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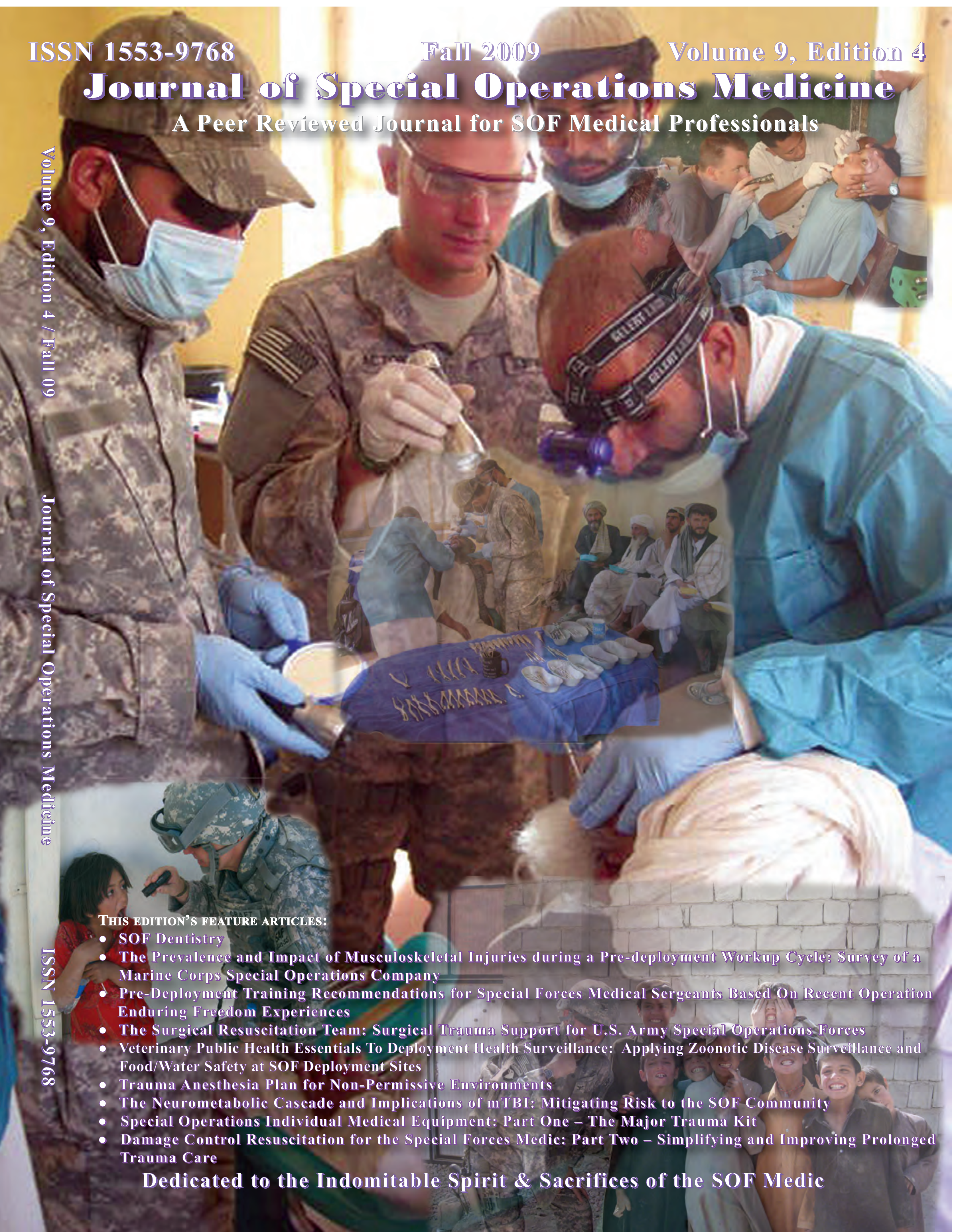
A Peer Reviewed Journal for SOF Medical Professionals



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THIS EDITION'S FEATURE ARTICLES:

- SOF Dentistry
- The Prevalence and Impact of Musculoskeletal Injuries during a Pre-deployment Workup Cycle: Survey of a Marine Corps Special Operations Company
- Pre-Deployment Training Recommendations for Special Forces Medical Sergeants Based On Recent Operation Enduring Freedom Experiences
- The Surgical Resuscitation Team: Surgical Trauma Support for U.S. Army Special Operations Forces
- Veterinary Public Health Essentials To Deployment Health Surveillance: Applying Zoonotic Disease Surveillance and Food/Water Safety at SOF Deployment Sites
- Trauma Anesthesia Plan for Non-Permissive Environments
- The Neurometabolic Cascade and Implications of mTBI: Mitigating Risk to the SOF Community
- Special Operations Individual Medical Equipment: Part One – The Major Trauma Kit
- Damage Control Resuscitation for the Special Forces Medic: Part Two – Simplifying and Improving Prolonged Trauma Care

Dedicated to the Indomitable Spirit & Sacrifices of the SOF Medic

Journal of Special Operations Medicine

Contents

Fall 09 *Volume 9, Edition 4*

Dedication 1

Medic Recognition 2

Feature Articles

SOF Dentistry 3
LTC Robert D. Harrington DMD, MPH

The Prevalence and Impact of Musculoskeletal Injuries During a Pre-deployment Workup Cycle: Survey of a Marine Corps Special Operations Company 11
LT Danny J. Hollingsworth, MPT, OCS, ATC

Pre-Deployment Training Recommendations for Special Forces Medical Sergeants Based On Recent Operation Enduring Freedom Experiences 16
MAJ John Hughes, MD; Maj Teresa Hughes, BSC

The Surgical Resuscitation Team: Surgical Trauma Support for U.S. Army Special Operations Forces 20
MAJ Kyle N. Remick, MD

Veterinary Public Health Essentials To Deployment Health Surveillance: Applying Zoonotic Disease Surveillance and Food/Water Safety at SOF Deployment Sites 26
MAJ Michael McCown, DVM; SFC Benjamin Grzeszak, 18D; SFC Jeffrey M. Rada Morales, 18D

Trauma Anesthesia Plan for Non-Permissive Environments 32
Maj Joshua M. Tobin, MD

The Neurometabolic Cascade and Implications of mTBI: Mitigating Risk to the SOF Community 36
MAJ Stephen M. DeLellis MPAS, PA-C; LTC Shawn Kane MD, FAAFP; Kris Katz PhD, ABPP

Special Operations Individual Medical Equipment: Part One – The Major Trauma Kit 43
MAJ Dirk Geers

Damage Control Resuscitation for the Special Forces Medic: Part Two – Simplifying and Improving Prolonged Trauma Care 53
Michael R. Hetzler 18D; Gregory Risk MD

Editorials 63

Abstracts from Current Literature 65

Previously Published 72

- **Diving Medicine: A Review of Current Evidence**
  James H. Lynch, MD, MS and Alfred A. Bove, MD, PhD
- **OPERATION SAMS**
  Dwight Jon Zimmerman

Book Review 84

- **April 1865: The Month That Saved America**

From the USSOCOM Command Surgeon 86
COL Tom Deal

Component Surgeons 87
COL Peter Benson USASOC
Brig Gen Bart Iddins AFSOC
CAPT Gary Gluck NAVSPECWAR
CAPT Anthony Griffay MARSOC

TSOC Surgeons 94
COL Rocky Farr SOCCENT
COL Frank Newton SOCPAC
Advancing the Art and Science of Medical Plans
LTC Brady Reed

NATO Surgeon 99
LTC Rhett Wallace

USSOCOM Education and Training Update 101
LTC Doug McDowell, APA-C

USSOCOM Medical Logistics 104
MAJ Marc Bustamante

USSOCOM Psychologist 106
LTC Craig Myatt, PhD

Need to Know 113
USSOCOM Care Coalition

Photo Gallery 115

Meet the JSOM Staff 117

Submission Criteria 118

COVER

ISSN 1553-9768

Dental project in southern Afghanistan in 2008. Dr. Craft was detailed from the U.S. Public Health Service to the U.S. Army CJTF 101/NATO Command South/Forward Operating Base in Afghanistan. The U.S. trained a team of local Afghan care providers and gave them the equipment, instruments, and supplies needed to conduct emergency dental clinics in high risk village locations. This program is still operating under the management of an Afghan NGO. *(Photo courtesy of CPT Charles F Craft)*

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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We need continuing medical education (CME) articles!!!! 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

SGT 1ST CLASS WILLIAM B. WOODS JR.

Sgt 1st Class William B. Woods Jr., 31, died Aug. 16 in Landstuhl, Germany from wounds he received Aug. 14 while conducting a mounted patrol in the Ghazni Province, Afghanistan, in support of combat operations while serving with 2nd Battalion, 20th Special Forces Group (Airborne).

He deployed in support of Operation Enduring Freedom in July 2009 as a member of the Combined Joint Special Operations Task Force – Afghanistan. He was a Special Forces senior medical sergeant.

Woods was a native of Hermann, MO and enlisted into the military in 1996 as a rifleman. After his initial Marine Corps enlistment, he later enlisted into the U.S. Army. He attended the Special Forces Qualification Course in 2003 and earned the coveted "Green Beret." He was then assigned to 2nd Bn., 20th SFG (A).

Wood's military education includes the Basic Infantryman's Course, Survival, Evasion, Resistance and Escape Course, Basic Airborne Course, Linear Infighting Neural-Override Engagement Instructor Course, Ranger Course, and Special Forces Qualification Course.

His awards and decorations include the Bronze Star Medal, Purple Heart Medal, Army Commendation Medal, Army Achievement Medal, Navy Achievement Medal, Army and Marine Corps Good Conduct Medals, National Defense Service Medal, Afghanistan Campaign Medal, Iraq Campaign Medal, National Defense Service Medal, Global War on Terrorism Service Medal, Afghanistan Campaign Medal, NCO Professional Development Ribbon, Navy Arctic Service Ribbon, Army Service Ribbon, Overseas Service Medal, Combat Infantryman Badge, Senior Parachutist Badge, Ranger Tab and the Special Forces Tab.

Woods is survived by his wife and two daughters of Chesapeake, VA; and his parents of Pacific, MO.

MEDIC RECOGNITITON

Our medics do great things, and are deserving of praise and heart-felt thanks for the demanding, often heroic duty they perform, as well as for the less sexy, mundane attention to detail that keeps our Operators and support personnel healthy and in the fight. In this column, I would like to acknowledge the diverse contributions of one of our medical logistics NCOs.

MSgt Arnold Guiao, USAF, just completed a tour of duty supporting the JSOTF-Philippines. He excelled in supporting the JSOTF as a logistician, and he pulled double duty supporting our critical care evacuation team, (CCET). His motto seemed to be "anything you need," and everything he did was done very well! He was a vital part of the critical care evacuation team, serving in many roles from medic to driver. Whenever the team was alerted, MSgt Guiao drove the team to the flight line and helped load equipment and casualties onto the aircraft. He remained invested in the mission until the team arrived back at base camp. Upon return, he helped unload and repackage equipment and supplies. He assisted with patient care on the flight line and with patients who presented for sick call. MSgt Guiao was also actively involved in civil-military operations that included local Armed Forces of the Philippines military and civilian hospital personnel. His ability to speak Tagalog and his personable nature were an asset many times over.

MSgt Guiao procured medical supplies with professionalism, always ensuring that missions would be fully supported. His efforts directly contributed to the CCET's ability to provide life-saving care in this JOA. He greatly improved all processes required to procure and manage over 500 line items ($395K) of medical logistics in a combat zone, including a system to accurately track expiring medications and supplies that were critical to mission accomplishment. His use of Prime Vendor Pharm and Prime Vendor Med-Surgical Bergen and Cardinal saved the JSOTF over $30K, and ensured timely delivery of critical shortages. He procured two essential carbon-fiber oxygen cylinders that put an end to a critical shortage of oxygen for transport. Before this, there was insufficient oxygen to transport two critical patients from Mindanao to Manila.

He researched and acquired $55K worth of Patient Movement Items (ventilators, monitors…). This significantly decreased the time of critical patient transports, and has a direct relationship between patient survivability and the efficiency of the CCET.

The teammates MSgt Guiao supported did not think any award bestowed upon him could match his enduring contributions to the JSOTF-Philippines. The intent here is to pay tribute to an outstanding USAF medical NCO and express sincere appreciation for a job well done!

SOF Dentistry

LTC Robert D. Harrington DMD, MPH

Abstract

Special Operations Forces (SOF) medics trained to deliver comprehensive dental care (extractions and fillings) to a population in a contested area can be one of the more important elements in a successful UW campaign. This article will highlight and review an inexpensive, lightweight, highly portable dental system that allows the SOF medic to deliver these vital dental services in the field.

SOF medics properly trained to treat a certain range of dental issues can have a positive impact on the overall mission effectiveness of their deployed team. The most noticeable effect of this training will be with the team's UW mission. The ability of SOF medics to deliver basic dental services (extractions and fillings) to a local population can be one of the most cost effective and productive components in running a successful "hearts and minds" campaign in a contested area. In addition, the ability to definitively treat dental emergencies for associated SOF personnel on deployment can also have a positive impact on unit effectiveness by decreasing the need to MEDEVAC the occasional dental emergency.

Dental clinic can be set up almost anywhere

Local Afghans delivering a patient to the SF medical Clinic

Set up in local Iraq Police Station

This article on the role of SOF dentistry in the UW mission is a compilation of the author's experiences as the Group dentist for the 19th Special Forces Group (Airborne) (SFG(A)) over the past 12 years. This experience includes participating in many multi-week Medical Civil Action Programs (MEDCAPs) in the Pacific region from 1995-2005 and, more significantly, three deployments as the Combined Joint Special Operations Task Force (CJSOTF) dentist in Afghanistan (2004, 2009) and Iraq (2006) with the 3rd, 5th, 7th and 10th Groups. Travelling to over 70 Operational Detachments – Alpha (ODAs) in these three Global War on Terrorism (GWOT) deployments has provided invaluable on-the-ground experiences that have helped determine what dental skills and instruments can be the most useful in the UW mission.

As mentioned above, the running of local health clinics and Village Medical Outreach Program (VMOPs) or MEDCAPs by the ODA at Special Forces (SF) firebases is probably the most effective way to gain local "atmospherics" for an area and to truly connect with the local civilian population. The quality of the medicine that can be delivered in a brief 15 minute encounter can be debated, but the real value is having the local population see the SF members outside of their vehicles and taking a personal interest in their medical problems.

During these UW medical missions with a SOF medical team that has the right skills and equipment, good dental care will be one of the more requested health services by the local population, especially in Afghanistan. This high demand for good dental care is the result of an almost total lack of competently trained dental personnel of any type in the country (with a few exceptions in the major cities such as Kabul and Herat).

The provision of dental care by the SOF medic is a low cost, quick, and definitive procedure that can be delivered in the most austere conditions. This delivery of definitive dental care (fillings or extractions) for an acute problem is a relatively quick and decisive procedure that can contrast with the more indeterminate results on the medical side when providing treatment for chronic, long term conditions like back pain and chronic fatigue.


Even Humvees have been used for dental clinics

The author's recent deployments to Iraq and even more so to Afghanistan as the CJSOTF dentist has reinforced this need for SOF medical providers to have the ability to provide both dental extractions and permanent fillings for the local population they treat. All my previous outside the continental United States (OCONUS) deployments were in the Pacific Command (PACOM) region (Fiji, Nepal, Mongolia, Vanuatu, etc.) and the vast majority of dental procedures performed there consisted of extractions. The Central Command (CENTCOM) region experience has been very different, with upwards of 75% of the dental procedures requested and performed on the local population being permanent restorations utilizing a glass ionomer material (FUJI IX).

This regional variance noted in the type of dental procedures requested (extractions vs. fillings) seems to be related to several factors. One important factor affecting the overall demand for dental treatment in an area involves the local diet. Contrary to common belief, the teeth in the more rural and poor areas of the world like Afghanistan, where there is little exposure to refined sugars, are noticeably better than in areas where the diet has a higher exposure to processed, sugar laden foods like sodas and candy.

Upwards of one-third or more of the local Afghans examined during these local VMOPs and at SF clinics had no observable dental decay. Of the remaining two-thirds, frequently several teeth needed treatment, but there was relatively little note of the rampant decay seen in other areas of the third world, such as the urban areas of Nepal and Honduras (with their higher availability of processed sugars in the diet). Consequently, immediate dental needs in rural Afghanistan were better met by offering a higher ratio of fillings vs. extractions.


Afghan patient, mid 30s with no visible cavities

A second and more complicated factor that affected this relatively higher demand for fillings vs. extractions was the rural Afghan's time frame of living more day to day with a shorter event horizon than we are used to. Whether the result of the hardships of living in grinding poverty with a certain daily level of danger and uncertainty, the perceived benefits of undergoing a treatment now to resolve a future problem did not seem to be as valued by this rural population

On innumerable occasions, a patient was seen with a presently quiescent dental abscess and it was explained in depth that it should be extracted to prevent future discomfort and pain. Many patients refused treatment since they explained that it was not hurting at the moment and did not see the need to extract. The ability to offer fillings as an extraction alternative is important since, invariabl[illegible] patient would agree to a filling on anoth[illegible] orated tooth.

An effective dental program for the ODA can be very cost effective and time productive. Due to the nature of dental problems, the dentist is generally able to more quickly diagnose and determine treatment options for a dental chief complaint than the medical providers can for their patients. Additionally, the dentist can operate up to six or seven chairs simultaneously and the total time for each definitive dental procedure can be as little as ten minutes.

The SOF Portable Dental Kit

The primary objective in developing a SOF dental kit was to put together a highly portable system that can be easily carried by one person and be effectively utilized in even the most remote areas where

SOF teams are operating. Especially in rural Afghanistan, movement by air with larger dental systems that require multiple Pelican boxes is very difficult and more time consuming than using our smaller system. Also, modifying the oral surgery and restorative equipment set and adding such items as FUJI IX restorative material and a wider array of exodontia forceps and elevators allows dentists to perform almost all the definitive dental treatments out in the field (both extractions and fillings).


