremely time consuming and can take upwards of one hour to implement.

The use of plasma forward is an obviously viable solution by SOF providers. Currently a limited number of operational care providers draw a predetermined amount of frozen AB+ plasma from existing war fighting stock. Plasma is maintained in accordance with DoD guidelines by using Hemacoolers, a commercial off the shelf (COTS) cryo-freezer, which was developed by the U.S. Army Medical Materials Development Administration (USAMMDA). Plasma is stored at -22 degrees Celsius.

SOF medical providers thaw plasma using warm water baths prior to high risk operations. Thawed plasma is maintained for up to three days at two to four degrees Celsius and then if unused, it is destroyed. Plasma is carried by operational medical personnel on the battlefield using Golden Hour technology to maintain the temperature requirements. Golden Hour containers are DoD approved coolers that maintain blood products at two degrees Celsius with no power requirements for 72 to 96 hours. Golden Hour containers are often left on infiltration/exfiltration and evacuation platforms and can be called forward as required or left for use during casualty evacuation. Four units of plasma can be carried in a single Golden Hour container.

SOF providers administer plasma thru an 18 gauge catheter using a standard 15-gtt IV tube. Plasma is warmed with an Enflow™ IV fluid warmer. Enflow™ warmers have been approved by Walter Reed Army Institute of Research (WRAIR) for use with blood and blood products. Plasma may also be given intraosseously (IO).

Due to logistics of storing plasma and plasma availability, this lifesaving technique is reserved for occasions when the stated operational needs are met. This technique has the potential to increase survival on a greater scale if the logistical concerns of storage, demand, and waste are met. Plasma waste is currently at 30 to 40% of overall war stocks. This is approximately 10,000 units annually in the operational theatres.

A solution for improving survivability of casualties on the battlefield today is to transition this lifesaving technique to other SOF forces now and eventually to all theatre forces. Increased fielding could increase waste, but addressing coagulopathy early may decrease overall use of resuscitative fluids, resulting in significant logistical dollars saved.

The long-term solution is to develop a field stable variant of plasma. Lyophilized (freeze-dried) plasma is one such solution. The development of lyophilized human plasma (LHP) would not only solve this logistical problem, but could also bring this lifesaving technique further forward to the tactical field care phase of combat casualty care. LHP was used during World War II as a resuscitative fluid of choice on the battlefield but was abandoned in the 1950s due to contamination with human papillomavirus (HPV). Pooled donor sources of plasma were used and techniques for screening of hepatitis were unavailable. Screening for bloodborne pathogens is now available and blood banking safety is markedly improved in the last 50 years.

The U.S. Special Operations Command (USSOCOM) has recently undertaken a research and development effort to study the feasibility of again freeze drying human plasma. The feasibility study completed in December 2007 showed that the development of LHP is feasible. Initial data shows that lyophilized plasma had all clotting and liable factors found in fresh-thawed plasma and is also stable in higher temperatures. Additional data is forthcoming. This study was conducted by USSOCOM and HemCon® Inc., a company with lyophilization technologies, in conjunction with USAISR. Studies conducted by WRAIR have also shown efficacy of LHP.

The U.S. Army has placed an urgent operational need on the development of LHP. The U.S. Army Medical Materials Development Agency (USAMMDA) has recently earmarked funding for the development of LHP. USSOCOM has also placed high priority on developing LHP. Their requirements are for a field stable variant of LHP that will be contained in a ruggedized container for use far forward on the battlefield by operational providers.

The fielding of the USSOCOM requirement is now slated for 2010. An urgent operational fielding of LHP should be implemented now to bring this lifesaving technology to battlefield as soon as possible. The cooperation of USSOCCOM, USAISR, USAMMDA, WRAIR, FDA, and industry could help to bring LHP to our Soldiers in a timelier manner with out sacrificing safety. Our Soldiers who risk their lives daily deserve no less.

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Thoughts on Aid Bags
Part Two

Justin A Ball, 18D; Michael R Hetzler, 18D

This is the second of two articles intended to provide lessons learned and theories and techniques on packing an aid bag for the urban direct action (DA) environment. As stated in Part One, these articles are by no means meant to be conclusive, free of error, or enduring. They have been developed from five years of experiences in Operation Iraqi Freedom (OIF) and are meant to provide information to assist in present operations, and to serve as a platform for further development and evolution. Remember, these theories were developed in the strict conditions of urban operations in Iraq and thus, provide a sustained capability and confident means of evacuation. Conducting a thorough mission analysis will provide what's needed to tailor medical requirements outside of those lines. The authors highly recommend that the first article should be taken in conjunction with this second part to provide a complete framework of thought and theory.

As mentioned in the first article, it is possible to achieve both a high level of care and a broad depth of supply. The equipment and supplies packed in vehicle resupply and litter kits, the items carried by cross-trained team Medics, and the aid bags on the evacuation platform as well as the mission aid bags provide the sustainability and Class VIII supply that you need for worst case scenarios. This even includes individual supplies carried by the Soldiers within the unit, as these supplies could accumulatively provide care for all personnel. Although the depth of care encompasses the entire spectrum, it should be reasonable to provide for some sustainability out of the aid bags alone.

Opinions for packing an aid bag are as diverse and debated as any tactic, technique, and procedure (TTP). There are numerous theories and priorities based on the situation, mission, and threat assessment and evacuation. The term "aid bag" is almost a misnomer; it implies that a Medic can carry everything needed in a single bag. This may be true in Combat Trauma Management (CTM) scenarios, but in truth this is far from reality. The aid bag fills one role in the depth of care theory, and should always be considered as part of the larger capacity to prepare for any worst case scenario in combat trauma. Because of the supplies and staging that can be achieved with depth of care, aid bags can be task organized more purposefully to provide advanced procedures at the point of injury. Room and weight in aid bags should not be sacrificed for redundant items such as Kerlix, dressings, or fluids since these can be massed from the Soldiers within the unit. Technology, supplies, and TTPs also constantly evolve, requiring the Medic to continually reevaluate and develop better methods.

The Assault Aid Bag

The assault aid bag can come in a variety of types, sizes, and manufacturers' designs, but a key principle to look for is a low profile so as to not hamper the ability to move tactically (see Figure 1). Whether in the assault or moving to provide care, speed and agility is absolutely essential for success in this environment. So, an aid bag size and placement has a major impact on those concerns. The size and depth of previous aid bags prevented best speed and mobility in the urban environment and would not allow easy maneuverability with others in close quarters. Additionally, an aid bag should be modular and as flexible as possible for the Medic to reconfigure and meet the requirements of as many types of missions as possible. Modular designs, multiple accessories, options for pock-

Figure 1: A few examples of low profile, commercially sold assault aid bags.

ets and retaining flaps, and of course, a liberal use of Velcro hook/pile taping allows for full use of the imagination and space provided.

An aid bag, with Velcro pile engineered as a liner on the inside of the whole bag, allows the removal of excess pockets and netting which affords more options for use of space. Small pieces of Velcro tape reinforced with a couple of small drops of super glue can be placed on kits and equipment allowing the Medic to tag and secure these items to the inside of the bag without fear of losing them. Even if the bag is moved or dropped while still open, a high level of confidence can be maintained that the supplies will not be lost. The super glue reinforces the adhesive of the Velcro tape attached to items even in the worst conditions of heat and use, ensuring that the tape will not come off. Utilizing this method allows the Medic to remove the netting and pockets, allowing another inch of space and width to provide more usable space or decrease the overall profile of the aid bag (Figure 2).

Figure 2: Every item in this aid bag is secured by using the Velcro pile lining (seen at the top) as an anchor but still allows quick identification and access of supplies by any member of the force.

The current SOF issue M9 Aid Bag was specifically developed for operations in Baghdad, Iraq. Experience has taught us that mobility and speed are vital in the urban environment. However, the aid bag should still provide enough room and have a flexible configuration for adaptability and ease of use without hampering operations. The depth of the aid bag was reduced by both lengthening and widening it while still retaining the same cube space. This flattening of the aid bag is what allows the Medic to move unimpeded through a house with other Soldiers. It raises the center of gravity to increase the Medic's ability to negotiate obstacles such as walls and windows. It also allows the Medic to sit in confined spaces and on small seats in vehicles and aircraft without compromising comfort or causing fatigue. Medics must ensure the M9 bag is not packed beyond capacity, thereby negating its inherent advantage (see Figure 3).

Figure 3: The difference between packing your bag for an assault and packing your aid bag with the kitchen sink results in how much speed and maneuverability you have.

As a general rule, the assault aid bag should provide lifesaving capabilities that may be needed in the first ten minutes of a wound or injury. This time represents the interval that may be required to recover the backup aid bag in order to treat either an urgent multi-system trauma or a mass casualty (MasCal) scenario. The aid bag should carry everything that is deemed necessary to sustain those casualties within that interval. It is also important to utilize the stock of supplies available through Individual First Aid Kits (IFAKs) carried by other Soldiers. Lifesaving and stop-gapping abilities from the aid bag should additionally complement the items carried on the Medic. They should be accessible quickly and incrementally as necessary.

Keep in mind the Tactical Combat Casualty Care (TCCC) principles and priorities when considering what to pack for the assault. The assault aid bag easily covers the Tactical Field Care phase of TCCC guidelines and best serves the Medic within that phase of care. When packing the assault aid bag consider the treatment priorities in what is packed based on the most significant threats. Recent studies find that the majority of Special Operations Forces (SOF) mortality comes from uncompressible hemorrhage, tension pneumothorax, airway obstruction, and sepsis, in that order.[1] This drives what the Medic carries on their body and what is packed in the assault aid bag, keeping in mind the amounts of supplies that are needed, and the access required (Figure 4).

Airway requirements in the assault aid bag can be packed for less speed than the equipment the Medic

Assault Aid Bag

- NasalPhyrangeal Airway x 2
- Airtrack x 1
- Bougie Device x 1
- Endotracheal Tube x 1
- Cric Kit x 1
- Manual Suction Device x 1
- Kerlix x 2
- Bleeder Kits x 4
- Hemostatic Pad x 2
- Hemostatic Gauze x 2
- Abd Dsg x 1
- Tac Wrap x 2
- Chest Kit x 2
- Large HydroGel Sheet x 1

Assault Aid Bag (cont)

- Cook Chest Device x 1
- 10g 3" Catheter x 2
- Fast 1 Kit x 2
- 250ml NS x 2
- 500ml Hextend x 1
- Head Wound Kit x 1
- Pain/Sedation Kit x 1
- Staple Gun x 1
- Epi Pen x 1
- IM Antibiotic Kit x 2
- 10cc Prefilled Syringe x 4
- Cravats x 5
- Safety Line x 1
- Tourniquets x 2
- MACE Cards x 3
- DNA Kit x 1
- Band Aids
- 25' 550 Cord

Px/Conscious Sedation Kit

- Lidocaine 2% w/o Epi x 1
- Morphine Syrettes 15mg/ml x 3
- Midazolam 10mg/2ml x 3
- Ketamine 500mg/5ml x 3
- Narcan 0.4mg/ml x 2
- Romazicon 0.5mg/ml x 2
- Zofran sublingual x 3
- 18g 1" needles x 3
- 21g 1 ¼" Needles x 3
- Tubex x 1
- 10ml Syringe x 3
- Benadryl 50mg/ml x 3

Head Wound Kit

- Head Doughnut
- Capnography Device x 1
- Furosemide 20mg/ml x 2
- 3ml Syringe x 1
- 18g Needle x 1

Figure 4: Possible inventory for an assault aid bag and inclusive procedure kits.

keeps on their body. It is important to have easy access emergency interventions such as a cricothyroidotomy kit. The assault aid bag can mirror that capability while also providing additional adjuncts such as an Airtrack® or an endotracheal tube introducer (AKA, a gum elastic bougie). Other options can include the King LT®, laryngeal mask airway (LMA), or the time honored laryngoscope and intubation kit. Suction may include devices such as the Squid Suction® or a basic 60cc syringe with a nasal pharyngeal airway (NPA) attached to provide some minimal capability. A bag-valve mask (BVM) may be carried here as well, but the argument can also be made that it can be sacrificed for mouth-to-tube ventilations by another Soldier until a BVM can arrive from the back-up aid bag. Exercising critical thought such as this provides additional room for more practical equipment when judging time requirements and use.

Breathing supplies should again be dependent on more urgent requirements but not so definitive that they could be deferred to the back-up aid bag. Chest kits noted in the first article should be carried in multiples here to provide identical and repetitive supplies for use or to throw to someone else for use. Precut Hydrogel® tape, Asherman (ACS)® dressings, or Hyfin® dressings may be used in chest kits as well as 3" 10-gauge needles for emergency needle decompression.[2] Larger (12" x 12") Hydrogel® sheets, which may be cut, folded, and packaged in a Ziplock® bag, should also be carried for treating those extra large "shark bite" wounds that often result from shrapnel events to the torso. (Figure 5). Other chest treatment devices such as the Cook Device® or the Uresil® Thoracic Vent may be included as well to provide additional capabilities as long as personnel are thoroughly trained and experienced with them.

Figure 5: A large sheet of Hydrogel® or a single layer of Saran Wrap® can provide large area coverage as an occlusive or abdominal dressing.

Vital circulation considerations in this respect have to meet the dressing requirements of anatomy while still keeping in mind the hypotensive resuscitation theories that are presently in practice. Initial hemorrhage control comes from the IFAKs that each Soldier is outfitted with and from the layering of supplies. Tourniquets placed on body armor, and the extra supplies found in vehicle aid bags will normally provide all that is necessary to meet requirements. However, during situations where the Medic may not be able to access additional supplies, it is important to have some small quantity of packing materials and dressings inside the aid-bag to provide that extra confidence needed for treating hemorrhage.

Additional dressings and hemostatics should initially come from the wounded person's own supply. However, having additional hemostatic materials in the assault aid bag is essential to provide the confidence needed to confront the most significant contributor to mortality. The next generation of hemostatics arrived recently and, whether they are styled in a pad, powder, or as packing, all are accepted in practice and considered essential for advanced hemorrhage control. Again, training with and gaining the essential experience and confidence to employ any hemostatic is essential to achieve their maximum effectiveness.

Head injuries provide more challenging wounds with a range of intangibles. Traumatic brain injury (TBI) can stem from multiple mechanisms of injury such as overpressure, high velocity or tertiary events from blast effects, or simple impact injuries occurring from a fall.[3-4] Head kits should include the essential elements of the head injury protocol and again, they are prepared to provide all the essential supplies needed for treatment in a single bag. A small padded "head doughnut" made out of rolled Kerlix and taped circumferentially can provide an effective pressure device for the highly vascular skin of the head. It can also provide extra protection when laid around an open skull fracture, facilitating a more effective dressing for the difficult anatomy of a head wound. A diuretic such as mannitol or furosemide may also be given in the field as long as the protocols are fully vetted, and the Medic is trained by their surgeons and have a high level of confidence in a rapid evacuation.

The Military Acute Concussive Exam (MACE)[5] is an excellent way to evaluate a head injury at the point of injury. Carrying at least three of these sheets laminated for use is a prudent precaution. This exam can be used to immediately evaluate the mental status of a patient that has a high index of suspicion for a head injury. The scoring method and ability to conduct serial exams with no special support requirements allows the Medic to make diagnostic decisions based on credible findings. This allows the Medic to make good recommendations on the status of Soldiers even if they initially appear uninjured post event. Those findings either allow the Medic to return them to the fight with high confidence, hold them to conduct serial testing off the original baseline evaluation, or triage and evacuate them for more thorough testing for a more conservative prognosis.

A large disposable skin stapler provides a convenient, fast, and efficient way to close any emergency surgical procedure such as a cricothryroidotomy, chest tube, or open abdomen. It additionally allows for fast and effective treatments of minorly injured noncombatants.

A padded roll of Saran Wrap® is another multifunctional tool that provides good care if used properly. The cellophane can cover badly burned areas or extremities in order to protect the burns, decrease pain, and provide some insulation against heat loss and painful nerve stimulation. It can also serve as a means to close abdominal wounds and eviscerations, to supply a large size occlusive dressing alternative for the chest, or protect traumatically amputated extremities for transport. But remember to always apply cellophane loosely to casualties and never wrap circumferentially in consideration of late swelling complications.

A field expedient DNA kit is a simple and inexpensive solution to taking high value targets or multiple enemy fatalities off an objective. Although commercial varieties are numerous and expensive, most experts point out that the same results can be achieved with a simple kit of a few unlined business size envelopes and medical cotton tip applicators (CTAs). These items should be carried in a Ziploc® bag to protect them prior to use. Make sure to never return any collected samples back into a Ziploc® bag as it will immediately degrade them. If hair, body fluids, or blood is collected, they should be individually packaged in the envelopes and marked with a date time group, location, and associated pictures for further documentation. In the most stringent conditions, those items should then be maintained in a strict chain of custody log and witnesses if the importance of the target and the confidence of the evidence require it.

Carrying multiple cravats also provides another multifunctional tool with no space loss and with very little weight. Cravats can be used for improvised tourniquets, splints and rags, slings and swaths, and protecting large-size wounds such as an abdominal evisceration.

Multiple prefilled syringes of normal saline in 5cc or 10cc sizes provide quick and efficient methods of flush for medications in an intravenous (IV) or intraosseous (IO) site or for the reconstitution of parenteral antibiotics. Prepare the syringes by taping an 18-gauge hard needle to the body of each so that they can be used with admin sets that do not use Luer locks.

Other items commonly carried and employed from an assault aid bag can include a "Safety Line" made of a twenty-foot length of 1" diameter tubular nylon looped and secured by a retraced overhand knot. This safety line can be employed in many fashions such as an expedient rappelling harness, a drag line for casualties, or as a lift to extract personnel from a vehicle. It can also be used to lower someone out of a window or down off of a roof, or just to secure a patient to a litter or chair. Medics also can carry another one-foot loop of tubular nylon with a snap link in order to secure aid bags, equipment, or litters to an aircraft floor. Packing twenty-five feet of 550 parachute cord in your aid bag always provides the indispensible solution to some unforeseen need as well. It is also smart to carry a bar or tube of a favorite sports nutrition supplement for those times when an extra boost of energy is needed, or just to sustain over a long operation. Never forget the inevitable requirement for simple and accessible Band-Aids®; a Medic without a Band-Aid® is like a commo man without a battery.

The Back-Up Aid Bag

The theory behind the back-up bag is more than just a storage area for resource intensive items such as chest tube kits, unscreened blood transfusion kits, and hazardous materials kits. This bag covers the evacuation care phase of TCCC principles and should give the Medic the ability to handle approximately five patients or allow the sustainment of a single critical casualty for a prolonged period of time. The back-up aid bag should replicate most, if not all, capabilities the assault bag has plus bring extra capabilities to the mix by maintaining special equipment and supplies. The "two is one, one is none:"rule is crucial here when replicating hemostatics, airway management, and treatment of a tension pneumothorax with the assault aid bag. This puts a cap on basic needs and leaves room for advanced devices.

Figure 6: A few commercial options for a backup aid bag.

Some criteria useful in selecting the appropriate bag is its storage capacity and the way items lie out in it (Figure 6). In a multiple casualty situation, it is essential to be able to open the back-up bag so that the supplies and equipment are exposed to all first responders. First responders will be able to work around it, accessing items from any direction without having to dig for items or ask where they are. Airways, Kerlix®, ACE® wraps, hemostatics, chest kits, SAM® splints, and C-collars should be instantly identifiable and available once the bag is opened. Other critical elements appropriate for the back-up aid bag may be military anti-shock trousers (MAST), casualty monitoring devices, Kendrick traction splints, and automatic ventilators presently available on the market. In keeping with a five-patient theme, extra medications, antibiotics, fluids, starter sets, and IO devices should fill up the rest of the bag (Figure 7). The pain and sedation kit in the back-up bag should be laid out exactly like the one in the primary bag so that if conducting a lengthy sedation while awaiting evacuation, the transition from one kit to another is smooth.

Back Up Aid Bag

- Bag Valve Mask x 1
- Manual Suction Device x 1
- Laryngoscope Kit x 1
- Bougie Device x 1
- Chest Kit x 2
- Chest Tube Kit x 2
- Large HydroGel Sheet x 1
- Kerlix x 4
- Bleeder kit x 4
- Abd Dsg x 1
- Chest Dsg x 1
- Hemostatics x 4
- Tac Wrap x 2
- Pain/Sedation Kit x 1
- IM Antibiotic Kit x 4
- SAM splints x 3

Back Up Aid Bag (cont)

- Hextend 500ml x 4
- Saran Wrap x 1
- 250ml NS x 2
- Burn Dsg x 2
- Head Wound Kit x 1
- Staple Gun x 1
- Stethoscope x 1
- Sick Call Meds
- Band Aids
- Epi Pen x 1
- Cravats x 5
- C Collar x 1
- Kendrick Device x 1
- MAST Pants x 1
- 3" Medical Tape x 2
- Rehydration Powder/Salts

- Chest Tube Kit
  - Betadine Swab
  - Heimlich Valve
  - Chest Tube
  - #10 Scalpel
  - Large Curved Kelly Clamps
  - Suture Materiel
- Unscreened Blood Transfusion Kit
  - 15 gauge needle x 2
  - Citrate Collection bag x 2
  - Y – Connector with filter x 1
  - Prepared bag of NS x 1
  - 50mg Benadryl INJ x 1
  - Disposable tourniquet

Figure 7: Possible list of supplies and equipment for a back up aid bag in the direct action environment and procedure kits that can be carried.

One common theme among mass casualty situations is the need for lots of pain medications, and this is especially true when working with indigenous forces due to their greater number of troops. Layering pain medications throughout the assault force by way of individual narcotic packs and what is stored in the back-up bag should amount to enough to treat more than the assault force. At first glance, an individual kit containing two morphine auto injectors, fentanyl lozenges, and antibiotics seems like overkill; but experience has shown that, even when they are all combined, this is only enough for the initial pain management in a MasCal. Delayed evacuation is a given in this situation, so ensuring an abundance of pain medications is entirely appropriate.

Consider toxic industrial chemicals (TICs) and toxic industrial materials (TIMs) as possible secondary exposure from an assault, especially in today's environment of home-made explosives (HMEs). These hazardous material (HazMat) threats can lead to smoke inhalation, organophosphate poisoning, chemical exposure, and contact irritants. Being able to determine the true source of a respiratory distress from a smoke irritant encountered in a burning house is doubtful, but it is important to carry the appropriate equipment and medicines to cover the largest number of reasonable threats. A bronchodilator such as albuterol and a respiratory steroid inhaler are simple stop-gap measures to treat inhalation injuries until evacuation to a CSH.

A stethoscope probably doesn't belong in an assault aid bag but it can be a useful tool in the back-up bag, especially if the pulse-ox isn't working well. A simple, yet accurate heart rate by stethoscope instead of guessing by palpation can guide treatments much more effectively, and it can also be an essential tool for determining death. In the future, advanced ultrasound devices may provide this capability in a more practical way without having to take off personal protective equipment (PPE) for use. Casualty cards are worth their weight in gold, especially in a MasCal event; so carrying an additional 15 cards is not a bad idea.

To avoid using up valuable space on fluids, consider distributing 250ml bags of normal saline to the assault force. When collected, this cache can provide up to four or five liters of supplies. Packing a few crystalloids and colloids also provides enough fluids to conduct limited resuscitation or to hang an unscreened emergency blood transfusion.

An outdated, but prevalent theme in packing an aid bag for direct action was that oral sick call medications are unnecessary. This is obviously a pre-war mentality. A simple but acute sickness can degrade warfighting ability and may even become a show stopper. Layering oral medications throughout all levels of your gear in either a small pill box that fits in a pocket or a small fishing lure box that fits into an aid bag is extremely resourceful, without taking up much room. When packing oral meds, consider acute threats that may be encountered and use pills manufactured small enough so that there is enough to treat the whole assault force. Some essential medications may include Immodium, should there be an outbreak of diarrhea, Zyrtec and Motrin for allergy issues, and Mobic and acetaminophen for headache and back pain. A back spasm while boarding a helo for an infil can be a liability on the objective, so having a small quantity of non-narcotic oral pain meds can make a huge difference. A small bottle of nitroglycerin, aspirin, and morphine can mean a lot if anyone starts having chest pain on target. Some extra Avalox (moxifloxacin) to cover a MasCal situation can double as a traveler's diarrhea treatment for the force. This will also cover items needed when conducting long-duration missions for sustainment, which includes oral pain meds, oral rehydration salts, and enough PO antibiotics to cover casualties from other accompanying units.

The authors hope that this two part series may provide some insight and lessons learned, as well as an impetus to take preparation and theories of care to the next level in this environment. Medics must constantly use imagination and debate to ensure the highest level of care possible for our wounded is maintained.

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The authors are assigned as 18Ds to USASOC and have accumulated 43 months of deployed time in both OEF and OIF between them.

A New Look On Civil Military Operations

Mickaila Johnston, MD; James Shearer, SFC; Woody Wilson, SFC

Abstract

Civil Affairs has a long history of helping ease the impact of war on a civilian population. To this end, providing medical care and education to a civilian population is beneficial. When these can be provided by host nation assets instead of solely by U.S. Forces, the benefits are exponential. Examined here is a summary of how a Civil Affairs team accomplished these goals in the Philippines during the spring of 2007.

As a Navy physician, I thought I knew what Civil Military Operations (CMO) entailed. After all, I had many classes at the Uniformed Services University of the Health Sciences, where a plethora of pictures were shown of Navy providers assisting a third world country with our unique medical skills. In the past, I didn't think I was far off. However, I was, as amplified by a story recently told to me by a Command Sergeant Major.

Approximately a year and a half ago, he was leading a Medical Civic Action Program (MEDCAP) on Sulu, Philippines. At that time, secondary to lawlessness and insurgency, security concerns were high. Specifically he indicated that two Operational Detachment – Alpha (ODA) teams, fully kitted up with body armor, helmets, and long guns, were required as a minimum to provide security to the U.S. medical providers.

This seemed in line with what had been taught of U.S. Navy civil military operations, classically, a large U.S. vessel would pull into the vicinity of the planned MEDCAP site, offload a security element, setup isolation borders / boundaries, and disembark a bunch of U.S. providers to render care. Metrics at that time were relative value units (RVUs) and numbers of host nation patients seen by U.S. providers.

Presently, I am acting as the Joint Special Operations Task Force - Philippines (JSOTF-P) Surgeon, in Zamboanga, Philippines. I recently had the educational experience of observing how a Civil Affairs Team runs their version of a MEDCAP. Their Special Operations Combat Medic (SOCM), SFC James "Levi" Shearer and their Team Sergeant, MSG Woody Wilson, were quick to tell me I would be in an observation role only. "Sure thing," I thought – "right up until they got loaded down and needed some help" – I was in for a shock!

Two days before our arrival, the provincial health office had delivered half of the anticipated medical supplies for the MEDCAP. The night before the MEDCAP, all of the supplies were loaded into a trailer. This turned out to be the only work U.S. providers would do during the entire evolution, and for that matter, essentially the only work U.S. Forces would do.

The next morning, the Philippine Marines escorted and provided security at the MEDCAP site. Upon arrival, we began unloading the medical supplies (again, half was host nation purchased and half was U.S. funded) and were agreeably assisted by a veritable cornucopia of volunteers that seemed to be coming out of the woodwork.

Through previous liaisons, the Civil Affairs Team had already established volunteer and benevolent host nation support. Non-governmental organizations (NGOs), host nation providers, and Armed Forces of the Philippines (AFP) personnel provided ALL medical care, ALL pharmaceutical management, ALL dental care, ALL minor surgical care, and ALL logistical processing of patients.

The key to this success is getting all the organizations in the same location at the same time. This was accomplished by breaking down the MEDCAP coordination into three meetings: initial (introduction of a possible site), midterm, and final planning conferences. During the initial planning conference, any possible concerns about the security or issues with the choice of location were addressed. The midterm planning conference was used to determine what each organization was able to bring to the MEDCAP and to determine transportation requirements, if any. The final planning conference was used to identify any problems that may have been overlooked and to finalize the date and time of the event. It is imperative to invite everyone to these meetings; their knowledge can be the difference between success and failure. Also, involving all the organizations during this process gives them a sense of ownership and pride in the project. These simple steps have made U.S. participation almost nonessential, and in Civil Military Operations, the main goal is to work oneself out of a job. What they have done with MEDCAPs is help the host nation foster a renewed rapport with a wide variety of local populations.

Neither myself nor any other U.S. medical provider assisted in any manner – not that we wouldn't or couldn't, but we simply weren't needed. We weren't needed because they had taught the regional health officers and other parties to plan and conduct their civic-based MEDCAPs on their own – it taught them to fish as opposed to providing them with fish. Reducing the overall participation of U.S. forces in projects like this MEDCAP builds the people's confidence and fidelity in their military and government. Instead of locals saying "Thank you U.S.," they are accurately saying "Our own government really cares."

Now in reality, it had a bit of a hometown fair feel to it. There were children's movies, games, prizes, and wonderful integration of the community with the Philippine Marines. With things like the games for children and adults and educational videos directed mostly at the youth, CMO is helping the host nation drive a wedge between lawless radicals / insurgents and the local people. In the end, the town, with help from Philippine organizations and Philippine Marines, had essentially put on their own MEDCAP. Through SFC Shearer's, and MSG Wilson's mentoring, over 500 men, women, and children were contacted, cared for, and countless more learned the great outcome of embracing their local government and Marines. What was once just a MEDCAP has now become a community event.

Author's Note: This article was written in the April/May 2007 time frame. Since then, all parties have moved on to new commands.

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SFC (P) Woody Wilson joined the Army on 11 Nov 93. His tours have included: Ft. Benning GA, 1/506th in Korea, 3/327th, 1/501st, 1/505th, and 2/60th. After his tour as a Drill Sergeant, he was assigned to 96th Civil Affairs where he graduated from the Civil Affairs course, and the Advanced Noncommissioned Officers Course (E-7 School) & Language School. He was deployed to Ethiopia, Africa, and then to the Philippines. Upon returning from the Philippines he was reassigned to HQ AFRICOM, Stuttgart, Germany, which is where he currently hangs his hat.

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Using Modeling to Predict Medical Requirements for Special Operations Missions

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Financial Disclosure

The authors of *Using Modeling to Predict Medical Requirements for Special Operations Missions;* Martin Hill, BA; Ralph Nix, BS, MS; Curt Hopkins, BS; Paula Konoske, PhD; and Gerry Pang, MS; has indicated that, within the past year, they have had no significant financial relationship with a commercial entity whose product/services are related to the topic/subject matter.

Objectives

1. Describe the use of modeling in determining medical supply requirements for military operations.
2. Describe how modeling provides an audit trail from the types of illness or injury to each inventory line item.
3. Explain the importance of current casualty data for modeling efforts.

Abstract

Background: The objective of this study was to show the benefits of modeling clinical supply requirements for Special Operations missions by providing an analysis and validation of the Air Force Special Operations Command (AFSOC) Rapid Response Deployment Kit (RRDK) Allowance Standard. **Method:** The Naval Health Research Center (NHRC) method of modeling clinical requirements was used to analyze RRDK needs. Investigators studied the operational requirements for the RRDK, and met with RRDK subject matter experts (SMEs) to determine the type of patient conditions care providers routinely encounter while deployed, as well as the type of clinical tasks they perform to treat those conditions. A model was then built using the SME input. A patient stream was developed reflecting the types and quantities of injuries and illnesses usually experienced by Special Operations Forces, and applied to the AFSOC model. **Results:** This study identified several instances of multiple National Stock Numbers being used to order the same medication or supply, adding unnecessary cost and additional work for logisticians The resulting quantities determined by the NHRC model lowered the cost of the RRDK by more than $10,000, along with a minor drop in cube.

Introduction

Special Operations Forces (SOF) have become the "tip of the spear" in the Global War on Terrorism. From Iraq to Afghanistan and in many small, mostly unheard of conflicts in between, commandos from the joint U.S. Special Operations Command (USSOCOM) are engaged in unconventional operations to prevent extremists from gaining footholds in countries where they can build an operational base, as Al Qaeda did in Afghanistan in the 1990s.

Special Operations missions fall into nine categories. Direction action missions are short-duration, small-scale offensive actions in hostile or politically sensitive areas. Special reconnaissance missions involve covert reconnaissance or surveillance operations. Foreign internal defense missions involve training a friendly country's military or security forces. Unconventional warfare missions involve a broad spectrum of military and paramilitary operations, and are usually of long duration. Counterterrorism missions include offensive actions taken to prevent, deter, preempt, or respond to terrorism. Weapons of mass destruction (WMDs) counterproliferation missions are taken to locate, seize, destroy, render safe, capture, or recover WMDs. Civil affairs operations are aimed at winning "hearts and minds" in foreign territory. Psychological operations involve actions taken to manipulate the behavior of a population, government, or military force. Information operations involve adversely affecting the information systems of an adversary.[1]

Many of these missions are joint operations, using SOF from the Army, Navy, Marine Corps, and Air Force, working under the aegis of USSOCOM. In most cases, these missions are accomplished with little or no publicity, or acknowledgment of the U.S. government. The U.S. Air Force contribution to these joint operations includes specialized cargo, transport, and attack aircraft squadrons, highly trained forward air controllers, combat weathermen, and "parajumpers," or combat rescue specialists, who are assigned to the Air Force Special Operations Command (AFSOC), which operates as part of USSOCOM.[2]

Providing healthcare to AFSOC and USSOCOM Operators is a special cadre of Air Force physicians, physician assistants, nurses, and independent duty medical technicians that specializes in Special Operations medicine. Unlike their colleagues in the rest of the Air Force, who provide support in the continuum of healthcare normally seen in conventional warfare, these AFSOC providers must provide care in the most austere environments, often without the kind of support seen in conventional battlefields. Despite the need for such self-sufficiency, AFSOC medical capabilities must remain small and light, and capable of being deployed on short notice anywhere in the world.[3]

The Naval Health Research Center (NHRC) has used its method of medical modeling clinical requirements to create and update U.S. Marine Corps medical capabilities and Authorized Medical Allowance Lists (AMALs) since the mid-1990s. Like AFSOC, Marine Corps medical units must remain small, light, and flexible.[4] In 2004, the Air Force Medical Support Agency, Surgeon General Support Logistics Office requested that NHRC conduct a proof-of-concept study to assess the validity and feasibility of using its medical modeling tool in U.S. Air Force Allowance Standard (AS) development and management.[5] Following the success of this proof-of-concept study, NHRC was tasked by the Air Force to model elements of its Expeditionary Medical System. In 2007, the Air Force asked NHRC to conduct another proof-of-concept study to demonstrate the benefits of modeling medical supply requirements for Special Operations missions using the AFSOC Rapid Response Deployment Kit (RRDK) as the prototype.

Method

The NHRC method of modeling medical supply requirements was developed to establish and/or review AMALs for various levels of care in the Navy and the Marine Corps. Its aim is to give clinicians in the field or the fleet the materiel they need to provide the best care possible, while still maintaining as small a logistical footprint as possible, in concert with current Navy and Marine Corps doctrine.[4] It involves a four-step process that begins with the identification of likely patient types to be encountered by a particular type of medical treatment asset, including combat wounds, nonbattle injuries, and illnesses. Patient conditions (PCs) created for the Defense Medical Standardization Board (DMSB) Treatment Briefs are used for this purpose.

The PCs are then linked to clinical tasks developed by DMSB and NHRC. Those tasks are, in turn, linked to each supply item needed to complete the task. A patient stream drawn from historical combat data is created using any number of casualty estimation programs, including NHRC's FORECAS, SHIPCAS, and PKCAS software.[6] The required type and quantity of equipment and consumable supplies can then be calculated based on the probability of those PCs occurring in a patient stream. Figure 1 provides a basic representation of the NHRC modeling process.

In this model, PC 166, a multiple injury wound, is being treated by an AFSOC RRDK at the Forward Emergency Care level of clinical capability (formerly Level 1B). The task profile shows the likely clinical tasks to be performed on this type of patient in that functional area, and the percentage of those patients expected to receive them. The "Equipment/Supplies" column identifies the items needed to complete the blood type and cross-task at that level of capability. Not shown in this figure are additional data fields used to calculate supply quantities, including the amount of each supply needed to complete the task, how often the task will be repeated in the first 24 hours of treatment, how often the task will be repeated in each subsequent 24-hour period, and the average length of stay at that facility

PC 166, a multiple injury wound involving penetrating wounds to the chest and kidney

PC Code	Capability of Care	Functional Area	Task	% of Pts	Supplies
001		CCATT	Triage	100	Sponge Surgical Cellulose, Cotton, Gauze 4X4
002	**Emergency Forward Care**	FFCU	Assess Patient	100	Pad ABD 7 5X8 White 3 Layers Sterile 240S
003	Forward Resuscitative	SPEARR	O2 Set Up	100	Dressing Pressure Cotton 7 5X8 Sterile Latex-free
-	Theater Hospitalization	**RRDK**	O2 Admin	100	Dressing Pressure Cotton 11X11 Sterile latex-free
166	Definitive Care	FFPED	Needle Thoracostomy	25	Tape Adh Surgical 198X2 White Hypoallergenic
167		FFCCU	**Emergency Control of Hemorrhage**	100	

Figure 1: Example of NHRC clinical requirements model.

Once the model is created, it is then imported into NHRC's Estimating Supplies Program (ESP), a software program that provides logisticians and medical planners the ability to project their medical supply usages for a variety of expeditionary scenarios. This basic modeling method, often referred to simply as ESP, is also incorporated into two other NHRC software programs: the ReSupply Validation Program which helps create "push packages" for resupply; and the Tactical Medical Logistics Planning Tool, used by medical planners for course-of-action analysis.

RRDK Mission and Capabilities

RRDK capabilities are designed to reduce the impact of trauma, disease, and nonbattle injury (DNBI) on missions pursued by AFSOC and USSOCOM personnel. The RRDK deploys in support of AFSOC air squadrons and USSOCOM missions to austere locations to provide limited medical care and preventive medicine (PM). More specifically, RRDK capabilities include:

Clinical capability: Provides limited advanced trauma and sick call for a population at risk (PAR) of 200–400 personnel. Also provides limited PM practices such as environmental health site assessments. Modularized into four components (two advanced trauma modules, a medical module, and an environmental module) to allow flexibility in configuring the RRDK to individual mission requirements.

Endurance: Includes enough portable supplies to maintain its clinical capability for 30 days without resupply.

Limitations: Is not self-sufficient. Requires provision of base operating support from host unit and/or shelter of opportunity. Patient holding is limited to a maximum of 12 hours, with an average of 6 hours.

Manpower: Includes one flight surgeon and two independent duty medical technicians, known as the Special Operations Forces Medical Element.[7]

The RRDK usually deploys with a second AS designed for casualty evacuation (CASEVAC). Though separate from the RRDK AS, many clinical tasks performed by the RRDK require equipment contained in the CASEVAC AS. These items were included in this study's modeling efforts.

RRDK Clinical Tasks

RRDK subject matter experts (SMEs) were presented a list of clinical tasks usually performed at the emergency forward care level of care, and asked to identify which tasks they were required to accomplish in the performance of their duties. Eighty-four clinical tasks were identified (see Table 1).

When modeling medications, the primary source for determining which drugs and dosages to use with which PCs was the Joint Special Operations Tactical Medical Emergency Protocol Drug List.[8] This was supplemented with USSOCOM's Tactical Medical Emergency Protocols,[8] and the Special Operations Forces Medical Handbook.[9] The drug reference database provided by WebMD's Medscape Today Web site was also consulted.[10]

RDDK Patient Stream

With its mission to provide healthcare support for trauma and DNBI at the "forward end of the spear" in every combatant command region, the RRDK is exposed to a large list of possible PCs. In teleconferences and a personal meeting, RRDK SMEs were asked to identify DMSB PCs representing patients they believed they were likely to encounter, and initiate stabilizing treatment for, while deployed. A total of 315 PCs were chosen. Table 2 shows the patient categories into which those 315 PCs fall.