Portable (electric) dental drill setup


Oral surgery kit

Dental drill kit

The current dental kit used on missions in Afghanistan is a modification of components in the Group Dentist Dental Kit and the 18D Dental Tac Set. The SOF Portable Dental Kit can fit into two small bags – the oral surgery and restorative kit fits into one medic's aide bag and the portable electric dental drill fits into another, smaller case. Everything, including all disposable items like gloves, Cidex® (for cold sterilization when no autoclave available), and gauze, can easily fit into one medium size backpack.

In addition, this compact and light system can be quickly set up and, more importantly, be broken down in only 10 minutes. This is an especially valuable element when one is treating local patients in semi-permissive areas where the security situation can change quickly and a hasty movement may be in order.

Cost Effectiveness of the SOF Portable Dental Kit

Fixed Costs Considerations

The now expanded nine Pelican Box 18D Medical Tac Set has a fairly large footprint. With that in mind, this suggested additional dental equipment set comes with only the minimum equipment required to perform those specific dental procedures that are most requested and will not take up much more additional space. Specifically, the Portable Dental Drill Kit (battery powered and minus the optional solar panel and air-water spray system) costs approximately $2,400 with a government purchase. The Oral Surgery Kit costs about $1600, depending on how many duplicate forceps and elevators are purchased from the basic list. At a minimum, at least three sets of each should be purchased to allow cold sterilization with Cidex®, when no autoclave is available, and one is planning on regularly incorporating DENTCAPs into their UW mission. The total cost for all durable items will come in under $5,000.

Variable Cost Considerations

The variable cost to perform each dental procedure is also very attractive. For an extraction, the cost should be under $5 for each individual extraction. Most fillings will cost around $10 per procedure. The material used for these semi-permanent fillings is FUJI IX, an older generation glass ionomer still used occasionally in the U.S. It is especially effective out at the firebases since it is a hand mixed, powder and liquid material that


Whole kit fits in one mid-size backpack


Fuji IX filling material — powder-liquid combination

doesn't requre any powered instruments to complete the mixing or filling process.

The nice thing about this ionomer is that it can be a one-for-one replacement for the ubiquitous intermediate restorative material (IRM) that has been in service with the SOF Medic's Kit for over 40 years. This restoration material has several major advantages over the traditional IRM. It is much easier to teach a novice

to mix it to a proper consistency than the more difficult IRM, it has a much higher compressive strength (to withstand breakage) and actually chemically bonds to the tooth to increase its overall longevity.

All these attractive attributes, including having a white base color that especially works well on front teeth, results in a very long lasting restoration well received by the rural Afghan civilian and military population. It also would be the material of choice for treating SF team members with broken teeth since in most cases FUJI IX will stay bonded to the affected tooth for many months until the team member can rotate back for more definitive care.

During the author's last three GWOT deployments, an average of six to eight U.S./Allied SOF personnel in each rotation were treated for major dental problems out at the firebases, using mostly FUJI IX fillings. Almost all of these more extreme cases would have otherwise required traveling back to the rear for treatment due to poor air connections; these members could have been lost to the team for up to two weeks or more.

The Portable SOF Dental Kit

1. Suggested extraction (exodontia) equipment

Since most SOF medics associate dental care for the local population through the usual prism of performing extractions, the oral surgical armamentarium that the author used during these rotations is listed first and appears below. Dentists are usually solo practitioners who additionally are creatures of habit, usually going all the way back to their training in dental school. Therefore, many dentists frequently differ on the best exodontia techniques and instruments to use. The following suggestions are the result of considerable trial and error in the field but with the following eight or nine instruments, one can comfortably say that all regular exodontia techniques can be accomplished in the field by SOF medics.

The general principles of exodontia are pretty standard – giving a local dental anesthetic, using an elevator to loosen the tooth, and then using a variety of forceps to complete the extraction. A suggested technique to deliver this dental anesthesia is with a self-aspirating syringe using a plastic, 27 gauge long or short needle. There are many excellent dental anesthetics

now available, but the most common still in use is 2% lidocaine with 1/100,000 epinephrine, in 1.8ml carpules.

The initial loosening of a tooth to be extracted utilizes some type of elevator. While a great variety in the sizes and shapes of elevators exists, with many dentists touting the benefits of each different style, our suggestion would be the 12B elevator. This one elevator, a favorite of the 18Ds, has the advantage that it can replicate elevator systems that require three or more

Extraction Instruments (Left to Right) 150 Universal Upper Forceps, 151 Universal Lower Forceps, #23 Cowhorn Forceps, Ash Forceps, 53 L Forceps, 53R Forceps, 12B Elevator, Self Aspirating Syringe

specialized instruments. Learning to use one instrument for a beginner seems to work better than trying to master several.

Suggested Forceps: (order with serrated edges for better grip).
150 Universal Upper: For extraction of upper anterior and premolar teeth
151 Universal Lower: For extraction of lower anterior and premolar teeth
Ash Forceps: Also for extracting lower anterior and premolar teeth
Cowhorn #23: For extraction of lower molar (two rooted) teeth
53R, 53L Forceps: For extraction of upper right and left, multi-rooted (usually three root) molars.

Optional exodontia instruments:
144S Forceps
Heidbrink 13/14 Root Tip Pick

If you are planning on scheduling regular and extensive dental related missions while deployed, have at least a minimum of three sets of the above listed instruments so you can properly sterilize them so that you can run a dental clinic for a full day of six to eight hours.

Suggested dental cleaning (prophylaxis) instruments:
13s-14s McCall
Curette Sickle Scalers

Instruments to be used for cleaning of teeth of team members and selected host nation personnel

2. Suggested Dental Restoration Kit
A. The Portable Dental Drill

Being able to use a portable dental drill will greatly expand the ability of the SOF medic to truly offer comprehensive dental care to the local population. The suggestion to add a portable dental drill system to a SOF medic dental kit is not made lightly. One needs to be properly trained in its use, but this recommendation is made confidently after using this system over the past ten years and seeing the successful placement of thousands of restorations by SOF medics after a relatively quick learning curve. In addition, the successful training of selected Afghan and Iraqi army medics in


Portable Dental in use on Iraqi Police Officer

these same techniques demonstrates that this portable system can also be used as a model to quickly train host nation medical personnel in dental procedures.

The main objective of using the dental drill is to open up a large enough window through the very hard enamel to allow the use of hand instruments to excavate and remove the underlying dentinal decay. This is best accomplished by using the drill under certain limited parameters. The first parameter is to use a relatively short bur such as a #245 (2.4mm) for tooth cutting purposes. By using this relatively short bur, and giving guidance to never cut down more than two-thirds the bur's cutting length, one minimizes the risk of getting too close to the pulp and causing irreversible damage to the tooth.

A second parameter to follow is to only cut in short bursts to prevent the buildup of bur generated heat on the tooth. This is more of a factor when drilling on teeth with small cavities that require the cutting of healthy tooth structure to gain access to the lesion. This is why a water spray is traditionally used in more advanced dental setups to prevent any heat buildup.

The fillings that are visually diagnosed in the field are seen without the benefit of x-rays, so the decay noted is much more prominent and deep. These deeper cavities, along with short drill bursts, will obviate the need for a more complicated water spray system since these teeth have a greater distance between the vital pulp and the drill access point. However, if one does desire the additional protection of a water spray while drilling, the portable Bell dental system has one available.

B. The Tooth Restoration Process

As we have noted several times, to ensure that one can provide for most dental requests from the local population, especially in Afghanistan, the additional ability to perform simple dental fillings should be included in any dental program run by the SOF medic. Atraumatic Restorative Treatment (ART) technique is a simple, easily learned program of providing permanent dental fillings with glass ionomer cements. This program of instruction has existed for almost 20 years now and is the preferred program for teaching "barefoot dentistry" in third world countries by such organizations as the World Health Organization and the United Nations. In addition to serving the local population, this is an excellent technique for providing definitive dental care to SOF team members in the field since this material actually bonds to tooth structure, as opposed to IRM which simply fills cavitated holes in teeth with little compressive strength.

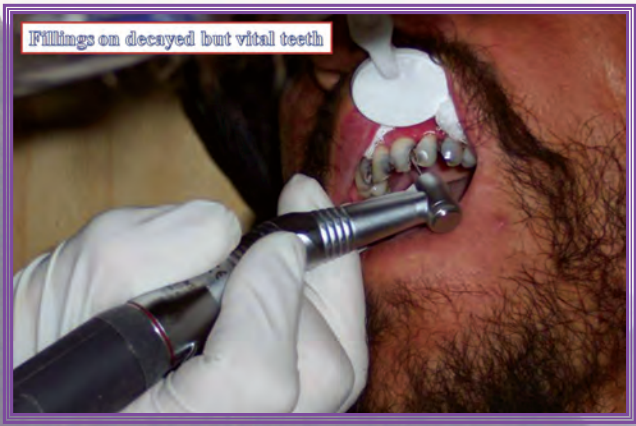
Atraumatic Restorative Treatment (ART)

This technique can be used to place simple, permanent fillings on non-infected teeth that have cavities accessable using simple hand instruments or after utilization of the portable dental drill. Teeth that have no pain on percussion are good candidates for this procedure because they are not infected. In addition, treatable teeth can have a history of hot and cold sensitivity but not one of spontaneous pain or facial swelling in the area of the tooth. A final test to help determine tooth vitality is to digitally palpate the outer buccal surface where the tooth root apex is located. No discomfort upon palpation will be an additional indicator of no apical infection.

What You Need

A basic setup to perform ART would include:

— Restorative material: FUJI IX (Posterior Glass Ionomer Restorative Cement)
— Standard package consists of 15g bottle of powder, 8g liquid
— Armamentarium; two to three complete sets of instruments and equipment needed to perform dental anesthesia (dental aspirating syringe, needles, etc.)
— Dental Spatula No. 24
— Spoon Excavator, No. 36/37
— Dental Hatchet
— Woodson Plastic Filling Instrument
— Dental Explorer
— Dental Mirror
— Mixing Pad, Parchment Paper, Dental
— Tofflemire Matrix Bands, (.0010 dead soft)
— Tofflemire Matrix Band Holders
— Small Can, Compressed Air
— Portable, Hand held Electric Dental Drill (30-40; #245 burs)


Fillings on decayed but vital teeth

What To Do

1. Proper tooth selection is most important; the tooth that is to be restored must still be vital (hot/cold sensitivity is okay but no spontaneous pain) and have no periapical (root) infection. The best teeth to restore have cavities on the occlusal (chewing) surface or on the roots of the tooth. Secondary sites for restorations are cavities between adjacent teeth.

2. Gain proper local or regional anesthesia in region of tooth to be restored. Note, this ART technique can be used in many cases on teeth that have not been anesthetized or drilled on if the cavitated area is large enough to allow easy access by the spoon excavators.

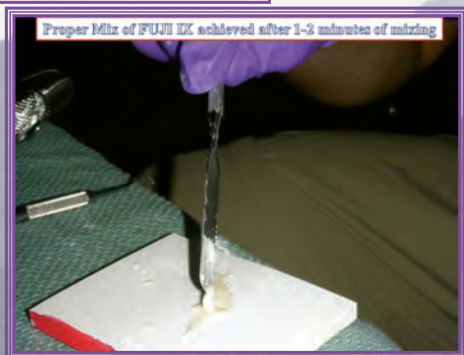

Giving local dental anesthetic

3. Initially, remove dental enamel overlying decayed tooth structure by using a dental hatchet. When the portable dental drill is available, removal of enamel and decayed dentin is expedited with the drill utilized in circular, cutting motion that does not penetrate any deeper than the cutting surface of the 245 bur.

4. Use the spoon excavator to remove as much infected dentin as possible after the enamel removal (loose, soft decayed material).


After drill is used to remove enamel, hand instruments are used to remove decayed Dentin

5. Mix equal amounts of FUJI IX powder and liquid with spatula on mixing pad, until material is fairly viscous.


Proper Mix of FUJI IX achieved after 1-2 minutes of mixing

6. Dry excavated tooth with quick spray of compressed air from an air can to remove obvious moisture.


Cavity prep dried with compressed air

7. To help give better retention to the filling, wet inner surface of tooth with FUJI IX liquid using a cotton pellet.

8. Drop the FUJI IX mixture into cavity, using a Woodson instrument. Push FUJI IX into cavity several times with quick jabs of the Woodson, this will help prevent air void formation.

9. Allow filling to set for a few minutes and then wet finger of gloved hand and vigorously rub down filling so it does not protrude above upper surface of tooth. Have patient bite down several times to make sure restoration is not too high.


Plastic (Woodson) instrument used to place FUJI IX into cavity prep

10. If an interproximal filling is being placed, attempt to use matrix bands to form wall between teeth for proper placement of the FUJI IX material.


Final restoration — this restoration could last 7-10 years

11. Group dentist should demonstrate a dozen or more of these restorations before SOF medics attempt their own restorations.


Patient examining final result

WHAT NOT TO DO

This ART works very well and one can gain proficiency relatively quickly. However, there are some things to keep in mind to prevent poor outcomes:

1. Improper tooth selection. Any tooth with a swelling at the apex of the root or is sensitive to precussion is not a suitable candidate.

2. Smaller fillings will have a better long term outcome vs. larger, more complex fillings.

3. Keep area of tooth cavity as dry as possible. No obvious saliva or blood in filling site. The dryer the cavity, the better the longevity of the restoration.

4. On larger fillings, make sure there are no air voids in tooth chamber.

5. ALWAYS make sure the restoration is not TOO HIGH.

6. A major advantage of these glass ionomer fillings is that the mix ratio of powder to liquid can be in a fairly wide range of viscous to fairly runny and still work well. This compares to the more sensitive mixing setting for IRM.

Conclusions

The portable SOF dental set as described in this article is a low cost, very portable, easily learned system that can deliver significant health benefits to the local population and to SOF team members in need. In addition to being a system that SOF medics can make great use of during their deployments, it can also be used as a template to set up a robust and comprehensive dental program by host nation personnel in even the most remote and poor areas.

Experience from training over 80 Iraqi and Afghan medics on this portable SOF dental system during three tours shows that a more formal dental training program of relatively short length (four to five weeks), utilizing this system, could help alleviate the chronic shortage of properly trained dental personnel in these and other countries.

Finally, this simple system can serve as a good example of developing an "Afghan solution" for an Afghan problem. On many recent tours of Afghan Army medical facilities, most had large western style dental clinics recently installed with powered dental chairs, compressors, and complicated plumbing. Unfortunately, it was frequently noted that large sections of these facilities were falling apart and partially inoperable within a year of installation due to lack of proper training and maintenance. This alternative SOF portable dental kit costs a fraction of the large clinic, requires at most five minutes of easily learned maintenance a day, and will function for years to come with minimal continuing costs. Sometimes simpler (and cheaper) really is better.

Background pictures: Inbound MEDVAC against sunset on Bagram Airfield, Afghanistan and Valley view in Northern Orozgun Province, Afghanistan. *Photos courtesy of LTC Bob Harrington.*

Afghan Commando medics being shown proper injection techniques

After several hours, Commando medics were doing local injections

After several days of training,
Commando medics were performing simple fillings and extractions

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The Prevalence and Impact of Musculoskeletal Injuries During a Pre-deployment Workup Cycle: Survey of a Marine Corps Special Operations Company

LT Danny J. Hollingsworth, MPT, OCS, ATC

Abstract

Musculoskeletal injuries are a primary cause of morbidity and missed training throughout the military. Only a handful of studies have been performed which focus on the Special Operations community. This study was performed to determine a baseline understanding of the prevalence of musculoskeletal injuries within an operational element of the newly formed Marine Corps Special Operations Command. The results of this survey reveal that nearly one-third of all members of 1st Marine Special Operations Battalion, Delta Company, experienced pain or physical limitation due to a musculoskeletal injury. Of those who were injured, nearly 30% reported that their injury impacted their ability to train during their pre-deployment training cycle. These results confirm that musculoskeletal injuries are a significant problem within the Marine Corps Special Operations Command. Further investigation is warranted to examine etiological factors resulting in these injuries and changes to training regimens that may result in decreased injuries.

Introduction

It is well documented that musculoskeletal injuries are responsible for a significant percentage of missed training days throughout the military. Studies show that up to 60% of all active duty outpatient visits are due to exercise-related injuries.[1] Additionally, Bohnker et al. found that more than 40% of Navy Physical Evaluation Board cases were due to musculoskeletal conditions.[2]

Strenuous physical activity is synonymous with military duty. Across all branches of service, physical fitness requirements are strictly enforced and the physical capacity of their members is tested on an annual or semiannual basis. Within this population there exists a group of servicemembers who are held to a much higher standard in terms of fitness and physical capacity. Members of the elite units within Special Operations Command (SOCOM) train and operate at levels of physical demand that far outweigh those of their non-SOCOM colleagues.

A review conducted by Jones and colleagues in 1994 revealed that the primary risk factor most closely associated with higher risk of injury was frequency and duration of exercise.[3] As the frequency and duration of exercise increases, so does the risk of musculoskeletal injury. Given the extreme levels of physical activity that Special Operations units engage in, it is natural to assume that they would experience increased incidence of musculoskeletal injuries.

Very few studies have been conducted within the Special Operations community. The studies that have been conducted reveal injury rates similar to non-SOCOM units. Lynch and Pallis examined injury rates within 5th Special Forces Group (Airborne). They reviewed all recorded patient encounters during fiscal year 2007 and found that musculoskeletal complaints comprised 40% of all clinical diagnoses.[4] In their discussion, Lynch and Pallis predicted that the actual number of injuries may be higher than 40%, as many Special Forces members will avoid reporting to the Troop Medical Clinic unless their injuries mandate it. Also, the authors did not include those who were initially evaluated and treated by the Group physical therapist whose primary duty is evaluating and independently managing musculoskeletal injuries .

The aim of this study was to examine musculoskeletal injury rates specifically within the operational component of a Marine Corps Special

Operations Battalion. To the author's knowledge, this is the first study conducted on this specific population.