Table 1. Rapid Response Deployment Kit Clinical Tasks

Task No.	Task Description	Task No.	Task Description
001	Triage	127	Patient Restraint (Gauze, Ties)
002	Assessment And Evaluation Of Patient Status	129	Perform Restrained Patient Control
005	Remove And Collect Belongings, Valuables And Equipment	142	Order And Document Appropriate Meds/Treatment
006	Establish Adequate Airway (Oro/Naso Pharyngeal Only)	145	Administer Appropriate Medication
007	Emergency Cricothyroidotomy	151	Gynecological Examination
010	Neurological Assessment	204	Provide Patient Safety Special Watch
011	Stabilize Spine (Collar/Spine Board)	221	Pericardiocentesis
017	Suction (Oral/Trach/Endo)	244	Hemacult Test- Feces/Emesis/Gastric Suction
019	Emergency Control Of Hemorrhage	245	Urine Testing
022	O2 Administration Setup	247	Place In Respiratory Isolation
023	O2 Administration Continuous (Nasal/Mask)	248	Force Fluids
024	Vital Signs	278	Arrange For Patient Evacuation
032	Set-Up Pulse Oximeter	279	Arrange And Document Return To Duty
038	Maintain On Ventilator	280	Patient Discharge Instructions
044	Setup Drainage Bottles/Pleurevac	359	Induce Local Anesthesia
046	Maintain Chest Tube Suction	453	Closed Reduction Of Dislocation
049	Start/Change IV Infusion Site	639	Pregnancy Determination - Hcg
050	Administer IV Fluid	740	Reduce Dislocation
063	Venous Cutdown*	748	Assemble Material/Clean Up
068	IV Infusion Terminate	802	Initial/Subsequent Non-Surge Debride Of Burn Or Open Wound
070	Bowel Sounds Assess	999	Morgue Care
071	Insert Ng/Og Tube	A6	Apply Tourniquet
073	Perform Ng/Og Suction	A12	Occlude Sucking Chest Wound
075	Irrigate Ng/Og Tube	A30	Wet/Cold Injury Therapy
076	Gastric Lavage	A6	Apply Tourniquet
079	Catheterization, Foley	D2940	Analgesic Filling†
082	Measure/Record Intake/Output	Z014	Intubation
085	Wound Irrigation	Z027	Cardio Arrest Resuscitation
086	Clean And Dress Wound	Z030	Electronic Monitoring Of Patient Vital Signs (Propaq)
092	Apply Ace Bandage	Z037	Bag Valve Mask Setup
093	Extremity Elevation	Z039	Perform Ventilation With Bag Valve Mask
096	Apply Sling	Z042	Insert Chest Tube
098	Apply Splint/Immobilize Injury	Z045	Change Drainage Bottles/Pleurevac
103	Circulation Check	Z083	Expose Patient For Exam
108	Minor Surgical Procedure (Debride/Suture/Incision)	Z094	Extremity Traction, Application/Adjust
110	Test Vision	Z103	Re-Establish IV Access (Intraosseous)
121	Eye Irrigation	Z277	Prepare For Evac Ground/Air
123	Eye Care (Dressings/Eye Patch)	ZZ02	Stain Eyes (Fluorescein Stain/Woods Uv Lamp)
124	Ear Care Irrigation	ZZ03	Needle Thoracostomy
125	Sponge/Hyperthermia Treatment	ZZ51	Clean And Prepare Instruments
126	Seizure Care/Precautions	ZZ58	Pressure Infuse Resuscitative Fluids (Equipment Task)

*Rarely performed in the field, but a required skill for RRDK flight surgeons. †Emergency dental care.

Table 2. Rapid Response Deployment Kit Patient Conditions by Category

Patient Category	Patient Category
Abdomen & Pelvis	Infectious/Parasitic
Battle Fatigue	Lower Limbs
Burns	Miscellaneous
Cardiovascular	Multiple Injury Wounds
Dermatological	Neuropsychiatric
Directed Energy Weapon Eye Lesion	Respiratory
Environmental	Sexually Transmitted Disease
Eye/Ear Disease	Spine
Female Specific	Sprains & Strains
Gastrointestinal	Superficial/Soft Tissue
General	Surgical
Genitourinary	Thorax
Head	Upper Limbs

Developing a patient stream for this study was problematic because data on casualties among SOF are typically classified. Therefore, no actual RRDK patient data were available for this study. However, the little amount of data published on SOF casualties indicates Special Operations Forces suffer a disproportionately high rate of casualties. Many Special Operations missions, such as reconnaissance and direct raids, while cloaked in stealth and secrecy, can erupt into sharp periods of intense combat. A 1995 Naval Postgraduate School modeling study of SOF attrition rates during such missions found a sharp climb in SOF casualties the longer a Special Operations unit remains in contact with an enemy, particularly during daytime raids.[11]

According to the Special Operations Warrior Foundation, between 1980 and 2004 SOF warriors represented about 2% of all active-duty forces, yet accounted for 24% of all combat losses, a casualty rate 12 times higher than conventional forces (personal communication, S. McLeary, January 1, 2004). Table 3 breaks down the SOF casualties suffered during several major contingency operations.

Table 3. Special Operations Forces KIAs vs. Conventional Force KIA, 1984–2004

Contingency Operations	Country	Total U.S. KIA	SOF KIA	SOF % KIA
Eagle Claw (Desert One)	Iran	8	8	100%
Urgent Fury	Grenada	19	13	68%
Just Cause	Panama	23	13	57%
Restore Hope/Task Force Ranger	Somalia	29	18	62%
Desert Storm	Kuwait & Iraq	147	25	17%
Allied Force	Kosovo	2	0	0%
Enduring Freedom	Afghanistan & Philippines	51	49	96%
Iraqi Freedom	Iraq	314	15	5%
Total		593	141	24%

KIA, killed in action; SOF, Special Operations Forces.
Source: Special Operations Warrior Foundation.

A 2007 study of SOF casualties by COL John Holcomb et al., quantified the methods of injury leading to SOF deaths during Operations Enduring Freedom and Iraqi Freedom. Explosions (40%), gunshot wounds (27%), and aircraft accidents (27%) made up the bulk of the causes of death, resulting in a total of 67% wounded in action (WIA)[12] (see Figure 2).

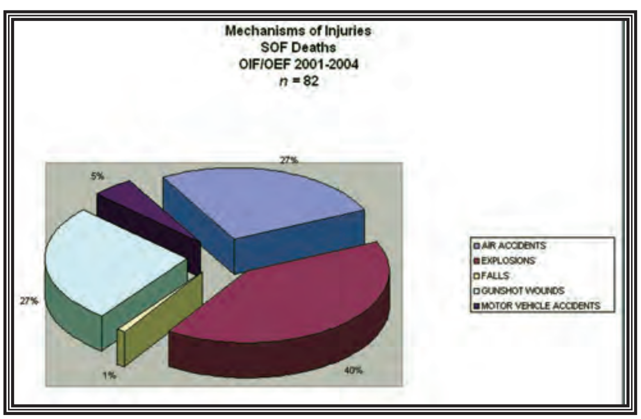

Figure 2: Causes of Special Operations Forces deaths. [12]

For this study, NHRC reviewed data from the Department of Defense Career History Archival Medical and Personnel System (CHAMPS) representing SOF casualties evacuated from Afghanistan and Iraq in March 2002 and December 2006. Ninety-seven casualties were identified. Of these, the largest cause of injury was explosives (53%), followed by penetrating ballistic wounds (26%; identified as "war wound, enemy cause"), with a total of 79% of injuries caused by combat action. Figure 3 provides a complete breakdown of these mechanisms of injury.

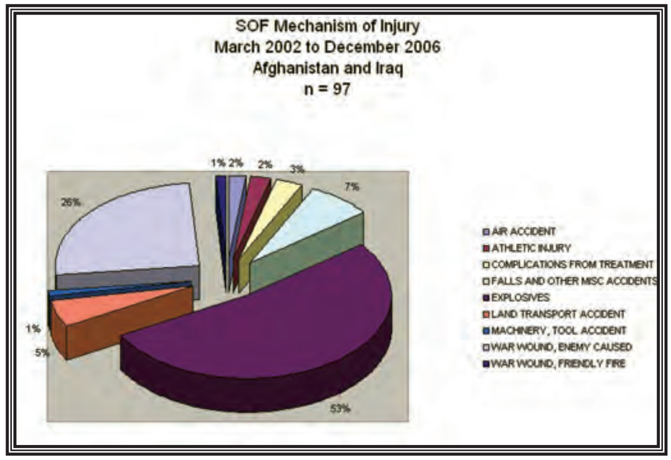

Figure 3: Special Operations Forces mechanisms of injury, from CHAMPS database.

While these statistics represent only the most severe casualties — those either killed or injured severely enough to require evacuation — they do indicate a higher ratio of combat-related injury to DNBI than experienced by conventional troops. Conventional forces, by comparison, suffer a nearly inverse proportion of DNBI to wounded in action (WIA) casualties. According to the Joint Patient Tracking Application (JPTA), a total of 77,240 casualties from all branches of the service were evacuated from Iraq and Afghanistan between 2004 and 2006. Of those, 80% were DNBIs, while only 20% were combat casualties.

These data showed that the present study required a patient stream weighted more heavily with combat injuries than most casualty projection programs are designed to produce. NHRC's warfare casualty forecasting software, FORECAS, was selected for use based on its ability to modify both combat intensity and environments.

Three patient streams were created: one each for desert, jungle, and urban terrains, and each with a PAR of 300 (the average RRDK mission requirement) engaging in moderate combat for 30 days. As stated previously, Special Operations missions are usually characterized by sharp, intense periods of combat lasting a short duration but resulting in a disproportionately high casualty rate. After several experimental FORECAS patient stream runs, it was determined that a moderate level of combat over a 30-day period best reflected this disproportionality.

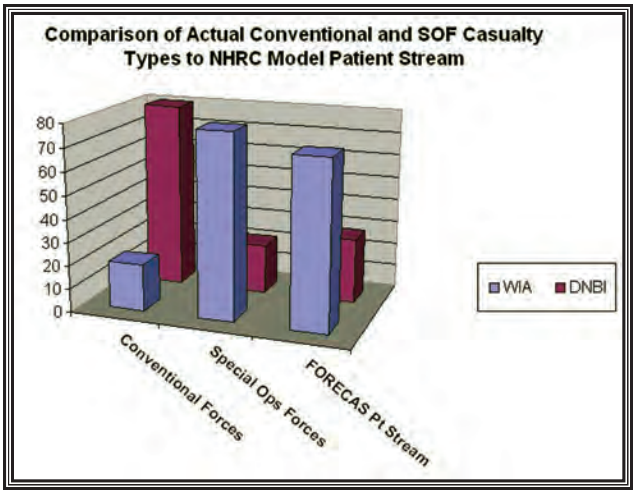

Figure 4: Comparison of actual conventional and Special Operations Forces casualty types and the NHRC patient stream.

The three patient streams were then aggregated. Averages were calculated for any PC appearing more than once, and then rounded to the nearest whole number. The resulting patient stream contained 97 patients, with 72% WIA and 28% DNBI. Figure 4 shows a comparison between the JPTA conventional forces casualties, the CHAMPS SOF casualties, and the NHRC patient stream. Figure 5 shows the patient category breakdown for the NHRC patient stream.

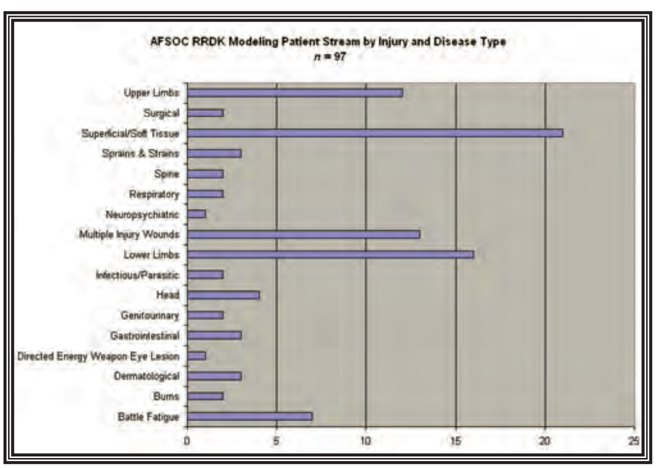

Figure 5: Rapid Response Deployment Kit model patient stream by injury and disease.

PMO	Capability	Functional Area	Task	Task Freq for 30 Days	Equipment/Supplies
950	-		Test Water for Coliforms	52	Bag water sample polyethylene Water sampling test reagent coliform 200S
951	-		Test Water for Chemicals	4	Water testing kit bacteriological Comparator Color: Hydrogen ion & residual chorine
952	RRDK	Sick Call	Habitability Survey	4	
953	-		Air Sampling	20	
954	-		Monitor Heat Conditions	300	
955	-	Preventive Medicine	Screen Treatment Logs for Infectious Diseases	30	

Figure 6: Preventive medicine objectives and tasks model.

Preventive Medicine Objectives and Tasks

Preventive medicine objectives (PMOs) are modeled with associated supplies and equipment, as depicted in Figure 6. Task frequencies are largely dependent on PAR size and the inherent disease risk for a given area of operations. Modeling assumptions for this study included deploying with a complement of 300 personnel for a 30-day period in an operational setting with minimal host-country infrastructure and preventive medicine.

Table 4. RRDK Preventive Medicine Objectives

PMO #	Objective Description
950	Water Sanitation
951	Pest Control
952	Heat/Cold Injury Prevention
953	Communicable Disease Control
954	Food Sanitation
955	Common Area Sanitation
956	Berthing Sanitation
957	Waste Management
958	Conduct Training
959	Industrial Hygiene

Nine PMOs were identified for the RRDK (Table 4), requiring a total of 31 PM tasks. However, at this far-forward level of care, many of these tasks are simply visual, requiring no equipment or consumables. PM supply quantities were calculated using a PM task frequency chart originally developed by NHRC for determining PM supply quantities for the Air Force's Global Reach Laydown (GRL) system, a similar forward emergency care medical and PM capability (see Table 5).[13]

Results

Of the 84 clinical tasks determined to be required by the RRDK mission, 15 did not occur in this patient stream (see Table 6). However, supplies sufficient to complete each of those 15 tasks at least one time were included in the final list. Because consumable supply quantities were rounded up to the nearest quarter package whenever possible, there should actually be enough supplies to complete each of these tasks more than once.

Task No.	PM Task	Daily	Weekly	Once	No. of Sites
Z504	Obtain Water Sample/Conduct pH Testing[*]	1			2
Z505	Obtain Water Sample/Conduct Chlorine Testing	1			2
Z506	Obtain Water/Ice Sample/Conduct Bacteriological Testing[†]		13		4
Z541	Conduct Vector Borne Disease Assessment[*]		1		1
Z548	Conduct Pest And Vector Identification[*]		1		1
Z580	Monitor Heat Stress Conditions	10			1
Z600	Screen Treatment Logs For Infectious Disease Cases[*]	1			1
Z607	Conduct Food Borne Illness Investigation[‡]			1	1
Z611	Dispense Std Prophylaxis/Contraceptive	1			1
Z640	Select Site Of Messing & Food Storage Areas[*]			1	
Z642	Conduct Inspections Of Messing & Food Storage Areas	1			1
Z644	Evaluate Food Sourcing And Transport[*‡]			1	1
Z660	Make Recommendations For Camp Setup[*]			1	2
Z661	Conduct Inspections Of Common Use Areas	1			1
Z662	Conduct Inspections Of Laundry/Shower Services	1			1
Z663	Conduct Inspections Of Latrines/Handwashing Site	1			1
Z680	Select Berthing Site[*]			1	1
Z681	Conduct Inspections Of Berthing Areas		1		1
Z700	Assist In Selection Of Waste Disposal Sites			1	2
Z701	Conduct Inspections Of Waste Disposal Sites		1		
Z790	Document/Report Inspection Results[*]		1		2
Z791	Make Recommendations/Troubleshoot Discrepancies[*‡]	1			1
Z910	Gather & Analyze Intel Data On Survey Area[*]			1	2
Z911	Conduct Visual Site Inspection And Record Results[†]			1	2
Z912	Develop Site Sampling Plan[*]			1	2
Z913	Map Out Site Inspection Grid[*]			1	2
Z914	Label & Record Sample Container			1	50
Z918	Collect & Interpret Ambient Air Sample[*]			10	2
Z924	Collect Soil Sample/Conduct Test 8[*]			8	2
Z926	Conduct Radiological Sampling/Monitoring[*]			18	2
Z930	Assessment Of Hazardous Waste[*]			1	10

Table 5. Preventive Medicine Objective Frequencies

[*]No supplies assigned this task.
[†]Includes bottled water sampling; with a shipment of 1000 bottles/week, 10 samples are taken. The four sites are two potable water sources (one sample each), the bottled water storage area (10 samples), and any ice shipments (one sample).
[‡]Tasks performed on an "as needed" basis.

Table 6. Clinical Tasks Not Included in Patient Stream

Task No.	Task Description
076	Gastric Lavage
084	Shave And Prep
124	Ear Care Irrigation
148	Obtain Specimen For Laboratory Analysis
151	Gynecological Examination
740	Reduce Dislocation
802	Initial/Subsequent Non-Surg Debride Of Burn/Wound
A10	Position For Postural Drainage/Place In Coma Position[*]
A30	Wet/Cold Injury Therapy
A2	Remove Casualty From Danger[*]
D2940	Analgesic Filling
Z108	Facility Site Set Up
ZZ01	Induce Vomiting

[*]No supplies required for this task.

During the modeling process, we discovered several medications that were identical in both formula and dosage, but were included under two or more different National Stock Numbers (NSNs) (see Table 7). Some of this may be due to logistical ordering errors. In other cases, multiple NSNs may have been chosen to allow distribution among RRDK modules. For this study, only one NSN was modeled for analysis, though all NSNs will be included in the final model unless otherwise instructed by AFSOC. However, should AFSOC decide to single up on these items, using the NSNs modeled for bisacodyl, erythromycin, and moxifoxacin is recommended because the packaging for these NSNs is best suited for distribution among RRDK modules.

When possible, in computing consumable supply quantities, all line items are rounded to the nearest quarter package. This not only provides logistics units an easier means of packing assemblages, it also ensures a more robust AS. Nevertheless, modeling the RRDK using NHRC's ESP model achieved a greater than $10,000 cost savings, mostly in medications (see Figure 7). A modest 4% savings was achieved in cube, while weight increased by less than 22.5 pounds (see Figure 8).

Table 7. Medication in RRDK Allowance Standard With Multiple NSNs

NSN	Nomenclature
6505008899034	Bisacodyl Tablets USP 5mg Film Enteric 1000S
6505001182759	Bisacodyl Tablets USP 5mg I.S. Tablet 100S[*]
6505010835988	Erythromycin Stearate Tablets USP 250mg 100S[*]
6505006041223	Erythromycin Tablets USP 250mg 100S
6505015034772	Moxifloxacin Hydrochloride Tablets 400mg (5/Strip) 30S[*]
6505015163194	Moxifloxacin Hydrochloride Tablets 400mg 50S
6505014622434	Sodium Chloride Injection USP 0.9% 500ml Bag 24S[*]
6505013306268	Sodium Chloride Injection USP 0.9% 500ml Bag 24S
6505013723425	Sodium Chloride Injection USP 0.9% 500ml Bag 24S

[*]Modeled for this study.

To increase confidence that the RRDK supply quantities estimated by ESP could handle varying patient loads, supplies for a second patient stream were calculated using the modeling program. This patient stream used patient condition distributions for con-

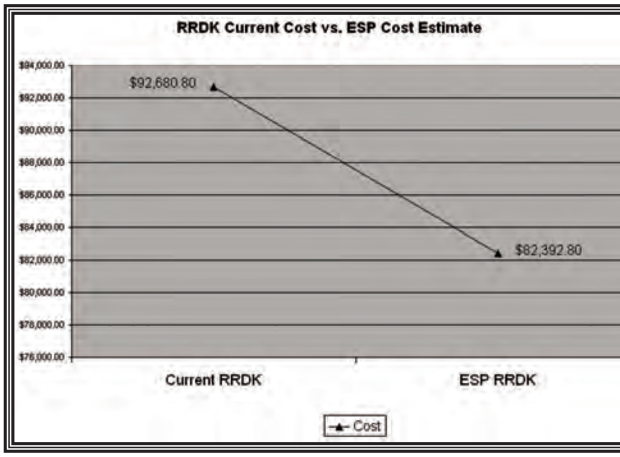

Figure 7: Current Rapid Response Deployment Kit cost vs. modeled estimated cost.

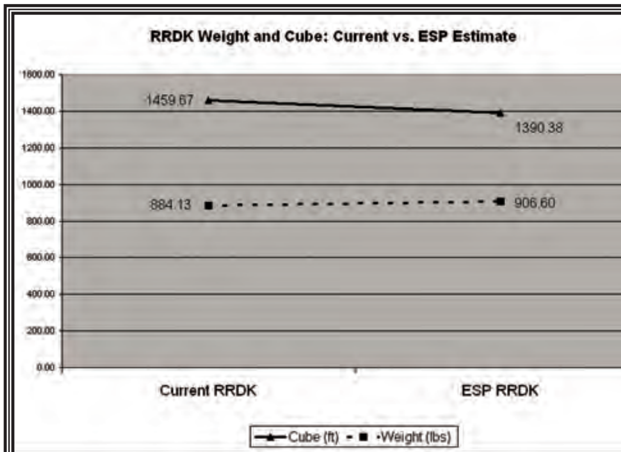

Figure 8: Rapid Response Deployment Kit weight and cube comparison.

ventional forces from the current conflicts, with a breakdown of 20% WIA, 26% NBI, and 54% disease, as compared to the combat heavy SOF patient stream of 72% WIA and 28% DNBI.

The supply requirements generated by this second patient stream were then compared to the RRDK allowance standard created by ESP and the quantities in the current RRDK AS. The RRDK supply quantities generated by ESP were adequate to handle more than 80% of the disease-heavy second patient stream requirements. This provided better coverage than the supply quantities currently stocked in the RRDK.

Discussion and Comment

NHRC's method of modeling clinical supply requirements has been used successfully to analyze conventional force medical supplies for the Navy, Marine Corps, and Air Force. Modeling medical requirements for an unconventional force posed particular difficulties. SOF missions, and casualties incurred on those missions, are typically classified information. Few data are available to develop statistical casualty forecasting software. Nevertheless, the information that is available on SOF casualties indicates that Special Operations units suffer a disproportionately higher ratio of combat casualties to DNBIs. This study was able to develop a patient stream simulating that disproportionality using the conventional warfare casualty project program, FORECAS. To increase confidence that the ESP-generated RRDK allowance standard could handle varying patient loads, a second disease- and NBI-heavy patient stream was run through the model. This showed the ESP-generated RRDK AS could provide a greater than 80% solution to widely divergent patient streams.

Exporting ESP capabilities to inventories other than those of the Navy and Marine Corps is a viable method of evaluating other preexisting medical systems' capabilities. In previous efforts, the inventories for the Air Force Mobile Field Surgical Team and the Critical Care Air Transport Team have been successfully incorporated in ESP. The Rapid Response Deployment Kit was included in the latest release of ESP (ESP 2.94), giving AFSOC planners a greater capability to configure the RRDK for a variety of patient streams. ESP and its family of logistics programs are also highly effective tools for configuring resupply packs, ensuring medical materiel sustainment across the spectrum of medical care facilities, while maintaining their clinical capability.

Finally, the ESP simulation creates an audit trail establishing clinical requirements for supply items in medical system inventories that enable logisticians and medical planners to validate current inventories and perform analyses of projected changes to future inventories. It also serves as a leading consumption indicator, making it easier to identify resupply requirements to ensure sustainment.

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Note: Please contact Dr. Paula Konoske for **Appendix A: RRDK Patient Conditions** at Paula.Konoske@med.navy.mil

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Ultrasound in Special Operations Medicine: A Proposal for Application and Training

Sean Keenan, MD; Andrew R. Morgan, MD; Robert Blankenship, MD; David A. Hubler, 18D

Abstract

Emergency ultrasound is gaining ground as a powerful diagnostic tool in the hospital setting. With ever-expanding indications, validated with scientific studies, it has become an accepted and relied-upon technology with daily use in emergency departments, and surgical and critical care settings around the world. Additionally, with the current worldwide combat operations and the resultant deployment of far-forward medical assets, the technology's use outside of the standard hospital setting has been demonstrated. This technology, however, has had limited use outside the forward surgical or medical officer-positioned assets, despite being standard equipment with some Special Operations units. We hope to stimulate discussion about its use in Special Operations medicine by educating the reader to the possibilities of this technology, and suggesting a reasonable training and fielding plan for its optimal use.

Introduction

Ultrasound (US) continues to gain credibility as a powerful diagnostic tool in the hospital setting. With ever-expanding indications validated by scientific studies, US has evolved from a radiology department-centric application to a routine part of daily practice in emergency departments (EDs), intensive care units (ICUs), and outpatient primary care clinics throughout the country. The military has contributed to the expanding role of US by deploying this technology to forward areas. However, no one has made any formal recommendations for training in the Special Operations Forces (SOF) community, and its adoption has been limited to date. SOF should lead the way to integrating this application into the forward-deployed environment, and place it into the capable hands of the Special Operations Medic.

The maturation of two advances in the last decade has made the landscape ripe for this opportunity in SOF medicine. First, the latest portable US technology has condensed the physical size of US equipment to make it far more practical in the deployed setting. For most laymen, the term "ultrasound" conjures images of the cumbersome cart-based machines associated with obstetric visits. Until the past decade, this was an accurate stereotype. Presently, several manufacturers make powerful portable US machines no larger than a laptop computer that, with accessories, pack to the size of a briefcase.

Secondly, emergency ultrasound (EUS) has emerged as a discrete and well studied discipline within the realm of imaging. The major impetus for this evolution was the demand for rapid answers to specific clinical questions at the patient's bedside. Formal diagnostic US studies provide a complex and detailed study of an anatomic region and require a radiologist or a registered diagnostic medical sonographer (RDMS). In contrast with a formal diagnostic study, in EUS the clinician, rather than technician, collects the images. In addition, a EUS study focuses on collecting images necessary to answer a specific clinical question rather than conducting a comprehensive survey of the anatomic region in question. Refer to Table 1 for a summary of key differences between the US disciplines.

The current worldwide combat operations were the first opportunity for military medicine to combine the principles of EUS with portable US technology on the battlefield and bring diagnostic imaging closer to the point of injury. However, most utility of this equipment has been limited to the hands of trained physicians and physician assistants assigned to Combat Support Hospitals, Forward Surgical Teams, and to the level of some lower-role field treatment facilities such as Battalion Aid Stations.[1] Many forward-stationed medical units are finding use for EUS where traditional diagnostic assets

Table 1. Comparison of "Traditional" Diagnostic US to Emergency US

	Setting	Scope	Training Requirement	Relative Exam Time
Diagnostic US	Radiology Department/ US suite	Comprehensive for given anatomical area	Formal residency or RDMS program	Longer due to detail of exam
Emergency US	Patient's bedside	Clinical problem-focused	Practice-based pathway	Brief: seconds to minutes

(plain radiography, computed tomography [CT] scans, magnetic-resonance imaging [MRI]) are limited, non-existent, or impractical.

Special Forces battalions currently field one US machine per battalion medical section. The authors have observed several merits favoring the forward placement of this technology in SOF units. As a mobile, non-invasive diagnostic device, EUS is ideally suited for austere military settings. The existing portable x-ray system fielded in Special Forces battalions has a much smaller breadth of applications, and is much larger and bulkier than the briefcase-sized hard case that contains a complete ultrasound system. We wish to educate the reader to the possibilities of EUS technology, and suggest a reasonable training and fielding plan for its optimal use.

The technology

Emergency ultrasound is best known for its traditional use in the evaluation of unstable patients. The focused abdominal sonography in trauma (FAST) exam is used in trauma centers around the world to rapidly assess free fluid in the abdomen and around the heart as a potential cause of hypovolemic shock. The extended FAST exam (eFAST) also includes views into the pleural cavity and is a common modification, as well as its use in the evaluation to exclude pneumothoraces. Table 2 details the respective sensitivities and specificities.

Table 2. Sensitivities and Specificities for Common Trauma Uses of EUS.[2-9]

	Sensitivity	Specificity
FAST	64-98%	86-100%
Pericardium	97-100%	???
Pneumothorax	59-100%	94-100%

The technology also can reliably identify abdominal aortic aneurysms and can image gall bladders and intrauterine pregnancies, as well as detect deep venous thromboses (DVT). More recent indications include evaluation of tendon integrity, as well as detection of fractures, foreign bodies under the skin, and abscesses. Ophthalmologic indications include detection of intraocular foreign bodies, detached retinas, and estimates of intracranial pressure.[10-12] Vascular access with ultrasonography is another common indication, as well as ultrasound guided-pleurocentesis and peritoneal drainages. Another potentially useful application is its emerging use with ultrasound-guided peripheral nerve blocks.

With each of these indications, many of which have been proven to be effective with relatively little time for hands-on instruction and practice, the technology can be a powerful tool in the hands of the properly trained clinician or technician. Additionally, the machine is easily transported, intuitive in its operation (user-friendly), and provides a rapid degree of sustainable and reproducible results in the end-user. Each U.S. Army Special Forces battalion has already fielded the technology, but the requirement for effective training remains.

Avoiding diagnostic pitfalls in clinical application

As with any new technology, there is a temptation to find applications that fit it, rather than first identifying a need, then applying the technology. With our recent combat experience and proven applications, EUS has found its way onto the medical landscape. Understanding its potential, and especially its limitations, is essential to integrating the technology into practice.

As with any diagnostic tool, the clinician should first delineate a question for the test to answer. For example, in the case of FAST exam, the question should be: "Is this patient's hypotension being caused by free-fluid (intra-abdominal hemorrhage) in the abdomen or in the pericardium (tamponade)?" This binary question directs the patient to a surgeon if a positive result is found in the right patient and appropriate clinical scenario. Another example would be: "Does the patient with multiple shrapnel wounds to the back with shortness of breath need a chest tube?" And if the answer to the previous question is "yes", then the next question should be: "Which side is affected?" thereby directing chest tube placement. Applying these same tests to a patient with chronic ascites, or pericardial effusion from cancer, or scarring of the lungs from severe tuberculosis, rather than the trauma patient in a correct scenario, clinicians may derive a false positive result, with a resultant incorrect overall assessment and ultimately an incorrect triage or evacuation decision.

The examples above demonstrate the need to understand not only the technical aspects of the technology (what we would consider the proper training of the individual), but also the *clinical application* of the technology. The medical officers implementing this strategy must understand not only the use but potential *misapplication* of this technology. Proper training should include vignettes to illustrate these pitfalls.

Training

Central to cultivating this new SOF capability is development of a training program to introduce and sustain US scanning and image interpretation skills. There are currently no guidelines for instructing non-physicians in pre-hospital US techniques. However, in 2001 the American College of Emergency Physicians (ACEP) issued a policy statement on EUS guidelines to guide emergency physicians seeking initial training in US in the post-residency setting.[13] Since ACEP intended the training model and guidelines for clinicians without a formal background in US, it closely mirrors the intent of a SOF Medic-specific US curriculum. In this section we incorporate some of ACEP's guidance and introduce a preliminary outline for starting a *de novo* US capability in SOF units and a basic outline for an introductory program of instruction.[13] Our intent is to initiate a dialogue and establish a starting point for the SOF community rather than dictate precise "how to" instructions.

We recommend establishing a Special Operator-level clinical ultrasound (SOLCUS) program with a 4-step process:

1. Analyze operational mission set and develop corresponding learning objectives.
2. Establish medical officer oversight and create a cadre of US subject matter experts.
3. Plan an introductory course for the general target audience.
4. Develop a skill proficiency plan and privileging criterion.

1. **Analyze operational mission set and develop corresponding learning objectives.**

The first step in establishing a training program is to analyze the unit's operational and medical mission and derive appropriate terminal learning objectives for the target audience, the SOF Medic. For example, Medics from units with a direct action focus may have particular interest in developing EUS skills in trauma applications. In contrast, Civil Affairs units may also benefit from many of the non-trauma applications to complement their foreign internal defense (FID) missions. Mission requirements will help tailor the scope of the training to align with the SOF unit's unique needs. Catering objectives to the specific requirements will hone efforts and eliminate time wasted on superfluous topics. Below are examples of learning objectives for the topics most relevant to a SOLCUS program:

General

- Define EUS in terms of its goals and limitations and contrast it with traditional diagnostic US.
- Delineate the list of applications relevant to a SOF Medic's scope of pre-hospital practice.
- Describe the training process and practice privileging for SOF Medics.

Physics

- Define basic physics terminology and concepts as they apply to US imaging: echogenicity, frequency, resolution, artifact, etc.
- Understand basic physics principles as they apply to US imaging.
  - Describe the basic physical characteristics of a sound wave and discuss the path of an ultrasonic wave as it travels from the probe to an object and reflected back to the probe.
  - Describe the appearance of fluid, soft tissue, bone and air in an US image and explain in terms of their respective physical properties.
- Operate and maintain the issued US unit.
  - Turn-on machine, change battery, and change probes.
  - Change modes, label images, save images and video loops.
  - Proper cleaning techniques and general maintenance.

Trauma

- Identify the indications for a focused abdominal sonography in trauma (FAST) exam and discuss the clinical algorithm for evaluating a patient with both a positive and negative examination in context of the austere, pre-hospital setting.
- Conduct a FAST examination by correctly identifying the four basic views and describing the relevant anatomy and relationships as well as the criterion for positive and negative examinations.
- Identify the indications for evaluating a patient with a suspected pneumothorax with US and discuss the treatment algorithm.
- Conduct a pneumothorax exam and describe the findings in a positive and negative examination.

Procedural

- Use real-time guided US to establish vascular access and discuss indications and contraindications.
- Use real-time guided US to assist a peripheral nerve block and discuss indications and contraindications.
- Use US to identify and remove a foreign body.

Extremity soft-tissue and musculoskeletal

- Distinguish superficial soft-tissue abscesses from simple cellulitis.
- Identify simple extremity fractures.
- Identify ruptured/severed tendons.

Special applications (supplementary)

HEENT

- Identify a retinal detachment.
- Distinguish peritonsillar abscess from cellulitis.

Vascular

- Employ doppler function to verify distal flow in an extremity.
- Approximate fluid volume status through caliber measurement of the IVC.

2. Establish medical officer oversight and create a cadre of US subject matter experts.

An effective SOLCUS program will require a cadre of subject matter experts under the direction of a EUS-competent medical officer. The variety of specialty backgrounds among medical officers in SOF medicine accounts for variable degrees of exposure to US. Of the specialties that routinely employ US in their practice such as radiologists, general surgeons, OB/GYNs, and cardiologists; few of these specialties routinely serve in SOF units. Even within emergency medicine, a specialty that *is* well represented in SOF medicine, US entered the residency curricula as recently as the last decade leading to a discrepancy in US skills across the experience of this specialty. A medical officer's lack of training in this technology may be the biggest impediment to propagating the merits of this skill. For this reason, it is imperative that SOF physicians and physician assistants anticipate their plan to train their target audience of SOF Medics with preemptive training in US.

The second portion of this step is creating a cadre of subject matter experts or "champions" by hand-picking a small number of motivated, innovative, clinically savvy Medics with longevity in the unit and aptitude for teaching. These champions, selected from the target audience's peer group, will become essential trainers within the unit because they lend credibility to the instruction by demonstrating the attainability and relevance of the skill. In addition, a cohort of champions will help assure continuity amidst inevitable unit turnover. The process of building US champions may more conveniently occur in conjunction with the medical officer train-up period.

The final portion of this step involves the identification of an appropriate training venue for a small group of medical officers and SOF Medics presumed to have no prior US experience. The advantage of beginning with a small cadre of soon-to-be SMEs is the ability to travel to a site with organized training. Many national medical conferences offer breakout sessions and seminars in US, to include the annual Special Operations Medical Association Conference (SOMA) in Tampa, FL. In addition, some teaching hospitals and physicians' groups have developed commercial courses in EUS, and the Army and Navy now send medical officers out to formal US fellowships, providing a formal military medical expertise that should be utilized to train the cadre for SOLCUS training.

Introductory courses typically include a combination of lecture and hands-on practical exercise and can range from a a half day to three days in length, with more advanced courses lasting longer. The ACEP guidelines recommend of minimum of 16 hours of didactics before attempting to collect cases in clinical practice. It may take two or three different courses to gain competency in the principles of US before applying them in practice.

3. Plan an introductory course for the general target audience.

The next phase of program development transitions the focus to the ultimate customer, the SOF Medic. In contrast with the champion development phase, the greater number of students in a general target audience course may preclude the ability to travel to a commercial activity leaving two alternatives: bring a commercial course to your unit, or plan and execute an internal course with your own SMEs. The advantage of contracting a course at your home station is the assurance of expert instruction and availability of training aids (extra US units, simulation aids, etc.), the obvious disadvantage is cost.

The greatest advantage of hosting your own course is the ability to tailor the objectives to precisely support your specific objectives. Courses instructed by civilians or even hospital-centric military personnel may not accurately cater to the unique requirements of the SOF environment. The biggest disadvantage is the significant investment of time required to train, plan, and execute a quality course with limited training aids and resources. In the event that your unit's medical team designs a custom course, first refer to the model learning objectives in phase one. Following the model of a commercial course, reverse engineer the lectures from the learning objectives and organize the course into alternating periods of instruction and practical exercise.

4. Develop a skill proficiency plan and privileging criterion.

After gaining the didactic background of a basic course in EUS, establishing a proficiency plan is paramount for *every* type of clinician, whether Medic or medical officer. The lectures and practical exercises of an introductory course merely expose neo-ultrasonographers to the skill. The clinical acumen to discern appropriate use of US and develop the hand-eye coordination required for effective scanning matures after many exams. The ACEP guidelines for EUS recommend collecting a minimum of 25 exams for each indication, e.g., 25 FAST exams in addition to 25 soft tissue and extremity exams. During this learning period, two primary methods of collecting these proficiency exams include proctored and case-control.[13] Proctored exams require the oversight of the exam by an US-proficient physician or ultrasonographer as the US trainee conducts the exam, providing real-time quality control. Case-control method involves obtaining a confirmatory test, such as a formal diagnostic ultrasound or an X-ray. This method defers clinical decisions from the trainee's exam until the confirmatory test can verify the results. Military emergency departments may have staff who are subject matter experts in EUS that could be a ready source for training and practice.

The quintessential goal of US for our community should be to incorporate a SOLCUS-like curriculum into the SOF Medic's initial curriculum at the Joint Special Operations Medical Training Center (JSOMTC). The ad hoc training program described above would become superfluous for SOF Medics if they could receive their didactic instruction in the course and begin collecting cases for proficiency during the subsequent phases of training. Then, as with many other perishable skills obtained in initial training, incorporate periodic review as part of Non-Trauma Module (NTM) training, the biennial blocks of instruction for Special Forces Medical Sergeants (18Ds) that include topics in dentistry, veterinary medicine, preventive medicine, and physical therapy. Medical Proficiency Training (MPT), the required hospital-based clinical rotations required for 18D recertification, can also serve as a venue for enhanced exposure to US. Alternatively, establishing the SOLCUS curriculum as an elective course at the JSOMTC with an associated additional skill identifier relieves the burden of packing additional training into the mainstream Medic pipeline while permitting the centralized creation of US champions that line battalions can then distribute among their teams.

Proposed application in Special Forces

We are confident that SOLCUS will find a niche in support of each type of SOF mission. As a case example, we propose a concept for applying SOLCUS to a Special Forces battalion. In this section we address two distinct issues: Aligning US application to support the Special Forces mission, and fielding the US asset within the battalion.

The full spectrum of Special Forces missions apply to both the lethal and nonlethal battlefields. In a similar manner, the imaging power of US enhances the complete spectrum of Special Forces medical missions by providing versatile imaging capability at the team level. Special Forces Soldiers are adept at an incredible array of missions to include unconventional warfare (UW), foreign internal defense (FID), direct action (DA), special reconnaissance (SR), counterproliferation (CP), and combat search and rescue (CSAR) to name a few.[1] The independent nature of the 12-man Operational Detachment – Alpha (ODA) at a remote forward operating base (FOB) in current combat theaters, or during a joint combined exercise for training (JCET) in other remote corners of the world epitomizes the austere conditions where evacuation to a higher level of care is at best difficult, at worst unfeasible or non-existent. Optimizing the 18D's medical independence in these situations becomes mission critical. Both the combat trauma and non-combat applications of SOLCUS are tools that can benefit these mission sets.