Methods

The subjects of this study included all members of 1st Marine Special Operations Battalion, Delta Company. This company had just completed an arduous pre-deployment training cycle of approximately 12 months and was in final preparations for deployment in support of Operation Enduring Freedom. All members of this Marine Special Operations Company (MSOC) were male and ranged in age from 19-38. (Table 1)

Research Instrument

Each subject completed a Musculoskeletal Injury Survey (Appendix A). The survey obtained basic demographic information from each subject to include age, rank, Military Occupational Specialty (MOS), years of active duty service, and years in the Special Operations and reconnaissance community. The subjects were asked if, during this pre-deployment workup cycle, they had experienced any pain or physical limitation due to musculoskeletal injury. For those who answered yes, they were asked to elaborate on affected body part, mechanism of injury, date of injury, level of medical care sought, number of lost training days, and finally they were asked to rate the impact of the injury on their ability to train using a 5-point Likert scale. The survey did not ask for any personally identifiable information. The author felt that the subjects may have been hesitant to answer the survey truthfully if they thought there might be some potential for recourse for unreported injuries. Members of this community are known for being highly motivated and eager to deploy; any potential roadblock to deployment is not welcomed by anyone.

Table 1. Demographic Characteristics of Subjects

Variable	All (n = 87)	Injured (n = 28)	Uninjured (n = 59)
Age (y)	26.8 ± 4.3 (19-38)	27.9 ± 4.0 (21-36)	26.3 ± 4.3 (19-38)
Years AD Service	7.6 ± 3.9 (1-19)	8.6 ± 3.8 (3-17)	7.1 ± 3.9 (1-19)
Years in Community†	4.1 ± 3.0 (<1-15)	4.6 ± 1.6 (1-15)	3.8 ± 2.8 (<1-14)
# Previous Deployments	2.6 ± 1.8 (0-10)	2.9 ± 1.6 (0-7)	2.4 ± 1.9 (0-10)

*Data are mean ± SD (range).
†Includes years in Marine Reconnaissance community.

Results

Eighty-seven (N=87) members of 1st Marine Special Operations Battalion, Delta Company, completed the survey. According to the most recent roster, this represents 94% of the company. Several members of the company remained on pre-deployment leave or were otherwise unavailable to complete the survey prior to deployment. It is felt that the exclusion of these members did not significantly impact the results of this study.

Twenty-eight (32%) of the subjects reported experiencing musculoskeletal pain or physical limitations during the pre-deployment training cycle. A summary of the survey responses is provided in Table 2.

Nine (32%) of the 28 injured subjects, reported having issues with multiple body regions, resulting in 41 total injured body regions. Chronic injuries accounted for 46% (n=22) of all reported injuries and 54% (n=19) of the injuries were traumatic in nature.

The most commonly injured body region was the knee, followed by the lower back and ankle (Figure 1). The survey did not specifically ask the subjects to identify unilateral versus bilateral joint injuries.

The average chronicity of injury was 22.3 months with a range of 1-170 months. The average number of lost training days was 6.03 with a range of 0-60. Twenty-nine percent (n=8) of the injured subjects reported that, as a result of their injury, their ability to train was at least moderately hindered, with two subjects stating they were unable to train.

Discussion

The results of this survey indicate that musculoskeletal injuries are a significant issue within the Marine Special Operations community. Nearly one-third of all Marines and Sailors in this MSOC experienced a

Table 2. Summary of Survey Responses: Injured Subjects

Survey Question	Number Reporting
Body region affected	
Lower extremity	19
Upper extremity	8
Spine	8
Multiple body regions	9
Mechanism of injury	
Overuse	18
Traumatic	23
Length of symptoms (months)	
<3	4
3-6	6
7-9	2
10-12	4
>12	12
Number of lost training days	
None	19
1-7	3
8-14	2
15-30	3
>30	1
Medical care sought	
None	8
Company corpsman (SARC)	7
Battalion Aid Station (BAS)	3
Physical therapy	8
Other	2
Impact on training	
None	5
Mildly hindered	15
Moderately hindered	5
Severely hindered	1
Unable to train	2

musculoskeletal injury or physical limitation during their pre-deployment training cycle. These results are consistent with the findings of Kaufman and colleagues, who reported a 33% injury rate among Navy

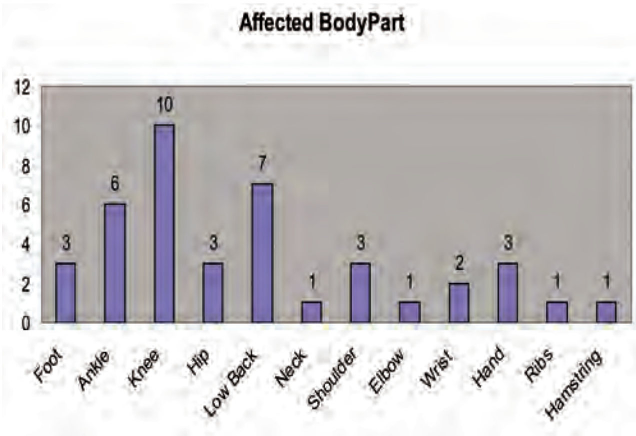

Figure 1:. *Musculoskeletal Injuries by Body Part*

Special Warfare candidates and Riddell, et al., who found a 33.5% injury rate among Royal Marine Commandos.[5,6]

In their study of the members of 5th Special Forces Group, Lynch and Pallis found a significantly higher injury rate of 40%. Their finding is consistent with the findings of studies performed on non-SOCOM units.

While the injury rates found in this study are not as high as those found among non-SOCOM units or in the Lynch and Pallis study, they do indicate that musculoskeletal injuries are a primary impediment to military combat training. Eight members of MSOC Delta missed training due to their injuries, with four members missing more than 20 days. Considering the inherent danger encountered by these Marines and Sailors on a daily basis during combat operations, any loss of ability to train is a significant concern. It is interesting to note that the number of members who missed training days exactly matches the number of members who rated the impact of their injury as a three or higher on the Likert scale.

Another interesting difference between this study and the Lynch and Pallis study is the location of musculoskeletal complaints. In the Lynch and Pallis study, neck and back injuries comprised 31% of all injuries, whereas only 19.5% of those surveyed in this study reported a neck or back injury. Additionally, Lynch and Pallis found that lower extremity injuries accounted for 32% of all injuries among the members of 5th Special Forces Group. Nearly half (46%) of all reported injuries in this survey involved the lower extremities.

The high incidence of lower extremity injuries in this survey is not a surprising finding considering that members of SOCOM units spend a significant amount of time performing long-distance, high-impact activities such as running and multiple-hour ruck marches. Numerous studies have demonstrated a dose-response curve with regard to the relationship between high-impact activities and lower extremity injuries.[3,7-9] Also, these findings are consistent with those found in studies by Almeida, et al and Kaufman, et al.[5,10]

In light of the evidence indicating that as frequency and duration of impact activities increases, injury rates also increase, it seems appropriate to reconsider current training concepts within the Marine Special Operations community. A recommendation for future study would be to compare injury rates and fitness level of a group of Special Operations Marines who undergo a training program designed around decreased volume with increased intensity. Several studies have shown improvements in aerobic capacity from short duration, high intensity interval training.[10-12] It is possible that implementing this type of training program may effectively reduce injuries without a negative effect on overall fitness.

Conclusions

Musculoskeletal injuries are a significant impediment to training throughout all branches of the military. Results of this survey indicate that the newly formed Marine Corps Forces Special Operations Command is subject to injury rates similar to those that have been reported in the limited number of studies that have been performed within the Special Operations community.

Previous epidemiologic studies have identified frequency and duration as the primary etiologic factor for running and impact activity injuries. Members of SOCOM historically have engaged in training programs that consist of very high weekly running and hiking mileage. Consideration of physical conditioning programs that focus on reduced volume and increased intensity may result in decreased injury rates without sacrificing fitness and combat readiness.

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Appendix A

Musculoskeletal Injury Survey

Age:______ Rank:______ MOS/Title:________

Years of service:______ Years in community:_______

# of deployments:_____ Date of last deployment:______

Deployed with:____

During this workup cycle did you experience any pain or any type of physical limitation due to a musculoskeletal injury? **YES / NO**

Body part affected:____

Mechanism of injury:____

Date of Injury:__________________ # lost training days:__________________

Did you seek medical care for this injury? **YES / NO**
If yes, from whom? **SARC / BAS / PT / Other**________________________

To what extent did this injury impact your training during this workup cycle? Please circle the most appropriate answer.

1 No impact
2 Mildly hindered
3 Moderately hindered
4 Severely hindered
5 Unable to train

Comments:____

____

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UNCONVENTIONAL WARFARE

UNCONVENTIONAL MEDICINE

Pre-Deployment Training Recommendations for Special Forces Medical Sergeants Based On Recent Operation Enduring Freedom Experiences

MAJ John Hughes, MD; Maj Teresa Hughes, PhD

Abstract

Retrospective analysis of patient records from two 1st Battalion, 7th Special Forces Group combat rotations in Operation Enduring Freedom reveals a high volume of medical activity over a wide range of medical issues managed by Special Forces Medical Sergeants (MOS 18Ds). The initial training curriculum for 18Ds has been modified to provide graduating 18Ds with a refresher course and updated credentialing before reporting to their first unit. However, due to the high operational tempo, subsequent biannual refresher training has proven difficult for at least one Special Forces unit. Units must plan ahead between deployments to balance medic recredentialing with unit pre-mission training and individual non-medical training.

Introduction

Special Forces Medical Sergeants undergo extensive medical training at the Joint Special Operations Medical Training Center (JSOMTC) at Fort Bragg, NC.[1] After being selected for Special Forces training and proving their aptitude to become an 18D, selectees undergo extensive trauma and basic medicine, pharmacology, veterinary, dental, preventive medicine, and medical technology training. Then, upon graduation from the overall Special Forces course, they are typically assigned as medics to Special Forces Operational Detachments where they are able to build and operate unconventional warfare clinics, train foreign military medics, treat military and civilian animals, perform basic dentistry, and manage complex trauma patients for prolonged periods under austere conditions. In addition to this, they are expected to maintain their non-medical Special Forces skills through training and attending schools for intelligence, scuba diving, high altitude low opening parachuting, sniping, and a variety of other skills.

The heightened operational tempo has affected all Special Forces units, putting them into deployment cycles where they spend time deployed in combat zones followed by time in garrison preparing for the next rotation. Often the "dwell time" is six months or less. This means that new 18Ds arrive to an Operational Detachment and have very little, if any, time to learn the ropes and prepare for war. With this deployment cycle, the newly trained medics may even report to a unit at war and meet their Operational Detachment at a remote outpost in a combat zone. While this situation is similar for many military occupational specialties (MOS), the time between deployments is compressed and there is much competition for the Special Forces Soldier's time. They have to redeploy, perform various equipment inventories, restore unit medical readiness, perform parachute jumps, maintain demolition proficiency, go on leave, order and prepare equipment for the next rotation, perform Pre-Deployment Site Surveys, perform mission analysis, and deploy for the next combat rotation. Additionally, the 18D MOS requires continued credentialing training via attendance at the Special Operations Combat Medical Skills Sustainment Course (SOCMSSC), a two-week course every two years;[2] the Non-Trauma Module (NTM), a two-day course every two years; and Medical Proficiency Training (MPT), clinical training for two to four weeks every two to four years.[3] On paper this seems simple, but it becomes complex when it must compete with all of the other Special Forces tasks in the contemporary expeditionary force.

Of critical note is that, while deployed, the 18Ds are often the only medical personnel in their remote firebase locations, limiting their available supervision. Therefore, it is essential that they maintain their extensive medical skills to be able to contribute as Special Forces medics.

Operational Medical Data

The following data is a compilation of medical information from 1st Battalion, 7th Special Forces Group's two consecutive combat rotations in Operation Enduring Freedom X (2007) and Operation Enduring Freedom XII (2008-2009). The data was transcribed from in-theater medical notes (SF600s) written by 18Ds and SOCM medics, documenting patient encounters in which they used controlled medications. These SF600s were reviewed and co-signed by the Battalion Surgeon or Physician Assistant at the end of each rotation, for both clinical quality control and to account for all issued controlled substances. Some patients received multiple prescriptions if they had severe, complex, or prolonged medical conditions. The inherent value of the SF600s is that they capture vast quantities of medical information on over two thousand patient encounters.

The 1st Battalion, 7th Special Forces Group medics saw well over 50,000 patients during the two combat rotations, but the only data utilized were for the 2,141 patients who were prescribed controlled substances by the 18Ds or other Special Operations Combat Medics (SOCMs).

Table 4: Patient Issues

Patient Issue	OEF X	OEF XII	Total
Fracture	23	147	170
Gunshot wound	47	51	98
Shrapnel wounds	60	51	111
Lacerations	11	20	31
Seizures	0	7	7
Amputations	15	11	26
Dental Issues	15	36	51
Burns	24	25	49
Dislocations	10	13	23
Kidney Stones	5	5	10
Scorpion Stings	5	5	10
Snake bites	1	1	2

Table 5: Medical Interventions

Intervention	OEF X	OEF XII	Total
Tourniquet	22	16	38
Debridement	68	66	134
Dental extractions	15	36	51
Reductions	10	13	23
Chest Tubes	7	4	11

Table 1: Medication Prescriptions

Medication prescriptions	OEF X	OEF XII	Total Used	% of Total
Total prescriptions	1374	767	2141	100%
Morphine IM	46	119	165	7.7%
Morphine IV	53	5	58	2.7%
Fentanyl 400mcg	47	0	47	2.2%
Fentanyl 800mcg	0	68	68	3.1%
Ambien	932	214	1146	53.5%
Lunesta	0	16	16	0.7%
Percocet	108	120	228	10.6%
Diazepam	67	203	270	12.6%
Versed	23	18	41	1.9%
Tramadol	0	3	3	0.1%
Tylenol w/Codeine	9	10	19	0.9%
Nubain	56	56	112	5.2%
Ketamine	22	17	39	1.8%

Table 2: Demographics of Patients Treated

Demographic	OEF X	OEF XII	Total	% of Total
U.S. patients	992	306	1298	60.6%
Afghan Patients	379	440	819	38.2%
Coalition Patients	6	14	20	0.9%
Male Patients	1359	748	2107	98.4%
Female Patients	15	19	34	1.5%
Patients under age 18	35	50	85	3.9%
Animals	1	7	8	0.4%

Table 3: Demographics of Special Operations Medics

Demographic	OEF X	OEF XII	Total	% of Total
Prescriptions by 18D	1296	764	2060	96.2%
Prescriptions by SOCM	81	3	84	3.8%

Implications of Operational Medical Data

Table 1 shows some variations in quantities of controlled substances used in OEF X and in OEF XII. This is most likely due to the evolving injury patterns, prescriber preferences, and turnover of medics between combat rotations. Table 3 shows that most controlled substances were prescribed by 18Ds *versus* SOCM medics, which is to be expected due to the large numbers of 18Ds and small number of attached SOCM medics in a Special Forces task force. Tables 4 and 5 show the breadth of injuries and interventions.

The data clearly shows that 18Ds see a wide variety of trauma and non-trauma issues while deployed. Most of these were handled with minimal on-line medical control. Over two thousand controlled substance prescriptions were used with no adverse effects. This shows that the JSOMTC curriculum is helping to produce well-trained medics for the Operational Detachments.

However, the timing of the training for these high-demand medics has needed improvement. The frequency of and short time between deployments severely limits the amount of time that groups and battalions have to complete new 18D training. Ideally, an 18D should present to his unit ready and able to handle a wide range of patient complaints without relying on a senior medic's close guidance. During both rotations, the vast majority of the assistance from the Battalion Surgeon and Physician Assistant went to the newest medics, many of whom arrived just before or during the deployment. The 18Ds demonstrated understanding of the skills and information taught at JSOMTC. However, the year of non-medical training between JSOMTC and reporting to an Operational Detachment dulled their skills and often necessitated on-the-job refresher training. Further, new 18Ds often arrived at their first units lacking field medical expertise. Little time exists in the operational timeline to provide extensive additional training for new medics. Additionally, little time is available to provide sustainment training between deployments.

In the past few months, JSOMTC has modified its curriculum to add a refresher and recredentialing course at the latter portion of the training, which should address this issue. Additionally, JSOMTC modified the curriculum so that the medic specific training is done in the second half of the 18D training plan so there is very little break between the end of medical training and reporting to the first duty assignment. Due to the large volume of students passing through and the complexity of the issue, some lag time of a few months will occur before students taking the refresher courses begin to show up at units. At printing 1st Battalion, 7th Special Forces Group had not yet received the newer medics, but the battalion's combat experience highlights the wisdom of this change.

Discussion of 18D Training

While 18D medics are better trained than they ever have been, as the OEF data shows, a wide variety of medical expertise is expected of 18Ds for combat deployments. To this end, the following are some areas that units should focus on for pre-mission train-up before deployments.

***Non-Trauma Module*:** Due to the high optempo and finite resources in garrison, it can frequently be difficult to ensure that all medics are current in NTM before deployment. Some creativity is often required to line up the resources to conduct an NTM that fits in with the pre-mission training and individual training cycles. The OEF experiences of the battalion highlight the importance of accomplishing this training before deploying. A good portion of the patients treated involved dentistry for local nationals, physical therapy for U.S. and coalition Soldiers, and veterinary care for local national livestock. To augment NTM training, the battalion also rotated the group veterinarian, dentist, and physical therapist to firebases to teach medics and augment care to local nationals. Practices similar to this model may prove critical to the advancement of 18D in-theater skill sets. (**Editor's Note:** this is also an excellent way for medical supervisors to learn "ground truth" regarding medical logistic issues, what kind of patients their subordinates are seeing, and what kind of additional medical training is desirable.)