The distinction between the combat trauma and non-combat applications of SOLCUS is important because it highlights its relevance to both settings. Combat trauma applications of US are those used to diagnose conditions as a result of contact with an enemy. This may be either direct contact that results in small-arms fire exchange, or indirect as in the case of stand-off weapons such as improvised explosive devices (IEDs). US has applications to both penetrating and blunt trauma; however, it is important to note that penetrating combat trauma to the abdomen indicates a surgical laparotomy, obviating the need for an abdominal US exam to verify the presence of intra-abdominal bleeding. Penetrating trauma to the chest however, begs the clinical question of significant hemo- or pneumothorax, or risk of cardiac tamponade, the detection of which is ideally suited for US application. While US enjoys relatively fewer indications in penetrating abdominal trauma, it is especially relevant to blunt thoracoabdominal trauma. This fact is particularly poignant given the prevalence of improvised explosive device (IED) blast injuries and motor vehicle accident (MVA) trauma in current combat operations. In these cases, US evidence of intra-abdominal bleeding or pneumothorax will influence patient management. Another indication equally applicable to the military setting is the accurate results used in initial triage, and patient reassessment, in mass casualty situations.

Ultasound's non-invasive and reproducible imaging is ideal for rapid triage and emergency clinical decision-making in combat-induced trauma scenarios. However, we acknowledge the irrelevance of US during "care under fire" phase of combat casualty care. In the same way, since this is not an aid-bag carried item, it will be equally irrelevant during "tactical field care." There may be some merit to pre-positioning the US unit at a predesignated casualty collection point (CCP) or on a ground or air CASEVAC platform to use for en route care.[14,15] Some ODAs may find use for an US unit on long-duration, vehicle mounted patrols, while others operating in close proximity to their FOB may choose to leave it in a fixed location. Only the creativity of the SOLCUS-trained 18D limits how the team practically employs this asset.

Non-combat applications are those that support medical treatment resulting from non-hostile intent. These may be traumatic or non-traumatic injuries or illnesses. The best examples of these applications include the routine and urgent care provided at sick call, or at a local national clinic or guerilla hospital.[16] The Special Forces Medic may be responsible for the care to his immediate teammates and allied troops, but also provide area medical and surgical support to indigenous populations as part of a medical civil actions program (MEDCAP), counter-insurgency (COIN) operations, or unconventional warfare (UW) operations. The diagnostic prowess of a SOLCUS-trained 18D could help identify a fracture, tendon rupture, foreign body, or differentiate an abscess from cellulitis. The information provided by this simple study influences management decisions by potentially affecting the treatment plan or strengthening an argument for evacuation.

The plan for fielding and positioning US units in an SF battalion may take a variety of forms; however, we believe that the ultimate goal should be to field one US unit per ODA, ODB, and medical section to pre-position this imaging modality in the most forward locations, widely distributing this capability throughout the battalion's battle space. The ODA's basic medical equipment set, known as the SF Tactical Set, has no organic diagnostic imaging capability. Each SF battalion headquarters medical section currently fields one cumbersome digital x-ray machine that requires multiple large storage containers to transport. In addition, the battalion medical section also owns a single US unit. With only two diagnostic imaging units in the battalion, the vast majority of the 18 ODAs in the battalion improvise without advanced diagnostic capability. Knowing that a transition to multiple US units per battalion will not happen at once, one interim course of action is to increase the authorization for US units in the battalion medical section to a number short of the unit-per-team goal, and allow the battalion medical officers to issue the US units to teams on a mission-by-mission or rotation-by-rotation basis. The criterion to distribute the US could be based upon the team's tactical mission, their accessibility to the next level of care, and the presence of SOLCUS-trained Medics.

Conclusion

The progress in ultrasound technology has made it increasingly compatible with the practice of medicine in austere environments. The imaging power of ultrasound enhances the full spectrum of SOF medical missions by filling a void in total body imaging capability at the Medic level in most SOF units. This adjunct will significantly impact the independent medical decision-making capability of the SOF Medic and facilitate the medical care of patients treated by SOF medical personnel.

With applications to trauma as well as routine medical care, the portable ultrasound system will save lives on the battlefield. In addition, this instrument will serve as a force multiplier on the non-lethal battlefield by bringing diagnostic capability to the patient and aiding difficult triage decisions. In contrast, existing portable X-ray systems have a much smaller breadth of applications and are much larger and bulkier than the solitary, hand-carried case that contains the ultrasound system. Fielding an ultrasound unit at the Medic level pre-positions this imaging modality in the hands of the SOF clinician in the most forward locations, widely dispersing this capability throughout a unit's area of operations and allowing better accuracy with mission-critical triage decisions and routine medical care

In a mature combat environment with routine medical evacuation and surgical support readily available, traditional clinical assessment and evacuation is still the best practice. However, there are many situations and missions where limited availability of evacuation assets and the need for greater diagnostic accuracy at the point of care will greatly influence triage and mobilization of limited and expensive assets. Initiating debate on this subject will direct future prospective research and refine the training requirements for the SOF medic to achieve the essential learning objectives. By training SOF Medics in the applications and limitations of the technology, the mature combat medical provider can weigh risks and benefits, and determine optimal use for this specialized tool to maximize the preservation of human life while assuring responsible stewardship of scarce resources.

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MAJ Morgan's on the left and SFC Hubler (scarf) is on the right.

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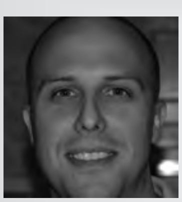

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Editorials

A Dangerous Waste of Time: Teaching Every Soldier Intravenous Line Placement

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The time has come to remove intravenous catheterization training from the Army's Combat Life Saver (CLS) Course. Obtaining intravenous (IV) access and initiating IV fluid resuscitation does not save lives on the battlefield. Returning effective fire, aggressive hemorrhage control with correct tourniquet and hemostatic dressing application, needle decompression of tension pneumothorax, and airway management are the Tactical Combat Casualty Care (TC3) skills that do save lives. The recent mandate by the U.S. Army Training and Doctrine Command (TRADOC) requiring all Soldiers entering Basic Combat Training (BCT) after October 1st 2007 to be CLS certified is an outstanding step to improve training across the Army in lifesaving first-aid skills.[1] However, requiring all Soldiers to be competent in placing an intravenous line and initiating treatment with IV fluids, per the current CLS standards, may not be the best use of precious training resources in the light of the most recent medical research and battlefield experience. In fact, it may result in additional injury or death to both injured Soldiers and their comrades providing aid.

The outcome of a battle casualty will often be determined by whoever provides initial care. In most cases this will be a fellow Soldier, not the Medic. The CLS course was developed to bridge the gap between self-aid or buddy aid until care could provided by the platoon 68W Combat Medic.[2] The CLS concept has been further refined over the last decade to reflect the concepts of TC3. Tactical Combat Casualty Care focuses on treating the leading causes of preventable battlefield death while minimizing the risk to first-aid providers and the tactical mission.[3] The TC3 concept is possibly the most significant advance in point of injury care since the distribution of the individual field dressing in the late 1800s.[4]

The most important battlefield first-aid skill is controlling hemorrhage, by far the leading and most preventable cause of battlefield death in modern warfare. Bellamy showed 7% of those killed in action during the Vietnam Conflict died of potentially preventable extremity hemorrhage.[5] A similar fatality rate from compressible extremity hemorrhage in Iraq was demonstrated by Cuadrado et al.[6]

Proper tourniquet application is the most important method in controlling severe hemorrhage in the tactical setting. Current military doctrine mandates use of a tourniquet as a first-line treatment for casualties who have extremity hemorrhage when care is administered under hostile fire.[7] Yet Soldiers' lives were lost in the early phases of the conflicts in Iraq and Afghanistan because a tourniquet was not applied.[8,9] The Army now issues individual commercially fabricated tourniquets to each Soldier deploying to a combat zone. More than 400,000 tourniquets had been issued.[10]

Other lifesaving skills emphasized in the TC3 include needle decompression of a tension pneumothorax and airway management, the second and third leading causes of preventable battle field deaths, causing 4% and 1% of all fatal injures respectively.[5,11]

The main purpose of performing IV catheterization in the setting of trauma is to administer fluids or blood products to treat hemorrhagic shock. Seven percent of traumatically injured patients on the battlefield require aggressive resuscitation.[12] Current transfusion protocols emphasize fresh whole blood and pro-coagulants rather than crystalloids to restore organ perfusion, prevent the dilution of clotting factors, and avoid hypothermia.[12] For patients in significant hemorrhagic shock, aggressive hemorrhage control at the point of wounding, followed by expeditious transport to surgical care is most important. Evacuation and subsequent surgical management of non-compressible truncal hemorrhage should not be delayed by attempts to place an IV.

In the management of shock, the traditional strategy of early fluid resuscitation beginning in the field and continuing into the operating room has been challenged, specifically in the context of penetrating thoracic trauma. In 1994, a prospective trial by Bickell et al., compared immediate versus delayed fluid resuscitation in hypotensive patients with penetrating torso injuries. They reported that patients in whom fluids were restricted until arrival in the operating room had lower mortality, fewer postoperative complications, and shorter hospital length of stay.[13] In a follow-up prospective trial, patients were divided into either restrictive resuscitation (goal systolic blood pressure (SBP) greater than 80 mm Hg) versus liberal resuscitation (goal SBP greater than 100 mm Hg). There was not a significant difference in mortality between groups but hemorrhage did take longer to control in the group with the liberal fluid strategy.[14]

These studies were largely responsible for significant changes in the management of injured Soldiers on the battlefield and were adopted by American Military and Israeli Defense Forces.[15-19] In 2003, the term "hypotensive resuscitation" was introduced in a paper entitled, "Fluid Resuscitation in Modern Combat Casualty Care: Lessons Learned from Somalia."[15] Current military pre-hospital doctrine now emphasizes restricting IV fluids in casualties who have controlled hemorrhage, normal mental status, and stable vital signs or even mild hypotension (systolic blood pressure greater than 90). A relatively small percentage of all combat casualties are likely to benefit from IV fluid resuscitation on the battlefield. These include patients with significant hypotension resulting from severe hemorrhage **that has been controlled**; and those with hypotension or severe hemorrhage **and** a head injury. All other casualties with uncontrolled hemorrhage and signs of shock may be challenged with a very limited amount of IV fluid (1000 mLs of Hextend); further fluid administration is likely to be detrimental. The practice of permissive hypotension is designed to prevent "popping the clot" off an injured vessel as well as diluting clotting factors with massive amounts of crystalloid fluid.

Proper IV placement is a skill that requires significant time to train. In the current CLS course, the IV portion is the longest, most resource and instructor intensive block of training. This time could be better spent focusing on tactical casualty scenarios and emphasizing other skills that actually save lives. In the civilian sector, basic emergency medical technicians (EMT-B) are not taught IV insertion. The first level of civilian EMT to have IV placement in their scope of practice is EMT-Intermediates. The national standard curriculum for EMT-I requires 300 to 400 hours of classroom and field instruction. EMT-I students are required to place at least 25 IVs on live patients of various age groups under instructor supervision to be considered competent in this skill.[20] The current 2006 CLS Course Instructor Guide (Edition B, Subcourse ISO0873) does not specify the number of successful IV catheterizations required to certify a CLS in this skill. It is left to the unit's medical officer. Certification will not mean CLS trained personnel will be competent in placing IVs. At best it will mean they are familiar with the procedure.

Casualties presenting in overt shock typically have difficult intravenous access. They are often extremely diaphoretic and their peripheral vasculature is constricted. Placement of an IV in a trauma patient in a moving ambulance by an experienced EMT-I or higher level provider takes 10 to 12 minutes and has a 10% to 40% failure rate.[21] Paradoxically, starting an IV in those patients who would most benefit from limited fluid resuscitation will be extremely difficult for even the most skilled medical provider.

In a hostile tactical situation combined with darkness, fatigue, and fear it will be very unlikely that a Soldier without significant medical experience will be able to place an IV under battlefield conditions. For this reason, TC3 guidelines emphasize sternal intraosseous catheter placement for fluid resuscitation.[22]

Insertion of an IV catheter is not without risks. Complications include local and systemic infections, thrombophlebitis, catheter embolism, and injury to associated nerves, tendons and arteries.[23-25] These complications are inversely related to skill and experience of the medical provider. Using non-medical personnel to train basic trainees will likely result in an increased rate of complications and lost duty days as Soldiers practice this skill on one another.

Based on the literature available and the lessons being learned from both Iraq and Afghanistan, it is clear that IV placement is not a critical skill needed at the point of wounding, while hemorrhage control is. Training all Soldiers to start IVs without the requisite understanding of the indications, contraindications, plus the risks and benefits of who would benefit from IV fluids and who could be harmed is a waste of precious training time that will result in many receiving unneeded or detrimental care on the battlefield. If Solders spend the vast majority of their first-aid training time learning IV placement, the most time consuming skill in the CLS course, yet one that does not save lives, which tool will they reach for under the stress of combat? How many Soldiers will be killed by snipers as they waste precious minutes starting IVs? How many casualties will have evacuation delayed while attempts to "get the IV" are made? How many will neglect proper tourniquet and dressing application in lieu of the more "technical" and "high-speed" IV insertion?

While most Soldiers will not benefit from IV training, it may have a place in some units. Units operating far forward with little or no organic medical support such as Special Operations Forces (SOF) may benefit from this training. These units are often small and have the time and resources to train to a high standard in advanced first-aid skills.

The recent mandate by TRADOC to train all Soldiers in IV placement is well-intentioned and shows our battlefield commanders want robust first-aid training for our warriors. It is the duty of the AMEDD and military healthcare providers to advise our combat commanders what constitutes the best practices of battlefield care. Yet, few AMEDD officers have ever cared for a patient under fire or experienced ground combat. Few understand the principles of Tactical Combat Casualty Care. Since the majority of the AMEDD's funding and focus is on hospital based care, we have in the past simply extended civilian trauma care principles to the battlefield. We can do better. Tactical and medical lessons from the present conflict must be synthesized to optimize the care of our Soldiers. This will require military healthcare providers to develop an understanding of combat and the nature of the battlefield in order to advise combat commanders how to balance the mission, training, and resources with optimal medical care during combat.

Many line commanders likely participated in IV training led by their unit medical officers during their formative years. Insertion of an IV on the "first stick" is probably considered by many of them as the quintessential battlefield medical skill. It is not. Rapid hemorrhage control is. Adding additional medical training for all Soldiers is much needed. TRADOC has taken an excellent first step. It is up to the military medical establishment to educate and advise our line commanders so together we can save lives on the battlefield and accomplish the Army mission.

LIST OF ABBREVIATIONS:
IV – intravenous
TC3 – Tactical Combat Casualty Care
TRADOC – Training and Doctrine Command
SOF – Special Operations Forces
SBP – Systolic Blood Pressure
AMEDD – Army Medical Department
CLS – Combat Life Saver
EMT-I – Emergency Medical Technician - Intermediate
BCT – Basic Combat Training

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Continuing Medical Education Test

Using Modeling to Predict Medical Requirements for Special Operations Missions

If you are a physician, PA, or nurse, place your answers on the Uniformed Services University of the Health Sciences (USUHS) Evaluation Form and send it in with your test. If you are a Medic, Corpsman, or PJ, please place your answers on the SOCOM Evaluation Form and send it in with your test.

1. Modeling medical supply requirements ensures clinicians
   a) do not spend over their budgets.
   b) get the proper type and amount of medical equipment and supplies they need.
   c) know what each piece of equipment does and how it is used.
   d) are restricted to only those supplies authorized by military leaders.

2. Historical data of combat injuries are used to determine
   a) which service members will get higher combat pay.
   b) when to send a medic or a qualified doctor with a patrol.
   c) the best way to perform surgical procedures under austere field conditions.
   d) likely patient types to be encountered under different battle conditions.

3. NHRC's study of the AFSOC Rapid Response Deployment Kit medical inventory
   a) showed that NHRC's method of modeling medical requirements can be used to determine clinical needs for Special Operations units.
   b) showed that modeling can be used to thwart terrorist attacks.
   c) suggested we are terribly unprepared for another Al-Qaida attack.
   d) indicated AFSOC requires additional doctors and corpsmen.

4. The AFSOC Rapid Response Deployment Kit mission is to
   a) provide immediate, frontline basic trauma care to conventional forces.
   b) respond immediately to a mass casualty incident in an urban environment.
   c) provide limited advanced trauma and sick call care, as well as basic preventive medicine measures, in an austere environment.

5. Modeling medical requirements
   a) can determine a capability's medical requirements without input from providers or logisticians.
   b) is the same no matter what type of medical capability you model.
   c) requires knowledge of the specific capability's mission requirements, and input from experienced providers.
   d) requires large amounts of balsa wood, a small sharp knife, and glue.

6. SOF casualties differ from conventional force casualties because
   a) SOF troops rely on stealth and guile.
   b) there are more conventional forces than Spec Ops Forces; they suffer a higher ratio of battle casualties to nonbattle casualties.
   c) SOF troops suffer a disproportionately higher ratio of battle to nonbattle casualties compared with conventional forces.

7. Modeling preventive medicine supplies requires knowing
   a) whether sanitation measures will require a slit trench or Port-a-John.
   b) what preventive medicine objectives must be performed, how often they must be performed, and at how many sites they must be performed.
   c) whether service members are getting proper food and exercise.

8. True or False: Using modeling to determine required clinical supplies is especially important for units that must remain small, light, and flexible.
   a) True
   b) False

9. In addition to knowing what type of casualties can be expected, modeling medical requirements involves such factors as
   a) pay grade for all providers.
   b) the required skill levels of providers, how long patients will remain at the treatment facility, and how long the facility is expected to operate without resupply.
   c) board certification of all providers, and the states in which they are allowed to practice.
   d) which branch of the service is involved, their overall medical command, and their budget for medical resources.

10. Medical modeling is
   a) a way to tell medical providers how to practice medicine.
   b) a means to second guess physicians.
   c) another tool in the tool box in the development of medical capabilities and for mission planning.
   d) a type of video game involving medical decisions designed to train providers.

If you are a physician, PA, or nurse, send in the Uniformed Services University of the Health Sciences (USUHS) Evaluation Form with your test.

If you are a Medic, Corpsman, or PJ, send the SOCOM Evaluation Form with your test.

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Journal of Special Operations Medicine
Volume 8, Edition 4 / Fall 08
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Using Modeling to Predict Medical Requirements for Special Operations Missions

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Educational Value:	**3 2 1**
I learned something new that is important.	_ _ _
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Abstracts from Current Literature

Later Life Disability Status Following Incarceration as a Prisoner of War

Hunt, Stephen C; Orsborn, Mack; Checkoway, Harvey; Biggs, Mary L; McFall, Miles; Takaro, Tim K.
Military Medicine, Volume 173, Number 7, July 2008, pp. 613-618(6)
AMSUS - Association of Military Surgeons of the U.S.

Abstract

Objective: Incarceration-related predictors of later life disability in former prisoners of war (POWs) have not been previously described. The objective of this project was to identify aspects of POW incarceration which are associated with later life disability status. **Methods:** Cross-sectional retrospective study of 328 former U.S. military personnel held as POWs (World War II and Korean and Vietnam Wars) who presented for evaluations at a Veterans Affairs medical center between January 1, 1997 and December 31, 2004 outcome measures were: (1) total number of later life disability conditions attributable to incarceration and (2) cumulative percentage later life disability attributable to these conditions. **Results:** We found significant associations between later life disability and POW experiences, including experiencing or witnessing torture, solitary confinement, forced marches, dysentery, pellagra, vitamin deficiencies, scabies, depression, and suicidal thoughts. **Conclusions:** Conditions of captivity and health concerns or emotional distress during captivity may contribute to long-term adverse health outcomes as measured by later life disabilities in individuals incarcerated as POWs.
Document Type: Research article

Acupuncture - A Useful Tool for Health Care in an Operational Medicine Environment

Spira, Alan
Military Medicine, Volume 173, Number 7, July 2008, pp. 629-634(6)
AMSUS - Association of Military Surgeons of the U.S.

Abstract

Acupuncture is a form of medical care that originated in China; it has evolved and progressed over thousands of years to become one of the most commonly used forms of healthcare throughout the world. Allopathic (Western) medicine has begun to seriously investigate and to use this system only in the past three decades. Although acupuncture's mechanisms for healing are not fully understood, it helps many conditions. Using acupuncture reduces or eliminates the need for expensive medications and the potential risk of adverse events resulting from medications, with cost savings and health benefits to patients. During a deployment of naval combat engineers to Iraq in support of Operation Iraqi Freedom, acupuncture was used in the health care of Sailors, Marines, and Soldiers. It objectively and subjectively improved the health of troops in the field. Troops were able to function while being treated, reducing or avoiding sick in quarters or light limited duty status and saving operational man-days. Acupuncture in the right hands can serve as a health force multiplier (amplifying a provider's clinical impact) and can be integrated into routine health care, whether in garrison or in the field.
Document Type: Research article

Middle Ear Pressure and Symptoms After Skydiving

Gutovitz, S; Weber, K; Kaciuban, S; Colern, R; Papa, L; Giordano, P
Aviat Space Environ Med 2008; 79:533-6.

Abstract

Objectives: Altitude-related otic barotrauma and its symptoms have been identified from air-travel, scuba diving, and hyperbaric chambers, but not in skydiving. It is not known whether skydiving-related otic barotrauma could cause symptoms severe enough for medical attention or be implicated in skydiving-related accidents. This study assessed the effect of altitude change on middle ear pressures in skydivers by comparing changes in pressure before and after a skydive, pressure changes in those who developed middle ear symptoms vs. those who did not, and pressures in those who attempted equalization vs. not. **Methods:** This prospective observational cohort enrolled skydivers on random days in Deland, FL. A tympanometer was used to measure middle ear pressures in decapascals (daPa) on the ground before and after skydiving. **Results:** Average middle ear pressures in 69 subjects were significantly different before (−23.5 daPa) and after (−70.5 daPa) the skydive. There were 13 subjects (18.8%) who had middle ear symptoms after descent, but there were no statistically significant differences in ear pressure changes in those with (−57.5 daPa) and without (−44.2 daPa) symptoms after their jump. There was, however, a significant difference in pressure in those jumpers who did (−32.7 daPa) and did not (−75.7 daPa) equalize successfully after their jump. **Conclusions:** Rapid skydiving descent from high altitudes causes negative middle ear pressure changes. The ability to equalize ear pressures after a jump had a large impact on the change in ear pressure. However, the change in middle ear pressure was not associated with the presence of middle ear symptoms.
Keywords: barotrauma; otic barotrauma; eustachian tube; skydiving
Document Type: Research article

Barriers to Hearing Conservation Programs in Combat Arms Occupations

Abel, SM
Aviat Space Environ Med 2008; 79:591-8.

Abstract

Introduction: The Canadian military instituted a hearing conservation program over 45 years ago. Yet the prevalence of noise-induced hearing loss is escalating. A focus group study involving four combat arms occupations was carried out to probe individuals' knowledge, attitudes, and behaviors relating to hearing loss prevention to find ways to improve compliance. **Methods:** One group each of 4-5 infantry Soldiers, artillerymen, armored Soldiers, and Combat Engineers, with the rank of Warrant Officer, Sergeant, or Master Corporal, and at least 5-yr of service participated. Discussions were led by a moderator and recorded by an assistant moderator. Questions posed related to susceptibility and consequences of hearing loss, benefits and drawback of hearing protection, and preferences. **Results:** Age range was 28-48 years and length of service 10-30 years. Individuals were exposed to noise from weapons, explosives, vehicles, and aircraft. Infantry Soldiers and artillerymen had confirmed moderate to severe hearing loss. Armored Soldiers and combat engineers had not perceived a change in hearing. Main concerns of using hearing protection were interference with detection and localization of auditory warnings, and perception of orders. Devices were often incompatible with other gear and difficult to fit. **Discussion:** Good hearing was critical to the occupations studied. Difference in hearing loss among groups was related to type and level of noise exposure. Loss of hearing and/or the use of hearing protection compromised situational awareness, exchange of information, and auditory task performance. Participants favored opportunities to try recommended devices, policies governing use, and sufficient funding to ensure protection for both regular and special forces.
Keywords: focus groups; noise exposure; noise-induced hearing loss; hearing protection
Document Type: Research article

Tourniquets: A Review of Current Use with Proposals for Expanded Prehospital Use

Gerard, S Doyle, MD MPH; Peter, P Taillic, MD

Prehospital Emergency Care, Volume 12, Issue 2 April 2008 , pages 241 - 256

ABSTRACT

The use of arterial tourniquets in prehospital emergency care has been fraught with controversy and superstition for many years despite the potential utility of these tools. This review examines this controversy in the context of the history of the tourniquet as well as its recent use in surgery and modern battlefield casualty care. Safe prehospital tourniquet use is widespread in the military and is based on sound physiologic data and clinical experience from the surgical use of tourniquets. The physiologic, pathophysiologic, and clinical underpinnings of safe tourniquet use are reviewed here, along with a discussion of alternatives to tourniquets. Prehospital settings in which tourniquets are useful include tactical emergency medical services (EMS) and other law enforcement environments as well as disaster and mass casualty incidents. Beyond this, we present arguments for tourniquet use in more routine EMS settings, in which it may be beneficial but has heretofore been considered inappropriate. Protocols that foster safe, effective prehospital tourniquet use in these settings are then presented. Finally, we discuss future directions in which tourniquet research and other initiatives will further enhance the safe, rational use of this potentially life-saving tool.

Keywords: tourniquet; hemorrhage; emergency medical services; disasters; hemostasis

The Correlation Between Ketamine and Posttraumatic Stress Disorder in Burned Servicemembers

McGhee, LL; Maani, CV; Garza, TH; Gaylord, KM; Black, IH

J Trauma. 2008 Feb;64(2 Suppl):S195-8; Discussion S197-8.

U.S. Army Institute of Surgical Research, Fort Sam Houston, TX 78234, USA
laura.mcghee@us.army.mil

ABSTRACT

Background: Predisposing factors for posttraumatic stress disorder (PTSD) include experiencing a traumatic event, threat of injury or death, and untreated pain. Ketamine, an anesthetic, is used at low doses as part of a multimodal anesthetic regimen. However, since ketamine is associated with psychosomatic effects, there is a concern that ketamine may increase the risk of developing PTSD. This study investigated the prevalence of PTSD in Operation Iraqi Freedom/Operation Enduring Freedom (OIF/OEF) service members who were treated for burns in a military treatment center. **Methods**: The PTSD Checklist-Military (PCLM) is a 17-question screening tool for PTSD used by the military. A score of 44 or higher is a positive screen for PTSD. The charts of all OIF/OEF soldiers with burns who completed the PCL-M screening tool (2002-2007) were reviewed to determine the number of surgeries received, the anesthetic regime used, including amounts given, the total body surface area burned, and injury severity score. Morphine equivalent units were calculated using standard dosage conversion factors. **Results**: The prevalence of PTSD in patients receiving ketamine during their operation(s) was compared with patients not receiving ketamine. Of the 25,000 soldiers injured in OIF/OEF, United States Army Institute of Surgical Research received 603 burned casualties, of which 241 completed the PCL-M. Of those, 147 soldiers underwent at least one operation. Among 119 patients who received ketamine during surgery and 28 who did not; the prevalence of PTSD was 27% (32 of 119) versus 46% (13 of 28), respectively (p= 0.044). **Conclusions**: Contrary to expectations, patients receiving perioperative ketamine had a lower prevalence of PTSD than soldiers receiving no ketamine during their surgeries despite having larger burns, higher injury severity score, undergoing more operations, and spending more time in the ICU.

Testing of Modified Zeolite Hemostatic Dressings in a Large Animal Model of Lethal Groin Injury

Ahuja, Naresh MD; Ostomel, Todd A. PhD; Rhee, Peter MD; Stucky, Galen D. PhD; Conran, Richard MD; Chen, Zheng MD, PhD; Al-Mubarak, Ghada A. MD; Velmahos, George MD; deMoya, Marc MD; Alam, Hasan B. MD
Journal of Trauma-Injury Infection & Critical Care. 61(6):1312-1320, December 2006

Abstract

Background: We have previously identified a granular zeolite hemostat (ZH) as an effective agent for control of severe bleeding, and it is currently being used by the U.S. troops in the battlefield. ZH causes an exothermic reaction on application, which theoretically can be decreased by altering its chemical composition or changing its physical properties. However, the effect of these alterations on the hemostatic efficacy is unknown. We tested modified zeolites and a chitosan based dressing against controls in a swine model of battlefield injury. **Methods:** A complex groin injury was created in 60 swine (40-55 kg). This included semi-transection of the proximal thigh (level of inguinal ligament), and complete division of the femoral artery and vein. After 3 minutes, the animals were assigned to (1) no dressing (ND), (2) standard dressing (SD), (3-5) SD + chemically modified ZHs, where calcium was substituted with sodium (Na), barium (Ba), or silver (Ag), respectively, (6) SD + physically modified ZH, where "beads" were packaged in a fabric bag, (7) SD + chitosan based dressing (CD). Resuscitation was started 15 minutes after application of dressing (500mL of 6% hetastarch over 30 minutes). Survival for 180 minutes was the primary endpoint for this study. In addition, blood loss, wound temperatures, and histologic tissue damage were recorded. **Results:** Mortality in the group that was treated with the application of bagged ZH was 10% versus 100% in the no dressing group and 50% in the SD group ($p < 0.05$ vs. ND and SD groups). The Na ZH group had a mortality rate of 43%, whereas application of Ba and Ag substituted zeolites, and CD were associated with a mortality rate of 25%. Ionic substitution of zeolite decreased the in vivo temperature peak by 5 to 10[degrees]C. No histologic evidence of tissue necrosis was noted in this experiment. **Conclusions:** The use of zeolite hemostat can control hemorrhage and dramatically reduce mortality from a lethal groin wound. Modifications of zeolite hemostat can decrease the exothermic reaction and attenuate tissue damage.

Spontaneous Globe Subluxation in a Patient with Hyperemesis Gravidarum: A Case Report and Review of the Literature

Julie Zeller MD; Scott B. Murray MD; Jonathan Fisher MD, MPH
The Journal of Emergency Medicine Volume 32, Issue 3, April 2007, Pages 285-287

Abstract

Globe subluxation, or anterior dislocation of the eyeball, is rarely encountered by emergency physicians. We report a case of subluxation of the globe secondary to severe vomiting followed by a discussion of globe subluxation, potential causes, procedure for reduction, and treatment for recurrent episodes. Early treatment by emergency physicians may prevent long-term complications and limit patient discomfort and anxiety.

Successful Treatment of Potentially Fatal Heavy Metal Poisonings

Ernest E. Wang MD; Niraj Mahajan MD; Brandon Wills DO, MS; Jerrold Leikin MD
The Journal of Emergency Medicine Volume 32, Issue 3, April 2007, Pages 289-294

Abstract

Pure inorganic heavy metal ingestions for suicidal intent are a rare occurrence. Most case reports on this subject focus on the serious neurological, hepatic, or renal side effects. We describe two cases of significant heavy metal poisonings (arsenic trioxide and mercuric chloride) that were successfully managed with aggressive decontamination and combined chelation therapy. Both chemicals were obtained in pure powder form through the Internet.

Chitosan Dressing Provides Hemostasis in Swine Femoralarterial Injury Model

Scott B. Gustafson, DVM, MS; Pam Fulkerson, DVM; Robert Bildfell, DVM, MSc; Lisa Aguilera, MS, AHT; Timothy M. Hazzard, PhD, DVM
Prehospital Emergency Care 2007;11:172-178

Abstract

Objective: Chitosan dressings have been shown to be effective in improving survival of severe parenchymal injuries in an animal model and in treating prehospital combat casualties. Our goal was to test the efficacy of chitosan acetate dressings in providing durable hemostasis in a high-flow arterial wound model. **Methods:** A proximal arterial injury was created with 2.7mm vascular punches in both femoral arteries of fourteen anesthetized swine. By using a crossover design, 48-ply gauze (48PG) or a chitosan dressing (HC) was applied with pressure to the injury for 3 minutes and then released. If hemostasis was not maintained for 30 minutes, a second identical attempt was made by using the same dressing type. If hemostasis was still not achieved, the dressing was considered an acute failure and the alternate dressing type was applied. If failure of hemostasis occurred between 30 and 240 minutes after application, the dressing was considered a chronic failure and the artery was ligated. **Results:** All 25/25 (100%) of the HC tests and 3/14 (21%) of the 48PG maintained hemostasis for 30 minutes. At 240 minutes, 21/25 (84%) of the HC tests and 1/14 (7%) of the 48PG maintained hemostasis. Statistical analysis by Fischer's exact test shows a significant ($p < 0.001$) difference in hemostatic efficacy between the 48PG and HC groups in this model, both at 30 minutes and at 240 minutes. **Conclusion:** Chitosan acetate hemorrhage control dressings provided superior hemostasis to 48 ply gauze in high inguinal femoral arterial injuries. Chitosan-based dressings may provide prehospital treatment options for hemostasis in patients with severe hemorrhagic arterial injuries.

Home Use of Automated External Defibrillators for Sudden Cardiac Arrest

Gust H. Bardy, MD; Kerry L. Lee, PhD; Daniel B. Mark, MD, MPH; Jeanne E. Poole, MD; William D. Toff, MD; Andrew M. Tonkin, MD; Warren Smith, MB, ChB; Paul Dorian, MD; Douglas L. Packer, MD; Roger D. White, MD; W.T. Longstreth, Jr., MD; Jill Anderson, RN, BSN; George Johnson, BSEE; Eric Bischoff, BA; Julie J. Yallop, PhD; Steven McNulty, MS; Linda Davidson Ray, MA; Nancy E. Clapp-Channing, RN, MPH; Yves Rosenberg, MD; Eleanor B. Schron, RN, PhD; for the HAT Investigators
NEJM Volume 358:1793-1804 April 24, 2008 Number 17

Abstract

Background: The most common location of out-of-hospital sudden cardiac arrest is the home, a situation in which emergency medical services are challenged to provide timely care. Consequently, home use of an auto-

mated external defibrillator (AED) might offer an opportunity to improve survival for patients at risk. **Methods:** We randomly assigned 7001 patients with previous anterior-wall myocardial infarction who were not candidates for an implantable cardioverter–defibrillator to receive one of two responses to sudden cardiac arrest occurring at home: either the control response (calling emergency medical services and performing cardiopulmonary resuscitation [CPR]) or the use of an AED, followed by calling emergency medical services and performing CPR. The primary outcome was death from any cause. **Results:** The median age of the patients was 62 years; 17% were women. The median follow-up was 37.3 months. Overall, 450 patients died: 228 of 3506 patients (6.5%) in the control group and 222 of 3495 patients (6.4%) in the AED group (hazard ratio, 0.97; 95% confidence interval, 0.81 to 1.17; P=0.77). Mortality did not differ significantly in major prespecified subgroups. Only 160 deaths (35.6%) were considered to be from sudden cardiac arrest from tachyarrhythmia. Of these deaths, 117 occurred at home; 58 at-home events were witnessed. AEDs were used in 32 patients. Of these patients, 14 received an appropriate shock, and 4 survived to hospital discharge. There were no documented inappropriate shocks. **Conclusions:** For survivors of anterior-wall myocardial infarction who were not candidates for implantation of a cardioverter–defibrillator, access to a home AED did not significantly improve overall survival, as compared with reliance on conventional resuscitation methods.

Artesunate for the Treatment of Severe Falciparum Malaria

Philip J. Rosenthal, MD
NEJM Volume 358:1829-1836 April 24, 2008 Number 17

Extract

A previously well, American-born 35-year-old man presents with a 5-day history of fever and progressive dyspnea and a 2-day history of jaundice. An evaluation 3 days before his presentation led to a diagnosis of a viral syndrome. The patient had returned 3 weeks earlier from a 1-month stay in West Africa. He reports receiving immunizations before travel and taking pills to prevent malaria weekly until his return to the United States.

The physical examination shows moderate respiratory distress, diffuse pulmonary crackles, and mild jaundice. His vital signs include a temperature of 39.8°C, respiratory rate of 32 breaths per minute, and oxygen saturation of 87% while he is breathing ambient air. Abnormal results of laboratory tests include a hematocrit of 32.2%, platelet count of 78 per cubic millimeter, total bilirubin level of 4.2 mg per deciliter (71.8 µmol per liter), and creatinine level of 2.2 mg per deciliter (194.5 µmol per liter). A Giemsa-stained blood smear shows numerous ring forms of *Plasmodium falciparum*, with parasitemia estimated at 2%. He is immediately hospitalized, and an infectious-disease consultant recommends that the Centers for Disease Control and Prevention (CDC) be contacted to obtain intravenous artesunate for his treatment.

Naja Kaouthia: Two Cases of Asiatic Cobra Envenomations

Gautam Khandelwal MD; Kenneth D. Katz MD; Daniel E. Brooks MD; Stephanie M. Gonzalez MD; Colleen D. Ulishney CSPI
The Journal of Emergency Medicine Volume 32, Issue 2, February 2007, Pages 171-174

Abstract

Envenomation from cobra bites causes major morbidity and mortality in Asia and Africa but rarely in the United States. We describe two patients bitten by the Asiatic Cobra (Naja Kaouthia)— both successfully treated in the emergency department. Patient 1 was a 23-year-old woman bitten in the buttock by her cobra. Examination demonstrated two puncture wounds. She developed cranial neuropathy, respiratory failure, and coagulopathy 10h later, necessitating endotracheal intubation and polyvalent antivenom administration. The patient recovered fully with minimal wound necrosis. Patient 2, a 44-year-old man, was bitten on the hand by his cobra. Examination revealed a puncture wound with progressive swelling. Edrophonium and monovalent antivenom were administered, and he recovered uneventfully. These cases emphasize the varied clinical presentations of the Asiatic cobra. Patient 1 developed delayed neurotoxicity, respiratory failure, and hematotoxicity with minimal wound necrosis, whereas Patient 2 experienced a more typical clinical course.

Emergency Medicine in Lebanon: Overview and Prospect

Jamil D. Bayram MD, MPH
The Journal of Emergency Medicine Volume 32, Issue 2, February 2007, Pages 217-222

Abstract

Emergency Medicine, established in the United States as a specialty in 1979 and in Canada in 1980, is drawing interest among countries throughout Europe, Asia, and the Middle East. Lebanon, located on the eastern coast of the Mediterranean Sea, like many other developing countries, struggles to advance its medical system. One of the main hurdles is the continuing violence and political turmoil. Attempts at healthcare system recovery have been met with a number of deep-seated structural problems. Data and references regarding emergency health care are rare. This article presents an overview of the current status of Emergency Medicine in Lebanon as well as ongoing related activities over the past decade and the plans for future development.

Parts of this article have been presented by the author at the Second Mediterranean Emergency Medicine Congress in Sitges, Spain, September 16, 2003. This article is the result of an extensive literature search on health and emergency medicine in Lebanon. It presents an expanded analysis with a comprehensive bibliography. The author is emergency medicine trained at Stroger Hospital of Cook County (Chicago) and has had three years experience in Southern Lebanon as a Chairman of the emergency department at Hammoud Hospital from July 1999 to June 2002. International Emergency Medicine is coordinated by Jeffrey Arnold, MD, of Tufts University School of Medicine and Baystate Medical Center, Springfield, Massachusetts.

Prehospital Emergency Medical Services In Malaysia

N.A.A. Nik Hisamuddin, MBGHB, MMED;* M. Shah Hamzah, BSG;* and C. James Holliman, MD, FAGEPt
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International Emergency Medicine is coordinated by Jeffrey Arnold, MD, of Tufts University School of Medicine and Baystate Medical Center, Springfield, Massachusetts
The Journal of Emergency Medicine, Vol. 32, No.4, pp. 415-421, 2007

Abstract

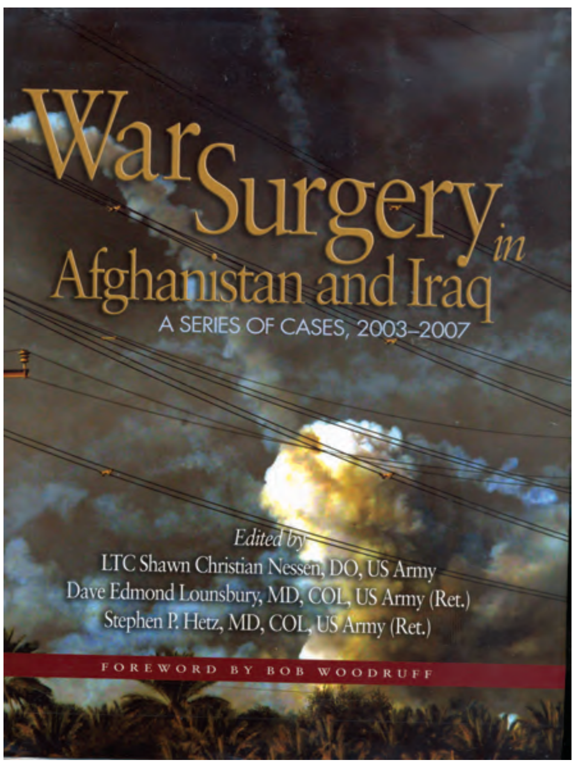
Once a very slowly developing country in a Southeast Asia region, Malaysia has undergone considerable change over the last 20 years after the government changed its focus from agriculture to developing more industry and technology. The well-known “Vision 2020: Introduced by the late Prime Minister, set a target for the nation to be a developed country in the Asia region by the year 2020. As the economy and standard of living have improved, the demand from the public for a better health care system, in particular, emergency medical services (EMS), has increased. Despite the effort by the government to improve the health care system in Malaysia, EMS within the country are currently limited, best described as being in the “developing” phase. The Ministry of Health, Ministry of Education, Civil Defense, and non-governmental organizations such as Red Crescent and St. John’s Ambulance, provide the current ambulance services. At the present time, there are no uniform medical control or treatment protocols, communication systems, system management, training or education, or quality assurance policies. However, the recent development of and interest in an Emergency Medicine training program has gradually led to improved EMS and prehospital care.