Train medics on proprietary medical devices before deployments: Due to rapidly evolving medical techniques and devices and limited training modules at JSOMTC, 18Ds new to the battalion frequently arrived deficient in knowledge of specific intraosseous devices and techniques (EZ-IO™, B.I.G™, FAST-1™), hemostatic agents (Celox™, Combat Gauze™), oral and parental narcotics, antibiotics, and techniques for packing aid bags and vehicles for combat operations. In the current arena, the difference between a senior and junior 18D on a detachment is sometimes defined by the senior 18D arriving on station one month prior to the junior 18D. Based on this, 18Ds need to arrive to their units trained on the equipment currently being used in the field to increase their functioning from the first day. JSOMTC has recently added some exposure to a few of the medical devices widely used in theater, so that the newly trained medics should soon begin arriving to their units armed with this knowledge. Pre-exposure to these devices proved beneficial to medics going through the 18D course and SOCMSSC. However, with ongoing rapid advances and fielding of new equipment, battalions should incorporate hands-on training with the newest medical devices in their pre-mission training plans.

Add topics to pre-mission training: The data from Afghanistan shows that the medics are likely to see scorpion bites, snake bites, and severe burns (in local nationals) that cannot be evacuated. Consequently, they require lectures on medical threats in the most likely countries to which they will deploy. Additionally, they would benefit from training on complex burn management that they may be forced to use in the absence of a forward surgical team or combat support hospital that may have skin grafting equipment.

Credentialing Issues for 18DS

The 18Ds and SOCMs are instilled with incredible ability by JSOMTC. Their extensive skill set is refreshed every two years via instruction. However, when they return to their home station, they are limited in what they are allowed to do by Army medical credentialing regulations. Army Regulation (AR) 40-68 *Clinical Quality Management*, specifies that "the 18D is a nonmedical MOS."[4] They are permitted to perform patient care within their skill set as long as they are directly supervised by a privileged provider. This means being in the same building as a physician or physician assistant and seeing patients with the direct knowledge of the supervisor.

Two weeks of sustainment training every other year with two weeks of clinical patient care does not appear to be sufficient to maintain their extensive skill set. The author recommends that AR 40-68 be revised to allow 18Ds to perform at least limited healthcare for their unit members in a minimally supervised capacity and to be able, at least in a limited way, to prescribe medications when at their home station during times of war. The exact method of achieving this is undefined at present as it will be difficult to determine and grant their credentialing status and electronic access to order medications. However, the benefit of providing at least limited home station credentialing is to allow them to practice medicine independently to continually hone their skills and accrue confidence. One solution may be to provide the medics autonomy to prescribe from a centrally funded pharmacy based on the Joint Special Operations Tactical Medical Emergency Protocol (TMEP) and Drug List.[5]

When the nation is not at war, 18Ds may have sufficient time to train and there may be fewer demands on their time in-garrison. However, as previously described, the increased operation tempo places such high demands on their time that allowing them increased medical practice in garrison may prove to enhance their medical readiness for deployments. (**Editor's Note:** The U.S. Navy seems to have effectively dealt with this very same issues with their IDCs – Independent Duty Corpsmen – by credentialing them with their local hospital, giving CHCS access and privileges, etc. Further information on their regulations can be found by entering "OPNAVINST 6400.1C, MCO 6400.1" into your search engine. The latest instructions I've found concerning their scope of practice issues are dated 15 AUG 07.)

Summary

Deployments are complex and challenging for 18D medics. In general, these medics perform well and are receiving sufficient foundational training. To enhance their readiness to practice nearly independently in theater, units should incorporate training on the newest medical devices and on the most recent theater specific topics before deploying to set medics up for the greatest chances of success.

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The Surgical Resuscitation Team: Surgical Trauma Support for U.S. Army Special Operations Forces

MAJ Kyle N. Remick, MD

Abstract

Special Operations Forces need trauma surgical support that is flexible and rapidly mobile. Current operations in the Afghanistan Theater of Operations required the U.S. Army 772nd Forward Surgical Team (FST) to provide support for Special Operations missions and conventional missions on short-notice using its mobile Surgical Resuscitation Team (SRT). The 772nd FST's experience over a 15-month deployment validates the concept of and the requirement for the SRT. This paper provides a framework for planners to design and implement this capability for support of U.S. Army Special Operations Forces (ARSOF).

Introduction

Special Operations missions require an inherent flexibility in all aspects of command and control. Medical support also must be designed for ultimate flexibility and adaptability as well. In the recent overseas contingency operations in Afghanistan, conventional combat trauma surgical support planning has included the utilization of fixed, non-mobile surgical assets. This has led to the peppering of "split" and "fixed" U.S. Army Forward Surgical Teams (FSTs), fixed-position U.S. Navy Forward Resuscitative Surgical Systems (FRSSs), and fixed-position U.S. Air Force surgical elements throughout the Afghanistan Theater of Operations. Combined Joint Special Operations Task Force-Afghanistan (CJSOTF-A) elements are forced to request surgical trauma support from the conventional system. Conventional units may be less responsive and less flexible than those needed to meet the rapidly-changing demands of the Special Operations environment. A contingency-based Surgical Resuscitation Team (SRT) is proposed to bridge the gap between trauma care by Special Operations medical personnel at the point of injury and the Role III theater hospitals. Furthermore, the SRT is proposed as a contingency surgical team for other remote operations not in the mature theaters of Iraq and Afghanistan.

The U.S. Army 772nd FST deployed to Afghanistan in July 2008. Prior to deployment, the team trained to perform its trauma surgical mission in both a fixed-location scenario and in a contingency-based mobile environment to provide maximal flexibility of support to combat commanders. During its 15 month deployment, the 772nd FST provided mobile trauma surgical support to the Combined Joint Task Force (CJTF) and to CJSOTF-A on three separate occasions. These were the first mobile surgical support missions in GWOT since 2002 in Afghanistan and since the initial phases of the Iraq invasion in 2003. The following describes the combat application of the SRT in the Afghanistan Theater of Operations in support of both conventional and Special Operations missions and provides a framework for developing a U.S. Army Special Operations Forces (ARSOF) SRT.

The Surgical Resuscitation Team (Light)

The 772nd FST developed two contingency packages for trauma support. The SRT (Light) provided contingency support to a mixed conventional and unconventional assault force in the Ghazni region in September 2008. The team consists of eight personnel: one general surgeon, one certified registered nurse anesthetist (CRNA), one trauma registered nurse (RN), one 68D operating room technician, two 68WM6 licensed practical nurses (LPNs), and two 68W medics. It can be lightened by removing one or two 68W medics or LPNs based on mission assessment. It can also be augmented for a total of ten personnel with the addition of a second general surgeon and/or one orthopedic surgeon if needed. (Figure 1)

The purpose of this team is to augment an existing advanced trauma life support (ATLS)-level trauma capability. The team provides life and limb saving surgery (LLSS) in support of contingency operations. Two

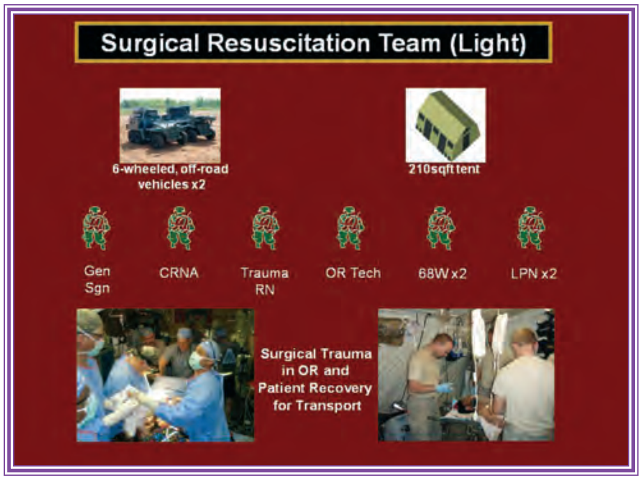

Figure 1: *SRT (Light) configuration*

military-style, six-wheeled, off-road vehicles along with personal rucksacks are utilized to transport equipment. This allows the team to "combat load" equipment onto a CH-47 Chinook helicopter by backing the vehicles onto the aircraft at the departure site. (Figure 2) At the destination, the vehicles provide a rapid off-load capability by simply driving off the back ramp of the CH47. They can then move to the setup site within minutes. (Figure 3) This minimizes time on ground at the helicopter landing zone (LZ). One dedicated CH47 helicopter provides insertion capability for the entire SRT (Light) package.

Figure 2: *Combat loading SRT vehicles on CH47*

Figure 3: *Combat Off-load of SRT vehicles and movement to setup site*

The vehicles provide the advantage of rapidly and easily moving all equipment a few hundred meters from the LZ to the set up site. The SRT (Light) is placed adjacent and connected to the existing ATLS facility. A 210sq ft tent (14ft x 15ft) is erected within 10 minutes using four to six personnel. A 6kW generator is used to power the entire package to include lighting, temperature control unit, operating room equipment, and blood refrigerator/freezer. During cold-weather operations, a portable heater is used to keep the operating room suite at high temperatures for prevention of trauma patient hypothermia. The remainder of the essential operating equipment is established and checked for functionality. See Figure 4 for a basic equipment list. Overall, the SRT (Light) establishes operations to receive a surgical trauma within 30 minutes.

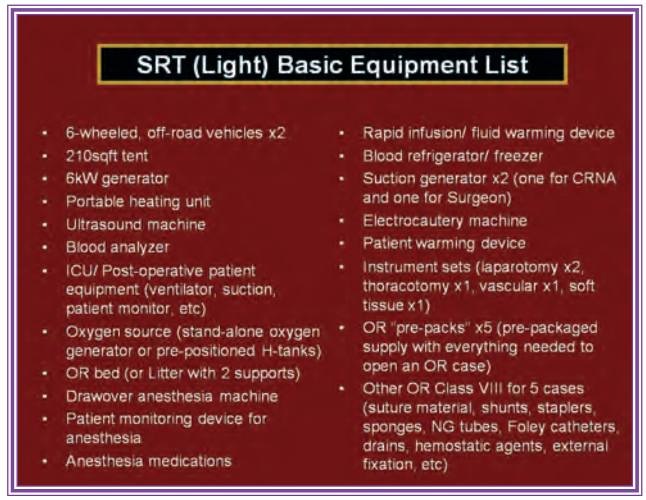

Figure 4: *SRT (Light) basic equipment list*

This team's SRT (Light) package moved on short-notice from our fixed-facility at Forward Operating Base (FOB) Fenty, Jalalabad, Afghanistan to FOB Ghazni and rapidly established operations. The SRT (Light) established surgical trauma capabilities immediately adjacent to the Ghazni Battalion Aid Station (BAS). (Figure 5) Rapid integration training was

Figure 5: *SRT (Light) at Ghazni*

conducted with the existing medical personnel. A four-bed ATLS capability existed at the location, and this was used for initial trauma evaluations. The team planned to transfer combat casualties needing LLSS to the SRT (Light) operating room. Post-operative recovery was planned in the pre-existing BAS with augmentation by the team's LPN and CRNA and necessary additional equipment (e.g. ventilator, monitor, suction, post-operative medications, etc.). The team assisted in the ATLS evaluation of several trauma patients during this week-long mission, but the SRT (Light) operating room capability was not needed.

The SRT (Light) carries equipment and supplies to manage five LLSSs prior to needing re-supply. A patient not needing a LLSS is evaluated, stabilized, and sent onward to the Role III facility. Examples of injuries and wounds requiring LLSSs are penetrating abdominal injuries with hemodynamic instability, penetrating chest injuries with massive hemothorax, blunt torso trauma with hypotension or instability, penetrating neck injuries with hard signs of vascular injury, and groin and axillary injuries with arterial vascular injury not amenable to tourniquet control. Extremity injuries without vascular injury, extremity vascular injury controlled by a tourniquet (within the acceptable warm ischemia time), and blunt abdominal trauma with negative focused abdominal sonography for trauma (FAST) examination and hemodynamic stability should not require LLSSs and can be transported to the Role III facility for surgery. This enables maximal SRT (Light) resource utilization for ongoing operations.

A Special Operations SRT (Light) package might substitute 18Ds or Special Operations Combat Medics (SOCMs) for some of the team's personnel. This team may be utilized as a rapidly-responsive surgical package in support of remote locations already containing an ATLS-resuscitative capability. This team can augment the existing trauma team with LLSS capability for up to five LLSSs prior to requiring re-supply. Its post-operative holding capability is limited when additional patients are expected, so an adequate plan for rapid medical evacuation to higher care must be developed accordingly.

The Surgical Resuscitation Team (Heavy)

The SRT (Heavy) team provides a full trauma resuscitation and recovery area as well as an operating room for LLSSs. It consists of the same eight personnel as the SRT (Light), augmented with a second general surgeon and/or an orthopedic surgeon as dictated by the mission. (Figure 6) It should not be lightened as that would significantly decrease the team's full capability.

This team is also fully mobile using two six-wheeled, off-road vehicles and the equipment carried by eight personnel. It can be "combat loaded" onto a single, dedicated CH-47 Chinook. It can rapidly move

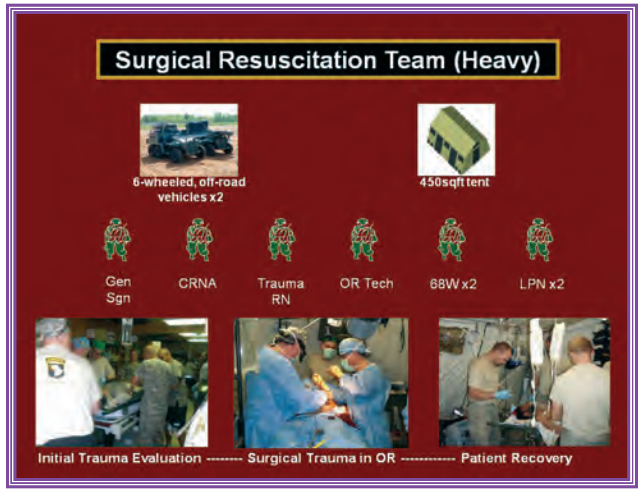

Figure 6: *SRT (Heavy) Configuration*

off of the LZ to the set up site. The SRT (Heavy) utilizes a 450sq ft tent (18ft x 25ft) with an internal wall divider panel. The divider is set so that one-third of the tent is the operating room and two-thirds of the tent is the trauma resuscitation and recovery area. (Figure 7) The tent and internal setup can be accomplished by an experienced team within 30 minutes.

Figure 7: *SRT (Heavy) Internal Setup*

The SRT (Heavy) provides two multi-functional beds in the front two-thirds of the tent. The equipment for these beds is designed and packed to provide initial trauma resuscitation for incoming patients and to transition to intensive care unit and recovery beds as patients come out of the operating room. The two multi-functional beds are designed with equipment and supplies for 20 initial trauma evaluations (10 trauma evaluations on each bed) before needing re-supply. The operating room section takes up the back one-third of the tent and is designed to handle up to five LLSSs prior to needing re-supply. (Figure 8) The SRT (Heavy) is designed to manage twenty trauma evaluations but only five LLSSs because most combat trauma patients do not require surgery and a portion of the remainder do not require immediate surgery at the SRT (Heavy). *The LLSS concept strives to*

Figure 8: *SRT (Heavy) Basic Equipment List*

conserve surgical trauma resources for the small percentage of patients that do need immediate LLSS.

This team's SRT (Heavy) package first proved itself in support of CJSOTF-A operations. On short-notice, the team deployed from Regional Command – East (RC-East) to Regional Command – West (RC-West). The SRT (Heavy) was augmented with a Special Operations Forces team of five personnel who provided security and communication for the remote mission. The team moved from Bagram in RC-East to Herat in RC-West via Air Force MC-130. (Figure 9) In Herat, the team planned and staged with the U.S. Marine Special Operations Command (MARSOC) element for movement to a remote location. A Spanish CH47 transported the team to a small outpost in a remote location in RC-West. (Figures 10 and 11)

Figure 9: *MC-130 SRT (Heavy) Movement from Bagram to Herat*

The team co-located with the MARSOC element within the walls of a half-destroyed stone building. (Figure 12) The team provided trauma resuscitation and surgical support to the MARSOC element for its entire mission in the area which lasted five weeks. During this time, the team performed six major trauma resuscitations and two major surgical procedures in the operating room.

Figure 10: *SRT (Heavy) Offload of Spanish Chinook*

Figure 11: *SRT (Heavy) Move to Setup Site*

Figure 12: *SRT (Heavy) Tent Setup Site*

One LLSS was performed on a MARSOC Marine with two gunshot wounds (GSWs) to the right upper extremity. His extremity was pulseless, and he was taken to the operating room for brachial artery exploration within the area of the GSW. Upon finding that his brachial artery was not injured, the team performed an upper and lower arm fasciotomy. His pulse returned immediately after the fasciotomy was performed, and his wounds were washed out, splinted, and dressed for transport. Spanish medical evacuation by "Puma" helicopter transported the Marine to Herat. (Figure 13) An Air Force MC-130 aircraft met the patient in Herat and transferred him to the Role III at Bagram Airfield. The patient arrived at the U.S. hospital six hours after injury for follow-on treatment and subsequently did well.

Figure 13: *Spanish Puma Medical Evacuation Helicopter*

The other operative intervention involved an elderly local female who was shot in the right arm. She was taken to the operating room for wound washout, splinting, and dressing. She was also evacuated by "Puma" helicopter to Herat where she received follow-on care by the Spanish Role IIB. The single patient requiring a non-surgical life-saving intervention (LSI) was an Afghan adult male who was shot in the head. He was noted to have a penetrating head injury, and was evaluated as an eight on the Glasgow Coma Scale (GCS). He was intubated, ventilated, and treated medically to minimize intracranial pressure until the medical evacuation "Puma" helicopter was able to transfer him to the Spanish Role IIB in Herat.

The SRT (Heavy) package was again utilized in January 2009. The team was tasked to establish a new FST location on short-notice at FOB Shank in RC-East. The area would be the site of an incoming Brigade Combat Team and required additional coverage for several weeks prior to arrival of a new FST into theater. The team deployed with similar personnel and equipment as in RC-West and set up adjacent to a Brigade Support Battalion Medical Company. (Figure 14) The team rapidly established the new FST site and performed initial trauma resuscitation for seven patients to include one major surgical procedure. (Figure 15) Additionally, one LSI patient (intubation and a chest tube thoracostomy) was resuscitated and further evacuated to the Role III.