Book Reviews

WAR SURGERY IN AFGHANISTAN AND IRAQ
A Series of Cases, 2003 - 2007

By LTC Shawn C. Nessen, MC, USA; COL David Lounsbury MC, USA (ret); COL Stephen Hetz, MC, USA (ret)
Office of the Surgeon General, Department of the Army Falls Chruch, Va.
Borden Institute, WRAMC, Washington. D.C. 2008

Review by CAPT Steve McCartney



War Surgery in Afghanistan and Iraq is by no means a definitive textbook of military surgery, nor was it intended to be. It is a most interesting and well documented collection of largely multisystem, twenty-first century combat trauma cases which illustrate the clinical and technical considerations adapted in real time in the Southwest Asian theatre long before they appear in surgical teaching. The peculiarities of war surgery, not seen by our civilian counterparts, are well illustrated as is the challenge of accurate information flow as a patient transverses from field care through several echelons of surgical care and surgical oversight changes back to CONUS at a Level V facility. The text also includes the topic of host nation combatant and non-combatant surgical patients who pose issues with follow-on care within Iraq or Afghanistan.

While the clinical photographs show the horrors of war, this text shows 83 cases that demonstrate the utility and results of standard and sometimes counterintuitive techniques in battlefield surgery. The text is edited by two experienced general surgeons and an internist who have largely partitioned the text into regional areas (thoracic, abdominopelvic, head-spine, etc), specialty areas (orthopedic, vascular, and acute resuscitation), and special scenarios (pediatrics, pregnancy, etc). The detailed case presentation is exceptionally valuable with each case having a sometimes dogma challenging commentary. Decision points, learning points, summary as well as clinical implications of the decisions executed in surgery are quite illustrative and allow the reader to learn by following the surgeons' thought processes, unique to each case. The photographs, courtesy of pocket sized digital camera technology, allow for easier understanding of the injuries and their treatment.

As a vascular surgeon trained in the late eighties, the use and success of the non-heparinized vascular shunt was enlightening to me. Our experience in OIF 2003 was not as successful. It was heartening to see its life and limb saving effects with multisystem trauma in concert with damage control surgery techniques.

One must congratulate the excellent staff at Borden Institute for producing this fine 440 page text. Many military texts of a variety of important topics are impaired by poor graphics, intent, layout, and design. This text avoids that as a most attractive publication and includes a heartfelt foreword by ABC's Bob Woodruff who is a benefactor of military medicine.

I recommend this well written book for civilian surgeons, house-staff, and most strongly for military surgeons and physicians who are to deploy into theatre. A perusal of the contributors reveals a delightful number of young Army Captains and Majors (and a four-star Air Force general) whom I hope will continue to excel and shift the paradigms in the care of our injured heroes who serve this great nation.

CAPT Stephen F. McCartney, Medical Corps,
U. S. Navy Force Surgeon
U.S. Marine Special Operations Command
Camp LeJeune, N.C.

** CAPT McCartney is a vascular surgeon who has served in OIF and OEF in forward Level II surgical platforms.*

Weekend Edition Saturday, August 9, 2008 - NPR interview with Dr. Hetz

U.S. combat deaths in Iraq are at their lowest point since the war started in March 2003. But at least 30,000 Soldiers have been wounded in action and the use of IEDs and other explosive devices has changed the nature of war injury.

Yet Soldiers are more likely to survive today than in any previous conflict because of improved medical knowledge and technology. And surgeons operating both inside and outside the theater of modern war have a new guide: the textbook *War Surgery in Afghanistan and Iraq*. The book is an instructional collection of cases taken from 2003 – 2007 for use among medical professionals.

Co-author Dr. Stephen Hetz tells Scott Simon that while the injuries in Iraq aren't necessarily new, the volume of blasts in Iraq is what causes so many devastating, traumatic injuries.

Hetz, who was deployed to Iraq twice, says the battlefield helps surgeons hone existing medical practices with a finer edge. One procedure that he says improved is called "damage control" — a procedure during which the major focus "is to stop the bleeding and further contamination" — whatever doctors can do to get the patient out of the operating room and to a place where he or she can be resuscitated. The process is faster and more effective, enabling higher survival rates.

The coffee-table sized book is not designed for public use. It features more than 400 pages of detailed case studies presented alongside graphic and often disturbing images. These photographs, informal and gruesome, were often taken on consumer digital cameras belonging to doctors and Soldiers serving in Iraq and Afghanistan.

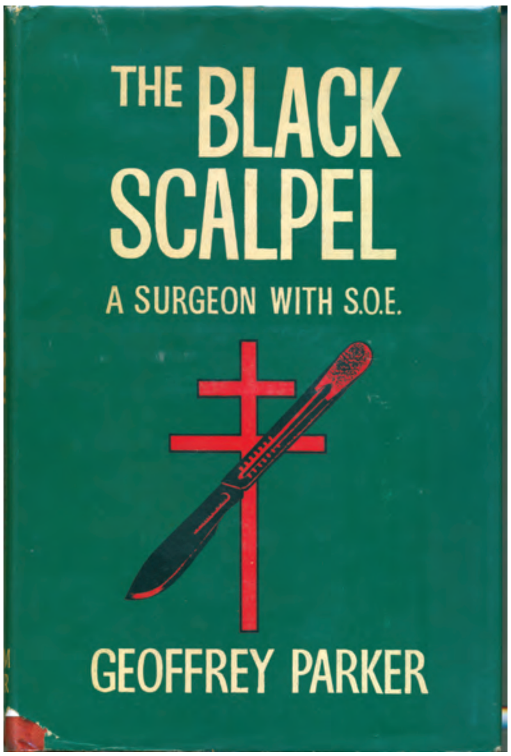
Hetz says based on this widespread availability of images and the sheer number of cases, a textbook for surgeons was a "natural offshoot of the war." He says that when he began assembling the book with two of his colleagues, Shawn Christian Nessen and Dave Edmond Lounsubry, a military edict was released limiting what was termed "actionable intelligence" — information or photographs about the conflict that could compromise the military's operations in Iraq.

The military expressed concerns about the book and Hetz and his colleagues had to submit the cases they wished to use for approval. The collection was finally published this year. Hetz says *War Surgery in Afghanistan and Iraq* is a significant book because many civilian surgeons have not seen the types of blast surgeries that occur in Iraq and Afghanistan, and can learn immensely from what the book has to show.

The Black Scalpel, A Surgeon with S.O.E.

Geoffrey Parker
William Kimber and Co, Limited, London, 1968 Hard Cover, 157 pages. SBN 7183 0081 5

Review by Joe Patterson



Pulled from deep in the archives of the COL Farr library, this 1968 text is an easy read if you use your best upper crust British accent and imagine you're sitting in the Explorers' Club. The author spends most of the 157 pages recanting his five months with the British Special Operations Executive (SOE) as a 40-something year old surgeon attached to local guerillas in 1944 France. He gained this position by possessing unique skills he happened to come by as a surgeon attached to the French Hospital in London and by volunteering for several weapons and airborne courses.

Lacking much discussion about guerilla medicine, Dr. Parker focuses instead on evading German soldiers and conducting special missions with the locals and SOE. He describes very detailed episodes of meeting with femme fatales in safe houses over coffee, but never describes the contents of his medical kit bag which he said were invaluable. The author breaks from this pattern in one chapter to discuss a field hospital he established which serviced a fairly sizeable number of casualties. He includes very limited discussions on surgically correcting untreated and poorly healed combat trauma and the impact occupation had on providing medical care for combatants and non-combatants. After this extremely brief interlude, it's back to anecdotes about the colorful individuals he worked with, and the hardships associated with his life evading imminent capture.

The final chapter appears to be a clearinghouse of 25 years of post conflict mental meanderings. Thoughts on atrocities he witnessed during the unlimited warfare of WWII are bounced off more recent conflicts in French Algeria and Ireland. Parker poses unanswered comments about politics, what makes an individual a hero or a terrorist, and why atrocities continue to occur around the world.

I can assume the author is recalling stories from 25 years earlier with a fuzzy lens of time worn fondness. Questions on the authors actual knowledge are raised by comments like "The technique of parachuting needs no description from me; it was a commonplace of war, and since then has been done hundreds of thousands of times with only an occasional minor accident and even fewer deaths…."

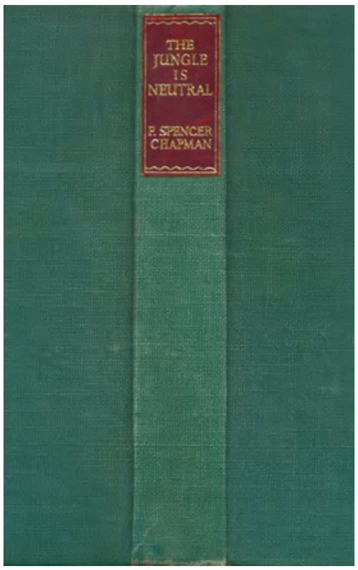
The book is long on color commentary about super cool SOF guy stuff, but short on super cool doctor guy stuff. The book is entertaining but would have been more accurately titled without a reference to medicine.

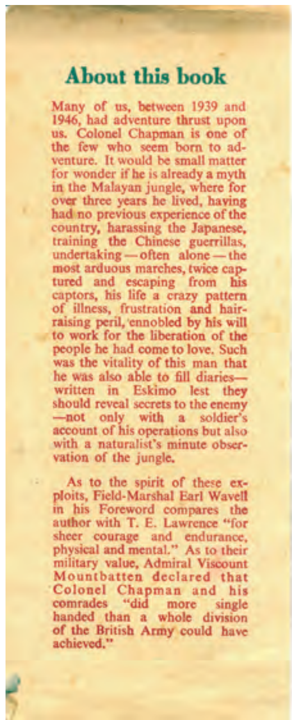
The Jungle Is Neutral

Colonel Fredrick Spencer Chapman

The Lyons Press; 1st edition Guilford CT 2003. Paperback 350 Pages. ISBN-10: 1592281079 ISBN-13: 978-1592281077

Review by CPT G.W. Horsley





About this book

Many of us, between 1939 and 1946, had adventure thrust upon us. Colonel Chapman is one of the few who seem born to adventure. It would be small matter for wonder if he is already a myth in the Malayan jungle, where for over three years he lived, having had no previous experience of the country, harassing the Japanese, training the Chinese guerrillas, undertaking — often alone — the most arduous marches, twice captured and escaping from his captors, his life a crazy pattern of illness, frustration and hair-raising peril, ennobled by his will to work for the liberation of the people he had come to love. Such was the vitality of this man that he was also able to fill diaries—written in Eskimo lest they should reveal secrets to the enemy —not only with a soldier's account of his operations but also with a naturalist's minute observation of the jungle.

As to the spirit of these exploits, Field-Marshal Earl Wavell in his Foreword compares the author with T. E. Lawrence "for sheer courage and endurance, physical and mental." As to their military value, Admiral Viscount Mountbatten declared that Colonel Chapman and his comrades "did more single handed than a whole division of the British Army could have achieved."

It has been suggested that in the past "The Jungle is Neutral" has been required reading for professional Soldiers. Presumably this requirement was for the book to be a primer on insurgent warfare as well as jungle warfare to professional Soldiers of a non-SOF type mentality. In this book, the author describes his experiences in the Malaysian Jungle during the years of 1942 through 1945 as a British Officer working with the guerillas. It is written as a memoir and it appears that the intended audience of this book is the uninitiated. Although we in SOF have already developed the mindset through self education or formal training that one would gain from this book, it is still a worthwhile read. I am in agreement with Field Marshall Earl Wavell, who in the foreword wrote "but for sheer courage and endurance, physical and mental the two men" (COL Chapman and T.E. Lawrence) "stand together as examples of what toughness the body will find if the spirit within it is tough".

This book provides excellent examples of insurgent warfare and the capabilities of an intent insurgency against invading Armies in the first 100 pages. The author conducted multiple successful guerilla attacks against the Imperial Japanese Army (IJA) and the infrastructure. However, after that, the book changes into an account of the author's trials and tribulations while hiding in the jungle from the IJA and their informants.

The latter part of this book is a record of the triumph of the human spirit, which in itself is worth reading. Unfortunately, a great deal of the time I could not help wondering why he was no longer fighting. It was suggested in the book that the Malaysian Communist Party (MCP) would not allow the author full freedom of movement. During his three years with the guerillas he trained them in basic soldier skills, but at no point were his understudies involved in any offensive operations. Any offensive operations by host nation forces were conducted by other units within the MCP, and were usually retribution/disciplinary toward individual targets (traitors) or small single buildings (local police stations). I understand that many times the author was gravely ill and understandably unable to perform rigorous physical activity but his acceptance of the limitations of the MCP left me scratching my head. His capture and subsequent escape remind us of our SERE training and that escape should be attempted as early as possible, while in the custody of persons not trained in incarceration techniques.

As a medical officer, I found the author's descriptions of the illness and disease that were his constant companion to be fascinating. These descriptions of disease reinforce the necessity, now that we have more information available to us, of a obtaining good country study, including medical considerations, as part of our planning process. The better prepared we are, the less likely we will have to enter into survival mode.

Sprinkled throughout the book are many pearls of wisdom. For instance, the author comments upon the psychological makeup necessary for survival. These observations hold true no matter what environment, and are as applicable today as the day they were written. Having previously exhibited the right mind set, though, does not mean that one will always have that mindset. Even SOF Operators can become overwhelmed as did the author, who committed suicide by pistol in 1971. The unintended lesson here is that we should always keep an eye on our Ranger buddies and intervene in their life even at the risk of our friendship if we think they are overwhelmed.

While this book may have been required reading in the past I would only recommend this today as a interesting memoir. We have the benefit of COL Chapman's lessons as well as similar lessons from our own Soldiers ingrained in us during our indoctrination and qualification processes. We are expected to not only survive but to complete the mission, though we be the lone survivor.

GUERILLA WARFARE

Che Guevara; Introduction by Marc Becker, ISBN:0-8032-7075-5. Printed by University of Nebraska Press

Review by Capt Keith Vollenweider

Ernesto "Che" Guevara is a name that brings up an image in the mind of millions around the world. From the iconic image on T-shirts of teens who can't possibly know who he truly was or what he did, to those that remember well the Cuban revolution and the goal of Guevara to spread guerilla warfare around the world as a means to overthrow governments that he saw as oppressive toward their own people, his name will be forever linked to the communist revolutionary movement of the 1950s and 1960s.

One important aspect of Guevara's personal life that is not commonly known is that he was a medical doctor before beginning his life as a revolutionary. It could be argued that his interest in alleviating suffering contributed to his later commitment to the overthrow of repressive governments. Others would point to his time travelling across Latin America on a motorcycle and seeing first-hand the lives of the poor as the impetus for his revolutionary zeal. Both certainly had their effect, and are covered well in Marc Becker's introduction to Guevara's *Guerilla Warfare*. For us, though, the medical insights of a seasoned guerilla fighter and doctor are of the most significance.

The book is actually a compilation of three of Guevara's essays, "Guerilla Warfare" (1960), "Guerilla Warfare, A Method" (1963), and "Message to the Tricontinental" (1967), the first having a section dedicated to the medical problems facing a guerilla movement. Most interesting is how much the observations of Guevara correspond to current practice in modern Special Operations medicine. Guevara distinguishes three types of medical care in guerilla warfare; the first he describes as the "nomadic phase." This is a nearly perfect description of our various combat medics: a doctor or medic embedded with the warfighters is one of them, going through every aspect of their struggles, and thus developing a bond with, and a respect amongst, his band. The morale boost resulting from having this medic with a guerilla force is also enthusiastically discussed.

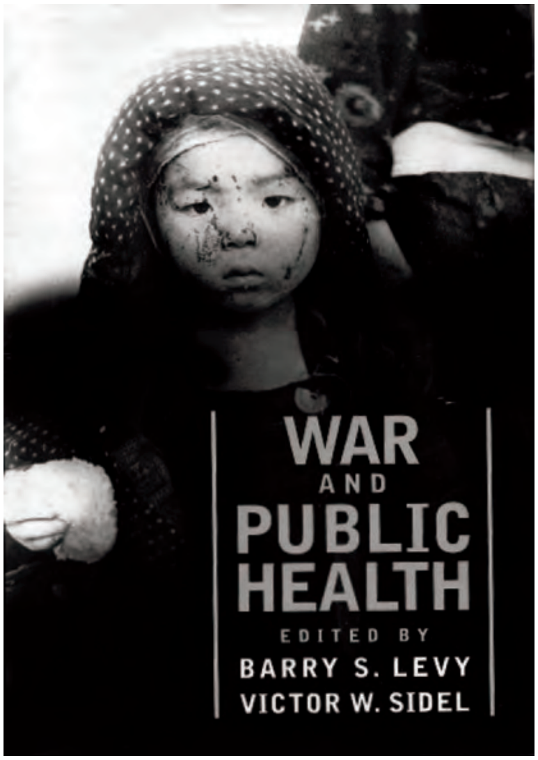
The second phase Guevara identifies as "semi-nomadic." This is the beginning of our Level 2 capability, specifically, the beginning of surgical care that relies on a minimal encampment or base of operations. For him this sometimes meant a peasant's home where surgery could be performed, then the patient could be left to recuperate. He lastly identifies the third of his phases, which corresponds to our various field hospitals and Level 3 and 4 facilities. Guevara discusses the minimal facility requirements and some of the common medical conditions encountered, many familiar today, such as orthopedic injuries, as well as medical logistics and patient evacuation to higher levels of care.

While the book contains a great deal of Guevara's justification for (and philosophy on) how to run a guerilla campaign, it still has great relevance for today's Special Operations medical personnel. The review of the challenges faced by forces that are nomadic and operating in austere, and often isolated environments, is important to understanding and planning for their medical care. Guevara's description for levels of care is right on, and his overall perspective and thoughts can provide us with an insight into the minds of some of our most committed adversaries. They certainly are reading this book.

War and Public Health

Barry S. Levy; Victor W. Sidel
Published by Oxford University Press in Cooperation with the American Public Health Association, New York, New York, 1997. 412 pages. ISBN 0-19-510814-0

Review by MAJ Kevin E. Cooper



War and Public Health begins with the words, "War has an enormous and tragic impact – both directly and indirectly – on public health. In sum, war threatens large elements of the fabric of our civilization." Unlike other books that focus on the impact of war on a nation's military or political structure, this one focuses on the impact of war on the human race, specifically women, children, and refugees. Drawing references to military conflicts throughout history, up to and including the Persian Gulf War, the authors provide a stark correlation between acts of war and the detriment to the human, non-combatant population.

War and Public Health uses statistical data from previous conflicts to illustrate the impact of war on the health of the civilian populace. The book is divided into seven chapters that focus on the consequences of war, the role of public health professionals and organizations in response to war, and the impact of war on the public health agenda. In addition, the book provides some insight into the role of public health officials and organizations in preventing/diminishing the health and environmental impact of both conventional weapons and weapons of mass destruction.

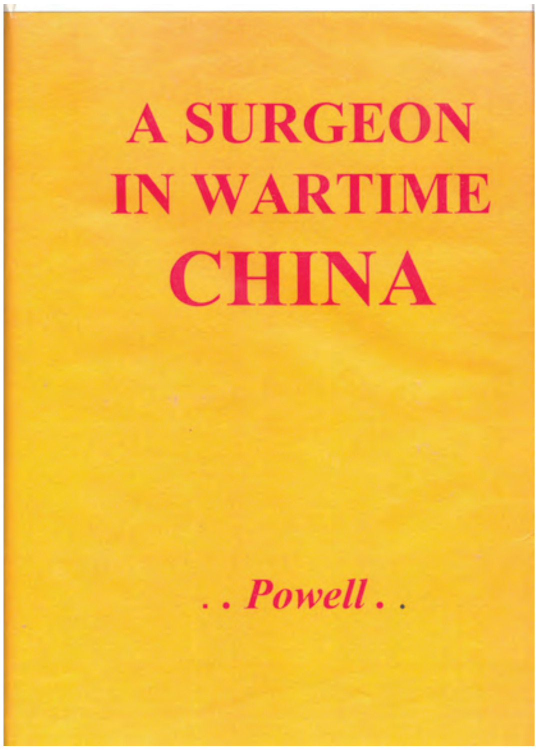
The use of research and statistical data is overwhelming throughout the book, and the authors do an excellent job of supporting their claims. Disease, civilian mortality both during and post-war, displacement of populations, degradation of healthcare, effects on agriculture, and economic effects of war are but some of the topics discussed. Towards the end of *War and Public Health,* the authors spend time providing their views on how health professionals can address these topics in a proactive and reactive manner, and how these professionals can minimize the consequences of such issues. Surveillance, advocacy, and education are their primary recommendations.

War and Public Health is definitely not a "feel good" novel for one to sit down and read to pass the time. The quote, "War is not healthy for children and other living things" is probably the best way to describe the message of this text. This book is best suited for a public health audience or other health professionals with a desire to understand the impact of and possible response to the greatest disease of all: war.

A Surgeon In Wartime China

Lyle Stephenson Powell, COL, MC, Retired
University of Kansas Press Lawrence, KS 1946
ISBN: 1432578243

Review by CPT Scott Gilpatrick



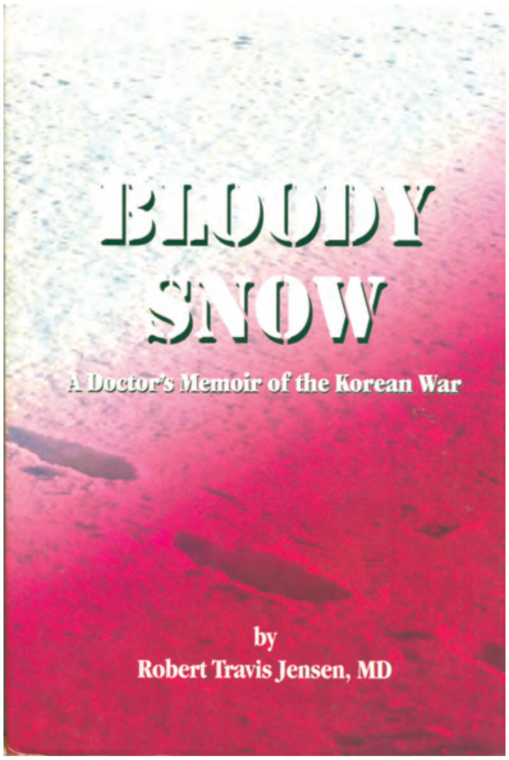
Dr. Lyle Powell was an ophthalmic surgeon who traveled China and worked in an Indian clinic doing surgeries on the various afflicted and disfigured people of the region until 1936. After a short stint at home with his family, he then traveled back to China in 1943 as a U.S. Army Air Corps surgeon and advisor in the China-Burma-India Theater during World War II. The first and longest chapter is all about the month-long trip from Miami to Cathay China. He and his fellow officers were assigned a unit of Chinese troops with the job of training and advising them to victory against the Japanese Empire in a manner similar to our Special Operations Forces (SOF). The rest of the book tells of the great successes he had training the Chinese military in all things medical. The author goes into great detail about the macro (corps) level movements and tactics of the Chinese units they trained and advised.

As a Ranger Medic for many years, I learned about the 5307th Provisional Unit, or Merrill's Marauders, and the exploits of men like LT Phil Piazza. The China-Burma-India Theater always seemed like the worst place in the world because of the tales of the malaria and typhus stricken Marauders and their 112-mile walk to seize the Myitkyina airfield from the Japanese. If you are looking for those stories, this is not the book to read. Dr. Powell did however, deal with the quieter side of war, building a military and advising them to success. Apparently his unit was instrumental in the establishment of medical training facilities and instilling the American military medical department way of doing business to a large, mostly undertrained, and antiquated Army.

Bloody Snow

Robert Jensen, MD

Book Review by SOCM Glenn Mercer



This hardback provides us with a first person narrative of a battalion, then regimental surgeon, involved in both offensive and defensive operations on the Korean Peninsula as part of the 7th Regiment, 3rd Infantry Division (ID) during 1950 and 1951. While Dr Jensen supported and served several elements in the conventional Army at large (to include line, service support, and fixed facilities), I will constrain my comments to his writings regarding direct conflict at Sachang-ni, Hungnam and offensive operations (1951) north of Seoul. Within the chapters he incessantly defines unit designations and operational relationships to the point of distraction. For the purposes of review, it is sufficient to note that Dr. Jensen was attached to the 7th Regiment during his combat tour. The first quarter of the text reviews his upbringing in the upper peninsula of Minnesota, physician training, and induction to the Army. It is not relevant to the JSOM or SG mission, therefore; it is not reviewed in detail.

SOF readers are encouraged to jump to page 86 when he commences his deployment process from Japan to a beachhead at Wonson. It is here where Jensen manifests lessons that still seem to be re-learned even today. In fact, he even lists them in the following chapters. Coming ashore in a landing craft, he was undertrained, underequipped, and leading a force that was composed of over 40% Korean Augmentation Troops to the U.S. Army (KATUSA). These South Korean nationals were inducted by force after the conflict began due to insufficient manning in the brigade combat teams (BCTs). This was unusually significant in that there was no core ability to translate in either direction or use a third language (Japanese) as a denominator. An interesting subtext of the book is the integration of these personnel into the medical platoon and their usage at the Role 1 medical support. This was never explored or recounted to the degree that I desired.

From this point, Dr Jensen began a 14-month combat deployment experiencing a frigid winter on the Korean peninsula. This period overlapped two significant operations of the war. The battle at Chosin Reservoir and the second recapture of Seoul. Conditions for the 7th Regiment in my interpretation were never optimal. It is this constant struggle to be effective that is the highlight of reading this book. Dr Jensen at times narrates down to the tactical level and it is these chapters that are most engaging. In one instance he describes using a wiper motor from a Jeep to create a suction system for his patients. Here the narrative truly engages, as opposed to the frequent vignettes regarding his faith, the reprinted letters home reflecting his personal concerns, and humanitarian efforts for the displaced Korean populations in the North and the South.

The months described in winter 1950 which includes the actions at Sachang-ni and the withdrawal to sea at Hungnam will hold the attention of the modern Medic or physician by the constant narrative of combat lessons learned the hard way. The most significant passages are when the author described the effects of the temperature, refugees, and the tactics of the enemy on the combat power of the Seventh. These lessons repeat themselves throughout the narrative and culminate on the battle for Hill 284 where Dr Jensen was again intimately involved in the tactical situation as the regimental surgeon.

This book contains a forward, preface, acknowledgements, a prologue, an epilogue, and appendices at the end of the book that add little to the quality of the narrative. While relevant to the author, they do little to raise the appreciation of the story which is really distilled down to a few chapters of engaging material. I would recommend the SOF reader, especially physicians new to the military, could benefit by reading Chapters 8 through 15. Otherwise, unless there is a personal interest, I would not recommend this book to anyone except the Army Medical Corps or those with a personal history of the 3rd ID during this period of conflict. Months long regimental and divisional battles are not a part of our recent military history so the strategic and operational details bear little value to modern SOF operations. It is when the author recounts the tactical challenges of close conflict with combined arms that *Bloody Snow* becomes very engaging.

Previously Published

Impact of Prolonged Exercise in the Heat and Carbohydrate Supplementation on Performance of a Virtual Environment Task

Stephen P. Bailey, PhD*; Craig Holt, MSƗ; Maj Kent C. Pfluger, USMCRƗ; Zina La Budde, BS§; Daniel Afergan, BS£; Roy Stripling, PhD§; Paul C. Miller, PhD*; Eric E. Hall, PhD*
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Abstract

Purpose: The purpose of this investigation was to determine whether performance of a virtual environment (VE) task is influenced by exercise in the heat and carbohydrate supplementation. **Methods:** Ten males completed four exercise trials to fatigue. During each trial, subjects cycled at a submaximal workload. Subjects exercised in a normal environment (NORM) and in a hot environment on different occasions. During exercise, subjects drank 10mL X kg^{-1} X $hour^{-1}$ of body weight of a 6% carbohydrate beverage (CHO) or a placebo. Subjects completed a VE task before, during exercise, and after fatigue. **Results:** More failures occurred during placebo than CHO during exercise. The NORM CHO trial had the fewest failures at fatigue. More kills occurred during exercise in the NORM CHO. **Conclusions:** Performance of a VE task was negatively influenced by prolonged exercise and heat stress. CHO supplementation may have a positive impact on performance of the VE task following prolonged exercise.

Introduction

Warfighters on the battlefield are typically exposed to a myriad of physical stressors including, but not limited to, extreme environments, heavy workloads, dehydration, and impaired nutritional status. Anecdotally, these stressors are believed to have a devastating impact on the ability of these individuals to act quickly and appropriately in a combat environment. Cognitive function and mood state have been shown to deteriorate in laboratory and field[1,2] experiments designed to simulate these stressful conditions. For example, Lieberman et al.[1] found decrements in visual vigilance, choice reaction time, short-term memory, and mood following an 84-hour simulated military sustained operation in a group of Soldiers. Lieberman et al.[2] had similar findings in Soldiers who were part of an elite light infantry unit following 53 hours of simulated combat activities in the heat.

A limitation of these experiments has been that the tools used to evaluate cognitive function typically do not closely approximate the actual psychomotor activities that a warfighter must perform on the battlefield. The use of a virtual environment (VE) can be useful at mimicking these activities and provide a vehicle for quantitative evaluation of performance in a simulated battlefield setting.[3] Unfortunately, there is limited empirical information describing how performance of a VE task is influenced by exposure to prolonged physical and environmental stress.

Decrements in cognitive function subsequent to combat training and prolonged military exercises have been associated with symptoms of hypoglycemia.[4,5] Owen et al.[4] found symptoms of hypoglycemia, precipitated as a result of 48 hours of military activity, were accompanied by reductions in memory recall and vigilance. Similar results have been described following prolonged exercise in a laboratory setting.[6-8] This concept is demonstrated by Grego et al.[6] who found blood glucose and cognitive processing speed to be reduced in trained cyclists during 3 hours of cycling at 66% of $V0_{2max}$. In contrast, 6% carbohydrate beverage (CHO) supplementation has been shown to attenuate these impairments in cognitive function following prolonged exercise stress.[8,9] For example, Welsh et al.[9] were able to prevent the decrements in performance of the Stroop Color-Word test precipitated by 1 hour of intermittent high-intensity exercise by providing subjects with regular doses (5mL X kg^{-1} every 30 minutes) of a CHO drink.

Cognitive function is also negatively affected by heat stress.[10,11] For example, Radakovic et al.[10] found that exposure to a hot environment (40°C) at rest for 90 minutes resulted in deficits in attention during a computer-based cognitive task. Interestingly, it appears that the negative effects of heat stress on cognitive function are more typically associated with more complex executive tasks[12] and these deficits can be attenuated with acclimatization and fluid replacement.[13] The purpose of this investigation was to examine the influence of heat and CHO supplementation on VE performance.

Table 1 Descriptive Data of Participants	
Participant Data	
Age	23 ± years
Weight	68 ± 2.7kg
VO_2 peak	49.3 ± 1.4ml x kg^{-1} x $minute^{-1}$
T_{vent}	68.1 + 2.7% of VO_2 peak

METHODS

Subjects

Ten moderately fit males (Table I) served as subjects in this investigation. All subjects were recent (within 5 years) graduates of the U.S. Naval Academy and signed an approved informed consent form before participation. Subjects consisted of temporary assigned duty ensigns and second lieutenants (awaiting departure to flight school, dive school, or The Basic School for the U.S. Marine Corps) and fleet lieutenants assigned to the Naval Academy as instructors. Subjects were excluded from participation if they had an orthopedic or other medical condition that prevented their participation.

Experimental Design

To participate in this investigation, subjects were required to complete a maximal exercise test and four experimental trials. Experimental trials were separated by at least 7 days and the order of experimental treatments for each subject was varied using a Latin square design. All experimental trials were initiated between 7:00 and 7:30 a.m. Before each experimental trial, subjects were required to refrain from consumption of caffeine, alcohol, over-the-counter medications, and any nutritional supplements for 24 hours and from eating for 12 hours.

Maximal Exercise Test

Subjects completed the maximal exercise test on a Lode Excalibur Sport (Lode Medical Technology, Groningen, The Netherlands). Before beginning the test, subjects warmed up for 10 minutes at 50 W. Upon initiation of the test, workload (W) was increased to 100 W and increased 25 W every minute until the subject was unable to maintain revolutions per minute greater than 65. During the test, expired gases were continuously collected and analyzed using a True One 2400 Metabolic Measurement system (ParvoMedics, Inc., Sandy, Utah). Although data were collected continuously, measures were averaged over 15-second intervals to determine peak oxygen consumption ($V0_2$ peak) and other physiologic measures used in subsequent analyses. To calculate $V0_2$ peak, the four greatest adjacent $V0_2$ values were averaged.

After completion of the test, the level of oxygen consumption and heart rate associated with the ventilatory threshold (T_{vent}) were determined by computer analysis (True One Software; ParvoMedics, Inc., Sandy, Utah). This was done by plotting ventilation (VE) versus oxygen consumption ($V0_2$) and the point where VE increased disproportionately to an increase in $V0_2$ was identified as T_{vent}. The heart rate associated with T_{vent} was then identified by plotting heart rate versus $V0_2$ and determining the heart rate associated with the $V0_2$ at which T_{vent} occurred. Visual inspection of the data by an experienced researcher (completed more than 500 maximal exercise tests used to determine T_{vent}) was used to confirm the physiologic measures associated with T_{vent}.

Experimental Trials

During each experimental trial, subjects exercised to volitional fatigue at a workload equivalent to 80% of ventilatory threshold (T_{vent}) as determined during the maximal exercise test. Exercise during experimental trials was completed on a Monark 818e cycle ergometer (Monark Exercise AB, Vansbro, Sweden). The desired workload (W) was created by having the subjects cycle at 80 revolutions per minute and manually manipulating the resistance on the flywheel. During two of the experimental trials, subjects exercised in a normal environment (NORM; ~22°C and 50% humidity). During the other two experimental trials, subjects exercised in a hot environment (HOT; -35°C and 70% humidity). Every 30 minutes during exercise, subjects drank 5mL X kg^{-1} of body weight of either a CHO (18mEq X L^{-1} of sodium and 3mEq X L^{-1} of potassium) or a water placebo (PLAC) indistinguishable in color and taste. Drinks were administered to subjects in a double-blind fashion (i.e., both the subject and all researchers were blinded to the contents of the drink). Drinks were provided by the Gatorade Sports Science Institute (Barrington, Illinois). Weights of the subjects were recorded immediately before and after completion of each experimental trial.

Physiologic Measures

Heart rate was recorded at rest, every 30 minutes during exercise, and at fatigue using a Polar Heart Rate monitor (Polar Electro, Inc., Lake Success, New York). Core temperature (T_{core}) was monitored continuously and recorded at rest, every 30 minutes during exercise, and at fatigue using a CorTemp Ingestible Core Body Temperature Sensor and a CorTemp Data Recorder (HQ, Inc., Palmetto, Florida). To measure T_{core} during experimental trials, subjects were required to ingest the CorTemp Ingestible Core Body Temperature Sensor just before sleeping the night before the experimental trial. Each individual sensor is calibrated by the manufacturer to ±0.0l°C in temperatures ranging from 20 to 45°C before shipment. This system has been shown to be highly correlated (r = 0.98) to rectal temperature during exercise in the heat.[14]

VE Task

Subjects completed a VE task at rest, after 60 minutes of exercise, and immediately after fatigue. The VE task was completed on a desktop personal computer in a room where the environment was consistent with the NORM environmental condition. The only visual and auditory stimuli available to the subjects during the VE task was that provided by the VE task. Subjects interacted with the VE task using a standard computer keyboard and a mouse. The VE task used in this experiment was an adapted version of Virtual Battlefield Systems (Coalescent Technologies Corporation, Orlando, Florida). Before completion of all experimental trials, subjects received one hour of training and practice with the VE task. During this training, subjects were exposed to several scenarios similar to that completed during the experimental trials.

The VE task was 10 minutes in length and was set in an urban warfare setting. Performance in the VE task was evaluated by four blinded evaluators. The number of failures (being killed by combatant forces) and number of kills (elimination of enemy combatants) during the VE task were quantitatively recorded. The ability of subjects to complete their mission, effectively use their resources, and move safely and effectively were qualitatively evaluated by each evaluator using a 1 (extremely poor) to 10 (excellent) scale.

Evaluators were trained to evaluate and score the VE task by reviewing five "example" trials. During this training period, inter-rater reliability for the quantitative measures (failures and kills) was very high ($r^2 \geq 0.96$). In comparison, inter-rater reliability for the qualitative measures was also strong ($r^2 \geq 0.74$). Intrarater reliability was also established by having reviewers re-evaluate a subset of trials (10 each). Intrarater reliability for the quantitative measures (failures and kills) was very high ($r^2 \geq 0.99$). Intrarater reliability for the qualitative measures was also strong($r^2 \geq 0.86$).

Volitional Fatigue

For this investigation, volitional fatigue was defined as the point in time subjects were unable to maintain a workload within 10% of desired workload continuously for 1 minute. Subjects were verbally informed when they were not exercising at the desired workload. If they were not able to return to the desired workload after 30 seconds, they were verbally informed that the trial would be terminated in 30 seconds if they did not return to the desired workload. If subjects did not return to the desired workload within another 30 seconds, the trial was terminated and total exercise time was recorded. Subjects were not allowed any extraneous visual (television) or auditory (music) stimuli at any point during the experimental trials. Furthermore, verbal encouragement was not provided by researchers during any of the experimental trials. Subjects were not aware of the elapsed time during experimental trials.

Data Analyses

All data presented in tables and figures are presented as mean ± SE. Differences in dependent measures across treatments and time were analyzed using a three-way (environment X drink X time) multiple analysis of variance. Significance was set a priori at the $p < 0.05$ level. When appropriate, the Newman-Keuls post-hoc procedure was used to identify specific differences between cell means.

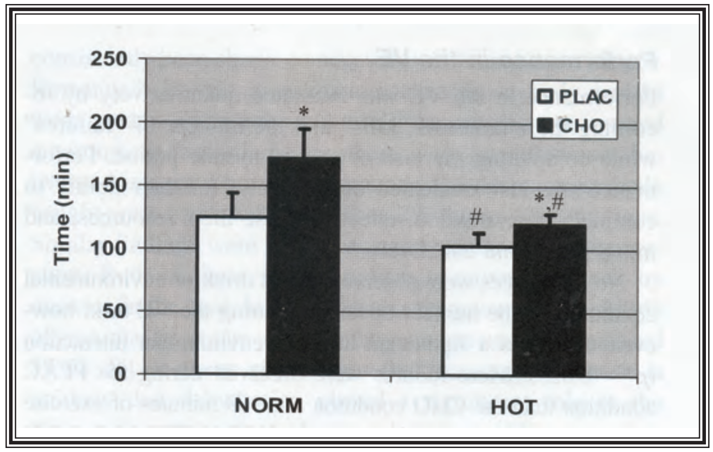

Figure 1: Impact of heat stress and CHO supplementation on exercise to volitional fatigue. *, Difference ($p < 0.05$) between PLAC and CHO conditions. #, Difference ($p < 0.05$) between NORM environment (-22°C and 50% humidity; NORM) and heat stress (-35°C and 70% humidity; HOT) conditions.

Results

Time **to** *Fatigue*

Exercise time to fatigue was impacted by both CHO supplementation ($p = 0.043$) and heat stress ($p = 0.013$) (Fig. 1); however, there was not an interaction (environment X drink) effect observed ($p = 0.27$). Exercise time to fatigue was greatest during the NORM CHO (169 ± 23 minutes) condition, followed by the NORM PLAC (128 ± 19 minutes), HOT CHO (110 ± 9 minutes), and HOT PLAC (101 ± 10 minutes) conditions, respectively.

Physiologic Measures

Heart rate was greater during the HOT conditions as compared to NORM conditions ($p < 0.0001$); however, a drink X environment interaction was not observed ($p = 0.81$). Specifically, heart rate was greater ($p < 0.05$) during exercise in HOT conditions as compared to NORM conditions after 60 minutes of exercise (NORM PLAC = 136 ± 4 beats per minute (bpm); NORM CHO = 129 ± 4 bpm; HOT PLAC = 154 ± 4 bpm; HOT CHO = 157 ± 4 bpm) ($p = 0.0001$) and at fatigue (NORM PLAC = 145 ± 4 bpm; NORM CHO = 143 ± 3 bpm; HOT PLAC = 157 ± 6 bpm; HOT CHO = 159 ± 4 bpm) ($p = 0.010$). No differences were observed between drink conditions at any time point.

Core temperature was greater during the HOT conditions as compared to NORM conditions ($p < 0.0001$); however, a drink X environment interaction was not observed ($p = 0.07$). Specifically, core temperature was greater during exercise in HOT conditions as compared to NORM conditions after 60 minutes of exercise (NORMPLAC = 37.91 ± 0.14°C; NORM CHO = 37.50 ± 0.14°C; HOT PLAC = 38.18 ± 0.07°C; HOT CHO = 38.33 ± 0.l7°C) ($p = 0.003$) and at fatigue (NORM PLAC = 37.55 ± O.22°C; NORM CHO = 37.95 ± 0.16°C; HOT PLAC = 38.52 ± O.22°C; HOT CHO = 38.59 ± 0.29°C) ($p = 0.032$). No differences were observed between drink conditions at any time point.

Body weight decreased more during the HOT (HOT PLAC = 1.4 ± 0.3%, HOT CHO = 1.7 ± 0.4%) trials as compared to the NORM (NORM PLAC = 1.0 ± 0.2%, NORM CHO = 0.9 ± 0.2%) trials *(p* = 0.015); however, no differences were observed between the drink conditions.

Performance in the VE

Performance in the VE was evaluated quantitatively by recording the number of "kills" and the number or "failures" while completing the task over a 10-minute period. Performance was also evaluated qualitatively, for their ability to complete their mission, effectively use their resources, and move safely and effectively.

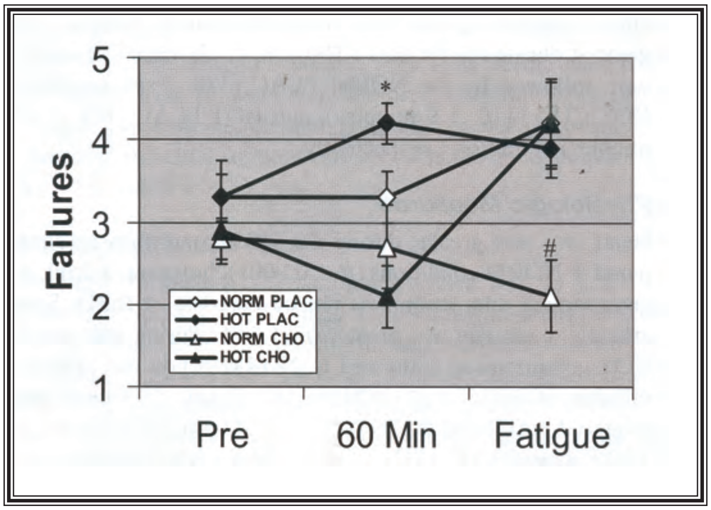

Figure 2: Changes in the number of failures during a VE task as a result of CHO supplementation and prolonged exercise in the heat. *, Difference *(p* < 0.05) between PLAC and CHO conditions. #, Difference *(p* < 0.05) between the NORM CHO condition and all other conditions.

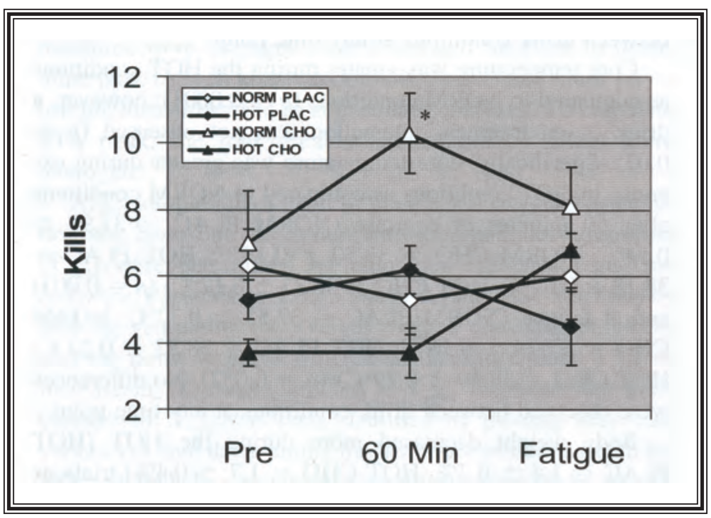

Figure 3: Changes in the number of kills during a VE task as a result of CHO supplementation and prolonged exercise in the heat. *, A difference *(p* < 0.05) between the CHO condition in the NORM environment (NORM CHO) and all other conditions *(p* < 0.05).

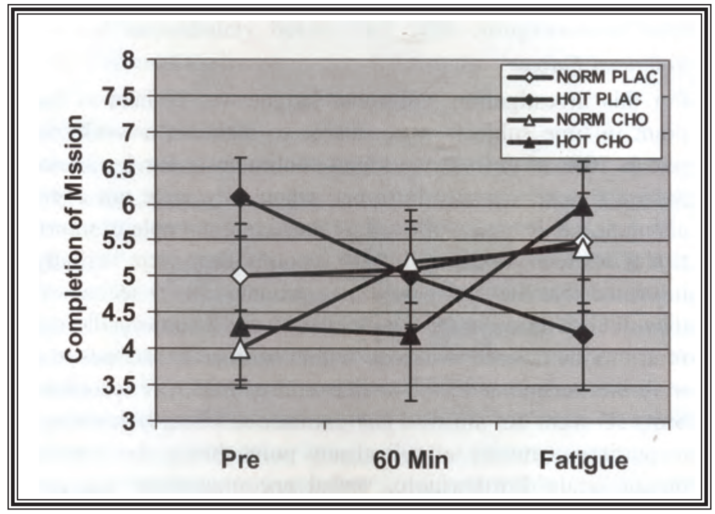

Figure 4: Impact of heat stress, CHO supplementation, and prolonged exercise on "completion of mission."

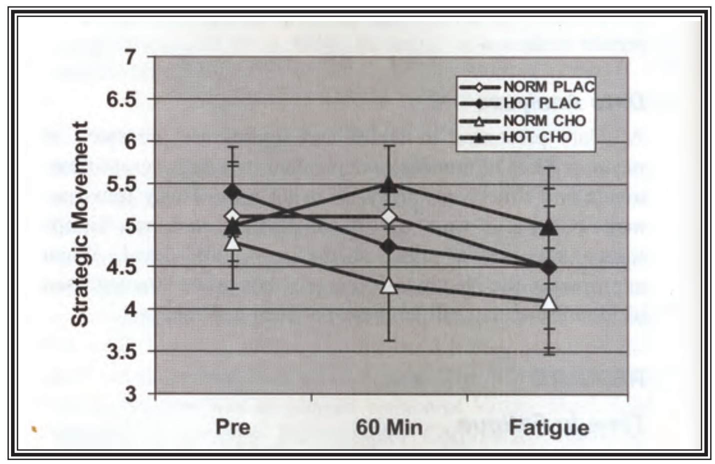

Figure 5: Impact of heat stress, CHO supplementation, and prolonged exercise on "strategic movement."

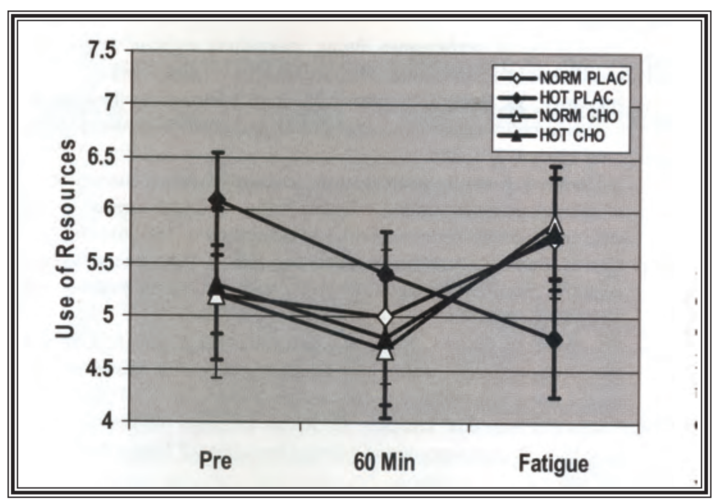

Figure 6: Impact of heat stress, CHO supplementation, and prolonged exercise on "use or resources."

No differences were observed across drink or environmental conditions in the number of failures during the VE task; however, there was a significant drink X environment interaction *(p = 0.023)*. More failures were observed during the PLAC condition than the CHO condition after 60 minutes of exercise *(p = 0.041)* (Fig. 2). Furthermore, the NORM CHO (2.1 $\pm$ 0.5) trial had the fewest number of failures at fatigue as compared to the other three conditions (NORM PLAC = 4.2 $\pm$ 0.5; HOT PLAC = 3.9 $\pm$ 0.3; HOT CHO = 4.2 $\pm$ 0.4) (Fig. 2).

Similarly, no differences were observed across drink or environmental conditions in the number of kills during the VE task. There was a significant drink X environment interaction *(p = 0.034)*. Specifically, more kills *(p = 0.015)* occurred after 60 minutes of exercise in the NORM CHO (10.3 $\pm$ 1.2) trial as compared to the other three conditions (NORM PLAC = 5.3 $\pm$ 1.2; HOT PLAC = 6.2 $\pm$ 0.7; HOT CHO = 3.7 $\pm$ 0.8) (Fig. 3). No differences between groups were observed at any other time point.

No differences were observed between any of the conditions at any time point for completion of mission (Fig. 4), strategic movement (Fig. 5), or use of resources (Fig. 6).

Discussion

The results of this investigation found that exercise time to fatigue was increased by CHO supplementation and reduced by exposure to heat stress. Furthermore, quantitative performance of the VE task, during and after cessation of exercise, in an urban warfare setting was positively impacted by CHO supplementation. Exercise time to fatigue at 80% T_{vent} was increased 32% in the normal environment. These findings are consistent with findings of other investigations.[15,16] By providing the body with a steady flow of exogenous CHO during prolonged exercise, CHO supple- mentation has been theorized to improve exercise performance by maintaining blood glucose, sparing endogenous glycogen, and influencing central nervous system function. The evidence that the use of CHO supplementation strategies similar to that used in this investigation are effective at maintaining euglycemia during prolonged exercise is strong.

CHO supplementation during prolonged exercise has been shown to “spare” liver glycogen;[17] however, the impact of CHO supplementation on the breakdown of muscle glycogen remains unclear.[15] CHO supplementation during moderate intensity exercise has repeatedly been shown to prevent the drop in blood glucose that is typically seen after 1 hour or more of continuous exercise when a water placebo is consumed.[18,19]

CHO supplementation may also improve physical performance through central mechanisms. Evidence suggesting that CHO supplementation influences physical performance through central mechanisms is provided by three different types of experiments. CHO feeding during relatively short (60 minutes or less) high-intensity exercise (>75% of $V0_{2max}$) consistently has been shown to have an ergogenic effect despite the fact that it is extraordinarily unlikely that an exogenous CHO source could influence energy production within the muscle.[20] Furthermore, a unique experiment by Carter et al.[21] found that exercise performance of a task approximately 60 minutes in length was slightly (2.8%), but significantly improved when subjects simply rinsed their mouth with a CHO solution. CHO supplementation during prolonged exercise has also been shown to indirectly influence the availability of various amino acids to brain, ultimately impacting production of various neurotransmitters that could influence exercise performance.[22,23]

Improvement of exercise performance in the heat subsequent to CHO feeding is theorized to result from attenuation of water loss and improved availability of glucose for energy production. Fluid loss equivalent to 2% of body weight has consistently been shown to negatively influence exercise performance.[24] In this investigation, changes in body weight were greater during the hot trials than during the normal environment trials; however, there were no differences between drink conditions. Furthermore, the decreases in body weight were consistently less than 2% during all conditions. Similar findings were found for heart rate and core temperature. Both of these variables were negatively affected by exercise in the heat; however, heart rate never exceeded 80% of maximal heart rate and core temperature never approached 39°C. All of these physiologic findings suggest that it is unlikely that dehydration played a significant role in the changes in performance observed here.

Quantitative performance during the VE task was best when subjects consumed CHO during the normal environment. This is demonstrated by the greater number for kills and lower number of failures seen under these conditions as compared to the other conditions (Figs. 2 and 3). CHO supplementation during exercise in the hot environment also resulted in a fewer number of failures than when the subject consumed the water placebo (Fig. 2). Considering the lack of differences observed in the physiologic variables (body weight, heart rate, and core temperature) it is not likely that the positive influence of CHO feedings was the result of differences in hydration status. Rather, it is much more likely that these differences are subsequent to differences in glucose availability.

As mentioned previously, the CHO feeding regime used in this investigation has been shown to maintain blood glucose levels during exercise in NORM and HOT environments.[19,25] Decrements in cognitive function following strenuous military field exercises and prolonged physical activity in a laboratory setting have previously been found to be associated with decreases in glucose availability. Furthermore, CHO feeding during prolonged exercise has been shown to be an effective strategy for attenuating these negative changes in cognitive function. Although assessment of cognitive function during these military exercises has used procedures that approximate function during combat (complex decision making, marksmanship, etc.),[1,10] this is the first investigation where changes in performance in a virtual warfare environment are negatively affected by prolonged exercise and heat stress. Furthermore, the use of CHO feedings during these stressors was effective at attenuating these negative changes. A significant limitation of this investigation, is the inability to more completely assess performance in the VE. We attempted to more fully understand this phenomenon by using blinded evaluators to qualitatively assess performance for three important areas (completion of mission, strategic movement, and use of resources). Unfortunately, these analyses provided no useful insight and do not appear useful for future analyses. Current advances in VE technology already allow for more sophisticated quantitative analyses of these types of missions and should be applied in future experiments that use a similar design. Furthermore, it seems prudent that evaluating cognitive function separately, but nearly simultaneously to completion of the VE task would provide valuable insight as to "cognitive" mechanisms that underlie changes in VE performance.

In summary, the results of this investigation demonstrate that the performance of a VE urban warfare task are negatively affected by prolonged exercise and heat stress. These negative changes appear to be attenuated by regimented CHO feedings, suggesting that availability of a CHO/electrolyte beverage during environmentally stressful combat environments may be a useful strategy for optimizing performance.

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The Challenge of Controlling Lead and Silica Exposures from Firing Ranges in a Special Operations Force

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Abstract

In 2000, Soldiers from a Special Operations Force had airborne lead exposures 20 to 38 times the permissible exposure limit. Their average blood lead level was 13.9 p.g/dL. Immediate implementation of pertinent Occupational Safety and Health Administration regulations was recommended. In 2003, investigators learned that the unit also used an outdoor firing range with exposures exceeding the permissible exposure limit. Attempts to conduct more detailed evaluations and control measures were hindered by frequent deployments in the unit and a strong commitment to realistic training. Despite these challenges, the controls implemented resulted in limited success. The average blood lead level in the unit was 6.8 p.g/dL in 2005, a reduction of 51%. Proper initial range construction is essential to controlling lead exposures at firing ranges. Occupational health specialists caring for these Soldiers must identify, assess, and mitigate exposures from firing ranges while respecting the importance of realistic training.

Introduction

Exposure to airborne lead resulting in elevated lead levels is well-documented for people working or extensively using indoor firing ranges.[1-4] Lead overexposure has also been demonstrated in outdoor firing ranges.[5,6] Overexposure is a concern among military, law enforcement, and security personnel and those who engage in the sport of shooting.[7,8]

Special Operations Forces (SOF) Soldiers contacted military public health authorities in 2000 because of their concerns about indoor firing range exposure. Investigation by military occupational health personnel revealed an indoor firing range for military operations on urbanized terrain (MOUT) that was extensively used. Later, military occupational health personnel learned that the SOF Soldiers were also training at an outdoor range. Both ranges exceeded the permissible exposure limit (PEL) for lead of 50µg of lead per cubic meter of air (or 0.05*mg/m*³), averaged over an 8-hour workday. Attempts to reduce exposures to lead were often resisted and interventions resulted in only modest improvements. The type of training described in this report is common and the challenges encountered in working with the SOF unit reported here are not considered unique to the unit studied. Military occupational health personnel must attempt to ensure that initial construction of SOF ranges is appropriate for managing lead exposure and to identify and assess existing SOF indoor and outdoor ranges. Despite the challenges encountered in working with an SOF unit, persistence in periodic assessment of lead exposures and in the implementation of controls, while respecting the importance of realistic training, can achieve a beneficial effect.

The affected population was an Army SOF unit that trained at both indoor MOUT ranges and outdoor firing ranges. The population of the unit was approximately 80 personnel assigned, but like all SOF, this was a dynamic population with frequent deployments, long periods of temporary duty, and personnel turnover. Overall average time spent at a firing range was estimated to be 24 to 40 hours per week per person, with thousands of rounds of ammunition being fired on the ranges each day. In addition to small arms ammunition, detonation cord explosives were also used on the ranges on a routine basis. SOF unit Soldiers deployed from their home base often, making follow-up difficult. The unit had a very strong commitment to realistic training and unit members resisted anything perceived as interfering with training, which was considered to be essential to survival in a hostile environment and to mission success.

Methods: Specimen Collection and Analyses

Personal air sampling was performed using Occupational Safety and Health Administration 121 methodology in the breathing zone of soldiers over a typical work day at both ranges, and analysis was performed by an American Industrial Hygiene Association Lead-Accredited laboratory at the Center for Health Promotion and Preventive Medicine-Europe. Blood lead levels were measured by standard laboratory procedures. Statistical analysis was accomplished with SAS software version 9.1 (SAS, Cary, North Carolina), using x^2 statistics for trend for proportions over time. Finally, analysis and mixed models were used to account for the within-person correlation due to repeated measures, and because the data were unbalanced.

Results

Sources of Lead Exposure

Lead sources included small arms ammunition primers, copper-jacketed lead ammunition at the outdoor firing range, and detonation cords. Rubber projectiles were used at the indoor MOUT ranges.[9]

Indoor Firing Ranges

The initial indoor MOUT range studied in 2000 was not a typical indoor firing range with a defined firing line, parallel lanes of fire, and a defined target area. Rather, it was an unused building that had been modified for training Soldiers to fight in an urban environment. The building contained no lead-based paint. Airborne lead concentrations of 0.98 to 1.90 mg/m^3 time-weighted average (TWA) were found, which are 20 to 38 times the PEL of 0.05mg/m^3 TWA.[10] Attempts to reduce the lead exposure failed, and this building was demolished in 2001, although its use continued until demolition due to absence of a suitable substitute. A subsequent indoor MOUT range was constructed with a ventilation system that was largely passive with inadequate air movement. Airborne lead concentrations in the second MOUT indoor site ranged from 0.06 to 0.22mg/m^3 TWA, again exceeding the PEL. Personal sampling demonstrated benzene, ethylbenzene, toluene, xylenes, carbon monoxide, nitrogen dioxide, and hydrogen cyanide below the applicable threshold limit values (TLV) and or PELs as a TWA. A third range was constructed in 2005 that only included passive, dilution ventilation due to a lack of utilities and similar personal lead levels were quantified.

Traditional Outdoor Firing Ranges: Flat Ranges

Traditional flat outdoor firing ranges were also used where lead and silica dust exposures occurred. The flat ranges had better passive ventilation in that they were not in tunnels. In 2004, lead levels were found to exceed the PEL at these ranges as well (0.03-0.05mg/m3). Quartz silica levels were also found to exceed the current TLV (0.018-0.030mg/m^3), but did not exceed the TLV at the time of the survey. Controls were implemented in the form of sand change, the addition of barrier curtains to contain the bullet catch sand, and lava rock on the floor of the range to prevent stirring up of the dust when walking around or firing prone. In 2006, both the lead and silica levels were below the PEL and TLV, respectively.

Nontraditional (Tunnel-Type) Outdoor Firing Ranges

A continued search for lead exposures in the SOF unit revealed the use of another type of outdoor firing range in 2003. The characteristics of this range were unusual. The outdoor range was linear, had a vaulted ceiling cover that gave it a tunnel-like appearance, and was open at both ends. Because enclosed outdoor firing ranges have been associated with overexposures to lead, the outdoor range was studied.[9,11] The sand berm used to stop the bullets behind the target had not been changed despite extensive use and was heavily contaminated with lead and pulverized into very fine talc-like dust particles due to heavy use. Lead-contaminated sand berms have been identified as sources of lead exposure and a potential environmental threat to soil and groundwater.[12] The SOF Soldiers typically stood very close to the targets, at 5 meters instead of the more typical 25 meters, thus increasing their inhaled dose by proximity to the berm particulate matter aerosolized by the impact of thousands of rounds over a short time period. The personal air sampling at the outdoor ranges revealed lead levels of 0.10mg/m3 to 0.23mg/m^3, exceeding the PEL. Notably, air sampling at these ranges also revealed quartz silica levels of 0.15mg/m^3 to 0.21mg/m^3, exceeding the 0.025 mg/m^3 TWA TLV as established by the American Conference of Governmental Industrial Hygienists.[13] Delays occurred in sand removal and replacement due to heavy contamination of the sand with lead and the requirements to dispose of it as hazardous waste. Removal of the contaminated sand and replacement with new sand in 2004 reduced the exposures but did not result in a drop in airborne lead and silica levels to below their respective PELs.

Blood Lead Surveillance

From 2000 through 2005, 255 unique SOF male Soldiers provided 422 blood samples. When a Soldier had more than one blood lead level taken within the same year, the first test was used to avoid overweighting these subjects and introducing the effects of subsequent administrative controls. There were only 31 samples excluded for this reason, leaving 391 lead levels for analysis. The number of samples per Soldier ranged from 1 to 6. The average age was 33.5 years (range 20-56) and the average blood lead level was 10.2µg/dL (range 1-48). In comparison, the geometric mean blood level in males aged 20 to 59 in the United States between 1999 and 2002 was far lower, at 2.0µg/dL (95% confidence interval: 1.9-2.0).[14] Mean levels markedly declined over time from 13.9µg/dL in 2000 to 6.8µg/dL in 2005 (Fig. I), a reduction of 51%. Similar trends were observed in the numbers and proportions of those with elevated levels (Fig. 2). Trend in values greater than 25µg/dL tended downward (p = 0.049, Cochran-Armitage trend test). The downward trend of blood lead levels of 10µg/dL or greater was even more dramatic ($p < 0.0001$). Because the numbers and thus proportion of unit personnel tested also increased over time from 55 in 2000 to 76 in 2005, analyses on Soldiers with repeated measures over time was performed by using the mixed procedure with repeated measures and modeling with compound symmetry. This analysis was conducted to assess whether the effects seen were merely due to the inclusion of lower risk personnel. This analysis showed an average decrease in lead level of 1.45µg/dL per year (t = 6.05,$p < 0.0001$) among Soldiers tested repeatedly over the years studied. This effect is also shown in Table I, which models the effect for each individual year as a categorical variable instead of the linear trend.

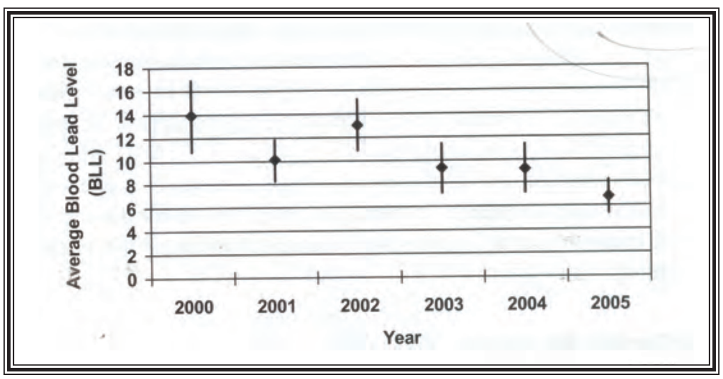

Figure 1: Mean blood lead levels (micrograms per deciliter) and 95% confidence intervals in SOF Soldiers studied, 2000-2005. Numbers of Soldiers tested by year: 2000 (55), 2001 (56), 2002 (62), 2003 (68), 2004 (74), and 2005 (76).

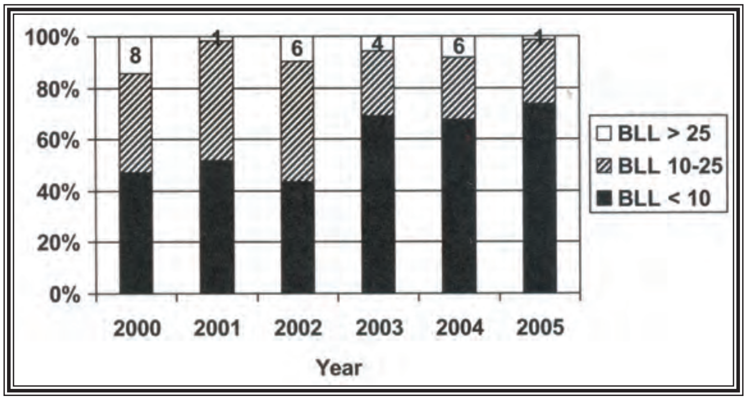

Figure 2: Percentages of SOF soldiers with different blood lead levels (BLL; micrograms per deciliter) by year who were studied during 2000-2005. Numbers shown in the shaded area are the actual number of Soldiers with a blood lead level of >25 ILgldL.

TABLE I. Mean Change in BLL (μg/dL) after Accounting for Repeated Measurements among Soldiers, 2000–2005

Year	Change in BLL (μg/dL)	SE	p
2000	0		
2001	−4.3	1.4	0.0021
2002	−1.0	1.4	0.5017
2003	−5.0	1.4	0.0005
2004	−5.8	1.4	<0.0001
2005	−7.1	1.4	<0.0001

Number of Soldiers with at least two repeated measurements: 91. BLL, Blood lead level.

Control Measures

Lead surveillance and respiratory protection programs were immediately instituted for all Soldiers using the ranges at least 30 days per year, based on Occupational Safety and Health Administration regulations.[10] These involved quarterly industrial hygiene assessments of the ranges with personal air sampling and biannual blood lead testing and surveillance. Clinical surveillance of the exposed Soldiers revealed no abnormal findings. Environmental, administrative, and personal protective controls were assessed based on guidance from the National Institute of Occupational Safety and Health http://www.cdc.gov/niosh/topics/ranges/[15,16] the Navy Environmental Health Center,[17] the Army Environmental Center's Range Program http://aec.army.mil/usaec/range/index.html,[18] and the National Association of Shooting Ranges http://www.rangeinfo.org/resource_library/facility_mngmnt/environment/Lead-OSHA.pdf.[19] These included replacement of the contaminated sand at the outdoor firing ranges, development of recommended time limits in the indoor and outdoor firing ranges, improved hygiene in removing contaminated dust at the indoor ranges, institution of mandatory uniform washing stations after each use at a range, and respiratory protection with a half-face respirator and high-efficiency particulate air (HEPA) particulate filter. Although ventilation is often the most significant management tool available to mitigate lead exposures, in this instance, the ability to enhance ventilation was limited due to design. Installation of neoprene curtain barriers in front of the bullet catches on the flat traditional ranges and lava rock on the floor of the flat ranges was also recommended. Substantial reductions in lead and silica exposures were noted after implementation of range hygiene and housekeeping practices. Replacement of the outdoor range sand reduced the lead and silica airborne exposures at the outdoor site to below their respective PELs. Attempts to quantify exposures in a more detailed fashion in the SOF Soldiers met with resistance due to training requirements.

Discussion

The Department of Defense recognized the need for greater surveillance for lead by releasing its 2004 Lead Biomonitoring Policy.[20] The Global War on Terror increased training requirements and changed the type of training for the military. One significant change was an increased focus on urban warfare. A corresponding increase in training at MOUT and other similar ranges was a necessary consequence for SOF Soldiers, conventional U.S. forces, and other security forces globally. Careful attention must be paid to identify and evaluate these nontraditional ranges to protect against lead exposures. Ideally, military occupational health professionals should have the opportunity to review and provide comments on plans for proposed firing ranges.

The effects of lead are well-known.[21] Clinical symptoms were not observed in the exposed SOF Soldiers. However, the clinical surveillance conducted was probably not sensitive enough to detect subtle findings. Of particular interest in this group are the neurocognitive effects of lead exposure.[22] Military forces could experience subtle effects that could have a detrimental effect on their fighting ability and chances for survival, such as delayed trigger squeeze or other reaction time.[23]

Several limitations were encountered. There were significant limitations to the amount of testing, investigation, and control measures that could be implemented. Frequent deployments led to difficulties in both exposure assessment and surveillance. The risk of firing range lead exposure in this group had to be weighed against the need for intense, realistic training. Other exposures might have confounded the association we observed, particularly since it is not known what activities unit personnel were engaged in before biomonitoring occurred. Temporary duties for official travel, such as sniper school, are common among SOF personnel and may be associated with lead exposures. Deployments in a war zone are also associated with many possible sources of lead exposure. Additionally, SOF Soldiers may have had hobbies or other nonoccupational sources of exposure, including recreational firing, which were not identified by investigators. Early in this investigation, in 2000, detailed interviews revealed no potential sources of lead exposure outside of military firing ranges. However, as the investigation progressed, comprehensive interviews with the SOF Soldiers were difficult to obtain. Despite the limitations described, the high airborne lead levels measured at the firing ranges, the high blood lead levels in Soldiers using these ranges extensively, and the declining blood lead levels observed with interventions support a cause-and-effect association. A small number of unit personnel (20) also responded to a more detailed history questionnaire attempting to quantify exposure. This subsample supported a dose-response relationship between hours of exposure at the firing ranges within the preceding 30 days and blood lead level.

The generalizability of our findings is unknown. Very few occupational exposures among SOF personnel have been examined, and it is unclear whether the firing range exposures we observed are unique, even within the SOF community. Due to the general similarity of construction designs among military training ranges, including MOUT sites, it is unlikely that we observed unique exposures.

Risks to SOF Soldiers from firing ranges similar to the ones we studied should be regularly assessed. With the increase in MOUT and other urban training and operations in the military due to the changing nature of the Global War on Terror, these exposures are expected to increase in non-SOF (conventional) and some civilian law enforcement and security forces as well.[24] Urban warfare training sites are a source of high exposure due to poor ventilation and infrequent decontamination. Because personal protective equipment and administrative controls are likely to be rejected by the SOF community, extremely high emphasis must be placed on preconstruction design review, achieving adequate ventilation systems and environmental hygiene to reduce lead dust, to include frequent bullet trap sand replacement and personal hygiene. Persistence by military occupational health professionals in identifying, and eliminating or controlling, exposures will be required, while at the same time respecting the need for realistic training. Greater emphasis should be placed on lead exposures in the SOF community, as well as others with extreme use of MOUT or other high-risk training sites. This includes implementation of an entrance blood lead and zinc protoporphyrin levels for all SOF forces, as well as periodic routine surveillance. Periodic testing would be most practicable in conjunction with human immunodeficiency virus serum draws for those indicated due to exposure.

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Go Pills in Combat Prejudice, Propriety, and Practicality

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Abstract

The military's use of medications for operational reasons has traditionally garnered substantial, often negative, attention from the popular news media — and sometimes from the scientific community as well. However, the author details how clear guidelines on the use of stimulants (and, by inference, other counterfatigue medications) in operational contexts optimize the safety, performance, and general well-being of U.S. military combat-aviation personnel while preserving their rights to make informed decisions about their own lives.

The military's use of medications for operational reasons has traditionally garnered substantial attention from the popular news media and sometimes from the scientific community as well. Unfortunately, this attention often is decidedly negative. For instance, although we now accept the appropriateness of vaccinating U.S. forces against germ warfare, in 1998, Secretary of Defense William Cohen's mandate that all personnel receive anthrax vaccinations prompted numerous congressional hearings and legal disputes. Meanwhile, the media reported that significant numbers of personnel were "leaving the armed forces because they did not want to be vaccinated."[1] The use of the nerve-agent pretreatment pyridostigmine created a similar controversy following the Persian Gulf conflict of 1991 because of the medication's wide use for what is generally referred to as an "off-label" indication.[2] Although a later ruling permitted its appropriate administration following either presidential orders or individual informed consent, questions continued with regard to the safety and wisdom of policies concerning this prophylactic intervention.[3] More recently, the military's use of dextroamphetamine to sustain the performance of sleep-deprived pilots created concern after two pilots blamed a friendly-fire incident in 2002 on their use of this medication.[4] Despite the fact that an Air Force investigation ultimately failed to implicate dextroamphetamine as a contributor to this unfortunate event, the general public knew nothing of this fact; thus, many people continue to question the military's use of dextroamphetamine and other performance-sustaining pharmacological compounds.

Incidents such as these contribute to ongoing debates about the ethics of using medications to protect or sustain (or augment) our military personnel. These debates are particularly pointed with regard to the military's use of counterfatigue medications—especially stimulants such as amphetamines. In fact, the issue of the appropriateness of using counterfatigue drugs to augment combat safety and performance has again become a topic of considerable discussion.[5] Some North Atlantic Treaty Organization members consider the U.S. military's use of prescription stimulants such as amphetamines unethical, and this stance on the ethical ramifications of "performance-enhancing drugs" may be largely responsible for the fact that the United States currently is the only major world power authorizing the operational use of amphetamines and some other counterfatigue medications.[6]

As a research scientist who has conducted numerous studies on the operational utility of prescription stimulants in U.S. aircrews, I find it difficult to understand why some people raise the question of *ethics* regarding the uses of these compounds.[7] The military's use of "cognitive performance enhancers" is ethical as long as (1) the decision to use a performance-enhancing/sustaining medication rests freely with the individual; (2) the use of the drug is safe within the context in which it is used; (3) the manner of the substance's use remains consistent with its dosage and pharmacological function; and (4) in general, the military employs medication options only after exhausting nonpharmacological alternatives.[8]

On these grounds, one might ask why anyone would consider physicians wrong to prescribe amphetamines (or other stimulants) to perfectly healthy, nonmilitary people so that they can get by with less sleep for the sake of working (or playing) longer hours. A close examination shows that such a prescription would meet the first criterion and possibly the third, listed above, but prescribing stimulants to healthy civilian workers violates the second and fourth criteria. Failure to meet the second criterion stems from the fact that, unlike military-aviation personnel closely monitored by medical personnel, civilians walk out of the physician's office (or the pharmacy) with a multiday supply of the drug, able to use it in the absence of close medical supervision. This is potentially unsafe, especially considering amphetamine's potential for abuse and, in this case, the fact that patients are free to modify the prescribed dosage in any number of ways (some of them possibly dangerous). Failure to meet the fourth criterion stems from the physician's not having exhausted the nonpharmacological alternatives. Unlike military pilots who use the stimulant medication to perform a potentially life-saving mission that they probably could not do effectively without the aid of the drug, civilian patients (who in this example do not suffer from some type of alertness *disorder*) really have the choice of remaining awake for a shorter period and choosing to sleep sufficiently rather than electing to take a drug in order to prolong wakefulness. Little downside accompanies this choice (to sleep) because although civilian patients won't be able to work or play longer than normal without the stimulant, they are unlikely to suffer harm as a result. Thus, offering stimulants to healthy civilians for everyday use clearly presents a less favorable risk/benefit ratio and a less favorable ethical stance than prescribing them for military pilots, who have little choice except to engage in sustained combat operations.

Do morality issues attach to the military's use of "cognitive-enhancing agents"? That is a difficult question to answer since different people define morality in various ways. For some, ethical actions are also moral; for others, morality refers to the concept of absolute "rightness" or "wrongness;" and still others define morality contextually. That is, if the ultimate outcome is "good," with no intent to harm another innocent human being, violate an innocent person's rights, or cheat people of their rightful possessions, then the actions are moral:[9] The U.S. military's use of performance-enhancing medications seems "moral" because it utilizes them to meet specific objectives upon which we as a nation presumably agree — and to do so in a way that improves the survivability of our personnel under less-than-optimal circumstances. We do not *force* our personnel to ingest stimulant medications against their will; neither do we force our enemies to ingest them. Rather, we offer the medications, which have been proven "safe," in order to protect the well-being of our military personnel.[10] For all practical purposes, we as a nation have essentially agreed that this type of medical intervention is acceptable to achieve desired tactical outcomes (extant policies authorize such use). Yes, these medications may contribute to our ability to harm our enemies, but we already use a variety of other strategies (technological, behavioral, etc.) for this purpose. The fact that cognitive enhancers provide a tactical advantage over our enemies is not considered cheating any more than the fact that our use of superior night-vision technology offers a tactical advantage. Also, I should note that in strict terms of fairness, we publish information on our use of or intent to use pharmaceutical performance enhancers in the open scientific literature, which our enemies are free to read and take advantage of. Thus, in my opinion, our use of these medications is both moral and ethical.

However, since the use of pharmacological compounds is a medical and/or behavioral-sciences issue and since published standards outline the principles of ethical actions in both of these fields, let us rely on these standards to address the appropriateness of using the medications that are the subject of this article. I first present a brief overview of the basic ethical principles that guide the behavior of physicians and psychologists. Then I discuss as a primary example the military's use of dextroamphetamine as a safe and effective fatigue countermeasure for combat-aviation operations, explaining why our current stance on the use of this medication — and, by inference, other counterfatigue (or performance-enhancing) drugs — does not pose an ethical dilemma for the U.S. military.

Basic Ethical Principles

General ethical principles are designed to inspire individuals to act in accord with the highest standards and ideals of their respective professions. Caring for others, inspiring trust, behaving honestly, treating people fairly, and respecting the essential worth of human life are core characteristics of ethical thoughts and actions. Ethical professionals strive to benefit those with whom they work and to minimize the possibility of doing harm. They are trustworthy and mindful of their responsibilities to others. They are truthful, accurate, and honest. These individuals take care to justly distribute their contributions among those for whom they are responsible. And, they respect the rights of every individual to privacy, general well-being, and self-determination. In summary, ethical professionals make every effort to treat others with the same fairness, dignity, and respect they would hope to receive themselves.[11] Given the basic tenets of ethical behavior outlined above, let us examine the military's use of dextroamphetamine as an example and determine whether guidance governing the use of this compound is ethically appropriate.

History of the Dextroamphetamine Policy

Fatigue from sleep loss and body-clock disruptions is a widespread problem in military operations, particularly in recent high-tempo actions associated with the Global War on Terror.[12] Such around-the-clock operations, rapid time-zone transitions, and uncomfortable sleep environments are common on the battlefield; unfortunately, these conditions prevent personnel from obtaining the eight solid hours of sleep required for optimum day-to-day functioning. Sleep in the operational environment often is fragmented for weeks at a time and sometimes totally nonexistent for days at a stretch.[13] Needless to say, such sleep deprivation rapidly degrades reaction time, alertness, attention, and mood, leading to seriously impaired safety and performance.[14] Generally speaking, every 24 hours of sleep deprivation produces a 25 percent reduction in operational performance, with higher-level cognition the most severely compromised of all capabilities.[15] Thus, unsurprisingly, *we have determined that fatigue exacts significant social, financial, and human costs and that it has been implicated as a causative or contributing factor in numerous military-aviation mishaps*.[16]

In an effort to counter fatigue-induced performance decrements, the military has invested substantially in what is often termed alertness-management research. This research resulted in an array of strategies, including duty-time limitations, behavioral countermeasures, napping interventions, and drug-based remedies designed either to enhance available sleep opportunities or to sustain performance despite sleep deprivation. The strategy of periodically using dextroamphetamine was one product of this research thrust, and I will use the procedures governing dextroamphetamine therapy as the primary example in this article.