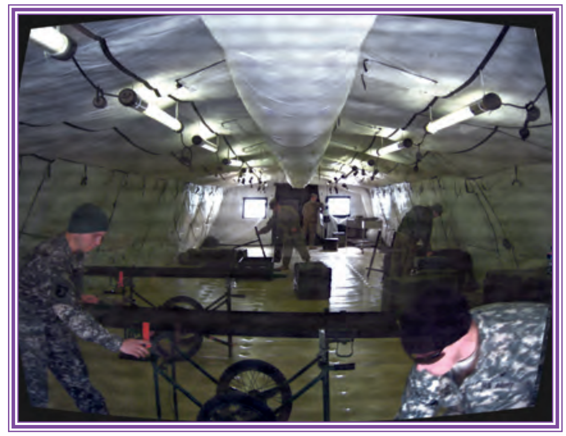

Figure 14: *SRT (Heavy) Setup at Shank*

Figure 15: *Operating Room at Shank*

A Special Operations SRT (Heavy) package might substitute 18Ds or SOCMs for some of the team's personnel. This team may be utilized as a rapidly-responsive trauma resuscitation and surgical package in support of remote locations without an existing trauma facility. Although it presents a slightly larger medical footprint than the SRT (Light), it is also self contained for the treatment of the first twenty trauma patients and five LLSSs. Although more robust than the SRT (Light), this team's post-operative holding capacity is still limited with ongoing operations, so an adequate plan for rapid medical evacuation to higher care must be planned accordingly. In contrast to medical support for conventional forces, the SRT (Heavy) may be all that is necessary to provide medical support for an entire Special Operations mission.

Conclusion

A U.S. ARSOF SRT may be useful to Special Operations Forces facing new and unique challenges in today's contemporary operating environment. It is ideally suited to provide surgical trauma support in remote areas of a mature theater of operations and for support in other austere environments far removed from civilian or military trauma facilities. The U.S. Army 772nd FST SRT experience validates this concept and provides a framework for planners to design and implement this capability in support of future ARSOF missions and other joint Special Operations missions.

Acknowledgments

I would like to especially give credit and thanks to Sergeant First Class Dan Cozine, the 772nd FST's Detachment Sergeant, MAJ Todd Jackson, the team's chief nurse, and the rest of the team's Soldiers. Their organization and attention to detail allowed my ideas for a mobile surgical team to become a reality. Additionally, I would like to thank LTC(P) Mark McGrail, the CJTF-101 Surgeon for his support of the mobile surgical team mission at the command level. His advocacy for use of the SRT allowed this capability to become a reality in the combat zone.

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Veterinary Public Health Essentials To Deployment Health Surveillance: Applying Zoonotic Disease Surveillance and Food/Water Safety at SOF Deployment Sites

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SFC Jeffrey M. Rada Morales, 18D

Abstract

The Special Operations Force (SOF) medic must have a public health and environmental awareness mindset while conducting operations in any AO. Whether deployed at a Forward Operating Base (FOB) or isolated outpost, the SOF medic can specifically apply two U.S. Army veterinary public health mission priorities – zoonotic disease surveillance and food/water safety. The SOF medic should be knowledgeable of and perform continual surveillance for zoonotic disease(s) present within animals in their AO that may affect the deployed SOF team, other American or host-nation Soldiers, and civilians. Likewise, the critical nature of ensuring safe food/water requires the SOF medic to aggressively and continually apply food/water safety principles in all deployment settings. SOF deployments to South America and Afghanistan have confirmed the need and benefits of employing a U.S. Army veterinary public health mission focus. This article is a reference for the SOF medic to expand his overall veterinary public health and environmental awareness skill-set thereby enhancing the varied, intricate, and, often times, political SOF missions.

Introduction

Deployment health surveillance (DHS) is critical to current and future military operations in order to protect deployed personnel from disease and occupational and environmental hazards.[1-3] DHS begins during the medical intelligence preparation of the environment as a part of the mission planning process. During the predeployment process, potential hazards are identified by performing a health risk assessment and risk management through use of information such as previously performed Occupational and Environmental Health Site Assessments (OEHSA), preliminary hazard assessments, industrial hazard assessments, environmental baseline surveys, and other medical intelligence products. This should occur as a predeployment planning process; however, some planning constraints such as time or availability of information, may limit this predeployment process and require execution once on the ground. Additionally, DHS is a continuous process that needs to occur from predeployment through post deployment. The SOF mission is especially enhanced by integrating veterinary public health and environmental assessment contributions to DHS requirements into operational planning. The SOF medic must be aware of the importance of health surveillance and stress the importance to the team leader and SOF planners at every level.

This article's intent is to give the SOF medic a guide and examples to reference before or during a deployment in order to integrate U.S. Army veterinary public health, specifically zoonotic disease surveillance and food/water safety, into the mission. The 7th SFG(A) first described zoonotic disease and other infectious animal disease surveillance in a SOF environment.[4,5] Operational Detachment – Alpha (ODA) medics supported the discovery of the zoonotic disease, ehrlichiosis, in Colombian military working dogs.[4] Another infectious disease surveillance study with equids determined the presence of equine infectious anemia (EIA) in Colombian military working horses.[5] Although not a zoonotic concern, EIA is a highly contagious and debilitating disease in horses.

Based on these findings, recommendations were made to enhance SOF operational planning, improve working animal health, and build rapport with the host nation.[4,5]

Other notable researchers have similarly reported valuable information from disease surveillance studies in Central and South American environments,[6] and potential SOF AOs in Brazil[4] and Ecuador's Galapagos Islands.[8]

Food/water safety and quality assurance is a guiding mission principle for the U.S. Army veterinary services and will be discussed in detail as to how the SOF medic can apply this principle when deployed to any AO.

Breakdowns in the spread of zoonotic disease and/or food/water safety control can have devastating effects to a FOB and the SOF mission due to troop health decline. Similarly, the effects on the local civilian population can be devastating in the short term with the potential for longer term impacts. Breakdowns in either or both of these events can likely lead to SOF mission delay, disruptions, or failure. Therefore, the SOF medic's focus should be to determine an emerging zoonotic disease or imminent health hazard before it impacts U.S. personnel or civilians. To do this is to help ensure mission accomplishment as well as to address the politics of winning hearts and minds. Therein lays the critical nature of this topic.

Sample Supply List

Needles/syringes: 3cc, 22 gauge, 3/4"
Latex gloves
Alcohol swabs, gauze
EDTA blood collection tubes – purple top
IDEXX SNAP 3Dx or 4Dx tests
Coolers and packaging materials

Sterile water collection bottles (500mL, 1L)
Food thermometers (bi-metallic or digital10)

Mission Execution

The SOF medic must plan for the DHS prior to deployment. This predeployment preparation includes developing and briefing the plan to the SOF mission planners, researching endemic diseases and environmental hazards in the AOR, and coordinating for materials and supplies (see table of sample supplies).

Within a support company or group, SOF units have organic medical, preventive medicine, and veterinary assets to support specific DHS planning or operations. Utilize these assets before and/or during the deployment to provide professional guidance and assistance with the plan.

After deploying to any SOF deployment site, i.e. FOB, the first step in the SOF medic's public health study or analysis is to conduct an initial environmental baseline survey and OEHSA. During the OEHSA, the SOF medic's focus is on two veterinary priorities; zoonotic and infectious disease control and food/water safety.

After site familiarization and if mission permits, the SOF medic initiates the zoonotic and infectious disease surveillance. The local animals in the areas surrounding the FOB (areas where U.S. personnel will be) will be tested as part of the surveillance plan. The testing sample can include dogs, cats, and equids (horses, mules, donkeys). The medic should meet with local health officials or representatives to discuss known and suspected endemic zoonotic and infectious diseases. Discussions will determine what local studies have been performed and if the local health officials have personnel to support the SOF medic's disease surveillance plan. It is very important to open good lines of communication with these officials to plan coordinated testing and to emphasize that the zoonotic disease surveillance will aid in the local population's overall well-being. Emphasizing the benefits to the locals in a SOF combat zone may be crucial in gaining their support, and winning hearts and minds. In most SOF deployment sites, the value of an animal such as a horse, donkey, or mule cannot be overestimated. The importance of horses and pack animals in combat to the Northern Alliance and specific American SOFs (SF ODAs, CIA, and Delta Operators)[9] in Afghanistan is well documented, especially in detailed accounts throughout the book *Horse Soldiers*.[10] Horses allowed for greater flexibility and speed of movement through rugged terrain which contributed to the Taliban defeat. Healthy horses and pack animals such as donkeys and mules were value-added assets and force multipliers. The SOF medic's consistent disease surveillance in a herd of horses can detect potentially catastrophic infectious disease states, such as equine infectious anemia (EIA).[5] Mission failure is the obvious concern with this disease and other diseases that lead to horse health and performance decline in a combat setting.

During disease surveillance, animal blood samples can be collected in EDTA tubes for later testing. Data for each animal should include species, breed, sex, approximate age, weight, and subjective statement of the animal's overall appearance. Samples may be tested at the FOB or may be sent to the Department of Defense (DoD) Food and Diagnostic Laboratory (FADL), Fort Sam Houston, TX, for more in-depth testing (i.e. horse blood samples to be tested for EIA, etc).

At the FOB, the SOF medic reviews the FOB's food, water, and ice safety plan, determining what exactly the FOB personnel are consuming and how. The goal is to ensure safe food, water, and ice is being served to U.S. personnel and that steps (control measures) are in place which will continually ensure this. U.S. Army and host nation cooks should be questioned on the sanitation procedures and cooking/holding temperatures (see temperature chart). Potentially hazardous foods (PHFs) should be identified (see PHF chart), and control measures applied to reduce the health hazards of improper storage, handling, and/or cooking. Moreover, a food and water risk assessment (FWRA) can be developed based on the types of food being consumed. The *Veterinary/Medical Supplement* to the *Technical Guide (TG) 248* is the reference when formulating the FWRA. Bottom line, control measures must be emplaced and monitored by US personnel to reduce food/water risks at any site and for any number of U.S. personnel. In addition, water samples from the kitchen and any other water source site on the FOB should be obtained and submitted to the DoD FADL for microbiological and chemical testing.

In Afghanistan, it has been documented that local water wells were intentionally poisoned and contaminated by the Soviets, Taliban, and other local warring tribal factions.[10] While there in 2001, a forward deployed SOF team was sickened (vomiting and diarrhea) and incapacitated for days during combat operations after drinking from local water sources.[10]

TEMPERATURE GUIDELINES[9]	
Food	**°F**
Ground Meat & Meat Mixtures	
Beef, Pork, Veal, Lamb	160
Turkey, Chicken	165
Fresh Beef, Veal, Lamb	
Medium Rare	145
Medium	160
Well Done	170
Poultry	
Chicken & Turkey, whole	165
Poultry breasts, roast	165
Poultry thighs, wings	165
Duck & Goose	165
Stuffing (cooked alone or in bird)	165
Fresh Pork	160
Ham	
Fresh (raw)	160
Pre-cooked (to reheat)	140
Eggs & Egg Dishes	
Eggs	Cook until yolk and white are firm
Egg dishes	160
Leftovers, Casseroles	165

Potentially hazardous foods are foods that require time-temperature control to keep them safe for human consumption.

Contains moisture - water activity greater than 0.85
Contains protein
Is neutral to slightly acidic - pH between 4.6 and 7.5

The U.S. Food and Drug Administration (FDA) Food Code identifies the following examples of PHFs:

Meat (beef, pork, lamb)
Poultry (chicken, turkey, duck)
Fish
Shellfish and crustaceans
Eggs (except those treated to eliminate Salmonella)
Milk and dairy products
Heat-treated plant food (cooked rice, beans, or vegetables)
Baked potatoes
Certain synthetic ingredients
Mushrooms
Raw sprouts
Tofu and soy-protein foods
Untreated garlic and oil mixtures

Since these foods can harbor pathogenic microorganisms and permit their growth or the production of toxins, special care must be taken to keep them out of the temperature danger zone for as long as possible. Time is another factor that can be controlled to minimize the chances of pathogenic outbreaks.[8]

Tests confirming one weak and two strong positives for E.canis alongside test insert.

Disease Surveillance Results

The following results are examples of two disease surveillance studies conducted at SOF deployment sites in South America. The first site was at sea level along the Colombian coast, while the second test site was at significantly higher elevation in an Ecuadorian valley 7,850 feet above sea level. Working and non-working dogs were the test subjects at both sites. To the author's knowledge, there are no military studies or reports of zoonotic or infectious canine disease surveillance studies conducted in Ecuador. Likewise, as noted in a recent infectious disease study on the Galapagos Island of Isabela, university researchers and authors are aware of only one previous heartworm disease study (early 1980s) in the Ecuadorian Galapagos and no prevalence reports from mainland Ecuador.[8]

On the Colombian coast, coordination was made with a local kennel of seven working dogs. Due to the high temperatures, humidity, presence of ticks and mosquitoes, crowded kennel runs, and no heartworm/flea/tick preventive, the working hypothesis was that the dogs would test positive for tick-borne disease as well as heartworm disease.

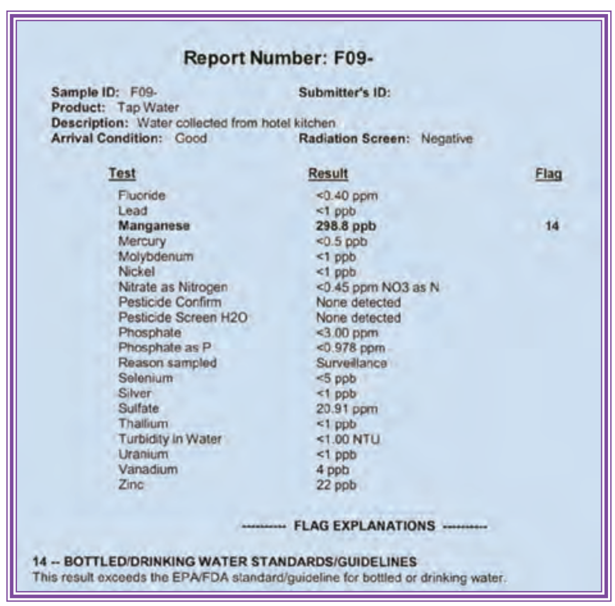
Test results confirmed three working dogs were positive for the tick-borne infectious and zoonotic disease ehrlichiosis (*Ehrlichia canis*). Specifically, two strong positives and one weak positive for *E. canis* (see photo above).

There were no heartworm antigen positive test results. These most recent surveillance findings in Colombian working dogs – zoonotic tick-borne disease and no heartworm disease – are similar to the surveillance studies documented by 7th SFG(A) in select SOF and Colombian jungle outposts in 2005.[4]

At the second site in mainland Ecuador, coordination was made with a local shelter of 60 non-working dogs. Most of these dogs were caught as strays and housed communally. Being a good representative sample of the local canine population, these dogs can provide valuable infectious disease insight. At this altitude, the temperature is more moderate during the day and cool at night. Shelter personnel indicated that mosquitoes and ticks were around, but uncommon. Dogs were tested on-site for heartworm disease and the tick-borne diseases *E. canis* and Lyme disease. It was not common practice in either areas for local veterinarians to test for these diseases or to prescribe heartworm and flea/tick preventive. All of the dogs tested in Ecuador were negative.

Water Surveillance Results

Additionally, as part of an overall OEHSA of a SOF deployment site, local water sources were inspected and samples obtained to be sent to the DoD FADL. Water may be sampled at host nation kitchens, hotels, barracks, community wells, or wherever water is being consumed or used in food/juice/ice preparation. Water sample size submitted for safety analysis should be a volume of at least 3L. Water test results are normally returned by the DoD FADL in two to three weeks due to the detailed testing. These and all results may be provided to the participating host nation officials for their use and awareness. See the example of the SOF deployment site water sample results returned by DoD FADL (Note: in this example, the manganese level exceeds U.S. EPA drinking water standards). The DoD FADL can supply select amounts of sterile water collection bottles when requested.



Report Number: F09-

Sample ID: F09- **Submitter's ID:**
Product: Tap Water
Description: Water collected from hotel kitchen
Arrival Condition: Good **Radiation Screen:** Negative

Test	Result	Flag
Fluoride	<0.40 ppm	
Lead	<1 ppb	
Manganese	**298.8 ppb**	**14**
Mercury	<0.5 ppb	
Molybdenum	<1 ppb	
Nickel	<1 ppb	
Nitrate as Nitrogen	<0.45 ppm NO3 as N	
Pesticide Confirm	None detected	
Pesticide Screen H2O	None detected	
Phosphate	<3.00 ppm	
Phosphate as P	<0.978 ppm	
Reason sampled	Surveillance	
Selenium	<5 ppb	
Silver	<1 ppb	
Sulfate	20.91 ppm	
Thallium	<1 ppb	
Turbidity in Water	<1.00 NTU	
Uranium	<1 ppb	
Vanadium	4 ppb	
Zinc	22 ppb	

---------- **FLAG EXPLANATIONS** ----------

14 -- BOTTLED/DRINKING WATER STANDARDS/GUIDELINES
This result exceeds the EPA/FDA standard/guideline for bottled or drinking water.

Water Test Results: *Example water test result from DOD FADL. Flagged for high Mn levels.*

DOD FADL, 2472 Schofield Road, Bldg 2630, Fort Sam Houston, TX 78234-6232
Phone 210-295-4210

Discussion

Blood samples were either packaged appropriately to be tested upon return to fixed facilities or were tested on-site. The IDEXX SNAP® 3Dx® Tests were used[14] (IDEXX SNAP® 4Dx® is now more applicable with its added test for the zoonotic tick-borne disease anaplasmosis).[15] The tests did not detect the presence of heartworm antigen in any of the samples. The tests detected the presence of *E. canis* in the South American working dogs. The positive results came from working dogs at sea-level in a coastal area of Colombia. The weather and humidity contribute to the higher populations of mosquitoes and ticks in these regions and therefore, a higher prevalence of associated disease. Conversely, infrequent mosquitoes and ticks found in the cooler and higher elevations of Ecuador, led to negative surveillance results in the non-working dog population. Future heartworm and tick-borne surveillance and prevalence studies should be conducted in the warm/humid Ecuadorian coastal regions such as Guayaquil, Manta, or Esmeraldas, where mosquitoes and ticks are more prevalent.