Amphetamines became available for prescription in 1937, and by the time of World War II, the German, Japanese, and British militaries used them to enhance performance on the battlefield. Although some reports indicate that U.S. forces used the drug during the Korean conflict, the U.S. Air Force did not officially sanction the use of dextroamphetamine for performance sustainment until 1960.[17] Subsequently, widespread use of amphetamines by military aircrews probably first occurred during the Vietnam conflict. The policies concerning stimulants evolved into Air Force Regulation 161-33, Tactical Air Command Supplement 1, *The Aerospace Medicine Program*, 1 January 1984, which sanctioned the use of amphetamines by single-seat pilots in particular due to their susceptibility to boredom and fatigue during deployments and extended combat air patrols. In 1996 Air Force leadership rescinded the long-standing approval to use amphetamines in aviation operations.

The Air Force suspended amphetamine authorization even though the use of dextroamphetamine evidently played no part in mishaps during Operation Desert Storm. (Fatigue contributed to a number of them, however.) Furthermore, one survey collected during Desert Storm noted the value of amphetamines for maintaining alertness in flight operations, and one squadron commander described the availability of the medication as a "safety of flight" issue.[18] These results, coupled with data from four placebo-controlled aviation studies conducted between 1995 and 2000 led, in part, to the reintroduction of approval to utilize dextroamphetamine in select combat Air Force operations in 2001.[19]

The Real Issues at the Heart of the Current Stimulant Policy

All three U.S. military services currently approve dextroamphetamine for the sustainment of combat-pilot performance under particularly fatiguing circumstances. When considering the ethical implications of using this prescription medication for maintaining the alertness of sleep-deprived but otherwise normal personnel, one must first consider a couple of points.

First, detractors of the current stimulant policy often describe the choice of whether or not to use stimulants as one between having well-rested pilots fly their missions drug free versus having sleep-deprived pilots fly their missions on drugs. However, as I have already noted, military operations often inevitably entail unavoidably high levels of fatigue. Thus, in actuality, the *real* choice lies between having sleep-deprived pilots fly the mission with the aid of proven, alertness-enhancing drugs versus having them fly the mission while struggling to stay awake on their own. Further, research has shown quite clearly that attempting to self-sustain wakefulness in the presence of substantial sleep pressure (fatigue) is a losing proposition.

Second, detractors often like to draw comparisons between civil-aviation operations, which do not allow stimulants, to military-aviation operations, which do permit them. They ask why the military allows these drugs when the civilian world does not. In answering this question, one should clearly understand that the two situations are not comparable.

One major difference is that combat-aviation missions are presumably significantly more stressful than commercial air-transportation operations. For instance, although airline-transport pilots no doubt experience stress from their responsibility for the safety of up to 400 passengers, they are rarely targets of enemy aggression. Combat pilots, however, routinely perform their duties under imminent and palpable threats to their own safety and, in fact, their very lives. Additionally, military aircrews routinely find themselves subjected to the most arduous and continuous flight schedules — sometimes requiring numerous, successive missions despite the absence of adequate crew rest — in order to sustain the operational tempo, whereas stringent crew-rest and duty requirements specified in Federal Aviation Administration regulations protect commercial crews from such circumstances.

Another major difference is that the consequences of cancelling a commercial flight differ markedly from those associated with calling off a military flight. If a fatigued airline pilot declines a flight due to concerns over his or her impaired performance capabilities, the airline may not like the decision, but, clearly, it jeopardizes no one's safety. Instead, the airline will replace the fatigued pilot with a rested standby pilot, who will complete the scheduled flight. Every major commercial air carrier has clear contingencies for such events. However, in a military context, already severely limited by the number of available pilots, an aviator's decision to decline a mission will probably result in delaying or simply not flying it. Like the airline passengers mentioned previously, those scheduled to fly aboard the affected aircraft likely will be safer, but what about the soldiers awaiting medical evacuation from the field? What about the units awaiting resupply of ammunition, food, and water? And what about the people threatened by enemy fire? What about their safety after cancellation or delay of a scheduled military mission?

When considering the military's position on stimulant use, one must remember (1) that combat is not a sporting event but an unpredictable, life-threatening, stressful, and fatiguing endeavor calling for the employment of every reasonable aid to success, and (2) that in order to protect and defend the lives of our friends and allies, U.S. military pilots must think far beyond the most immediate ramifications of their decisions regarding mission acceptance and completion. It is within this context that we must consider the ethics of stimulant use (as well as the use of other performance-enhancing medications).

Current Guidelines for Amphetamine Use in Air Operations

Much careful forethought went into the U.S. military's current dextroamphetamine policy, with the aim of protecting individual war fighters — primarily aviators — and of fulfilling our military objectives.[20] Moreover, as I will show (primarily by citing Air Force policies/procedures as an example), guidance ensures that we can achieve these aims without compromising professional ethical principles. The following tenets assure the appropriate use of dextroamphetamine:[21]

1. Clear guidelines dictate the circumstances under which one can utilize dextroamphetamine in operational contexts; they also extend its use to exceptional circumstances. These guidelines specify mission durations and drug dosages.

2. Prior to using dextroamphetamine, each pilot must read and sign a detailed informed-consent agreement to ensure sufficient knowledge about both the positive and potentially negative effects of the medication. Failure to obtain documented informed consent precludes the operational use of the drug for that individual.

3. The population authorized to utilize stimulant medication (military aviators) is by nature young, healthy, and likely free of any medical complications that would contraindicate the use of dextroamphetamine. Military pilots must routinely undergo recurrent physical examinations in order to document the necessary good health required to remain on flight status.

4. In addition, since individual responses to any type of medication are difficult to predict even in the healthiest population, the military requires a documented predeployment ground test, conducted under the supervision of a military physician, to guard against problematic idiosyncratic reactions.

5. In the operational environment, qualified medical personnel control the supplies of dextroamphetamine, dispensing it in appropriate amounts when needed and documenting its use in carefully maintained records. These personnel collect unused medications upon mission completion and secure them as appropriate.

6. The ultimate decision regarding whether or not to use dextroamphetamine during an operational mission always rests with the individual aircrew member. No one is ever required to ingest a stimulant.

7. Medical personnel authorize the use of dextroamphetamine as a fatigue counter-measure only after exhausting every other nonpharmacological option. The military never turns to drugs as the first solution to a fatigue problem in the field and does not consider them a substitute for planning adequate crew work/rest.

8. Ultimately, with all options on the table, leadership, in collaboration with appropriate medical personnel, carefully considers the option of using stimulant medications in terms of the criticality of the mission, the potential for known hazards, and the ultimate safety of affected personnel.

Does this list of safeguards optimize the ethical use of dextroamphetamine (and, potentially, other medications) in operational aviation contexts? By following these guidelines, we mitigate the known dangers of fatigue with a scientifically proven method validated by laboratory studies and field testing. Every individual receives a predeployment test dose to guard against idiosyncratic side-effects. Therefore, we achieve the ethical principle of "doing no harm." The decision to utilize the medication in support of an operational objective is made jointly by the leadership, the physician, and the individual warfighter to ensure that operational concerns do not override the safety and health of crew members. Thus, the medical community demonstrates trustworthiness and responsibility towards our military personnel. Prior to administering the medication (or making it available) to individuals, medical personnel obtain documented informed-consent agreement, the information contained therein based on currently available scientific knowledge about the positive and negative effects of dextroamphetamine. Thus, this process conveys truthful, accurate, and honest information to personnel. Upon authorization of dextroamphetamine, aviators throughout the affected unit have access to the drug, making the benefits of this fatigue countermeasure equally and justly available to everyone in the group. Finally, no individual aviator is ever *required* to use dextroamphetamine, and, most often, when the time to decide comes, the individual crew member does so privately, in light of his or her perceived needs during the actual flight mission (when neither the flight surgeon nor the unit commander is present). Thus, the policy essentially respects the principle concerning privacy, general well-being, and self-determination.[22]

Conclusions

The U.S. military has the responsibility of balancing operational objectives and individual rights while protecting the health of the force. By its very nature, achieving this balance can prove challenging, particularly during stressful and fatiguing combat operations. However, the military has dedicated a substantial amount of work to the development and implementation of comprehensive fatigue-management programs that employ administrative, behavioral, *and* pharmacological strategies. When all else fails, the medication option offers an important counterfatigue intervention, but in today's "just say no to drugs" climate, pharmacological treatments often seem to create an opportunity for spirited debate. However, with regard to the use of medication for performance sustainment, the military has developed a conservative approach designed to meet organizational objectives without compromising individual autonomy or well-being. As I have shown in this article, clear guidelines on the use of stimulants (and, by inference, other counterfatigue medications) in operational contexts optimize the safety, performance, and general well-being of the U.S. military's combat-aviation personnel while preserving their right to make informed decisions about their own lives. Recent survey data suggest that the current policy is working and that there is little perceived pressure to use stimulants if individuals have personal misgivings about doing so.[23] This finding, in combination with the fact that untreated fatigue has cost numerous lives throughout the years but that stimulants have *never* been implicated in a single Air Force mishap, makes a strong argument for the ethics of continuing to employ counterfatigue medications.

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Physical Fitness Influences Stress Reactions to Extreme Military Training

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Abstract

Background: Physical fitness and physical conditioning have long been valued by the military for their roles in enhancing mission-specific performance and reducing risk of injury in the warfighter. It is not known whether physical fitness plays a causal role in attenuating acute military stress reactions or the evolution of post-traumatic stress disorder. **Objective:** The objective of this study was to determine whether physical fitness influences the impact of stressful events during military survival training in 31 men. **Methods:** Participants self-reported their most recent Physical Readiness Test scores and completed a trait anxiety measure before survival training. Participants also completed the Impact of Events Scale (lES) 24 hours after training. **Results:** Aerobic fitness was inversely associated with the total IES score ($p < 0.01$, adjusted R^ = 0.19). When adjusted for trait anxiety, this relationship was substantially attenuated and no longer significant ($p = 0.11$). Trait anxiety was inversely associated with aerobic fitness ($p < 0.05$) and positively related to IES ($p < 0.001$). **Conclusions:** Physical fitness may buffer stress symptoms secondary to extreme military stress and its effects may be mediated via fitness-related attenuations in trait anxiety.

Introduction

Post-traumatic stress disorder (PTSD) is an important public health and military problem, since PTSD symptoms are thought to occur in as many as 15 to 20% of individuals exposed to combat.[1] However, the temporal course of PTSD development is difficult to quantify in an experimental setting. One important early marker of PTSD evolution in individuals exposed to extreme conditions concerns the impact of stressful events, including avoidance (avoiding situations that remind one of a previously experienced traumatic event), intrusion (experiencing intrusive or disturbing thoughts as a result of the event), and heightened arousal (experiencing anger, irritability, heightened startle response, and hypervigilance as a result of the event).[2,3]

There is a sustained interest in understanding characteristics that may serve as buffers against (or vulnerabilities for) acute stress reactions and subsequent PTSD development.[4-6] One such factor has been termed resilience[6,7] or psychological hardiness.[5] These constructs are generally understood as an ability to "bounce back" from stressful or traumatic events. Research has shown that psychological hardiness buffers the effects of work-related stress in healthcare workers,[8] athletes,[9] casualty assistance workers,[10] and Persian Gulf War Soldiers.[5] Other factors that may influence stress reactions and PTSD development include depression, anxiety,[11,12] social support,[13] and intelligence.[12] Furthermore, proposed neurochemical, neuropeptide, and hormonal predictors include neuropeptide Y,[14] cortisol, dehydroepiandrosterone,[15] dopamine, and benzodiazepine receptors.[6] Finally, several neural mechanisms of reward and motivation (e.g., hedonia, optimism) and adaptive social behavior (e.g., altruism, teamwork) have also been suggested to serve protective roles.[6]

Physical fitness and physical conditioning have long been valued by the military for their roles in enhancing mission specific performance and reducing risk of injury in the warfighter. It is not known whether physical fitness plays a causal role in attenuating acute military stress reactions or the evolution of PTSD. However, there is substantial literature documenting possible buffering effects of physical activity, exercise, and/or physical fitness with respect to stress reactivity,[16,17] state and trait anxiety [18,19] and depression,[20,21] as well as positive links to neurogenesis[22,24] and cognitive function across a wide variety of populafions.[24] In light of this literature, it is plausible that physical fitness may influence stress reactions to intense military training.

The purpose of this study was to examine whether physical fitness influences the impact of stressful events during military survival training. We hypothesized that physical fitness would buffer these stress reactions, and that this observed effect would be mediated through attenuations in trait anxiety.

Methods

The present study was part of a larger ongoing program of research examining individual differences in human performance and stress resilience in extreme military environments. The study was approved by the Institutional Review Board at the Naval Health Research Center (San Diego, California). Before participation, all prospective participants were informed of their rights as human subjects and each gave written, informed consent to participate.

Thirty-one male participants completed measures of physical fitness and trait anxiety ~3 weeks before participating in Survival, Evasion, Resistance, and Escape (SERE) training in the San Diego area. SERE training and our associated program of research have been described in detail elsewhere.[25] Briefly, U.S. military members at high risk of capture are required to attend SERE training, which includes a period of confinement in a Resistance Training Laboratory (RTL). After an initial phase of classroom-based didactic training, students are taken to the field where they receive applied training in survival, evasion, resistance, and escape techniques. Students are then released into the field and tasked with the goal of evading enemy captors. Upon eventual capture, students are taken to the RTL where they are expected to apply their recently learned skills of resistance to political indoctrination and captivity-related challenges. The structured, choreographed nature of this training platform provides a unique and unprecedented medium in which to examine human stress and performance in a realistic military context. Moreover, since a component of SERE training is designed to simulate the prisoner-of-war experience, it offers a unique medium in which to study the effects of mock captivity stress on many aspects of human functioning. Twenty-four hours after the conclusion of SERE training (i.e., release from RTL), participants completed the Impact of Events Scale-Revised (IES-R).[3]

Physical Fitness

Prior to SERE training, participants reported the results of their most recent Physical Readiness Test (PRT). Military personnel are required to maintain a standard level of physical fitness by scoring satisfactorily on the PRT, which is administered semiannually. The time required to complete a 1.5-mile run on a standardized course as part of the PRT was used as a measure of aerobic fitness (lower values indicate higher fitness). The maximum numbers of sit-ups and pushups performed in 2 minutes were used as measures of core fitness and upper body fitness, respectively. Self-reported physical fitness test scores have been shown to correlate highly with objectively recorded scores. Specifically, Jones et al.[26] found self-reported push-ups, sit-ups, and run time during an Army physical fitness test to be correlated to objectively recorded scores at 0.83, 0.71, and 0.85, respectively.

Trait Anxiety

Prior to SERE training, self-report of anxiety was assessed with the trait portion of the Spielberger State-Trait Anxiety Inventory. The 20-item trait anxiety inventory asks respondents to describe how they generally feel, using a 4-point Likert-type scale (almost never, sometimes, often, almost always). Examples of items include "I feel pleasant," "I worry too much about something that does not matter," and "I make decisions easily." The trait anxiety inventory is scored by reverse coding each positive item and then summing across all items. Scores range from 20 to 80, with lower scores indicating less anxiety and higher scores indicating a greater level of anxiety. The scale is widely used, and its reliability and validity has been established in several different populations.[27,28] Internal reliability of the trait anxiety scale in the current study was acceptable (Cronbach's a = 0.77).

Impact of Events Scale-Revised

The IES-R was administered 24 hours after the conclusion of SERE training. This self-report measure is designed to assess current subjective distress for any specific life event. The IES-R has 22 items, comprising three subscales corresponding to the Diagnostic and Statistical Manual of Mental Disorders-Fourth Edition[29]-specified PTSD symptoms: avoidance (IES-avoidance; mean of eight items measuring the extent to which the respondent avoids situations that remind him or her of the stressful or traumatic event), intrusion (IES-intrusion; mean of eight items assessing the extent to which one experiences intrusive thoughts), and hyperarousal (IES-arousal; mean of six items measuring anger, irritability, heightened startle response, and hypervigilance). A total IES score (IES-total) is composed of the sum of the three subscales. With this scale, respondents are shown a list of difficulties people sometimes have after stressful life events and are asked to indicate how distressing each difficulty has been with respect to a stressful captivity-related problem on a scale of 0 (not at all) to 4 (extremely). Adequate reliability and predictive validity have been shown for this scale[30,31] and Cronbach a reliabilities in the present sample were 0.73, 0.79, and 0.70 for IES-arousal, IES-avoidance, and IES-intrusion, respectively. Cronbach a reliability for IES-total was 0.89.

Data Analysis

Preliminary analysis incorporated the use of normal probability and residual plots to assess compliance with the assumption of linear regression and screen for the presence of influential outlying data values. These plots revealed that the normal distribution was an appropriate assumption. Means (and SDs) and percentages were used to describe continuous and discrete characteristics, respectively. Linear regression was used to examine predictors of stressful events during SERE training. Pearson correlation coefficients compared the relative strength of these associations.

To assess confounding and the mediating influence of trait anxiety on the relation of aerobic fitness with the impact of stressful events during SERE training, we examined the change in the **ß** coefficient for run time (aerobic fitness) when each factor was added individually to a base model including only run time. SPSS Statistical Software System, version 15 (SPSS Inc., Chicago, Illinois) was used to perform all analyses. All tests of hypotheses were two-sided and based on a type I error rate of 0.05.

Results

Characteristics of the Sample

Detailed sample characteristics are presented in Table I. Mean age, body mass index (BMI), and years of military service for this sample were 21.7 years (SD = 2.2), 24.2 kg/m^ (SD = 1.6), and 1.8 years (SD = 0.9), respectively. Highest level of education reached was high school for most subjects (77.4%) and 22.6% were college educated. Most subjects were Caucasian (87.1%). Regarding military occupational specialty, 80.6% were students under instruction to become aviation warfare specialists/rescue swimmers, while the remaining 19.4% were students undergoing advanced instruction to become special warfare (SEAL) officers. Mean trait anxiety scores in the present sample were slightly lower than those found in a normative college-aged population.[27]

TABLE I. Characteristics of Military Men Ages 19 to 30 Years *(N = 31)*

Characteristic	Mean (SD)
Age (years)	21.7(2.2)
Height (cm)	179.6(7.1)
Weight (kg)	78.2 (7.3)
Body mass index (kg/m')	24.2(1.6)
Years of military service	1.8(0.9)
Push-ups (repetitions) "	88.8(13.2)
Sit-ups (repetitions) "	99.1 (12.9)
Run time (min) "	9.6 (0.8)
IES-arousal	0.9 (0.7)
IES-avoidance	0.8 (0.6)
IES-intrusion	1.1 (0.5)
IES-total	2.8(1.6)
Trait anxiety	30.2 (5.2)
Education, (%)	
High school graduate	77.4
College graduate	22.6
Military occupational specialty, (%)	
Special warfare (SEAL) student	19.4
Aviation warfare student	80.6

± Maximum number of push-ups and sit-ups completed during 2-minute sessions; number of minutes to run 1.5 miles.

Predictors of Stressful Events during Survival Training

Univariate predictors of the impact of stressful events are indicated in Table 11. Age and BMI were not associated with IES-total. Years of military service demonstrated a non-significant inverse relationship with IES-total *(p* = 0.08), although years of military service was fairly restricted in range (mean =1.80, SD = 0.87, range = 4). Trait anxiety was positively associated with IES-total *(p* = 0.001). SEAL students demonstrated a notably lower IES-total than aviation warfare students (1.90 [SD = 1.70] versus 3.00 [SD = 1.53]) although these differences did not reach statistical significance *(p* = 0.18). Similarly, there was a trend for differences between participants with a high school (mean = 3.05, SD = 1.53) versus a college education (mean = 1.82, SD = 1.53) *(p* = 0.07).

TABLE II. Univariate Predictors of the Impact of Stressful Events during Military Survival Training in Men Ages 19 to 30 Years *(N = 31)*

Variables	Impact of Stressful Events-Total			
	ß	**SE**	***r***	***P***
Age (years)	-0.042	0.132	-0.06	0.8
Body mass index (kg/m^2)	0.077	0.179	0.08	0.7
Years of military service	-0.587	0.318	-0.32	0.08
Trait anxiety	0.173	0.047	0.56	0.001

Relationships between Physical Fitness and Impact of Stressful Events

Univariate relationships of measures of physical fitness with the impact of stressful events during survival training are shown in Table III. As indicated, upper body fitness as measured by number of push-ups performed in 2 minutes was inversely associated with IES-avoidance *(p* = 0.02) and IES-total *(p* = 0.05). Core fitness as indicated by number of sit-ups performed in 2 minutes was inversely associated with IES-arousal *(p* = 0.04) as well as IES-total *(p* = 0.04). Aerobic fitness as indicated by number of minutes to run 1.5 miles (higher times indicating lower fitness) was inversely associated with IES-arousal *(p* = 0.007), IES-avoidance *(p* =0.02), IES-intrusion *(p* = 0.05), and IES-total *(p* = 0.008).

Assessment of Mediating Role of Anxiety

Due to its robust relationship to impact of stressful events as well as substantial relationships with core *(p* = 0.07) and upper body fitness *(p* = 0.001), aerobic fitness was selected as the physical fitness variable with which to investigate possible confounding as well as the mediating influence of trait anxiety. An examination of models assessing these relationships is demonstrated in Table IV. Whereas aerobic fitness was significantly associated with IES-total in the regression model ($p = 0.008$), this relationship was not appreciably altered when adjusted for age, BMI, years of military service, education, or military occupational specialty. When adjusted for trait anxiety, however, this relationship was substantially attenuated and no longer significant (ß = 0.544, p = 0.10).

Discussion

The present study was initiated to determine whether physical fitness influences the impact of events occurring during a stressful mock captivity phase of military survival training. We demonstrated that aerobic fitness was inversely associated with the impact of stressful events, and that this relationship may be mediated via fitness-related attenuations in trait anxiety.

To the best of our knowledge, this is the first study to link measures of physical fitness to acute military stress reactions, although the military has long valued physical fitness as a means of enhancing hardiness in the warfighter. Previous research has demonstrated convincing links between physical fitness and aspects of mental health in both clinical and healthy populations. As noted earlier, there is substantial literature documenting beneficial effects of physical activity, exercise, and/or fitness relative to stress reactivity,[16,17] anxiety,[18,19] depression,[20,21] as well as neurogenesis,[22-24] and cognitive function.[24] Georgiades et al.,[17] for example, studied the effects of exercise and weight loss on mental stress-induced cardiovascular responses in individuals with high blood pressure. After 6 months, participants in an exercise group and participants in a behavioral weight loss group (including exercise) had lower levels of systolic blood pressure, diastolic blood pressure, total peripheral resistance, and heart rate both at rest and during mental stress, compared with inactive controls.

In another randomized trial, Blumenthal et al.[20] showed that 16 weeks of exercise treatment was as effective as antidepressant medication in reducing depression among patients with major depressive disorder. In a recent animal study, Pereira et al.[22] showed that exercise had a direct impact on dentate gyrus cerebral blood volume, a hippocampal subregion known to support neurogenesis, in mice. These researchers then showed similar effects in humans and that these changes were correlated to cardiopulmonary and cognition function. Given the relationship of the hippocampus to memory and stress,[32,33] this offers mechanistic insight into the possible link between exercise training, concomitant improvements in physical fitness, and stress resilience.

As an extension of these and related findings, Tsatsoulis et al.[34] proposed that, since the stress response is a neuroendocrine mechanism that occurs in anticipation of physical action, physical activity should be the natural means to prevent the consequences of stress (i.e., strain). These authors offer additional mechanistic possibilities, including peripheral actions influencing metabolism such as insulin sensitivity and the partitioning of fuels toward oxidation rather than storage. The extent to which these metabolic processes are causally implicated in stress resilience awaits further research.

Limitations of this study should be addressed. We used a less-than-optimal measure of physical fitness — self-reported scores from a recent PRT. This, of course, is less desirable than "gold standard" measures such as peak volume of oxygen uptake (VO2) using metabolic technology. However,

TABLE III. Univariate Relation of Physical Fitness Measures to the Impact of Stressful Events during Military Survival Training in Men Ages 19 to 30 years *(N = 31)*

	Impact of Stressful Events															
	Arousal				Avoidance				Intrusion				Total			
Variables'	**ß**	**SE**	**r**	**P**	**ß**	**SE**	**r**	**P**	**ß**	**SE**	**r**	**P**	**ß**	**SE**	**r**	**P**
Push-ups (repetitions)	-0.12	0.009	-0.24	0.2	-0.017	0.007	-0.41	0.02	-0.013	0.007	-0.33	0.1	-0.043	0.021	-0.36	0.05
Sit-ups (repetitions)	-0.02	0.009	-0.38	0.04	-0.013	0.008	-0.3	0.1	-0.013	0.007	-0.3	0.1	-0.046	0.021	-0.37	0.04
Run time (minutes)	0.392	0.137	0.47	0.007	0.286	0.117	0.41	0.02	0.24	0.117	0.36	0.05	0.922	0.323	0.47	0.008

TABLE IV. Various Models Assessing the Relation between Aerobic Fitness and the Impact of Stressful Events during Military Survival Training (*N = 31*)

	Impact of Stressful Events-Total		
Models†	***ß***	**SE**	***P***
Run time (minutes)	0.922	0.323	0.008
Run time (minutes) + age	0.918	0.330	0.009
Run time (minutes) + body mass index	0.957	0.327	0.007
Run time (minutes) + years of military service	0.961	0.302	0.004
Run time (minutes) + education	0.881	0.440	0.05
Run time (minutes) + military occupational specialty	0.955	0.422	0.03
Run time (minutes) + trait anxiety	0.544	0.326	0.1

† See Table I footnote and "Methods" for a description of these variables.

the fact that we observed robust relationships between aerobic fitness and military stress reactions despite its crude measurement justifies additional research with more sophisticated tools.

There are two important strengths of the current study. First, our findings regarding the link between physical fitness and military stress reactions is novel and may open the door to a new line of inquiry that may improve our understanding of prevention and treatment for combat stress and PTSD. Second, this study was conducted within the survival training environment, offering an unprecedented level of ecological validity. Specifically, SERE training is a standardized and systematic, yet realistic and intense, course of training modeled after the experiences of American prisoners of war from the Korean and Vietnam conflicts. Short of actual military combat, it is among the best forums in which to examine human reactions to acute military stress in a controlled fashion.

More research is needed to better understand the possible relationships between physical fitness and acute military stress reactions, including both resilience and vulnerability factors. Wherever possible, future research should employ more sophisticated measures of aerobic (e.g., peak VO2 uptake) and muscular fitness (e.g., percentage of 1 repetition maximum or 10 repetition maximum). More research is also needed to test our proposed mediating role of trait anxiety in the physical fitness-stress reaction relationship as well as other possible mediating factors. Furthermore, it would be of interest to examine the relationship of physical fitness to other military stress endpoints, such as hormonal markers (e.g., cortisol), dissociative symptoms (i.e., how perceptually connected or disconnected an individual is relative to his or her environment), as well as cognitive function and overt performance. Also, it would be particularly valuable to prospectively examine the effects of exercise training and concomitant fitness changes on military stress reactions in a randomized, controlled setting.

In summary, we examined the influence of physical fitness on the impact of events occurring during a stressful mock captivity phase of military survival training. We demonstrated that aerobic fitness was inversely associated with the impact of stressful events, and that this relationship may be mediated via fitness-related attenuations in trait anxiety.

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Editorials

Editorial Comment on *Physical Fitness Influences Stress Reactions to Extreme Military Training* (Taylor, et al., 2008).

By LTC Craig A. Myatt and SOCM Glenn Mercer

The Taylor et al. (2008) article offers a modest effort in determining whether physical fitness plays a causal role in attenuating acute military stress reactions or the evolution of post-traumatic stress disorder (PTSD). Physical fitness training is a human performance factor that is doctrinally measured by the use of a military standard fitness test applied in each of the Services. Scientifically, physical fitness is measured physiologically.

Taylor et al. (2008) relied on self-reported physical fitness scores with no validation of the self-reporting. They employed none of the widely accepted measures of physical fitness in applied physiology, such as maximal oxygen consumption rate or peak volume of oxygen uptake (VO_2). They stated in their conclusions that they used a "less-than-optimal measure of physical fitness", but suggested that their efforts were warranted to gather data in a first-of-its-kind study to link measures of physical fitness to acute military stress reactions. Questions regarding the construct validity of the study surface upon review as do questions regarding the application of psychometric tests to measure psychological stress.

The use of the Trait Anxiety-scale from Spielberger's State-Trait Anxiety Inventory (STAI) was methodologically flawed. Why measure Trait Anxiety before the stressor (SERE training) and then use another psychometric instrument, the Impact of Event Scale-Revised, after the stressor? A stronger methodological approach would have included a repeated-measures design using the State-Anxiety Scale from Spielberger's STAI. The authors took a credible topic for research and gathered convenience data, data that was readily accessible, rather than generating data in a robust methodological fashion.

Military Hardiness as a Buffer of Psychological Health on Return from Deployment

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Introduction

The work environment can be the source of many stressors for individuals, contributing to high levels of strain that can negatively affect health. The military environment is a workplace with the full range of occupational stressors,[1] as well as additional stressors specific to the military environment.[2] The effects of these military occupational stressors on physical and psychological health have been previously identified.[3] Military occupational stressors associated with deployment may require military personnel to deploy away from the home environment for long periods of time and to be exposed to dangerous work environments. In their 1998 article, Bartone et al.[4] identified isolation, ambiguity, powerlessness, boredom, and danger as stressors specific to the deployed environment. Deployment-related stressors have also been shown to affect psychological and physical health both during deployment and after return to the home station.[4]

Research on the nature of the link between stressors and health over the past several decades has indicated that several factors moderate the effect of work stress on strain outcomes.[5] Several work-related variables have been identified as buffering the impact of stress on physical outcomes and psychological outcomes such as depression. Some of these work-related variables are job engagement,[6] job commitment,[7] perceptions of job control,[8] and social support at work.[9,10] Individual difference variables such as dispositional optimism, a generalized expectancy for positive outcomes, have also been associated with better psychosocial adjustment and less depression.[11]

Another individual difference variable that has been found to buffer the effects of stress is psychological hardiness. Psychological hardiness[12] is defined as a personality style or tendency, fairly stable over time, that is composed of the following interrelated components: (1) commitment (vs. alienation), referring to the ability to feel deeply involved in activities of life; (2) control (vs. powerlessness), the belief one can control or influence events of one's experience; and (3) challenge (vs. threat), the sense of anticipation of change as an exciting challenge to further development.

Since 1979, an extensive body of research has shown that hardiness buffers ill effects of work-related stress on health among a wide variety of occupations. For example, hardiness has been found to relate to work-related stress among middle managers,[13] healthcare workers,[14,15] and athletes,[16] among others. In addition, the concept of hardiness has been shown to influence outcomes among U.S. Army casualty assistance workers,[17] Gulf War soldiers,[18] peacekeeping soldiers,[19] Israeli soldiers in combat training,[20] and Israeli officer candidates.[21]

Military Hardiness: A Context-Specific Measure of Hardiness in the Military Workplace

Although hardiness has been found to moderate the effects of military occupational stressors, the conceptualization of hardiness is a relatively global psychological construct. In response to this global conceptualization, occupational health researchers have adapted the generic measure of psychological hardiness described by Kobasa[12] for use in specific stressor contexts. For example, Pollock and Duffy[22,23] developed the Health-Related Hardiness Scale, which redefines hardiness as a personality resource that enables individuals to adjust to, cope with, or even benefit from health problems. This scale measures (1) a sense of commitment to good health, along with the motivation and competence to cope effectively with a health-related stressor; (2) the perception of control over one's ability to appraise and interpret health stressors and to perform health behaviors; and (3) a sense of challenge regarding one's ability to manage one's health through reappraisal of health stressors as stimulating and potentially beneficial experiences. This adapted measure predicted patients' health status, their compliance, and their recovery from medical challenges[23] and also exhibited a moderating effect on self-ratings of health.[22]

In the present study, the context-specific adaptation of the hardiness construct is explored as it relates to military occupational stressors. Rather than focusing on the global concept of psychological hardiness, hardiness is measured as the degree to which military personnel are committed to, feel challenged by and have some sense of control over their work experiences in the military environment.

Purpose

The purpose of the present research was to examine whether military hardiness buffered the impact of demands of deployment on physical and psychological health. Furthermore, the study looked at the longitudinal effects of stressors during deployment by measuring military hardiness and deployment stressors during deployment and measuring strain outcomes 5 to 6 months after deployment, when soldiers returned and reintegrated into their home duty environments. By taking a longitudinal approach, we addressed weaknesses identified in previous studies that relied on cross-sectional designs.[22,24]

Hypotheses

Specifically, we investigated the relationships between deployment stressors and health outcomes among soldiers during and after their participation in a peacekeeping deployment. We hypothesized that (1) military hardiness is correlated with psychological health during and after deployment, (2) military hardiness is correlated with physical health during and after deployment, (3) military hardiness moderates the effects of deployment stressors on psychological health after deployment, and (4) military hardiness moderates the effects of deployment stressors on physical health after deployment.

Methods

Participants

The sample in the present study consisted of 629 U.S. Army soldiers stationed at a U.S. base in Germany who were deployed to Kosovo for a 6-month peacekeeping mission. The average age was 25.7 years. In terms of gender, 93% were male and 7% were female. In terms of rank, 60.9% were junior enlisted personnel, 32.8% were noncommissioned officers, and 6.3% were officers. In terms of marital status, 52.5% were married, 40.7% were single, and 6.8% were divorced or separated.

Measures

Deployment Stressors

The Deployment Stressor Scale is composed of nine items that reflect deployment stressors identified by Bartone et al.[4] Items include boring and repetitive work, concerns about accidents and injury, uncertainty regarding redeployment dates, concerns about family members left behind, and health and financial concerns. Soldiers were asked to "rate how much trouble or concern is caused by" any of the stated events. The ratings were given on a 5-point scale (1 = very low to 5 = very high, with an option for "does not apply"). The Deployment Stressor Scale was developed through a series of studies[4,25-27] in which subject matter experts provided stressor items based on feedback from deployed soldiers. Previous studies have demonstrated the construct validity of the Deployment Stressor Scale,[4] as well as its reliability.[25] Cronbach's a for this study was 0.82.

Psychological and Physical Health Outcomes

Physical health was assessed with the Physical Symptoms Scale (PSS), a scale that has been used in past research with military samples.[26,27] The PSS consists of 22 common physical symptoms, such as headaches, intestinal upsets, and back problems. Soldiers were asked to rate the frequency of each symptom that occurred in the previous month on a 4-point response scale (from "not at all" to "very often"). The scale score was derived by summing the number of symptoms endorsed as occurring often or very often. Cronbach's a for the PSS in this study was 0.87.

Depressive symptoms were measured with the Center for Epidemiological Studies-Depression (CES-D) Scale.[28,29] It is composed of seven items such as "felt sad" and "felt lonely," with a 7-day response option. Cronbach's a for the CES-D Scale in this study was 0.90.

Military Hardiness

The Military Hardiness Scale was developed for this study and is composed of 18 items reflecting the three components of psychological hardiness.[12] Military-specific commitment is composed of seven items that reflect a strong identity with the military and commitment to the mission. Military-specific control includes six items reflecting job control and personal influence on mission outcomes. Military-specific challenge includes five items reflecting the degree to which the individual exerts personal resources in response to occupational demands. These items and the sources from which they were adapted are listed in Table I. Cronbach's a for the Military Hardiness Scale in the present study was 0.90.

TABLE I Military Hardiness Scale Items
Commitment
I am proud to be in the U.S. Army.[a]
I am an important part of my company.[a]
What I do in the Army is worthwhile.[a]
I feel responsible for my job performance.[b]
I am committed to my job.[b]
How well I do in my job matters a great deal to me.[b]
How I do in my job influences how I feel.[b]
Challenge
My job is very challenging.[c]
It takes all my resources to achie\'e my work objectives.[c]
I work at fuU capacity in ail of my job duties.[c]
I strive as hard as I can to be successful in my work.[d]
When I work 1 really exert myself to tbe fullest.[d]
Control
I have personal control over my job performance.[e]
Once I am given instructions. I am pretty much left alone to do my job.[e]
I am allowed to do my job without constant supervision from others.[e]
I feel that what I am doing is important for accomplishing my unit's mission.[f]
I am making a real contribution to accomplishing my unit's mision.[f]
What I do helps accomplish my unit's mission.[f]

a Job involvement/engagement.[40]
b Military identity, adapted from the Military Self-Esteem Scale.[41-42]
c Challenge.[43]
d Work intensity.[43]
e Job control, adapted from the Job Diagnostic Survey GeneralSatisfaction Scale.[44]
f Task significance.[45]

Procedure

Surveys were administered to soldiers at two points in time. For the first data collection, stressors, hardiness, and health were measured during a 6-month peacekeeping deployment to Kosovo. Surveys were administered on site in Kosovo after soldiers had been deployed for 3 to 4 months. For the second time point, surveys of health outcomes were administered after deployment. Surveys were conducted 1 to 2 months after soldiers had returned to garrison in Germany.

All participants were volunteers who provided their informed consent. All data were collected under an approved human use research protocol and were treated confidentially. Surveys took ~45 minutes to complete and were administered in large groups of 20 to 150 soldiers.

TABLE III Summary Of Moderated Multiple Regression Analyses For Deployment Stress, Military Hardiness, and Depression					
{N = 629)					
Variables	**B**	**BSE**	**β**	**R2 Change**	**P**
Step 1				0.249	0
Time 1 depression	4.88	0.4	0,465		0.001
Step 2				0.011	0.025
Deployment stressors	0.663	0,39	0.064		NS
Militar\' hardiness	-0.487	0.38	-0.045		NS
Stress-hardiness	-0.863	0.37	-0.081		0.02
Time 2 CES-D Scale score, adjusted R2 = 0.26; F14,617) = 54.274; p < 0.001, NS, not significant.					

Analytical Strategy

The hypotheses were analyzed with a hierarchical moderated regression analysis. To control for the effects of deployment health on subsequent postdeployment adaptation, deployment health was entered first in the two regression equations, as a covariate. Moderated analysis requires that the interactive term created with the predictor and moderator be significant but does not require significant main effects of the predictor on the criterion to test moderators.[30] In addition, the independent variable (deployment stressors) and the moderator (military hardiness) were z-transformed before being entered into the regression equations, following the data-centering approach offered by Aiken and West.[31]

Results

Table II displays the means, SDs, and intercorrelations for key measures.

Multiple Regression: Psychological Health

In the first regression analysis, we tested military hardiness as a moderator of the impact of deployment stressors on depression after deployment, while statistically controlling for depression symptoms at the time of the deployment. Significant main effects for military hardiness and deployment stressors were not found for depression. However, a significant deployment stressors / military hardiness interaction was found; hardiness and stressors measured during deployment were related to psychological health after deployment. Specifically, when both hardiness and deployment stressor levels were high, as measured during the deployment, depression levels were lower after deployment (Table III). This relationship is presented graphically in Figure 1.

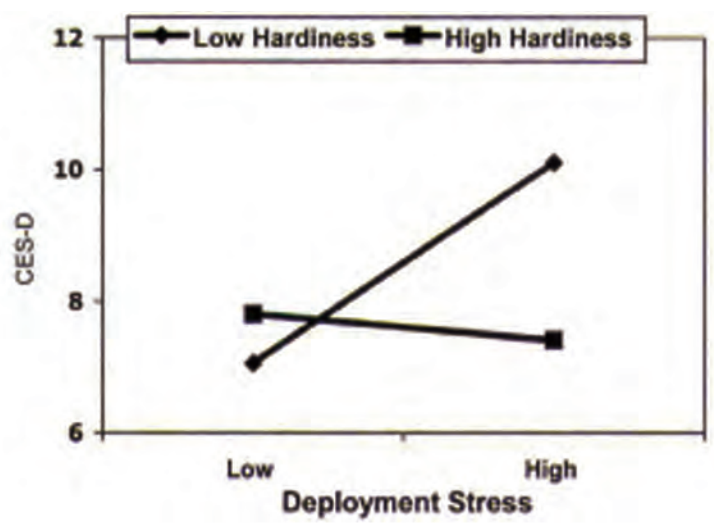

Figure 1: Results on deployment stress and military hardiness and their interaction with respect to postdeployment depression [CES-D Scale scores) [N = 629).

TABLE II Means, SDS. and Intercorrelations Among Variables						
		Correlation				
Variable	**Mean (SD|**	**1**	**2**	**3**	**4**	**5**
1. Deployment stressors	2.85 (0.72)	–				
2. Military hardiness	3.77 (0.55)	0.06	–			
3. Physical symptoms (deployment)	2.04 (2.69)	0.28a	–0.03			
4. CES-D (deployment)	11.4 (12.15)	0.31a	–0.023a	0.46a		
5. Physical symptom (after deployment)	1.76 (2.97)	0.20a	0	0.52a	–0.32a	
6. CES-D (after deployment)	7.9 (10.5)	0.20a	–0.16a	0.30a	0.50a	0.46a
Deployment stressors and military hardiness were measured during deployment. p< 0.01.						

TABLE IV Summary of Moderated Multiple Regression Analyses for Deployment Stress, Military Hardiness, and Physical						
Symptoms in = 6291						
Variables	**B**	**BSE**	**β**	**R2 Change**	**P**	
Step 1				0.293	0	
Time 1 physical symptoms	5.25	0.37	0.26			
Step 2				0.005	NS	
Deploynient stressors	0.214	0.1	0.08		0.035	
Military hardiness	-0.008	0.1	-0.003		NS	
Stress-hardiness	-0.041	0.1	-0.014		NS	
Time 2 PSS score. adjusted R2 = 0.294: f(4.612)						

Multiple Regression: Physical Health

In the second regression analysis, we tested military hardiness as a moderator of the impact of deployment stressors on the number of physical illness symptoms after deployment, while statistically controlling for physical symptoms during deployment. Although a significant main effect for deployment stressors was found, neither the main effect of military hardiness nor the stressors-hardiness interaction was significant (Table IV).

Discussion

Military hardiness was correlated with psychological health both during deployment and after deployment but was not correlated with physical health. Thus, the hypothesis regarding the relationship between military hardiness and depression was supported. Soldiers with higher military hardiness scores reported lower depression levels. However, there was no support for our hypothesis regarding the relationship between military hardiness and physical health.

When deployment depression levels were statistically controlled, military hardiness interacted with deployment stressors to predict postdeployment depression, supporting our third hypothesis. Among soldiers who experienced high levels of stressors on a 6-month peacekeeping deployment, those who were high in military hardiness fared better 5 months later, in terms of depression, than did those who were low in military hardiness. Contrary to our expectations, military hardiness did not moderate the impact of deployment stressors on physical symptoms.

These results indicate that military hardiness may be valuable for understanding the impact that individuals' appraisal of and responses to deployment-related stressors have on depression after deployment. The longitudinal nature of this effect of military hardiness on depression could be a useful opportunity to help support soldiers in their adaptation after deployment.

The failure of military hardiness to buffer the effect of deployment stressors on physical health symptoms points to inconsistencies in the literature regarding the moderating effects of hardiness on health. This discrepancy in the literature has yet to be resolved.[22] It may be that soldiers' appraisal of stressors may not affect their physical health after deployment. In fact, other studies also found a difference in the way soldiers respond to mission stressors in terms of physical and psychological health.[32] Still, deployment-related stressors correlated with physical health after deployment, suggesting that other variables may more effectively buffer this relationship.

Limitations

There are several limitations to the present study. Self-report data may be biased by affective response set and retrospective recall. We addressed the issue of affective response set by controlling for self-reported symptoms during deployment. In terms of retrospective recall, Bramsen et al.[33] and Schlenger et al.[34] found that retrospective recall of military events such as exposure to deployment stressors is not necessarily biased.

Another potential limitation is that the variance explained by the interaction of military hardiness and deployment-related stressors is relatively small. Although only a small amount of the total variance in the depressive symptoms is accounted for, other researchers have cautioned against relying on the size of an effect to determine its importance.[35] Still, the small explained variance underscores the point that psychological health outcomes are multidetermined.

Implications of Military Hardiness

Military hardiness is an example of adapting the more general construct of psychological hardiness to a specific context. As in the case of health-related psychological hardiness,[23] military hardiness applies the basic components of psychological hardiness to a specific occupational setting. The development of a context-specific conceptualization of hardiness may serve as a catalyst for research that addresses the well-established impact of military occupational stressors on psychological well-being.[2,3,36] Studies with other branches of military service, as well as military personnel involved in combat operations, will be important in developing the concept of military hardiness.

Beyond the application of hardiness to the military setting, the context-specific nature of military hardiness can be readily adapted to other occupational settings. The components of psychological hardiness (control, challenge, and commitment) may be relevant for employees in their appraisal of and responses to the stressors inherent in their occupations. The benefit of developing a relatively specific occupational hardiness construct is that interventions designed to enhance this personal resource can be implemented and adapted to the specific needs of the organization. Recent developments indicate that training[37,38] can enhance psychological hardiness. The methods and procedures used to train hardiness could also be included in training programs geared to specific occupational settings.

In the military, leaders can play a role in enhancing military hardiness in several ways.[39] They can model a hardy approach to military life and work that demonstrates commitment, control, and challenge. By emphasizing military identity, commitment can be enhanced. By emphasizing the significance of individual contributions to the mission, control can be enhanced. Challenge can be encouraged by leaders framing work-related events as opportunities for military personnel to work at their full potential.

For units on deployment, military hardiness training may bolster the physical training they already receive. Although much military training is geared toward physical toughness or resilience, military hardiness training can support the development of psychological resilience. Previous research found that soldiers' physical recovery from a high-intensity training mission was more efficient than their psychological recovery,[32] suggesting the need for a more comprehensive training program that includes both physical and psychological elements. The role of military hardiness in moderating the impact of deployment stressors on psychological symptoms such as post-traumatic stress disorder and anger is also an important area of future research. Because psychological recovery may be a challenge after exposure to mission stressors, military hardiness may a useful approach to enhance psychological well-being.

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Editorials

Editorial Comment on *Military hardiness as a buffer of psychological health on return from deployment* (Dolan & Adler, 2006)

By LTC Craig A. Myatt

Dolan and Adler (2006) generate a thorough methodological approach to a lingering concern on military hardiness and resilience. Since 1979, extensive research showed that hardiness buffers ill effects of work-related stress. As a relatively global psychological construct, hardiness is a personality resource influenced by several, if not many, variables. Dolan and Adler apply the hardiness construct as it relates to some of several military occupational stressors and then analyze the strength of those military stressors in association with hardiness and each other by selecting a multiple regression model for their study.

With four well defined hypotheses, Dolan and Adler used the Military Hardiness Scale (MHS) to measure the moderator variable hardiness. To measure the impact variables "stressors," "depression," and "health," they respectively used the Physical Symptoms Scale (PSS), the Center for Epidemiological Studies-Depression Scale (CES-D), and the Deployment Stressor Scale (DSS). Dolan and Alan interestingly ran two regression analyses without offering justification for doing so while employing a hierarchical moderated regression analysis. They, otherwise, clearly defined which outcome supported each hypothesis and generated valid conclusions based on their results.

The strength of the conclusions in the Dolan and Adler study rests in reasonable extrapolations that they make regarding leadership and psychological resilience. They assert that military leaders can "model a hardy approach to military life and work that demonstrates commitment, control, and challenge." They further state that "military hardiness training can support the development of psychological resilience." Those factors lend themselves to further research and application in the military using social learning models suitable for effective change agency.

Educational Resources

MEDICAL REFERENCES

Administration of Health Care
Disrupted Health Services: http://www.who.int/hac/techguidance/tools/disrupted_sectors/en/index.html
Health Care Management Tools: http://erc.msh.org/toolkit/
Health Information Management Tools: http://www.humanitarianinfo.org/IMToolbox/
Management of Health Care Delivery: http://www.who.int/management/en/

Administration and Contingency Planning
USHHS Health and Disaster Preparedness Tools: http://www.ahrq.gov/prep/
CDC Emergency Preparedness Planning: http://www.bt.cdc.gov/planning/
USDHS Resources: http://www.dhs.gov/index.shtm
Hospital Readiness: http://www.aha.org/aha_app/issues/Emergency-Readiness/index.jsp

Aerospace Medicine, Aviation Medicine and Patient Transport
Aerospace Medical Resources: http://aeromedical.org/Links/avmed_links.html
Medical Evacuation Links: http://usasam.amedd.army.mil/medevac/interest.htm
Aviation Medicine Resources: http://www.nh-tems.com/Aviation_medicine.html
Flight Medic Resources: http://www.flightweb.com/glinks/index.php?category=2

Alternative Medicine
U.S. Center for Complementary and Alternative Medicine: http://nccam.nih.gov/
WHO Center for Traditional Medicine: http://www.who.int/medicines/areas/traditional/collabcentres/en/
U.S. National Library of Medicine Resources: http://www.arctichealth.org/tm.php ;
and http://americanindianhealth.nlm.nih.gov/trad-healing.html
Ethnobotanical Resource Directory: http://www.cieer.org/directory.html
Ethnomedicine Links: http://www.ethnomedico.com/english/links.htm and: http://www.univie.ac.at/ethnomedicine/
Ethnopharmacology Resources: http://medicinus.info/research/areas/ethnopharmacology/
Herbals: http://www.botanical.com/botanical/mgmh/comindx.html
Psychoactive Substances: http://www.ethnopharmacology.com/
and http://www.erowid.org/psychoactives/psychoactives.shtml

Anesthesiology
Anesthesiology References: http://www.asahq.org/Links/refsdb.htm
Anesthesiology Links: http://www.asahq.org/Links/linksOfInterest.htm
and http://www.asra.com/links/index.html#indexes

Chemical, Biological, Radiological and Hazardous Materials
Bioterrorism Emergencies Preparedness and Response: http://www.bt.cdc.gov/bioterrorism/
Chemical Emergencies Emergency Preparedness and Response: http://www.bt.cdc.gov/chemical/
Radiation Emergencies Emergency Preparedness and Response: http://www.bt.cdc.gov/radiation/
CBNRE Information & Analysis Center: http://www.cbiac.apgea.army.mil/
Food Safety, Animal and Plant Health Portal: http://www.ipfsaph.org/En/default.jsp

Hazardous Materials Database: http://www.cameochemicals.noaa.gov/
Poison Control Center: http://www.ipl.org/div/kidspace/poisonsafe/pcenters.html
Poison Plants Database: http://www.cbif.gc.ca/pls/pp/poison?p_x=px
Toxicology Databases: http://www.atsdr.cdc.gov/toxpro2.html

Dental
Dental Emergencies: http://www.webmd.com/oral-health/guide/handling-dental-emergencies
Dental Emergencies and Injuries: http://www.ada.org/public/manage/emergencies.asp
Dental Disease and Trauma Research: https://www.usaccc.org/research/DentalDisease.jsp

Dermatology
Atlas of Dermatology: http://www.brooksidepress.org/Products/OperationalMedicine/DATA/operationalmed/Manuals/GMOManual/clinical/Dermatology/AtlasofDermatology.htm
Dermatology Links and Resources: http://www.hsc.stonybrook.edu/som/dermatology/links.cfm

Disaster Medicine and Management
Centers for Disaster Medicine: http://hsc.unm.edu/som/cdm/index.shtml ;http://www.gwemed.edu/1189844732663.html ; and http://www.mcg.edu/ems/COM/Disaster/
Pre-Hospital and Disaster Medicine: http://pdm.medicine.wisc.edu/home.html
Disaster Medicine Links: http://pdm.medicine.wisc.edu/links.html
Centers for Disaster and Humanitarian Assistance: http://www.cdham.org/ ; http://www.cdmha.org/Resources.htm ; and http://coe-dmha.org/
Disaster Management Toolkit: http://www.hsc.usf.edu/nocms/publichealth/cdmha/toolkit_dm/Index_English.pdf
Disaster and Emergency Management Information Network: http://ccs.tamu.edu/homeland_security/

Diving and Hyperbaric Medicine
Diver's Alert Network: http://www.diversalertnetwork.org/
Diving Medicine Links: http://scuba-doc.com/lnks.html
Diving Diseases Research Center: http://www.ddrc.org/
Diving Medicine Symptoms and Treatment: http://scuba-doc.com/sitemap.html
Navy Diving Manual: http://www.supsalv.org/manuals/diveman5/divManual5.htm
Hyperbaric Medicine Links: http://www.scuba-doc.com/hbolnks.htm and http://www.virtual-anaesthesia-textbook.com/vat/hyperbaric.html

Emergency Medicine
Center for International Emergency Medicine: http://www.iemh.org/
Links and Resources: http://www.acep.org/ACEPmembership.aspx?id=25148

Environmental Health and Medicine
Center for Health and the Global Environment: http://chge.med.harvard.edu/
Environmental Health Links: http://www.sis.nlm.nih.gov/enviro/envirohealthlinks.html
Environmental Health in Emergencies: http://www.who.int/water_sanitation_health/hygiene/emergencies/en/
Environmental Medicine Links: http://www.uib.no/isf/guide/occu.htm
International Union for Circumpolar Health: http://www.iuch.org/
Maritime Medicine Center: http://www.gwemed.edu/maritime.htm
National Institute of Environmental Health Science: http://www.niehs.nih.gov/
Travel Medicine Resources: http://gorgas.dom.uab.edu/geomed/links2.html
Wilderness Medicine Links: http://wms.org/links/interest.asp

Epidemiology
Epidemiological Statistics and Applications for Public Health: http://www.openepi.com/Menu/OpenEpiMenu.htm
Population Health Metrics Online: http://www.pophealthmetrics.com/
Public Health Emergency Countermeasures: http://www.hhs.gov/aspr/ophemc/index.html

Family Medicine
Center for Family Health Information and Technology: http://www.centerforhit.org/
Family Medicine Resources: http://www.aafp.org/online/en/home/aboutus/relatedsites.html
Family and Primary Care Medicine Studies: http://www.graham-center.org

Forensics
Forensic Science: http://www.ncjrs.gov/spotlight/forensic/Summary.html
Forensic Investigation Links: http://www.nlectc.org/links/forlinks.html
Forensic Science Links: http://www.lib.msu.edu/harris23/crimjust/forsci.htm

Geospatial Health Resources
Geospatial Mapping: http://www.cdc.gov/nchs/gis.ht; http://datawarehouse.hrsa.gov/ and http://www.who.int/health_mapping/en/

Humanitarian Assistance
Global Humanitarian Studies Links:
http://www.sipa.columbia.edu/academics/concentrations/ha/ghsi/introduction.html
Relief Web Library: http://www.reliefweb.int/rw/lib.nsf/doc205?OpenForm
UN Humanitarian Information Management Toolbox: http://www.humanitarianinfo.org/IMToolbox/

Improvised Medicine
Improvised Medicine: http://www.paladin-press.com/category/s
Midwives Handbook: http://www.hesperian.org/Publications_and_Resources.php
Where There is no Doctor: http://www.healthwrights.org/books/WTINDonline.htm
Where There is no Dentist: http://www.healthwrights.org/books/WTINDentistonline.htm
Where Women Have No Doctor: http://www.hesperian.org/Publications_and_Resources.php
Where There Is No Psychiatrist: http://www.asksource.info/pdf/30256_wherethereisnopsych_ch3_2003.pdf

Infectious Diseases
Center for Infectious Diseases Research: http://www.cidrap.umn.edu
Communicable Disease Control in Emergencies: http://whqlibdoc.who.int/publications/2005/9241546166_eng.pdf
Disease Control Priorities Project: http://www.dcp2.org/main/Home.html
National Center for the Control of Infectious Diseases: http://www.cdc.gov/ncpdcid/
Outbreaks and Surveillance: http://www.who.int/csr/don/en

International and Cross-Cultural Health
Cross Cultural Healthcare Program: http://www.xculture.org/
Cross Cultural Medicine Resources: http://www.ethnomed.org and http://medicine.ucsf.edu/resources/guidelines/culture.html
CDC Global Health Office: http://www.cdc.gov/cogh/index.htm/
Global Health Council Resources: http://www.globalhealth.org/
Global Public Health References: http://www.pbs.org/wgbh/rxforsurvival/resources.html
Global Public Health Institutes (Resource Pages): http://www.ianphi.org /
International Medicine Programs: http://www.gwemed.edu/1189932253869.html
USHHS Global Health Office (Issues & Resources): http://www.globalhealth.gov

Laboratory
Clinical Lab Science Resources: http://members.tripod.com/~LouCaru/index-5.html
Laboratory Links: http://wwwn.cdc.gov/nltn/mltl.aspx

Mass Causalities
Community Based Mass Prophylaxis: http://www.ahrq.gov/research/cbmprophyl/cbmpro.htm
Mass Care and Shelters Guide: http://www.cdsscounties.ca.gov/coplanners/
Mass Causality Resources: http://www.bt.cdc.gov/masscasualties/

National Mass Fatalities Institute: http://www.nmfi.org/
Surge Capacity and Facility Capacity: http://www.bt.cdc.gov/masscasualties/surgecapacity.asp
and http://www.bt.cdc.gov/masscasualties/capacity.asp

MATERNAL-CHILD HEALTH
Antenatal Guidelines or Crisis Conditions: http://www.icrc.org/web/eng/siteeng0.nsf/html/p0875
Maternal/Child Health Resources: http://www.who.int/making_pregnancy_safer/publications/en/

MEDICAL ANTHROPOLOGY
Global Directory of Medical Anthropology http://www.medanthro.net/directory/submit.asp
Medical Anthropology Web http://www.medanth.org/ and http://vlib.anthrotech.com/Specialized_Fields/Medical_Anthropology/

MEDICAL GEOGRAPHY
http://userpages.umbc.edu/~earickso/Index.html
http://userpages.umbc.edu/~earickso/MGSGRelatedLinks.html

MEDICAL GEOLOGY
Medical and Health Geology: http://www.medicalgeology.org/ and http://energy.er.usgs.gov/health_environment/medical_geology/

MENTAL HEALTH
CDC Mental Health Resources: http://www.bt.cdc.gov/mentalhealth/
Critical Incident Stress Management and Resources: http://www.icisf.org/
Disaster Mental Health Resources: http://www.trauma-pages.com/disaster.php
International Mental Health and Resources: http://www.iop.kcl.ac.uk/international/?project_id=80
Psychological Testing: http://www.guidetopsychology.com/testing.htm and Assessments: http://www.psywww.com/resource/bytopic/testing.html
U.S. Mental Health Information Center: http://mentalhealth.samhsa.gov/

MILITARY MEDICINE
International Committee for Military Medicine: http://www.cimm-icmm.org/index.html
Military Medicine Links: http://www.au.af.mil/au/awc/awcgate/awc-medi.htm

MORGUE AND REMAINS MANAGEMENT
Disaster Victim Identification Guide: http://www.interpol.int/Public/DisasterVictim/guide/default.asp
Disaster Morgue Operations: http://www.winid.com/dmort7/Final%204-WHITE.doc
and http://www.hhs.gov/aspr/opeo/ndms/teams/dmort.html
Management of Human Remains: http://www.icrc.org/web/eng/siteeng0.nsf/html/p0858 and http://www.paho.org/english/dd/ped/ManejoCadaveres.htm

OBSTETRICS AND GYNECOLOGY
Reproductive Health Care in Emergencies: http://www.who.int/reproductivehealth/pages_resources/listing_emegency.en.html

OPHTHALMOLOGY
American Academy of Ophthalmology Resources: http://www.aao.org/
Eye Disorders Online: http://www.merck.com/mmpe/sec09.html; http://www.ophthalmologyweb.com/default.aspx; http://www.thehighlights.com/Merchant2/merchant.mvc; and http://www.websightmd.com/

PALLIATIVE MEDICINE
Palliative Medicine Resource Guide: http://www.aahpm.org/physresources/index.html
PATHOLOGY
Armed Forces Institute of Pathology: http://www.afip.org/

Pathology Links: http://members.tripod.com/Pathnet/links.htm and http://pathologylinks.com/index.php?title=Eric%27s_Pathology_Links

Peacekeeping and Stability Operations
https://pksoi.army.mil/
http://www.au.af.mil/au/aul/bibs/peaceops06.htm
http://www.carlisle.army.mil/ietcop/index.cfm

Pediatrics
Child Health in Emergencies: http://www.who.int/child-adolescent-health/publications/pubemergencies.htm
Pediatric Immunization Guide: http://aapredbook.aappublications.org/current.shtml
Pediatric Patient Management: http://practice.aap.org/topicBrowse.aspx?nodeID=4000
Pediatric Resources: http://pages2.inrete.it/mbiomed/pedi.htm and: http://www.lib.uiowa.edu/hARDIN/MD/ped.html

Pharmacology
Drug Information Guide: http://www.drugs.com/
Merck's Clinical Pharmacology: http://www.merck.com/mmpe/sec20.html
Orphan Drugs: http://www.orpha.net
Psychopharmacology Resources: http://www.ascpp.org
WHO Essential Medicines: http://www.who.int/medicines/publications/en/

Public Health
Centers for Public Health Preparedness: http://www.asph.org/cphp/cphp_home.cfm
Public Health Links: http://www.sph.emory.edu/PHIL.php
Public Health Association Resources: http://www.apha.org/programs/resources/
Public Health Emergency Countermeasures: http://www.hhs.gov/aspr/ophemc/index.html
Public Health Preparedness Tools: http://www.phpreparedness.info/tools.php

Radiology and Medical Imaging
Med Pix Medical Image Database: http://rad.usuhs.edu/medpix/index.html
Radiology Education Gateway: http://tmcr.usuhs.mil/
Radiology Links and Resources: http://www.radiologyeducation.com/
Public Health Image Library: http://phil.cdc.gov/Phil/home.asp

Refugee Management
Care and Shelter Tools: http://www.cdsscounties.ca.gov/coplanners/default.asp?id=31
Center for Refugee and Disaster Medicine: http://www.jhsph.edu/refugee/

Refugee Decision Support Resources
http://www.unhcr.org/cgi-bin/texis/vtx/refworld/rwmain
UN Humanitarian Aid Links: http://www.unhcr.org/cgi-bin/texis/vtx/reflink/download.htm
UN Refugee Links: http://www.unhcr.org/cgi-bin/texis/vtx/reflink

Surgery
Hospitals for War Wounded – A Guide for Set Up: http://www.icrc.org/web/eng/siteeng0.nsf/html/p0714
Integrated Management Toolkit for Essential and Emergency Surgical Care: http://www.who.int/surgery/publications/imeesc/en/index.html
Practice Guidelines for Surgical Care in Emergencies: http://www.who.int/surgery/en/ESC_in_disasters.pdf
Surgical Care at the District Hospital: http://www.who.int/surgery/publications/en/SCDH.pdf
Surgery for Victims of War: http://www.icrc.org/web/eng/siteeng0.nsf/html/p0446

Tactical Medicine
Centers for Tactical Medicine: http://www.mcg.edu/ems/COM/Tactical/; http://www.gwemed.edu/opmed/tacmed.htm; http://www.gwemed.edu/1193734316069.html; and https://www.usaccc.org/index.jsp

Telemedicine
U.S. Army Telemedicine: http://www.tatrc.org/
US HHS Telehealth: http://www.hrsa.gov/telehealth/
Telemedicine Resources: http://tie.telemed.org/links/
Telemedicine Links: http://www.quasar.org/21698/textfodder/telelink.htm

Tropical Medicine
American Society of Tropical Medicine: http://www.astmh.org/
Global Network for Neglected Tropical Diseases: http://gnntdc.sabin.org/
Institute of Tropical Medicine Library and Resources: http://lib.itg.be/bibhome.htm
International Registry of Tropical Imaging: http://tmcr.usuhs.mil/toc.htm#
Tropical Medicine Links: http://hml.org/WWW/tropical.html and: http://www.astmh.org/links/index.cfm

Veterinary Medicine
Advanced Veterinary Information System: http://www.aviscollege.com/
Animal Disease Alerts, Information and Resources: http://www.oie.int/eng/en_index.htm
Animal/Plant Health Inspection Service and Resources: http://www.aphis.usda.gov/
Bio-security Center for Animal Health Emergencies: http://www.biosecuritycenter.org/
Diagnostic Tests and Vaccines for Terrestrial Animals: http://www.oie.int/eng/normes/mmanual/A_summry.htm
Global Early Warning System for Animal Diseases: http://www.who.int/zoonoses/outbreaks/glews/en/index.html
Veterinary Resources: http://informatics.vetmed.vt.edu/Projects.htm
Veterinary Emergency and Critical Care Links: http://veccs.org/
Veterinary Environmental Health Center: http://www.emc.ncsu.edu/
Veterinary Public Health and Zoonotic Disease: http://www.who.int/zoonoses/vph/en/
World Veterinary Association Links: http://www.worldvet.org/Web_Links.html

GENERAL REFERENCES, GUIDES AND TOOLS:
Alerts & Threats
Bio-security Center: http://www.upmc-biosecurity.org/
Epidemic and Pandemic Alert: http://www.who.int/csr/en/
Medical Threats Briefings (by Topic): http://usachppm.apgea.army.mil/hiomtb/
Relief Web: http://www.reliefweb.int/rw/dbc.nsf/doc100?OpenForm
Security News: http://www.planetdata.net/ and http://www.globalsecurity.org

Basic References
Anatomy Atlases Online: http://www.anatomyatlases.org/
Health and Medical Sites: http://www.lib.uiowa.edu/hardin/md/idx.html
Health Science Libraries: Health Sciences Libraries Online: http://www.lib.uiowa.edu/hardin/hslibs.html
Martindale's Medical References: http://www.martindalecenter.com/Medical.html
Medical Algorithms, Scales, Tools, Assessments & Scoring Systems: http://www.medal.org/visitor/login.aspx
Medical Dictionary Online: http://cancerweb.ncl.ac.uk/omd/
Merck Health Guides Online: http://www.mercksource.com/
Military Medical Resources: http://www.medtrng.com/medicaloperations.htm
National Library of Medicine Gateway: http://gateway.nlm.nih.gov/gw/Cmd
Practice Guides: http://www.fpnotebook.com/; http://www.emedicine.com/; http://www.lib.uiowa.edu/hardin/md/; and http://www.acep.org/practres.aspx?id=30232
USUHS Learning Resource Center: http://www.lrc.usuhs.mil/

Books (Online)
Books for Doctors: http://www.freebooks4doctors.com/fb/special.htm
E-Learning Toolkit for Essential Surgical Care: http://www.steinergraphics.com/surgical/index.html
Environmental Medicine Text: http://www.envimed.com/emb.shtml
Dermatology: http://telemedicine.org/stamford.htm
DSM-IVR: http://psych.org/MainMenu/Research/DSMIV.aspx

First Aid in Armed Conflicts: http://www.icrc.org/web/eng/siteeng0.nsf/html/p0870
Global Health Council Publications: http://www.globalhealth.org/publications
Medical Bookshelf: http://www.ncbi.nlm.nih.gov/sites/entrez?db=books
Military Medicine: http://www.brooksidepress.org/Military.htm; and http://www.bordeninstitute.army.mil/published.html
Military Biodefense Manuals: http://usamriid.detrick.army.mil/education/instruct.htm
Merck Manuals Online: http://www.merck.com
Merck/Medicus Portal: http://www.merckmedicus.com/pp/us/hcp/hcp_home.jsp
Primary Trauma Care Manual: http://www.steinergraphics.com/surgical/manual.html

Courses (Online)
Virology Course: http://web.uct.ac.za/depts/mmi/jmoodie/welcome1.html
Medical Super Courses: http://iier.isciii.es/supercourse/assist/topicsearch.htm
WMD Online Preparedness Education Program: http://opep.usuhs.edu/

Journals (Online)
Federal Medicine: http://www.usmedicine.com/index.cfm
Medical Journals: http://www.biomedcentral.com/ and http://www.plos.org/
Medical and Science Journals: http://www.ispub.com/ostia/index.php?xmlFilePath=journals.xml
Medical and Science Journals for the Developing World: http://www.biomedcentral.com/developingcountries

Training
Advanced Burn Life Support: http://www.ameriburn.org/ablscoursedescriptions.php
Advanced Disaster Life Support: http://www.bdls.com/
Advanced Hazmat Life Support: http://www.ahls.org/ahls/ecs/main/ahls_home.html
Advanced Medical Life Support: http://www.naemt.org/AMLS/default.htm
Advanced Wilderness Life Support: http://awls.org/index.htm
BiodefenseEd.org: http://www.biodefenseeducation.org/
Biochemical Organic Radiological Disaster Educational Response System: http://www.bordersalertandready.com/
Blast Injury Training: http://www.bt.cdc.gov/masscasualties/tiidefacts.asp
Center for Domestic Preparedness: http://cdp.dhs.gov/index.html
Diploma in Remote and Offshore Medicine: http://www.diprom.rcsed.ac.uk/
Disaster Education Extension Network: http://eden.lsu.edu
Disaster Mental Health Institute: http://www.usd.edu/dmhi/
Diver Medical Technician Training: http://www.nbdhmt.com/dmt.html
Emergency Management Institute: http://www.training.fema.gov/EMIWEB/
Health Care: http://www.medweb.emory.edu/MedWeb/SPT—Home.php
Humanitarian Resource Institute: http://www.humanitarian.net/
International Trauma Life Support Course: http://www.itrauma.org/
JEMS Training Links: http://www.jems.com/education_and_training/index.html
NAEMT Training: http://www.naemt.org/educationalPrograms/
Medicine for Mariners: http://www.medicineformariners.com/
Medicine in Challenging Environments: http://www.trueresearch.org/mice2006/
Pre Hospital Trauma Life Support: http://www.naemt.org/PHTLS/
Remote Area EMS: http://www.raems.com/index.html
Remote Medicine Guides: http://www.remotemedicine.org/Guides.htm
Terror Medicine: http://www.terrormedicine.org/
Training in Tropical Diseases: http://www.who.int/tdr/index.html
USMA Terrorism and Counterterrorism Training: http://www.teachingterror.com/

Upcoming Events

Special Operations Medical Association Conference (SOMA)
15-18 December 2008

THURSDAY, DECEMBER 11, 2008			
TIME	**LOCATION**	**SPEAKER**	**PRESENTATION**
1500-1700	Office 1-2	REGISTRATION	Until 5:00 pm only
SATURDAY, DECEMBER 13, 2008			
0700-0800	Hall MR 8-9-10	Continental Breakfast	
0900-1700	Office 1-2	**REGISTRATION**	
0800-1700	MR 8 - 9 -10	USASOC Surgeon Component Meeting	Agenda under USASOC Tab
0940-0955	Hall MR 8-9-10	USASOC Surgeons AM BREAK	time to be determined
0800-1700	MR 12	75 Ranger Breakout Meeting	Agenda under Ranger Tab
0800-1700	Florida I - II - III	NSW Surgeons Component Meeting	Agenda under USSOCOM Tab
0800-1700	MR 4	MARSOC Surgeons Component Meeting	Agenda under USSOCOM Tab
0800-1700	MR 11	USSOCOM CEB MEETING	Agenda under USSOCOM Tab
1430-1455		USASOC SURGEONS PM BREAK	
1200-1700		SOMA Country Store	
SUNDAY, DECEMBER 14, 2008			
TIME	**LOCATION**	**SPEAKER**	**PRESENTATION**
1000 - 1700	Office 1-2	REGISTRATION	To be determined
1000-1700		SOMA COUNTY STORE	
0700-0800	Hall MR 8-9-10	CONTINENTAL BREAKFAST	
0800-1700	MR 8 - 9 - 10	USASOC Surgeon Component Meeting	Agenda under USSOCOM Tab
0940-0955	Hall MR 8-9-10	USASOC Surgeons AM BREAK	
0800-1700	MR 12	75 Ranger Breakout Meeting	Agenda under USSOCOM Tab
0800-1700	Florida I II III	NSW Surgeons Component Meeting	Agenda under USSOCOM Tab
0800-1700	MR 4	MARSOC Surgeons Component Meeting	Agenda under USSOCOM Tab
0800-1700	MR 11	USSOCOM CEB MEETING	Agenda under USSOCOM Tab
1430-1455	Hall MR 8-9-10	USASOC Surgeons PM BREAK	
1600-2300	Florida Ballroom	Exhibitors set up	
1710-1745	Greco Board Room	SOMA Planning Committee & TRUE Update Meeting	
MONDAY, DECEMBER 15, 2008			
0700-0800	Florida Ballroom	Continental Breakfast	With Exhibitors
0700-1700	Florida Ballroom	Hall	Exhibitors Registration
0700-1700	Office 1 -2		Pre-Registration
0700-1700	Lobby Bridge		On Site Registration
1300-1730	Gallery	USUHS Personnel	CME Sign IN
1000-1700	Gallery		SOMA County Store
0800-1700	Grand Ballroom	Abstract Presenters during breaks	Abstracts
TIME	**LOCATION**	**SPEAKER**	**PRESENTATION**
0700-0800	Embassy Suite	Continental Breakfast	
0800-1700	Embassy Suites Hotel Skyway 1	Col Ian Wedmore, MD EM Consultant, Surgeon General	**BY INVITATION ONLY** Lecture and Hands on Review of Portable Ultrasound Machine (FAST)
0800-0810	Grand Ballroom	COL (Ret) Robert Saum, President, SOMA	Greetings and Opening Remarks

0810-0830	Grand Ballroom	ADM Eric T. Olson, USSOCOM Commander	USSOCOM Welcome
0830-0900	Grand Ballroom	BG Loree Sutton, Director, Defense Center of Excellence (DCoE) for Psych, Health and Traumatic Brain Injury	An overview of the Defense Center of Excellence for Psych, Health and Traumatic Brain Injury
0900-0930	Grand Ballroom	MSG Brendan O'Connor, Senior Medic 7th Special Forces Group	Lessons From a Long War
0930-1000	Grand Ballroom	Maj. Ingrid Wilzing. MD Cpl1 Bart deGraff Dutch Special Forces	Dutch SOF Medical Experiences in Afghanistan
1000-1030	Florida Ball Room	BREAK Coffee with Exhibitors	
1030-1100	Grand Ballroom	Maj. Bob Mabry, MD Dept. of Combat Medic Training, Ft Sam Houston, San Antonio, Texas	Battlefield Airway Management-Lessons Learned from OIF/OEF
1100-1140	Grand Ballroom	COL. Warren Farr MD, USSOCOM Surgeon, Jim Lorraine, SOF Warrior Program	USSOCOM Surgeon's Update/SOF Warrior Program
1140-1300		Lunch on your own	
1300-1330	Grand Ballroom	HMC Ronnie Bayless MARSOC	MSOC Medical Integration in Western Afghanistan
1330-1400	Grand Ballroom	Lt Col Mark Ervin MD, AFSOC	Air Force Special Operations Surgical Team
1400-1430	Grand Ballroom	Bijan Keiribadi, USAISR.	Update: New Hemostatic Agents
1430-1500	Grand Ballroom	Capt Shawn Alderman MD. 2/1st SFG(A)	Counter Insurgency MED OPS in Support of OEF-Phillipines
1500-1520		BREAK - Coffee with Exhibitors	
1520-1550	Grand Ballroom	COL J. Kingsbury MD. Dean, Joint Special Operations Medical Training Center, (JSOMTC) Ft Bragg, NC	Update on SOF Medic Training
1550-1620	Grand Ballroom	COL Peter Weina MD. Walter Reed Institute of Medical Research	Leishmaniasis, A Major Concern for the Deployed Force
1620-1650	Grand Ballroom	CAPT (Ret) Edward "Mel" Otten, Navy, Wilderness Medical Society	Wilderness Medicine for the SOF Medic
1930-2200	Room 10	SOMA Board of Directors	Board Meeting
1700-1900	Florida Ballroom	Exhibitors/Attendees Reception	All Attendees Welcome
		TUESDAY, DECEMBER 16, 2008	
0700-0800	Florida Ballroom	Continental Breakfast	With Exhibitors
0700-1700	Office 1 -2	Registration	Pre Registration On Site Registration
0700-1200	Florida Ballroom Lobby	Registration	Exhibitors
1000-1700	Gallery	SOMA Country Store	
1300-1730	Gallery	USUHS	CME Sign in
0800-1700	Grand Ballroom Foyer	Abstract Presenter available during break	Abstracts
TIME	**LOCATAION**	**SPEAKER**	**PRESENTATION**

0800-1150.	Grand Ballroom	Moderators; MSG Duane Bevitt, LTC Robert Harrington	SOF Medical Lessons Learned: Vignettes by SOF Medics: Topics To Be Covered: 1.Causualty Vignettes 2.Combat Medical Lessons learned 6-8 Medics will discuss medical lessons learned while deployed on overseas missions
1150-1300		Lunch on your own	
1150-1300	MR 8	NAVSOC Surgeon's Luncheon (Invited only)	
1150-1300	MR 9	AFSOC Surgeon's Luncheon (Invited only)	
1150-1300	MR10	USASOC Surgeon's Luncheon (Invited only)	
1150-1300	Terrace Restaurant	MARSOC Surgeon's Luncheon (Invited only)	
1300-1330	Grand Ballroom	Anthony Atala MD, Director Institute for Regenerative Medicine. Wake Forest University	Medical Breakthroughs in Treating the Wounded Warrior
1330-1400	Grand Ballroom	Major Florent Josse MD, Anesthesiology, Military Hospital ULM, German Federal Army (Bundeswehr)	Use of Ketamine in Field Operations Overview and Concept
1400-1430	Grand Ballroom	COL. Chester "Trip" Buckenmaier.MD Dept. of Anesthesiology, WRAMC	Acute Pain as Disease; Protocols for Tx. on Battlefield
1430-1500	Grand Ballroom	SFC John Dominguez, 96th Civil Affairs	Medical Operations in Civil Affairs.
1500-1520		Break Exhibit Showcase	
1520-1550	Grand Ballroom	LTC Douglas Lougee. Brooke Army Medica Center	Pediatrics for SOF Operators.
1550-1640	Grand Ballroom	Capt (Ret) Frank Butler, NAVSOC. Moderator	Panel Discussion and Review: Recent TC3 (Tactical Combat Casualty Care) Updates.
1640-1710.	Grand Ballroom	COL (Ret) Robert Saum, President, SOMA.	Annual SOMA Membership Meeting and Report of SOMA Officers. Election: SOMA President SOMA Treasurer
1715-1830	Grand Ballroom		SOFMH 2 Review Board Meeting
1800-1820			Gather for Mess Night
1830-2100	Grand Ball Room	Mess Night	
		WEDNESDAY, DECEMBER 17, 2008	
0700-0800	Florida Ballroom	Continental Breakfast	With Exhibitors
0700-1700	Office 1-2		Registration
0700-1030	Grand Ballroom Foyer		Abstracts
1000-1700	Gallery	SOMA County Store	
1000-1730	Gallery	USUHS	CME Sign In
TIME	**LOCATION**	**SPEAKER**	**PRESENTATION**
0800-0830	Grand Ballroom	Maj Rob Schultz ,USASOC	SOF Medical Logistics.

)830-0900	Grand Ballroom	LTC John Kragh, MD USAISR	New Research for Tourniquet Use.
)900-0930	Grand Ballroom	Major Dirk Geers, Belgian SOF	Belgian Army SOF in Chad-Medical Aspects of Special Operations in a EU Stability Operation
)930-1000	Grand Ballroom	Capt Justin Schlanser DVM, 75th Ranger Regiment	Military Working Dogs - Common Combat Injuries and Treatment
000-1020	Florida Ball Room	BREAK & EXHIBITORS SHOWCASE	
020-1200	Florida Ballroom	Exhibitors Breakdown and Leave	
020-1050	Grand Ballroom	Rick Hammeshar, MD USSOCOM CEB	Management of Non Battle Related Knee and Ankle Injuries in Austere Environments.
050-1120	Grand Ballroom	LTC Kathleen Farr, USASOC, Capt Scott Gilpatrick USSOCOM PA	USSOCOM ATP Program-What the SOF Medic is Doing Today
120-1150.	Grand Ballroom	COL Dave Ludlow, MD 19th SFG(A) Group Surgeon.	Principles of OB-GYN for SOF Operators.
150-1300		Lunch on your own	
330-1700	Grand Ballroom Salon E	Centers for Excellence (DCoE) for Psychological Health (PH) and Traumatic Brain Injury (TBI) Moderator: CDR Arita Topics: "Building Resilience" COL Greene CDR Jerry O'Toole "Mild TBI Assessment and Management in a Deployed Setting" COL Jaffee, K Helmick Mild TBI Assessment and Management in a Deployed Setting	Strengthening The Force-Enhancing Psychological Health Readiness
330-1700	Grand Ballroom Salon I J	Dr. Alan Frankfort, MAJ Joachim Sahm, MD et al	Airway Management For SOF Operators: Lecture and hands on session- pig tracheas and mannequins are used to demonstrate latest airway techniques.
330-1515	Grand Ballroom Salon D	Col Dave Ludlow, MD	Lectures and Hands on Review of Basic Suture techniques.
515-1700	Grand Ballroom Salon D	COL Seth Izenberg, MD Burn Trauma/Flight Surgeon, Western Regional Medical Command	Burn and Wound Care in the Austere Environment - Lecture and Hands on Demos
330-1700	Grand Ballroom Salon F	Moderators : LCDR Steve Kriss, DO WMS, CAPT (Ret) Edward "Mel" Otten WMS, US Navy	Wilderness Medicine 1 Lectures and hands on Demos Including Tropical Diseases, Ortho TX. In Remote Areas, Snake and Insect Bites
330-1700	Grand Ballroom Salon A-B	Maj Don Goss, Ft. Bragg; Mr. Wood. Navy Special Warfare Research Group 2.	Concepts in Rehabilitation and Human Performance. Session 1- Topics include Review NSF Human Performance Optimization (Screening), Fundamentals of Movement, Military PT Practice
330-1700	Grand Ballroom Salon G-H	LTC Joes Baez, USSOCOM	Display, New SOF Medical Equipment, including Equipment for USASOC, USSOCOM, and Other Agencies.