The findings of this research reconfirm the presence of a zoonotic tick-borne disease, ehrlichiosis, in a SOF deployment area of South America. Therefore, SOF medics must educate and ensure tick preventive measures for all U.S. personnel operating in these areas. SOF medics can recommend DEET-containing repellents and other measures such as keeping ACUs/pants tucked into boots. For working dogs in these areas, recommend Frontline Plus® or Advantix®. The latter has permethrin, which gives the added repellent benefit. *E. canis* positive working dogs can be treated with doxycycline by the local or military veterinarian.

Food/water security and the SOF medic's application of a FWRA is a must in the SOF deployment AO. The inherent risks with certain foods (i.e. PHFs) and water must be determined and known. Additionally, food and water vulnerabilities have to be considered as targets of opportunity for enemies of the U.S. It is documented that at the Al-Farooq training camp, Al Qaeda soldiers are taught to shoot, throw a grenade, and poison water, food, and people.[10] Intentional or unintentional food/water tampering or poisoning can incapacitate a large number of personnel at any one time (i.e. at a SOF FOB). Recall the SOF ODA sickened and thereby incapacitated during combat operations after drinking local water deemed to be safe by Afghan allies.[10] These and other examples emphasize the point for knowledgeable SOF medics and the need for consistent and timely food/water surveillance.

The goal of this article is to increase the SOF medic's knowledge and skill-set specifically in DHS. Further, this article displays that zoonotic and infectious disease surveillance and food/water assessments are critical in a deployed AO, whether in combat or not. These programs must be consistent and continual in order to ensure overall success. In these AOs, SOF training or combat missions are indeed intricate and sometimes political. This article describes alternative means for SOF, specifically enabled by the SOF medic, to win local hearts and minds in conjunction with or without the standard Civil Affairs (CA) or Non-Governmental Organization (NGO) operating procedures. These alternative means focus on two areas in which lives are dependent in these AOs – food/water and families' animals. Offering safe or improved food/water techniques and healthy animals to a developing host nation community or combat torn region is absolutely invaluable. This will improve the human condition in these areas and ensure the safety of U.S. personnel. This is the SOF commitment, to liberate the oppressed – *De Oppresso Liber*.

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Dr. Michael McCown is a graduate of the University of Florida College of Veterinary Medicine and served as a U.S. Army VCO thru 2006. He had the honor and priviledge to serve with the U.S. Army Special Forces while on active duty. Dr. McCown is honored to have worked with all of the Special Forces NCOs, especially with Ben and Jeff (SFCs G and Rada). They are the best of the best, great Americans who live duty, honor, country. Ben was wounded in action: Jeff gave everything – he gave his life while serving something bigger than himself. These NCOs are warriors, they are pro fessionals, they are an inspiration forever. These NCOs should be recognized for the work they do everyday and should be the ones highlighted in this study and journal article.

SFC Benjamin Grzeszak is a Special Forces Medical Sergeant currently assigned to 7th SFG(A). He has served three combat tours with 7th SFG(A) in Afghanistan in support of the Global War on Terrorism and two deployments to South America.

SFC Jeffrey M. Rada Morales entered the U.S. Army in April 1995 as an animal care specialist. He then served at JFKSWC&S, Fort Bragg, NC, as an animal care NCO and a SF medic veterinary medicine instructor. SFC Rada played an integral part in the overall education of current and past SF medics. His motivation and initiative to excel drove him to compete for and earn the coveted Green Beret in 2007. After achieving Special Forces Qualification and training as SF medic (18D), he was assigned to 1st Bn, 7th SFG(A) as an ODA senior medic. While deployed to Afghanistan, SFC Rada died June 28, 2008 in support of combat operations in the Arghandab District, Kandahar province.

The *JSOM* Fall 08 Vol 8 Ed 4 was dedicated to SFC Jeffrey M. Rada Morales. Jeff was an inspiration as a Soldier, NCO, and a person. His legacy continues to be an example for all that knew him. He will always be remembered for his intuitive and sincere input into the lives of many and for inspiring this and other research projects. This one's for you Jeff! Thank you.

Trauma Anesthesia Plan for Non-Permissive Environments

Maj Joshua M. Tobin, MD

Abstract

The current war has, like past conflicts, presented the medical community with opportunities to innovate novel approaches to old problems. Although trauma anesthesia is provided adequately in the majority of cases, a standardized approach for treating these complex and critically ill patients is lacking. While this technique was developed for anesthesia in non-permissive environments, the principles suggested here could serve as a template for trauma anesthesia in other environments as well. The algorithm is designed as a standardized protocol in an effort to simplify the approach to these complex patients who often present in a dynamic environment. A list of required equipment is included to serve as a guide for preparation prior to employment of the algorithm.

Introduction

Napoleon's Aide-Surgeon-Major Dominique Jean-Larrey was one of the first to propose advanced medical care in the field, followed by evacuation to higher levels of care by dedicated military assets. In his case, horse drawn carriages called "flying ambulances" were used. Recent conflicts have proven no exception to the concept of advanced medical care in the forward environment.[1] Inclusive in the concept of forward surgery is the provision for battlefield anesthesia. For teams operating in the far forward, non-permissive environment such a plan must provide anesthesia for a major abdominal case (e.g. exploratory laparotomy for trauma) with equipment that can be carried on the back of the individual physician. The anesthetic plan must account for surgical anesthesia, as well as the initial and on-going resuscitation of a major trauma case. This includes adequate sedation, hypnosis, and analgesia for the surgery, as well as muscle relaxation. Potential emergencies and resuscitation must also be anticipated. Some concerns unique to the austere environment include limiting the weight of the equipment needed, providing power to any electronic equipment used, and carrying all of the medication required for the case in a backpack.

A review of the literature finds little that discusses possible methods for providing the anesthetic for trauma and emergency surgery in austere environments.[2,3] Although some of the guidelines proposed here may be basic (e.g. have your emergency medications immediately available), these techniques are included because they have sometimes been neglected in the past with disastrous results. It is important to note that these suggestions are intended for austere environments with patients *in extremis* where laboratory, radiology, and other support services are not available.

The equipment referenced here can be carried in a standard ruck sack at a weight under approximately 45 pounds, not including oxygen supply. It is convenient to pre-package the gear that will be used together in vacuum sealed, zip lock-type bags (e.g. IV/IO bag, intubation bag, monitoring equipment bag, etc). Their retrieval from the ruck sack and employment can thereby be made more efficient. Medications can be carried in a small, hard-plastic pelican-type case. Although these medications will potentially be exposed to temperature extremes, it is unclear what the clinical significance of these temperature extremes is.[4] Keeping medical gear in a temperature controlled environment is obviously preferred if possible.

The algorithm is designed as a standardized protocol (see Figure 1) in an effort to simplify the approach to these complex patients who often present in a dynamic environment. A list of required equipment is included to serve as a guide for preparation prior to employment of the algorithm (see Table 1). Included below is a proposed algorithm for the anesthesia and resuscitation of trauma patients in non-permissive environments.

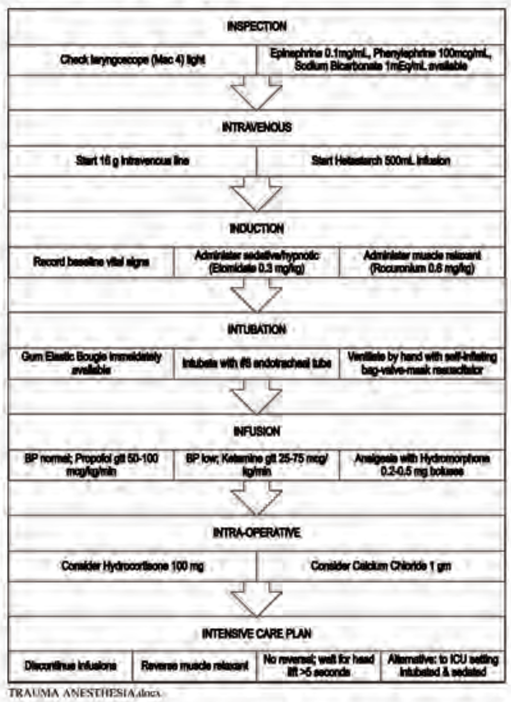

Figure 1 Trauma Anesthesia Algorithm

Table 1 **<u>Trauma Anesthesia Equipment List</u>**

1-	Laryngoscope handle with AA batteries
1-	Macintosh 4 laryngoscope blade
4-	AA batteries
1-	Gum elastic bougie
2-	Endotracheal tube stylet
2-	#8 Endotracheal tube
2-	#7 Endotracheal tube
1-	Self-inflating bag-valve-mask resuscitator
1-	Electrocardiogram monitor with oxygen saturation and non-invasive blood pressure capability
1-	Sphygmomanometer (if monitor unavailable)
1-	Stethoscope
2-	16 gauge angiocatheter
2-	14 gauge angiocatheter
2-	15 gauge intraosseous needle
30-	Alcohol swabs
4-	Occlusive intravenous site dressing
1-	1 inch roll medical tape
2-	Intravenous tourniquet
4-	Macro-drip intravenous tubing
2-	Hetastarch (500ml)
2-	Normal Saline (1000ml)
2-	Lactated Ringer's (1000ml)
1-	Battery-powered, rechargeable syringe infusion pump
4-	Microbore intravenous extension tubing (for use with syringe pump)
2-	Lever lock cannula (to attach syringe pump tubing to intravenous line)
3-	Syringe (60ml)
6-	Syringe (20ml)
15-	Syringe (10ml)
25-	18 gauge needle
3-	Epinephrine pre-filled syringe (10ml at 0.1mg/ml)
3-	Phenylephrine (1ml at 10mg/ml)
3-	Normal Saline (100ml)
3-	Sodium Bicarbonate pre-filled syringe (50ml at 1meq/ml)
2-	Etomidate (20ml at 2mg/ml)
3-	Rocuronium (5ml at 10mg/ml)
2-	Propofol (100ml at 10mg/ml)
2-	Ketamine (10ml at 50mg/ml)
4-	Hydromorphone (1ml at 2mg/ml)
1-	Hydrocortisone (2ml at 50mg/ml)
2-	Calcium Chloride (10ml at 100mg/ml)
1-	Standard ruck sack

Inspection

Have airway equipment prepared at all times. This includes inspecting the quality of the light at the end of the laryngoscope blade on a regular basis and ensuring that endotracheal tubes are available. If only one laryngoscope blade is to be carried due to weight restrictions, take a Macintosh 4. It can be appropriately placed in the vallecula as designed, or used as a "modified Miller" blade to manipulate the epiglottis in difficult airways. A gum elastic bougie is useful in difficult airways without adding much weight. Use a laryngoscope handle with AA batteries, rather than C batteries. AA batteries are more readily available in the austere environment, thus streamlining the re-supply needs of the team and decreasing overall equipment weight.

Prepare emergency medications for immediate use at all times. Potent medications that support hemodynamics are important to any resuscitation. The potent vasopressor and inotropic effects of epinephrine are well known. Sodium bicarbonate supports cardiac contractility[5] and can be useful in cardiopulmonary collapse. Phenylephrine supports systemic vascular resistance via direct alpha agonist activity without an increase in heart rate, making it useful for hypotension at induction of anesthesia. Valuable preparatory time is saved when these medications are carried in pre-packaged syringes. One can add phenylephrine 10mg in 100ml of normal saline for a concentration of 100mcg/ml. A single 10ml syringe can be prepared for immediate use.

Intravenous

Obtain vascular access with a 16 gauge angiocatheter, or larger. The flow rates possible through a 16 gauge angiocatheter (220ml/min) are double those of an 18 gauge catheter (105ml/min). If it is not possible to quickly establish intravenous access, place an intraosseous line. Administer 500ml of hetastarch. Although hetastarch can inhibit factor VII and von Willebrand factor, resulting in impaired platelet function, this effect is generally seen with volumes over one liter.[6,7] Importantly, the use of colloid allows a minimum volume of resuscitation fluid to be carried in the physician's backpack. Administer a second 500ml of hetastarch at a slower rate, then resuscitate as needed with crystalloid. Titrate fluid administration to blood pressure, and more importantly, urine output. The goal urine output is 1-2ml/kg/hr. Place a second intravenous line as time permits.

Although blood bank facilities are unlikely to be available in the austere environment, the "walking blood bank" has been used in the past. Team members with an appropriate blood type, who have been prescreened for communicable diseases, donate whole blood for use in surgery. There is an emerging body of literature regarding the appropriate ratio of blood products for use in trauma,[8] as well as novel applications in the trauma patient of medications useful in massive hemorrhage.[9,10] A detailed discussion of these practices, however, is beyond the scope of this communication.

Monitor electrocardiogram and blood pressure if available; however, a monitor may be prohibitively heavy. If a non-invasive blood pressure monitor is not available, the following rule has proven useful. A palpable carotid pulse suggests a systolic blood pressure of roughly 60mmHg, a femoral pulse 70mmHg, and a radial pulse 80mmHg. A manual sphygmomanometer is useful for interval measurement of vital signs without adding much weight.

Induction

Induce anesthesia using etomidate at a dose of 0.3mg/kg as a sedative/hypnotic and rocuronium at a dose of 0.6mg/kg as a muscle relaxant. There is a slightly longer onset of action for rocuronium than succinylcholine (60-90 sec v. 30-60 sec). The side effects of succinylcholine, such as increase in intracranial pressure and hyperkalemia; however, are avoided with the use of a non-depolarizing agent. Furthermore, rocuronium can remain out of refrigeration (60 days) significantly longer than succinylcholine (14 days) making it more suitable for use in the austere environment. Additionally, a longer acting non-depolarizing muscle relaxant is needed for abdominal wall muscle relaxation in a major abdominal case.

Intubation

Intubate the trachea with a #8 endotracheal tube and ventilate by hand with a self-inflating bag-valve resuscitator. Administration of oxygen is obviously ideal; however, large oxygen cylinders are prohibitively heavy. Smaller liquid oxygen systems under development (Backpack Medical Oxygen System; Essex Cryogenics of Missouri, Inc.; St. Louis, MO) may allow administration of oxygen concentrations greater than 40% for shorter duration "damage control" surgery.

Infusion

Start a propofol infusion at 50-100mcg/kg/min. A variety of small syringe pumps that have rechargeable battery packs are readily available for accurate delivery of intravenous anesthesia. In the event of battery failure, intermittent bolus dosing can be used. Titrate the infusion to blood pressure and sedation/hypnosis. If the blood pressure is low, start a ketamine infusion at 25-75mcg/kg/min. Advantages of ketamine include support of the sympathetic nervous system (most notably blood pressure) and bronchodilation. Airway reflexes are maintained with ketamine. Side-effects of ketamine include dissociative anesthesia and a theoretical increase in risk of seizures.

Maintain analgesia with hydromorphone in 0.2-0.5mg intravenous boluses. Hydromorphone is significantly more potent than morphine and is not associated with the histamine release, and resultant hypotension, of morphine. Hydromorphone is packaged in concentrated 2mg vials, again saving weight.

Intra-Operative

Administer hydrocortisone 100mg; so called "stress dose steroids." The intense mineralocorticoid activity of hydrocortisone improves sensitivity to catecholamines, decreases inflammatory markers, and decreases vasopressor requirements while avoiding some of the unwanted side effects of glucocorticoid administration. While it is ideal to verify a cortisol level before administration of hydrocortisone,[11] this is not an option in the austere environment. One can assume some degree of adrenal insufficiency and catecholamine depletion in a major trauma patient.[12]

If the patient experiences hypotension refractory to fluid resuscitation, then administer one gram of calcium chloride. Again, without laboratory facilities this is not ideal; however, the risks of low calcium (most significantly, unremitting hypotension) are greater than the risks of mild hypercalcemia (nausea, vomiting, constipation, ileus, shortened QT interval, nephrocalcinosis).

Intensive Care Plan

At the conclusion of the case, discontinue any sedative-hypnotic infusion. Extubate after reversing the effect of the muscle relaxant with neostigmine and glycopyrrolate. If these medications are not available, wait for the clinical duration of the muscle relaxant to pass (an induction dose of rocuronium will last 35-75 min). A clinical assessment of return of airway reflexes is the evaluation of sustained head lift. A sustained head lift greater than five seconds suggests adequate return of airway reflexes.

Conclusion

The current war has, like past conflicts, presented the medical community with opportunities to innovate novel approaches to old problems. Although trauma anesthesia is provided adequately in the majority of cases; a standardized approach for treating these complex and critically ill patients is lacking. While this technique was developed for anesthesia in non-permissive environments, the principles suggested here could serve as a template for trauma anesthesia in other environments as well.

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Sources of Financial Support: None

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The Neurometabolic Cascade and Implications of mTBI: Mitigating Risk to the SOF Community

MAJ Stephen M. DeLellis MPAS, PA-C; LTC Shawn Kane MD, FAAFP; Kris Katz PhD, ABPP

Abstract

Over the last decade, our understanding of biochemical changes that occur in the brain following an injury has increased dramatically. Although we have been able to discern and image severe injury and traumatic changes using techniques like computed tomography (CT) and magnetic resonance imaging (MRI) for decades, we have only recently begun to understand the physiologic changes that occur following a mild traumatic brain injury. Understanding the pathophysiology of a disease process enables healthcare providers to treat their patients better, but military healthcare providers shoulder the additional burden of conserving the fighting force. Neurocognitive testing in concert with clinical acumen and conservative profiling enables providers to protect their patients from further injury; while educating the patient and the chain of command will prevent additional injury and long-term cognitive sequelae, ultimately preserving the fighting force.

Over the last decade, our understanding of biochemical changes that occur in the brain following an injury has increased dramatically. Although we have been able to discern and image severe injury and traumatic changes using techniques like CT and MRI for decades, we have only recently begun to understand the physiologic changes that occur following a mild traumatic brain injury (mTBI). It's incumbent on healthcare providers to understand the implications of these changes, the difficulty diagnosing mTBI, the sequelae, and potential risks to the patient during recovery.