1330-1500	Grand Ballroom Salon C	COL Chester "Trip" Buckenmaier MD	Lecture and Hands on Review of Regional Block Techniques for SOF Operators
1500-1700	Grand Ballroom Salon C	Maj. Bronson White, DO	Osteopathic Manipulation for the Field Lecture and Hands on Review of Proper Techniques
1900-2300	MR 10	USSOCOM CEB Command Surgeons Dinner (Invited only)	
THURSDAY, DECEMBER 18, 2008; 0700-1200			
DATE/TIME	**LOCATION**	**SPEAKER**	**PRESENTATION**
0700-0800	Grand Ballroom Foyer	Continental Breakfast	
0700-1300	Office 1-2		Registration
0800-1200	Gallery		SOMA County Store
0800-1730	Gallery	USUHS	CME Sign in
0800-1730	Gallery	TRUE Staff	CEU distribution
0800-1520	MR 4	60 people	Army Meeting??
0700-0800		Blast Conference Material Distribution	
0800-1700	Florida Room	Steven Scott, MD Coordinator	Blast Conference
1200-1300	MR 1	Blast Conference Lunch invited only	
0800-1700	Grand Ballroom Salon G-H	LTC Jose Baez, USSOCOM	Display, Lecture and Hands on Review: New SOF Medical Equipment, including Equipment for USASOC, USSOCOM, and Other Agencies.
0800-1000	Grand Ballroom Salon F	Erik Schobitz, MD Shady Grove Hospital	Pediatrics for SOF Operators- Review of principles of pediatric care for war zones
1000-1100	Grand Ballroom Salon F	Jim Kreter, MD Loma Linda University Medical Center	Field Eye Care; Tips and Techniques for the Austere Environment
1100-1200	Grand Ballroom Salon F	Capt Gerald Depold, JSOMTC	Need/Use for Adaptive Eyewear for Indigenous Forces
0800-1200	Grand Ballroom Salon I-J	LTC Andy Pennardt MD, Robert Hesse, Ft. Bragg.	To CRIC or not to CRIC: Lectures and hands on review of latest airway access techniques for SOF Operators.
0800-1200	Grand Ballroom Salon E	Moderator: COL (Ret) Warner Anderson, Director, International Health, Office Assistant Secretary for Medical Affairs	Reestablishing Health Care Systems After War. Lectures and Panel Discussion: Examples include Iraq, Afghanistan.
0800-1200	Grand Ballroom Salon D	0800-0900; Capt Peter Christensen, Danish SOF-"Strength and Rapid Muscle Force Profile After Long SOF Operations" 0900-1000: LTC Pat Garman-Officer Surgeon General "Update of DOD Immunization Program" 1000-1100: Capt Nick Barringer, 75th Ranger Regiment "Misuse of Diet Supplements" 1100-1200 Kieran Clark, Oxford University "DARPA Study -Ketone Use for Maximizing Physiological Performance"	Minuteman Lecture Series

0800-1200	Grand Ballroom Salon A-B	0800-0810: Introduction, MAJ Amy Young, 97th CA BN Surgeon 0810-0900 "SOF Civil Affairs" SFC John Dominguez, 97th CA, A Co Senior Medic 0900-1000 " Medical Civilian Reconnaissance" SFC Jeffery Bell, 95th CA BDE Senior Medic; SFC Marcus Smith 97th CA C Co Senior Medic 1010-1040 "Civil Affairs Medical Ops, the Dynamic Front" Maj Amy Young 1050-1130 "The MedCAP Mindset" SFC John Dominguez; MSG Patrick Donihoo, 97th CA, BN Senior Medic 1130-1200 Questions/Open Discussion	Civil Affairs Medicine Symposium
0800-1000	Grand Ballroom Salon C	0800-9000 LTC Robert Forsten, DO USASOC Command Psychiatrist. "Comorbidity and Combat: PTSD and TBI at Ft Bragg" 0900-1000 LTC Ben Solomon Chief, TBI and Neuro-Rehab Ctr. "Use of Intensive Cognitive Rehabilitation for Mild TBI"	TBI and PTSD and TX in the SOF Community
1000-1200	Grand Ballroom Salon C	1000-1100 "Review of European TCCC Concepts" MAJ Florent Josse MD/ LTC (Ret) Karsten Ladehof, Germany 1100-1200 - "Yearly Review of TREMA" LTC (Ret) Karsten Ladehof, Germany, President of TREMA	European TCCC Review Session
1300-1700	Grand Ballroom Salon I-J	Moderator: Maj Steven Baty, DVM, USASOC Veterinarian	VET Techniques for the SOF Community. Lectures and hands on sessions reviewing vet techniques SOF operators
1300-1500	Grand Ballroom Salon D	COL Seth Izenberg, MD - Burn Trauma/Flight Surgeon, Western Regional Medical Command	Burn and Wound Care in the Austere Environment - Lecture and Hands on Demos
1500-1700	Grand Ballroom Salon D	Maj Gerold Kouchi Group Dentist,20th SFG (A)	Dental Review for SOF Operations -Review of DX and TX of Dental Issues in the Field, Including Extractions, Field Expedient Filling, Trauma

Human Performance Forum

Glenn Mercer, SOCM

This edition provides our readers with updates on two of our projects currently underway at Naval Special Warfare (NSW) East. The first is a set of graphic updates and discussion on a Hydroworx project recently placed into service at the Naval Special Warfare Group 4 (NAVSPECWARGRU4) HQ. After several years of negotiation with both the Amphibious Base Public Works Directorate and Hydroworx engineers, the team decided that the best resolution was a novel engineering technique developed specifically in support of NSW. The device, with all of its HVAC controls and water maintenance systems were installed in a shipping trailer. This unit was then surveyed and certified as a permissible outbuilding for this area of the base. While not a heavy tare weight as a dry system, it failed to meet load tolerances as a suspended load inside the HQ building due the weight of the water. In close consult with the Navy civil engineers, representatives from Hydroworx initiated this novel design concept to bring the capability to fruition. Figure 1 provides a longitudinal view of the work area. This particular model has a two-patient capacity depending on the modalities that the staff is using. Special features include gait analysis camera (with capture), high velocity jet for tissue work, and directional head jets for stationary swimming or additional resistance for their reconditioning patents. Additional information on Hydroworx capabilities can be found at http://www.hydroworx.com/. Specifically this is a 1000 series model selected by NAVSPECWARGRU4 Athletic Trainers for specific requirements.

Figure 2 depicts the installation site and shipping trailer. Coastal Virginia is subject to hurricanes and severe Nor'easters. The HQ building in the background is essentially at sea level with a wet slip on the north side. Floods on the first deck where the human performance and rehab spaces are located are annual events. However, a significant advantage of this system is that it can be married up to a tractor, drained within hours, and moved to a secure location.

Figure 1

Our second update is on the University of Pittsburgh Human Performance Initiative (HPI) located at NAVSPECWARGRU2. Having commissioned in April after significant IRB negotiations with Portsmouth Naval Medical Center, the project is now functional. Initially planned as a two year effort through Office of Naval Research it appears that data streams are accelerating from the investigators working full time on site. Having had

Figure 2

This has the potential to be the first piece of an objective study that compares Operators to a SOF baseline versus some arbitrary or assumed similar sports-based pattern. We have long held that this occupation is analogous or comparable to many sports and some demanding occupations, but precisely similar to none. It was an essential point of performance that the investigators were able to access large num-

the opportunity to be one of the NSW reps to co-draft the objectives with the project lead, I am pleased to see this effort showing daily yield. While the study aims and objectives are not blinded, it is appropriate to keep the primary mission retained within Special Warfare at this time. The HPI concept as a solution and intervention set is clearly dependent on the results of the data points that are now accumulating.

Figure 3

Figure 4

bers of SOF personnel in the deployment cycles with a frequency to account for the many training variables we experience. Pictured in Figure 3 is one of our personnel being tested for cardio respiratory capacity.

Leveraging state–of-the-art science remains a critical node for assessing or commissioning a science effort inside the wire. Inter-deployment training schedules are precise with little room for wasted time. Consideration of a task statement or pre-proposal must meet litmus tests regarding common sense, yield to the community, and capacity to bring cutting edge science to the process. Figure 4 depicts a subject in the middle of activity analysis. Specifically, deceleration patterns and sheer forces that are captured by high-speed, high-resolution cameras with sensors (reflective points, lower torso).

Time and data will reveal if our suspicions regarding conventional SOF physical conditioning and capacity were correct. In either case, it appears that the progressive changes made in the last four years are working and are substantiated by the data points in NSW East. Presently, three major Echelon III commands provide performance and rehabilitation services with full-time staffs. Two of them have commissioned performance studies from the University of Pittsburgh and Old Dominion University that are executing concurrently. The recently approved Warfighter Performance and Rehabilitation Center (WRPC) should only accelerate these organic efforts to their maximum potential. It is expected that by the start of fiscal year 2010, these three commands will be the exemplar models for all of DoD.

Picture This...

Timothy Shapiro, CRNA, MS
Kevin Paicos, 18D

Situation:

A 10-year-old male patient presents for care at a clinic in Farah Province, Afghanistan. He has a history of a rash that encompasses the face, arms, and hands. A language barrier exists and no further history can be elicited. Using the *SOF Medical Handbook* as a resource, how would you describe the physical appearance of the following individual? We faced a similar situation and the following is our synopsis aided by the JSOM Operational Tele-dermatology consult. What is your assessment?

DESCRIPTION

This is a pigmented, nonpruritic, macular, and papular rash. The father, the primary historian, states he noticed the onset of symptoms one year ago. The rash is asymmetric, has clearly demarcated borders, and covers all sun-exposed areas of the face, torso, and antero-posterior aspects of the arms and hands. The rash is sclerotic and the skin of the face and hands has a leather-like texture. His face is deeply scarred and shows excessive hair growth for his age. There are fibrotic changes to his left auricle. Sparse vesicles and small bullae are present on the posterior right hand. The distal phalanges are shortened and insensate to pin prick; motor function is intact. His feet are normodactyl and unaffected. He has no constitutional symptoms or cognitive dysfunction, and he interacts normally for his age. His appetite is normal. Vital signs are unremarkable and his family history is unremarkable. By birthright, he is the second eldest with three sisters and one brother, all of who are asymptomatic by history. Parental permission was obtained to photograph the child who also gave his consent.

ANSWER

Following a tele-dermatology consult derm.consult@us.army.mil, the child was diagnosed with a form of porphyria. Broadly defined, porphyria is a disorder caused by abnormalities in the chemical production of heme, a component of hemoglobin found in blood, bone marrow, and the liver. It occurs as a result of mutations in one of the genes required for heme production, and it is classified as hepatic or erythropoietic, which is determined by the source of the enzyme deficiency. Regardless, both classes entail the accumulation of substances known as porphyrins. This young boy has congenital erythropoietic porphyria (CEP), also known as Günther Disease.

EPIDEMIOLOGY

Registries for porphyria are nonexistent, which complicates the reporting of the disease. Although porphyria is common, occurring worldwide with an incidence between 1:500 and 1:50,000, CEP is extremely rare. Less than 300 hundred cases have been reported up till 2000, with a wide array of nationalities involved. This disease occurs equally among males and females, with no racial predilection and the prognosis is generally good. Sources indicate afflicted individuals may live well into the 4th to 6th decade of life.

PATHOGENESIS

While the majority of genetic porphyrias are expressed via a dominant inheritance, CEP is a genetic disorder that follows an autosomal recessive mode of inheritance. Therefore, expression of the disease requires both parents to possess the genetic defect and pass it to the fetus.

CEP is the result of a genetic mutation in the UROS gene, producing a deficiency in the quantity of uroporphyrinogin-III synthase (URO-III). URO-III is an enzyme that catalyzes the production of heme in the red blood cell. The deficiency of this enzyme prevents hydroxymetilbilene (HMB) to undergo further efficient metabolic degradation. As a result, approximately 85-90% of HMB undergoes a reaction known as decarboxylation via another path into intermediate compounds. This intermediate compound undergoes no further degradation and a compound called coproporphyringen-I accumulates.

This results in excessively elevated levels of porphyrins. Porphyrins then accumulate in the erythrocytes, bones, skin, and other body tissues and are excreted in urine and feces. Their deposition into bone and teeth can cause osteopenia and a reddish discoloration (erythrodynia). The prevalence of porphyrins in the integument are photo reactive and oxidized by ultraviolet (U/V) light. This spectrum is present in sunlight and fluorescent lights, and any unprotected skin will succumb to a wide array of cutaneous dysfunction. These compounds also affect the liver and spleen and may cause anemia, enlargement, and dysfunction.

Clinical Discussion

The child depicted was seen in the clinic on a second occasion after the tele-derm consult was established. Additional pictures were shared and further research of the disease conducted. Symptoms typically begin in infancy although recognition may be delayed until they become more profound in later childhood or early adolescence. Although rare, a review of the literature also describes a sparse population who experience this disease very late in life, usually as a result of chemical or medicinal exposures. Signs and symptoms vary by type, but all of the cutaneous forms are characterized by skin photosensitivity, redness, blistering, pigmentation changes, secondary infection, scarring, anesthesia, and increased hair growth.

The primary symptom is extreme, season-related skin photosensitivity. Simple exposure to sun, including light filtered through window glass, may induce symptoms. The exposure sensitizes the skin, which typically becomes tender and often develops vesicles and bullae. When viewed with a Wood's lamp, the fluid contained will fluorescence a pinkish-purple. Once the lesions rupture, the dermis is left reddened and extremely sensitive. Once ruptured or avulsed, this protein medium may be colonized and infection may ensue. The product is delayed healing, leading to eventual scarring and mutation of the exposed skin. Pigmentation changes are due to porphyrin accumulation and the ensuing sclerosis. Digits may become clubbed or shortened and show hypertrichosis, an excessive growth of hair, which is sometimes referred to as "werewolf hand." In this case, all of these symptoms were assessed with the exception of the fluorescence. In the absence of a Wood's lamp, this could not be tested. Additionally, laboratory analysis could not document hematological findings, although approximately 25% of the cases have been documented to be anemic.

Hemolytic anemia and hepatomegaly can be mild or severe in this form of porphyria. Labs were not available and no palpation of the patient's abdomen was performed at the initial visit, but on follow-up, both were present. Severe anemia can lead to bone fragility and a history of fractures, but was not likely in this case. While the oral mucosa was pink, the reddish discoloration of accumulated porphyrians may discredit the assessment of the

gingiva. However, the child did not demonstrate exertional dyspnea or a resting tachycardia. The vesiculobullous lesions are also common on all other sun-exposed skin, including the face, ears, neck, arms, and legs, where the pattern of repeated seasonal exposure, tissue necrosis, secondary infection, and scarring occur. Such disfigurement may contribute to psychosocial dysfunction and loss of self-esteem. This patient presented with involvement of all sun-exposed skin, especially the face and left ear, and very limited involvement of the anterior thorax and abdomen. Destruction of auricular and nasal cartilage, common in advanced cases of CEP, had not yet appeared in this young patient.

CEP discolors the urine red (which may also fluoresce when inspected with a long-wave UV light), as well as the teeth due to the deposit of porphyrins in these tissues. The initial examination did not detail inspection of the child's urine. Keratoconjunctivitis with visual loss may appear, but neither was present in this patient. This manifests when scarring of the face results in lagophthalmos, the inability for the eyelids to protect the ocular globe. Following completion of this research it was decided to return the patient to the clinic for a follow-up evaluation, further online consultation if needed, and discussion of therapy with the parent.

Diagnosis/Treatment

The only definitive treatment for this disorder is allogeneic bone marrow transplantation. This treatment has been shown to restore full enzymatic function in limited patients, and improve the function in others. Unfortunately, this treatment is cost-prohibitive and unavailable in Afghanistan. As a result only symptomatic care could be rendered. Therapies include reinforcement of sun avoidance, especially at peak solar intensity, complete covering of skin surfaces, and the use of wide-brimmed hats and gloves when not feasible to avoid U/V exposure.

Topical sunscreens with physical, light reflective agents such as zinc oxide or titanium oxide are also helpful and are available locally. The use of oral vitamin E and C has been shown to be of limited therapeutic effect but is an available regimen (antioxidative properties). Finally, topical eye lubrication can help ameliorate visual impairments associated with this disease. The patient was given all of this information, as well as two pairs of light gloves, a supply of vitamins, eye lubrication, and sunscreen and a referral to return to the clinic for further care.

He was seen three weeks after these instructions were provided. No new symptoms had arisen and he improved, as manifested by his body being devoid of bullae or vesicles. His father indicated all instructions were being followed, although on this occasion the boy had only a baseball-style cap, and open sandals. The father was given more vitamins, eye lubrication, sunscreen, and the need for a wide-brimmed hat and the use of "close-toe" shoes was reiterated.

In our experience, the utility of tele-medicine proved invaluable. Initially, our limited resources supported a diagnosis of leprosy. While outside the scope of this article, misdiagnosis would change the therapy and could have exacerbated his symptoms. We hope this discussion demonstrates the utility of the Operational Tele-dermatology site at derm.consult@us.army.mil. Their direction, resources, and expertise were prompt and concise, proving invaluable to the deployed healthcare provider. By forward thinking and utilizing consultations, you truly elevate the quality of care, exemplifying our motto…..*De Oppresso Liber.*

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SSG Kevin Paicos is an 18D with the 20th SFG(A) currently attached to the 3rd SFG(A) deployed in Afghanistan. SSG Paicos has been an 18D with service in the 1st Grp., 10th Grp., and 11th Grp. (Reserve). His prior service has included tours in the Philippines, Okinawa, Taiwan and Denmark.

CPT Shapiro is a reservist assigned to the AMEDD Army Professional Medical Command (APMC) and is currently deployed with the 948th Forward Surgical Team in Al Kut, Iraq. Originally enlisted as a medical specialist and a practical nurse, he later reclassified as an infantryman prior to receiving a commission. He is a nurse anesthetist and a 2006 graduate of the Excela School of Anesthesia. His service affiliations include Fitzsimons Army Medical Center (AMC), the 339th CSH, the 48th CSH (FWD), and the 1-112 INF(M) in the Pennsylvania Army National Guard.

COL Daniel Schissel originated "Picture This" for the Med Quiz. He is a 1993 graduate of the Uniformed Service University of the Health Sciences and completed his internship with the family practice department at Fort Bragg in 1994. He then served as the 2/10th Special Forces Group (Airborne) Surgeon and followed on as the 10th SFG(A) Group Surgeon. He completed his residency training in dermatology at the Brooke Army Medical Center in 1999. COL Schissel is presently stationed in Heidelberg, Germany as a staff physician and the European Regional Medical Command Dermatology Consultant. He has been selected as the U.S. Army OTSG Dermatology Consultant. COL Schissel has authored the dermatology section of the new SOF manual, serves on the USSOCOM Medical Curriculum and Examinations Board, and is the U.S. Army Aviation Dermatology Consultant.

Dyspnea Following Initial Scuba Diving Training

Bradley Hickey, MD; Joe Alcock, MD, MS; Rick Kulkarni, MD; Luis Soler
Release Date: April 23, 2008

Goal
The goal of this activity is to reinforce and highlight common concepts, situations, and presentations that healthcare providers will encounter on a regular basis in order to provide supportive continuing education that illustrates real-world conditions and situations.

Learning Objectives
Upon completion of this activity, participants will be able to:
1. Recognize the usual presentation of a commonly encountered medical condition in clinical practice.
2. Generate an appropriate list of medical conditions that can result from pulmonary barotrauma.

Background

A 27-year-old man presents with progressive dyspnea following an initial scuba-diving training session. He states that he felt normal and did not have any difficulty breathing immediately following the training dive; however, approximately one hour after the dive, he began to feel some mild chest tightness directly under his breastbone. Over the next eight hours, his chest tightness progressed to difficulty breathing with a frequent, nonproductive cough. He states that any physical exertion worsens his shortness of breath, whereas drinking cool water improves it. The patient remembers that he accidentally held his breath as he ascended from a depth of approximately 12ft to a depth of 10ft of freshwater in a swimming pool. He explains that he had been instructed to not hold his breath on ascent; however, he had become distracted and did not realize he was ascending.

On physical examination, the patient is an anxious-appearing, healthy young man with mildly labored breath-

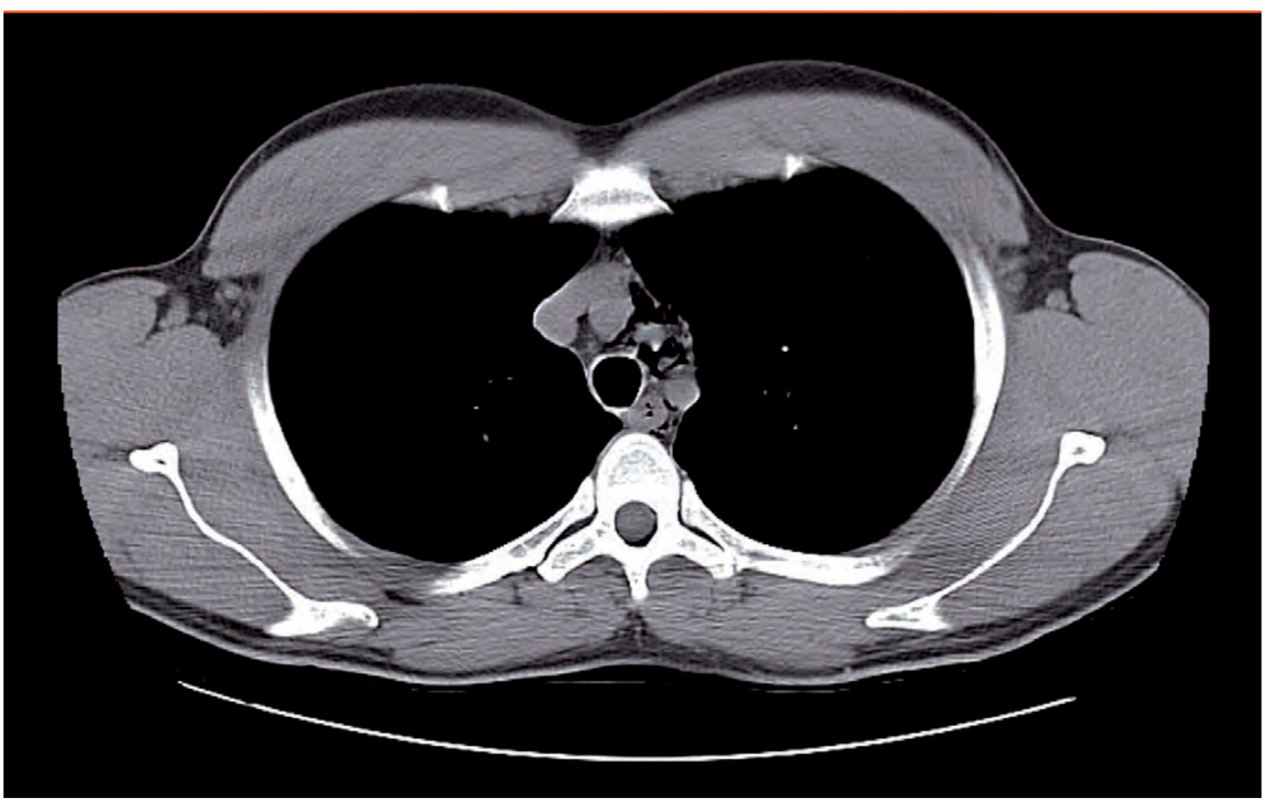
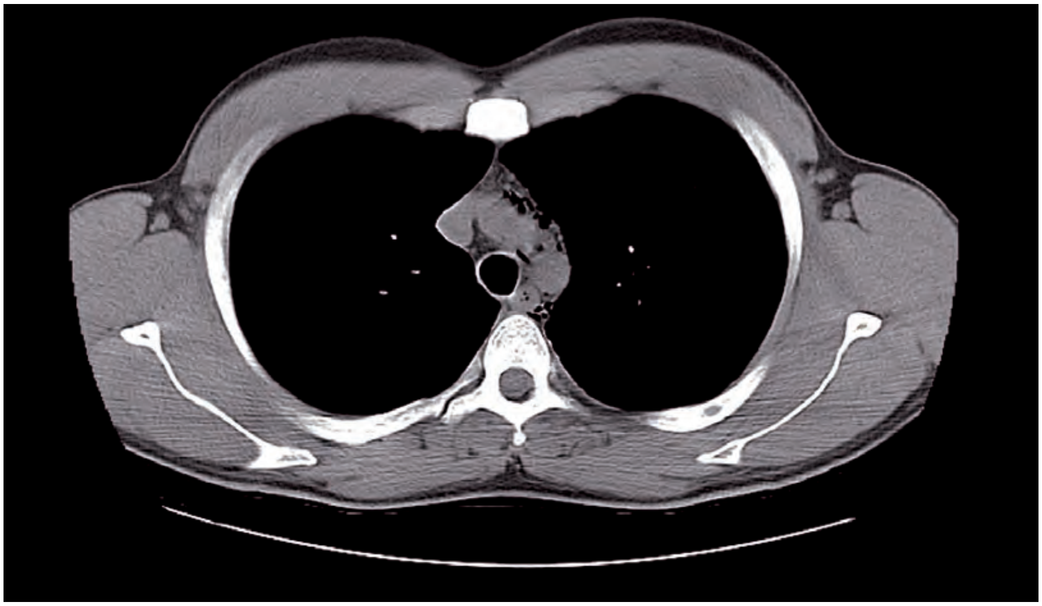


Figure 1



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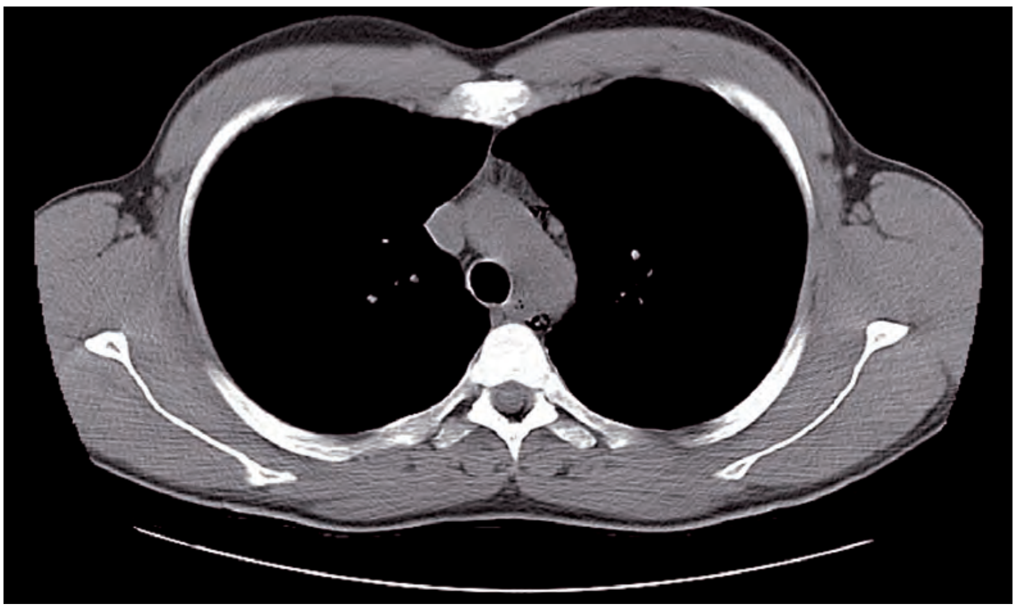

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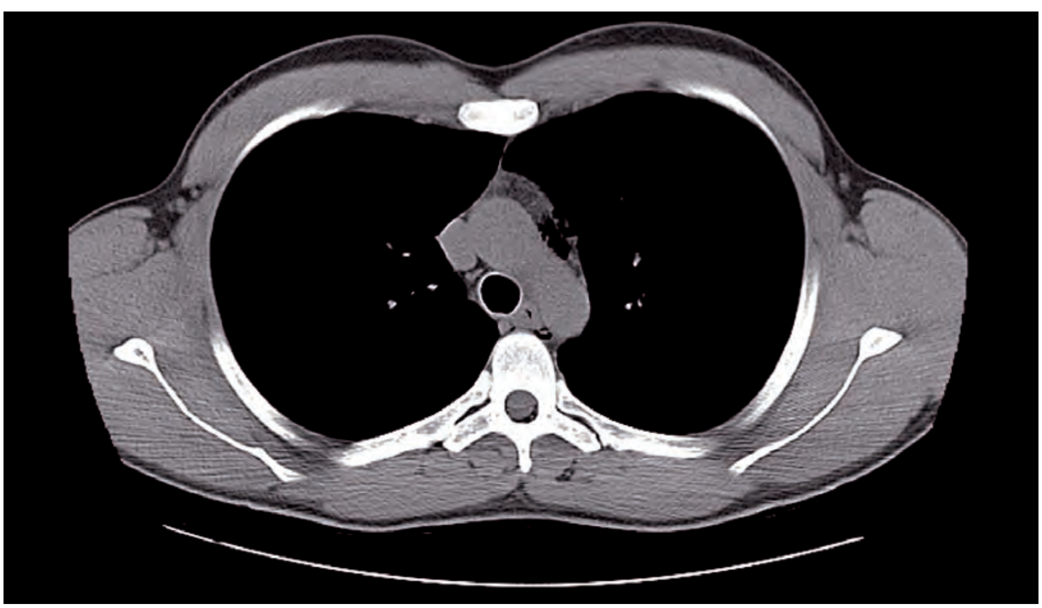

Figure
4

ing. He has a pulse rate of 71 bpm, a blood pressure of 129/85mm Hg, a respiratory rate of 16 breaths/min, and an oxygen saturation of 98% while breathing room air. Auscultation of the lungs reveals clear breath sounds. There is no dullness to percussion throughout the lung fields. His speech is normal; his neck is without fullness, jugular venous distention, tracheal deviation, or subcutaneous emphysema. There is no pedal or extremity edema present. The heart sounds are normal. The neurologic examination reveals no deficits. The remainder of the physical examination yields no abnormalities.

A chest radiograph is unrevealing. Computed tomography (CT) scans of his chest are obtained (see Images 1-4).

Internal question

What is the cause of this patient's dyspnea?

Hint:
The cause is one of five conditions that can result from pulmonary barotrauma.

Myocardial Infarction
Acute Respiratory Distress Syndrome
Pneumomediastinum
Pneumonia
Pulmonary embolism

Discussion

The CT scans reveal abnormal mediastinal gas or pneumomediastinum. The lungs are otherwise well expanded without evidence of pneumothorax, pneumopericardium, subcutaneous emphysema, or other abnormalities. Pneumomediastinum is one of five conditions that can result from pulmonary barotrauma or pulmonary overinflation syndrome (the others are arterial gas embolism, pneumothorax, subcutaneous emphysema, and pneumopericardium). The underlying pathologic process of pulmonary barotrauma occurs when gas expansion in the lungs ruptures the lung tissues and dissects into the adjoining tissue. Once lung tissues rupture, the trapped gas, which is at a relatively high pressure, will seek an area of relatively lower pressure. In this case, the escaping air from the lung ultimately resided in the mediastinum. Carolan and Vaughan stated that "the generally accepted explanation for the development of PM [pneumomediastinum] is that free air tracks from ruptured peribronchial vascular sheaths toward the hilum of the lung. From there, it extends proximally to the mediastinum."[2] Although the various factors that predispose a person to pulmonary barotrauma have been well elucidated, the actual injury mechanism is not well understood.[3]

The underlying physics include the following. Pulmonary barotrauma while diving is directly related to Boyle's law, which states that, at a constant temperature, the volume of a gas varies inversely with its pressure. As a result of Boyle's law, gas inhaled while a diver is at a lower depth will expand as the diver ascends toward the surface. In general, the expanding gas is allowed to escape through the glottis as the diver breathes while ascending. If a diver's glottis is closed, as in breath holding, the expanding gas causes pulmonary overpressurization. Air trapping caused by asthma, chronic obstructive pulmonary disease (COPD), and blebs can predispose a diver to pulmonary barotrauma.

The clinical presentation, diagnosis, and treatment of pneumomediastinum can vary greatly. The most common presenting signs and symptoms are chest pain, dyspnea, dysphonia, and the presence of other conditions that can result from pulmonary barotrauma. The diagnosis of pneumomediastinum is dependent upon imaging studies. Chest radiography is the most common method used to diagnose this condition. However, although this imaging modality may be insensitive, it is still useful as a first-line modality that can also detect other coexisting injuries, such as a pneumothorax. In the event that pneumomediastinum is suspected but not detected on chest radiographs, CT scanning should be performed. In this case, the chest radiograph was normal; however, a significant amount of mediastinal air was noted on the CT scans.

The treatment of pneumomediastinum is dependent upon the clinical presentation. Most cases of pneumomediastinum will resolve spontaneously, and no further therapy is necessary other than administration of supplemental oxygen to hasten the process of mediastinal air absorption. The increased amount of consumable oxygen and decreased amount of inspired inert gas (ie, nitrogen) help to provide an increased gradient for trapped air to return into solution. In the case of a very large amount of trapped mediastinal air, a patient may present with respiratory compromise secondary to poor ventilation or with cardiovascular compromise secondary to increased intrathoracic pressure and decreased venous return. In either situation, immediate surgical intervention is warranted. There have been reports of percutaneous drainage being effective; however, mediastinoscopy and thoracotomy remain the primary treatments.[2]

The following conditions can also occur as a result of pulmonary barotrauma:

The potential space between the lung and chest wall provides an area where escaping trapped air due to pulmonary barotrauma can eventually cause a pneumothorax. The most common presenting signs and symptoms of a traumatic pneumothorax are chest pain, dyspnea, tachycardia, decreased or absent breath sounds, increased resonance on percussion, decreased chest wall movement, and, in the case of a tension pneumothorax, tracheal deviation, jugular venous distention, hypotension, and cyanosis.[1] Tension pneumothorax is an emergency that requires immediate intervention. A needle thoracentesis can be a temporizing measure; however, definitive treatment will require the placement of a thoracostomy tube. In the case of a simple or nontension pneumothorax, the treatment may range from observation with spontaneous resolution to the placement of a thoracostomy tube (depending upon the clinical presentation of the patient).

An arterial gas embolism (AGE) is the result of lung tissue rupture with injury to the pulmonary vasculature. This type of injury shunts air into the pulmonary venous circulation, which is then distributed to end organs, such as the brain, through the systemic circulation. The most common signs and symptoms of an AGE are cranial nerve deficits, paralysis or weakness, poor coordination, sensory abnormalities, and unconsciousness. Additionally, the signs and symptoms of an AGE will manifest very quickly following pulmonary barotrauma. In fact, more than 98% of AGEs manifest within 10 minutes following the initial trauma. An AGE requires immediate action because it closely resembles a stroke or an end-organ infarction. The length of time it takes to get a patient to definitive treatment is directly correlated to the amount of end-organ tissue ischemia and irreversible hypoxic injury at presentation. A patient should be immediately placed on 100% oxygen, if available, for transport to the nearest hyperbaric oxygen treatment facility. Hyperbaric oxygen therapy will force any remaining gas within the systemic arterial system back into solution, thus restoring normal blood flow. Additionally, hyperbaric oxygen helps supply oxygen to ischemic areas that would otherwise progress into irreversible hypoxic injury.

Jouriles stated that "pneumopericardium is caused most commonly by an increase in intra-alveolar pressure above atmospheric pressure, resulting in rupture of alveoli. Air dissects into the hilum and mediastinum, through the pericardial reflection on the pulmonary vessels, and into the pericardium."[4] Like other conditions that can arise from pulmonary barotrauma, pneumopericardium can range from clinically insignificant to a life-threatening situation. A hemodynamically stable patient with pneumopericardium can be observed as the condition resolves. Anecdotally, a brief treatment of 100% oxygen may speed up the reabsorption of gas from the pericardium. If a pneumopericardium results in hemodynamic instability, an emergency pericardiocentesis is indicated.

Subcutaneous emphysema arises when air dissects the pulmonary interstitium and ultimately resides in the subcutaneous tissues. The diagnosis of subcutaneous emphysema can be made via physical examination or with ancillary studies (ie, chest radiography or CT scanning). On physical examination, the skin will have notable crepitus on palpation. Additionally, the locally affected area will appear full. The presence of air within the subcutaneous tissues on chest radiographs or CT scans is diagnostic of subcutaneous emphysema, which, unlike other conditions that arise from pulmonary barotrauma, is benign. Subcutaneous emphysema is unlikely to be an isolated finding after pulmonary barotrauma; therefore, a complete physical examination and ancillary studies are warranted to evaluate for the presence of AGE, pneumothorax, pneumopericardium, or pneumomediastinum.

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COL "Rocky" Farr was the distinguished honor graduate of his Special Forces 18D class in 1968 and completed 41 years of active service last April. He served as a recon team member with the 5th SFG(A) in SOG-Studies and Observations Group. He attended the DLI (German) and joined Detachment A, Berlin Brigade, an early special mission unit. He became the SF instructor at the ROTC Detachment, Northeast LA University and completed his BS. As a SFC, he taught in the 18D course and was selected for MSG. COL Farr was accepted to the Uniformed Services University of the Health Sciences and while a medical student, he was the medical platoon leader for the 11th SFG(A). He received his MD in l983 and has completed residencies in aerospace medicine, and anatomic and clinical pathology. He commanded Company F (ABN), 3rd BN, Academy BDE, Academy of Health Sciences as Course Director of the Special Operations Medical Sergeant's Course; and advisor to the 12th SFG(A). He was Chief, Department of Pathology, Blanchfield Army Community Hospital, and Flight Surgeon, 50th Medical Company (Air Ambulance), 101st ABN Division (Air Assault). COL Farr was the Division Surgeon of the 10th Mountain Division (Light Infantry) until becoming Deputy Commander of the U.S. Army Aeromedical Center. He attended the Air War College before becoming the Deputy Chief of Staff, Surgeon, U.S. Army Special Operations Command; Command Surgeon, U.S. Army Special Forces Command; and Command Surgeon, U.S. Army Civil Affairs and Psychological Operations Command. He became the Command Surgeon of the U.S. Special Operations Command in Tampa, FL in July 2006. He has numerous operational tours to include Bosnia, Kosovo, Kuwait, Vietnam, Cambodia, and Afghanistan.

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Pararescue Creed

I was that which others did not want to be. I went where others feared to go, and did what others failed to do. I asked nothing from those who gave nothing, And reluctantly accepted the thought of eternal lonliess ... should I fail. I have seen the face of terror; felt the stinging cold of fear, and enjoyed the sweet taste of a moment's love. I have cried, pained and hoped...but most of all, I have lived times others would say best forgotten. Always I will be able to say, that I was proud of what I was: a PJ It is my duty as a Pararescueman to save a life and to aid the injured. I will perform my assigned duties quickly and efficiently, placing these duties before personal desires and comforts.

These things I do,

"That Others May Live."

A Navy Poem

I'm the one called "Doc"... I shall not walk in your footsteps, but I will walk by your side. I shall not walk in your image, I've earned my own title of pride. We've answered the call together, on sea and foreign land. When the cry for help was given, I've been there right at hand. Whether I am on the ocean or in the jungle wearing greens, Giving aid to my fellow man, be it Sailors or Marines. So the next time you see a Corpsman and you think of calling him "squid," think of the job he's doing as those before him did. And if you ever have to go out there and your life is on the block, Look at the one right next to you...

I'm the one called "Doc".

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