Since 11 September 2001 mTBI risk to Special Operations Forces (SOF) has increased significantly due to continuous deployment cycles around the globe. Traumatic brain injury (TBI), mTBI, and concussion seem to be the signature injuries of the Global War on Terrorism. Though Soldiers on today's battlefields have the most advanced protective ensemble of any force fielded in America's history, modern ballistic helmets were designed to protect against penetrating trauma but are poor barriers against explosive pressure and blast effect.

The Neurometabolic Cascade

Immediate and widespread cellular chemical changes occur within the brain following injury. The force required to initiate this cascade may be insufficient to cause physically evident changes on CT or MRI. However, the speed with which these changes occur and the self-perpetuating nature of cellular demise is usually sufficient to cause changes in mentation, memory, motor function, and postural stability. A 80g force of translational acceleration may be sufficient to initiate biochemical change.[1] To put this in perspective, Brolinson et. al., demonstrated an average linear acceleration force of 20.1g in over 11,000 non-injury producing collegiate football impacts.[2]

Upon impact, glutamate and other excitatory neurotransmitters attach to N-methyl-D-aspartate (NMDA) receptors leading to a rapid ion shift across the cell membrane. Rapid loss of intercellular potassium and influx of calcium forces up-regulation of the sodium-potassium pumps in an attempt to restore normal resting membrane potential. As sodium-potassium pumps deplete cerebral stores of adenosine triphosphate (ATP) compensatory hyperglycolysis occurs. Furthermore, as extracellular potassium levels rise, neuronal depolarization continues, and excitatory neurotransmitters are released propagating widespread neurotransmission and cellular glucose consumption. This excitatory cycle of NMDA receptor activation, potassium release, and signal propagation is rapid and widespread.[3] Furthermore, glucose deficit and widespread neuronal activity result in decreased cerebral blood flow at a time when supply and demand are already critically mismatched.[4]

In the uninjured state, cerebral oxidative metabolism typically runs near maximum potential. During this post-injury cellular energy crisis, oxidative metabolism falters as calcium accumulates within the mitochondria. Additionally, decreased oxidative metabolism leads to decreased ATP production, further exacerbating the energy deficit. This additional energy deficit serves as a secondary stimulus for increased glycolysis.[1] Increased cellular effort yields lactic acid which the cell is incapable of metabolizing in its weakened state. As lactic acid levels rise, cellular pH decreases. Cellular acidosis results in cell membrane damage and blood-brain-barrier permeability with resultant cerebral edema.[3]

Intercellular magnesium levels are also affected almost immediately following a head injury. Magnesium is necessary for ATP production, cellular membrane potential, protein synthesis, and regulation of NMDA receptors. As magnesium stores wane, ATP production decreases and NMDA receptors are activated more readily. As protein synthesis fails, the cell membrane is further weakened and calcium accumulates within the mitochondria. This hypermetabolic state and ensuing energy crisis is a precursor for widespread cellular demise and potential cellular death.

Following the exhaustion of glucose stores and consumption of available ATP, the cell membrane is weakened and begins to leak. In this weakened state, the resulting cerebral edema makes the brain vulnerable to additional insult or overstimulation. Should additional trauma occur during this depressed state, the brain has little reserve to compensate. Even if no further physical injury occurs, studies have shown that overstimulation of the brain during this vulnerable recovery period may increase the size of the lesion and prolong the recovery period.[5] This cascade of effects at cell level is shown in Figure 1.

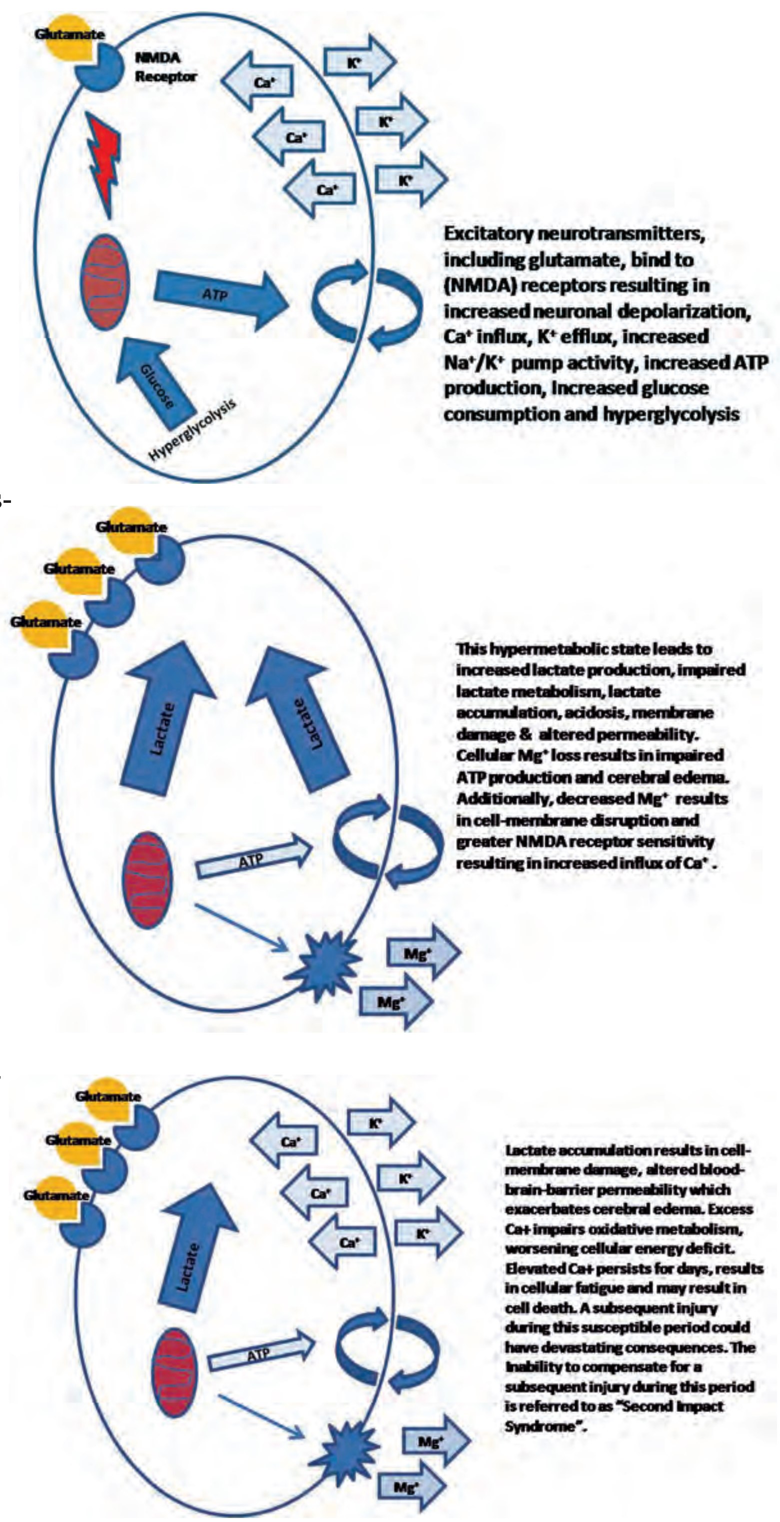


Figure 1

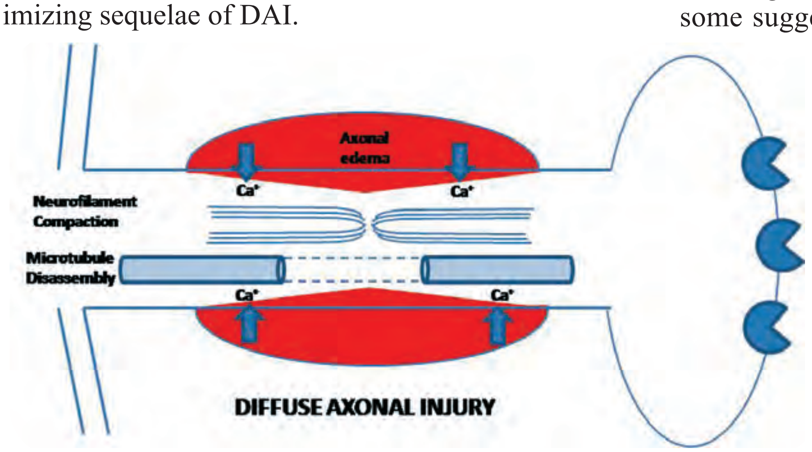
Diffuse Axonal Injury

Stretching and shearing of white matter and axons following even mild head trauma is referred to as diffuse axonal injury (DAI). The majority of mTBIs result in changes in parenchymal cytoarchitecture sufficient to cause changes in neurocognitive affect, but are usually not significant enough to manifest as changes on CT or MRI. Rarely, axonal shearing injury, or DAI, may result in hemorrhage identifiable with standard imaging techniques. The axolemma is the portion of the cell membrane surrounding the axon of a neuron and is responsible for maintaining the membrane potential of the neuron. Axolemmal permeability results in additional influx of calcium and mitochondrial swelling. Axonal stretching further alters membrane potential and depolarization.

Stretching or tearing of the normally elastic axons leads to disruption of cytoskeletal structures. Axonal transport continues up to the point of disruption, then stops abruptly. Build-up of transport organelles at the site of disruption accumulates and causes edema. Neurofilament compaction occurs in the center of axonal swelling, resulting in secondary axotomy. The detached ends of neurofilaments retract and form axonal bulbs or "retraction balls".[6] These microscopic structural changes in neurofilaments occur in as little as five minutes, with resultant secondary axotomy beginning as early as four hours post-injury.[7] Influx of calcium into axons may adversely affect axonal microtubules as well. Though not all microtubules are affected, those closest to nodes of Ranvier seem to be the most calcium sensitive. In the presence of excess calcium, and under pressure from local edema, microtubules rapidly break down and undergo disassembly.

Diffuse axonal injury (DAI) characteristically occur in the brain stem, corpus callosum, and frontal hemispheres. Lesions also typically occur in the frontal and temporal lobes and may occur in the cerebral cortex, superior cerebral peduncles, basal ganglia, thalamus, and deep hemispheric nuclei. The majority of lesions occur where the grey and white matter meet, likely due to the differing densities of adjoining tissues.[8-11] Typically in mTBI only the cytoskeleton is disrupted. However, in some cases proteolytic disruption of the cytoskeleton and cell membrane lead to apoptosis and cell death. In mTBI the mitochondria, dendrites, and damaged cytoskeletal components have limited ability to regenerate and heal, typically occurring in about two weeks.

Diffuse axonal injury is typically classified by severity. Grade I is characterized by widespread axonal damage without focal neurologic abnormalities. Grade II is characterized by widespread axonal damage with focal deficit, typically in the corpus callosum. Grade III is characterized by widespread axonal damage, focal deficit and rostral brain stem injury which may include tears of the tissue.[12] There are no specific treatment modalities for DAI beyond stabilization and palliative care. Managing intracranial pressure is essential in minimizing sequelae of DAI.



Alterations in neurotransmission

Long-term alterations in excitatory as well as inhibitory neurotransmissions are possible following even mild TBI. Studies have shown that adrenergic,[13] cholinergic,[14] and glutamatergic[15] transmissions are all potentially affected. Down regulation of excitatory neurotransmission has been implicated in impaired memory, shortened attention span, and learning deficits. Down regulation of inhibitory neurotransmission has been implicated in compromised inhibition and development of seizures.[16] Furthermore, plasticity, as measured by NMDA-dependent long-term potentiation, may be persistently impaired.[17]

Post traumatic amnesia and anterograde memory impairment are clinical manifestations of a disrupted cholinergic neurotransmission system. In the acute phase of TBI, disruption of the cholinergic system manifests as an altered level of consciousness, unrelated to dysfunction of the reticular activating system. New learning and memory impairment are manifestations of other conditions associated with deficient cholinergic transmission, such as Alzheimer's disease. Theoretically, therefore, disruption of cholinergic neurotransmission would likewise be responsible for learning and memory deficit following TBI.[1]

Diffuse amyloid plaques form in over one-third of individuals who survived at least six days following a TBI of apparently any severity.[18] Deposition of beta-amyloid (Aβ) throughout the brain occurs following cerebral ischemia, increased intracranial pressure, cerebral contusions, DAI, or cerebral edema. Graham et al. has suggested that the deposition of Aβ is the result of acute traumatic stress in nerve cells.[19] Amyloid precursor protein (APP), up-regulated acutely following TBI, is the source of the Aβ. While APP may be neuroprotective, by protecting against hypoglycemia by reducing calcium and glutamate neurotoxicity within the cell, abnormal processing of APP results in Aβ deposition.

There is debate in the literature about the primacy of Aβ deposition or neurofibrillary tangles in dementia. Neurofibrillary tangles correlate more closely with cognitive impairment in Alzheimer's disease and some suggest it precedes formation of extracellular amyloid deposits.[20] Nevertheless, it is generally accepted that neurofibrillary tangles are the proximate cause of dementia and have at least some relationship with amyloid deposits. Monniere et al. demonstrated in-vitro neuronal dystrophy, gliosis, and reactive astrocytosis when astrocytes were plated on Aβ. These characteristic findings are consistent with dystrophic neurites observed in the presence of in-vivo Aβ in Alzheimer's disease.[21] Considering the results of Morrerie and colleagues' findings, it is reasonable to deduce that Aβ may be contributory to cognitive impairment in TBI.

Implications of mTBI to the patient and the force

Post-Concussive Syndrome

Post-concussive syndrome (PCS) is the presence of concussive symptoms for weeks or months after a concussion, and is marked by four dominant symptoms: 1) brief alteration in consciousness or neurological function with acute changes in mentation and speed of processing, 2) physical symptoms such as headaches, dizziness, vertigo, and fatigue, 3) cognitive deficits in short term memory, attention, and concentration, and 4) an increased vulnerability for changes in mood and emotional functioning.[22] The literature suggests that these post-concussive symptoms typically resolve within tendays to three months, although about 15% may continue to experience symptoms up to a year after the concussion.

Persistent post-concussive syndrome (PPCS) is typically defined as symptoms that last for more than three months. There are a number of modifying factors that may influence recovery, to include: 1) symptom number and severity, 2) the presence of post-traumatic amnesia, 3) prolonged loss of consciousness (>1 min), 4) the recency, timing, and frequency of prior concussions, and 5) a history of migraines, psychiatric conditions, or ADHD/learning disabilities. While there is debate about the relative primacy of these factors, most acknowledge that a patient's outcome is based on a complex interaction of neurological, physical, and psychological factors, and that one's premorbid personality, available coping resources, environmental demands, recovery expectations, external support, and PCS education may significantly influence these factors. It is also important to remember that PCS symptoms may be mirrored by post-traumatic stress disorder (PTSD) symptoms, and that PTSD can exacerbate the cognitive symptoms of PCS.[23] In particular, noise sensitivity, fatigue, anxiety, insomnia, decreased concentration, decreased memory, anger, irritability, and depression may overlap.

Post-concussive syndrome has been a much debated topic in the literature, particularly when it comes to definitions and nomenclature. Despite this, there is general consensus that even concussions without a loss of consciousness can result in the above noted neurometabolic cascade and white matter abnormalities, particularly in the corpus callosum, hippocampus, and fornix.[22] In fact, the literature has begun to demonstrate the presence of pathological changes in the brain in some samples even in the absence of a concussion. For example, Zhang et al.[24] and Chappell et al.[25] have demonstrated white matter pathology in a sample of young healthy boxers with no neurological impairment using diffusion tensor imaging. Similarly, Zetterberg at al.[26] demonstrated the presence of CSF markers for neuronal and astroglial injury seven to ten days after a bout in 14 amateur boxers that was positively associated with the number of hits during the bout. Of note, none of these amateur boxers received a knock-out punch, or met behavioral criteria for a concussion. Together, these studies highlight that pathological changes do take place in the brain, even when neurobehavioral symptoms may not be readily apparent.

Baseline neuropsychological testing

Recent research and clinical experience suggests that an exclusive reliance on an individual's self-report of symptoms may be an inadequate benchmark for the disposition of those with PCS or TBI. Concussion management in sports at the professional, collegiate, and high school levels now frequently includes neuropsychological baseline and post-injury testing for return-to-play decisions. McCrory et al.[27] recently published the consensus statement on concussion in sport, in which the clinical value of neuropsychological assessment is reinforced. While in most cases the cognitive sequelae largely resolve during the time course of other symptoms, it has been shown that cognitive recovery commonly follows the other PCS symptoms.[28,29] Moreover, Van Kampen et al.[30] found that the inclusion of neurocognitive testing improved the identification of athletes who still had PCS symptoms from 64% (self-reported symptoms only) to 83% (cognitive data only) to 93% (self-report and/or cognitive data).

A premorbid baseline measure of the cognitive domains most susceptible to decline following a brain insult is largely considered the gold standard in clinical neuropsychology. In the absence of an individual's premorbid baseline, normative data must be used to determine if someone's performance falls within the "normal" range. One limitation with using normative data, particularly for the SOF community, is that most normative datasets are predominantly derived from samples with average levels of intelligence. In contrast, SOF members go through rigorous selection criteria that have resulted in a community with largely above average intelligence. As such, the application of "average" norms to someone with a recent concussion, and who is premorbidly "above average" may suggest the absence of cognitive sequelae when in fact there has been a decrement. Returning these individuals to duty would put them at greater risk for additional mTBIs, and possible even second impact syndrome.

To mitigate these risks and facilitate individualized comparisons as opposed to the use of normative data, we undertook the task of collecting baseline neurocognitive data from nearly every member of an elite Special Operations unit. The Immediate Post-concussion Assessment and Cognitive Testing (ImPACT) was chosen as the baseline and post-injury measure because of its relative psychometric strengths (strong reliability and validity), the ready availability of alternate forms for repeat testing, and ease of use in both garrison and deployed environments. From our experience, the vast majority of PCS cases returned to baseline within 10 days, with consultation by a clinical neuropsychologist facilitating test interpretation as needed. After seven to ten days, the sensitivity/specificity of computerized neurocognitive testing declines, so a comprehensive neuropsychological evaluation is recommended should recovery time exceed ten days. In our experience, roughly one in ten cases required a comprehensive neuropsychological evaluation, and in these cases significant moderator variables likely delayed each individual's recovery time (prior concussions, psychiatric symptoms).

While the neuropsychological presentation following mTBI can be highly individualized, impaired attention (slower reaction time, increased distractibility, and difficulty multitasking), memory (verbal or nonverbal), executive functioning, and emotional dysregulation tend to be common cognitive symptoms. Even after a patient returns to baseline on neuropsychological testing, and is otherwise asymptomatic at rest, the literature suggests there may be continued cognitive vulnerabilities to physiological or psychological stress. For example, Ewing, McCarthy, Gronwall, and Wrightson[31] demonstrated that those with mTBIs who have returned to baseline on tasks of vigilance and auditory memory at ground level may still demonstrate residual cognitive difficulties at altitude due to the physiological stress of hypoxia (altitude of 12,467ft).

Other research has suggested that high levels of stress can decrease information processing speed and increase subtle memory deficits during mentally challenging tasks.[32] Together, these studies suggest a continued vulnerability that may exist when more stressful conditions are encountered than the highly standardized and optimal environment of a clinical neuropsychological evaluation. As such, even with a return to baseline on neurocognitive testing, a specific job-performance evaluation may be prudent to ensure the absence of more subtle inefficiencies that may manifest under the more extreme conditions in which SOF personnel may find themselves (i.e. HALO/HAHO, etc.).

Profiling, return to duty, and force protection

Most of the management guidelines for combat and military duty related mTBI are based on the ever evolving management of sports related concussion. Much can be gained from applying elite level sports medicine practices into our community of Special Operations "Warrior-Athletes". However, it is incumbent upon military healthcare providers to understand the significant differences in returning a symptomatic athlete to play early verses returning a symptomatic special operator to duty early. Returning to unrestricted duty, both in combat and in training, while still symptomatic not only puts the individual at much greater risk but also puts every person around and associated with them at much greater risk due to the nature of their work. Therefore, it is recommended that healthcare providers conservatively apply return to play/duty guidelines and use a multi-disciplinary team approach when making final return to duty decisions.

Currently, the mainstays of mTBI treatment are physical and cognitive rest and protecting the brain from further insults while it is recovering.[33,34] It is postulated that the previously discussed metabolic dysfunction may lead to significantly increased neurological vulnerability if even minor trauma is sustained while the brain is still healing.[35] Preventing a subsequent mTBI while the brain is still recovering may potentially minimize the risk of catastrophic neurologic sequelae as well as long term lingering post-concussive symptoms, mental health issues (depression), and behavioral health issues (ADHD/ADD).

Profiles are typically looked upon with distain in the SOF community. In mTBI cases, clearly written duty restrictions that are understood by the patient and the chain of command are essential to the long term health of the individual and their successful return to duty. The mTBI profile is unique in that it should limit both physical and cognitive activities. It is vital to the patients' recovery that the uniqueness of each profile be explained to both the patient and their chain of command in order to maximize compliance. The physical limitations are typically the easiest to write and should limit physical training (both cardiovascular and weight lifting activities), airborne operations (both static line and military free fall), close quarters battle, marksmanship or demolitions training, operating military vehicles, and/or other high risk training.

Cognitive activities that require concentration and attention to detail (TOC battle captain duties, LNO duties, video gaming, and even pleasure reading) may exacerbate symptoms and prolong recovery and should be prohibited.[33] The duration of each profile will vary from patient to patient and will depend on how each individual responds to their injury. Individual Services may have mandatory periods of duty restriction based solely on the diagnosis of an mTBI. Providers should be cognizant of the requisite challenges affecting specific occupations (i.e. aviation personnel) when prescribing duty restrictions.

It is recommended that the patient follow up with their healthcare provider at short intervals to allow for individual recovery patterns with a subsequent gradual increase in physical and mental activity. Furthermore, computerized cognitive testing at regular intervals will reveal cognitive improvement, stagnation, or decline. Self-reported symptom scales typically return to normal before patients return to baseline on cognitive evaluations. Therefore, neuropsychological test results are equally important in determining duration and limitations of the profile.

Once the patient is completely asymptomatic at rest (meaning not requiring any medications that may mask or modify the symptoms of a mTBI) they may begin a graduated return to duty program.[33] The Defense and Veteran's Brain Injury Clinic (DVBIC) recommends an exertional testing program in its Consensus Statement on the acute management of mTBI/concussion in the deployed setting. However, due to the typical fitness level of SOF, exertional challenges may not identify many Special Operations patients who are still impaired.[36]

The breadth of mission-requirements within SOF will preclude the development of a SOF specific gradual return to duty program. Therefore, unit-medical personnel should consider each patient's duty requirements and develop individualized return-to-duty plans in concert with the patient and their chain of command. Regardless of the patient's job, the key non-negotiable tenant of every return-to-duty program is that the patient should not proceed to the next level if they develop symptoms while exercising, or anytime after exercising.

It is recommended that the return-to-duty program follow a crawl-walk-run type of progression, starting with light aerobic exercise with the gradual addition of military mission-specific requirements. Special Operations missions require a high degree of mental dexterity along with physical prowess. Due to this fact it is vital that the gradual return to duty program include a combination of mental and physical tasks, performed simultaneously, to better reflect real life mission requirements.

Educating the patient and the chain of command is an integral part of the process and starts with the diagnosis and continues until the patient is medically cleared for duty. Mild TBIs are unique from many other medical conditions in that typically, the severity of the diagnosis cannot be determined until the patient recovers or fails to recover. Investing the time to explain the uniqueness of each individual's injury and our inability to accurately predict a timeline, for disease progression and recovery, is paramount to controlling the expectations of both the patient and the chain of command.

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Special Operations Individual Medical Equipment Part I – The Major Trauma Kit

Dirk Geers

Abstract

Special Operations Forces (SOF) Operators need a variety of individual medical items that can generally be broken down into three types of medical kits: a major trauma kit, to treat major traumatic wounds; an in-use medical kit, to prevent or treat anticipated common medical conditions during operations; and a survival medical kit, to treat minor injuries and ailments when in a survival/evasion situation.

Aim

The aim of this article, the first in a two-part series, is to provide an insight on how an individual major trauma kit for SOF *could* be custom-built.

Operational requirements

The major trauma kit should allow an Operator to self-administer or receive effective treatment for as many field-treatable injuries encountered during operations as possible. At the same time, the kit should be durable and as light and as small as possible.

Conditions for use

The individual major trauma kit can and should be used to treat serious wounds inflicted upon the individual carrying the kit, whether collective medical supplies, such as those carried in the team medic's aid bag, are readily available or not. In addition, it may be used to complement the survival medical kit for non-trauma situations in a survival/evasion situation.

Criteria for selecting kit contents

First of all, the kit has to meet the operational requirements listed. A balance should be sought between light weight and compactness on the one hand, and comprehensiveness on the other. Both requirements are obviously contradictoryand influenced by several mutually interacting factors, such as the range of injuries considered as field-treatable, existing equipment (based on available technology), the accepted scope of practice and medical training level of individual SOF Operators, and time available for initial and refresher medical training.

Being effective means that any item as such is medically effective *and* can be used in tactical situations, in accordance with the principles of Tactical Combat Casualty Care (TCCC).[1] Effectiveness should be evidence-based, not just based on the manufacturer's claims. To be effective, the kits contents should also be easy to access and use when under stress. This often overlooked issue is very important, as the stress of combat will cause fine motor skills to deteriorate.[2] This consideration is even more important if there's a high likelihood that any replacement items will be different from the original. The fact that a piece of kit performs superbly in a hospital emergency room or in a non-hostile pre-hospital environment is totally irrelevant.

"As many field-treatable injuries as possible" means that at a minimum, items essential for the immediate treatment of most, if not all, causes of potentially preventable death on the battlefield, should be included. While also important is having the ability of treating non-life-threatening injuries so as to give some comfort to wounded Operators, allowing them to stay in the fight. Based on data from the pre-Global War on Terror causes of death on the battlefield, there seems to be a general understanding that in order to avoid between 70 to 90% of all the potentially preventable deaths, there should be an additional focus on the ability to treat massive extremity bleeding and tension pneumothorax.[3] A capability for advanced airway management may be added since despite its low occurrence rate,[4] fatal upper airway obstruction can be successfully treated in the field. Experience from recent operations seems to confirm these priorities for SOF.[5]

Being durable implies the kit has to withstand exposure to the influences of environmental conditions – mainly water/humidity and temperature extremes – and physical pressure during tactical evolutions, while its contents have as long a shelf life as possible.

Contents should reflect the threat and the general environment Operators are working in. This implies that the contents of one's trauma kit *may* vary with a unit's mission profile (e.g. a vehicle-borne direct action mission in urban terrain may require one – and an amphibious special reconnaissance mission may require another) and hence, may either be modular or contain items that are doubled in different kits.

No matter how good an item is, non-availability makes it useless, in which case an acceptable substitute should be identified. Price, distribution restrictions of controlled medicine at individual Operator level, late or limited availability in a unit's supply system, insufficient production rates, etc. may all cause an otherwise good product to be unavailable.

The number of items which cannot be easily used on oneself should be limited to the absolute minimum whenever possible, so as to optimize the potential for self-aid.

Finally, contents should be selected so they can be used in accordance with the tactical-medical protocols used by the Operator's unit.

Possible contents

Taking into account the above criteria, possible contents are listed below:

Tourniquet(s)

A tourniquet is required to stop massive hemorrhage of extremities during the care under fire phase,[6] irrespective of the question whether or not the bleeding can be stopped by any other method, the tactical situation usually leaves no other feasible option for effective hemorrhage control. During the subsequent tactical field care phase,[7] a tourniquet can be used to stop otherwise uncontrollable extremity bleeding.

In spite of the lack of statistically significant data currently available, it seems reasonable to assume that, based on a single Israeli study, two-thirds of tourniquet applications occur on lower-limbs and one third on upper-limbs.[8] There is thus little doubt that lower-extremity bleeding deserves more attention, especially as it is more difficult to achieve effective arterial occlusion in lower extremities than in upper.[9] However, even with only half as many occurrences of severe upper-extremity bleeding, the need for one-handed tourniquet application is required for those routinely operating in small patrols.[10]

Two studies show that in over 18% of reviewed cases, more than one tourniquet was used on the same casualty.[11,12] The question whether all tourniquets were really indicated in each case is irrelevant, as they will be applied whenever it is believed they're needed, in accordance with TCCC guidelines. If more than one in six casualties with severe extremity bleeding may require two tourniquets, it could be prudent to include at least two in an individual kit. The second tourniquet can also be applied next to the first if a distal pulse is still present.[13]

Appropriate tourniquets should be simple, without complex internal mechanical devices that cannot be seen, and which may malfunction unbeknownst to the user.

Care must be taken to ensure the latest version of an approved tourniquet has been selected. Some tourniquets have been modified over time, based on feedback from the field where some shortcomings were identified, without their names being changed. These changes are often not apparent to the uninitiated.

For SOF units routinely operating in a maritime environment, sustained salt water exposure is an important concern, as very few tourniquets are suitable.[14]

Hemostatic dressing

As incompressible hemorrhage may occur at sites not amenable by a tourniquet. A hemostatic dressing may be required to stop heavy external bleeding that

cannot be stopped by pressure with a conventional dressing alone, during the tactical field care phase.[15] When selecting a hemostatic agent, a loose granular or powder form should be avoided since these cannot be used for self-aid and there may also be a serious risk of the product being washed away by blood. A hemostatic dressing, depending on the type, may require a gauze dressing during its application, as well as a bandage to hold the hemostatic dressing in place after its application. Note that some types of hemostatic dressings are erroneously called bandages, which may be misleading as to the actual adjuncts required.

Wound dressings and bandages

To treat a serious combat wound not requiring hemostatic agents, two items are required: sterile gauze to provide pressure directly onto the bleeding vessel and a bandage to keep the gauze in place and maintain direct pressure, while freeing the hands of the care provider.

The bandage – whether a simple stand-alone bandage or integrating a wound pad (i.e. a field dressing) – should be easy to apply, provide pressure on

the wound, and have an integral securing device that doesn't come easily undone by accident. If the bandage is not elastic, such as the gauze bandages of the standard military field dressings that have been used for decades, it will be virtually impossible to reach the same amount of pressure achieved by elastic bandages. On the other hand, if the bandage is too elastic, it will require more force to apply sufficient pressure, and may tear holes in itself when applied.[16] In addition, it may be beneficial to have self-adherent properties or intermediate hook and loop strips ensuring the bandage doesn't completely unroll if the ends are accidentally dropped.

Military field dressings usually combine a bandage with a sterile compress or wound pad in between both ends of the bandage. These are also known as field dressing, first field dressing, field first-aid dressing, battle dressing, or battle pack.[17]

In spite of incorporating an integral, yet thin, sterile compress, it does not replace the gauze required to pack deeper into a bleeder. Whereas a more voluminous gauze dressing can be used in combination with a simple elastic wrap, and is usually be the less expensive option.

Gauze dressings come in several shapes and sizes, such as packages containing multiple square pads, rolls, or folded gauze strips. There is now a versatile field dressing containing gauze stored in and accessible from a compartment behind the wound pad. New types of gauze incorporating hemostatic properties are becoming available. While greater flexibility may be offered by a single device, traditional gauze can also be used for other applications not warranting the use of much more expensive hemostatic gauze, e.g. to dress superficial wounds.

Although many nations have been issuing a single field dressing to deployed personnel, the requirement to carry at least two can be found in several U.S. and British tactical manuals. Not only do combat casualties often have multiple injuries,[18] many have multiple wounds on more than one body part.[19] Where traditionally the most common pattern of injury on a conventional battlefield was multiple small fragment wounds of the extremities,[20] there has now been a shift towards a significantly larger proportion of usually more severe injuries from bullets in recent urban combat operations,[21] including Special Operations in an urban environment.[22]

Note that a second field dressing should never be applied on top of another field dressing that is unable to stop a bleed, as often recommended in many first aid classes, as this will serve no other purpose than to hide the still ongoing underlying bleeding.

While carrying more than one seems reasonable, the dressing's size should also be considered. Future studies on contemporary wound patterns, linked to the occurrence of improvised explosive device attacks in current counterinsurgency operations, may suggest each Operator carry at least one large field dressing. Operational experience has shown that when an abdominal (i.e. large-surface) bandage is required, it has to be available, there is no reliable substitute.[23]

Chest seal(s)

A large, well-sticking chest seal is recommended for the treatment of an open pneumothorax. There are a few alternate options are available. Paraffin gauze has been used as an occlusive dressing; however, care must be taken to not get it stuck in the chest wound as there is concern of complications when cleaning the chest cavity during surgery. Plastic or aluminum foil laminate will require strong tape (applied on all sides) or a thick pad maintaining continuous pressure to the dressing. Purpose-made chest seals – some have one or more one-way valves – will circumvent all these issues. The valves may help in preventing the development of a tension pneumothorax, but the fundamental requirement is the ability to stick well to a chest covered by body fluids, which should not be taken for granted. It may be recommended to carry more than one chest seal,[24] and some manufacturers now offer a single package containing two occlusive chest dressings, with at least one without a valve, in order to reduce cost.

Catheter for needle decompression

A catheter should be available to perform a needle decompression of the chest if a tension pneumothorax develops. It is an effective and easy procedure to treat a life-threatening condition.[25] The catheter's diameter should be at least 14 gauge, with which a needle thoracocenthesis works very well,[26] and may be as large as 10 gauge.[27] A minimum cannula length of 4.5cm, as previously recommended,[28] may be too short to reach the pleural cavity in a significant percentage of patients due to chest wall thickness,[29] especially in a military population, where an 8cm catheter seems to be more appropriate.[30] Although an internal Department of the Army memorandum makes the use of a 3¼" catheter imperative,[31] the benefit of this (much more expensive) longer catheter has been questioned by some highly-experienced field practitioners,[32] since a normally insufficient cannula length catheter of 2" may be overcome by inserting the catheter at the mid-axillary line, instead of the commonly-used mid-clavicular line.[33] Since there are reports of prehospital needle decompressions being performed so close to the heart that cardiac or major vascular injuries almost occurred,[34] this may also be safer.

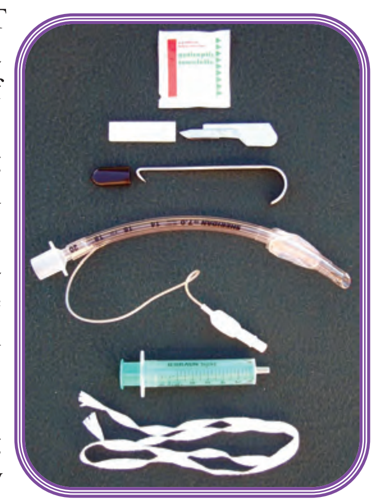
Airway management kit

A basic airway management kit consists of nothing more than a nasopharyngeal airway (NPA) and preferably – especially in a dry, dusty environment – a small lubricant sachet, although water may be used instead to lubricate the airway.[35] Intended to keep an airway open when there is a risk of airway obstruction caused by the tongue falling back, it is not absolutely required, as the same effect will be obtained by placing the casualty in a proper position. Placing an unconscious casualty in the semiprone recovery position may be required anyway, even with an NPA in place, to prevent aspiration of blood, mucous, or vomitus.[36] If an NPA is to work well, it shouldn't be too short, nor too long. Tube length is much more important than its width, and correlates to a person's height. A 130mm long NPA is suitable for the average 163cm person and a 150mm NPA suitable for the average 183cm person.[37] An NPA with a big flange is more convenient than a model requiring a safety pin through the smaller flange.

A surgical airway kit will provide the tools for establishing the advanced airway of choice in the tactical environment SOF operates in. It may consist of a disinfecting wipe, scalpel, tracheal hook (to stabilize the larynx), tube, syringe (to inflate the cuff), and securing strap.

The scalpel will often be a size 10, due to common availability. Other types, such as a number 11,[38] number 15,[39] or number 23[40] scalpel have been suggested, but difficulties to obtain this blade and associated training issues may preclude this option.

The tube is usually a cuffed 6.0 to 7.0mm endotracheal (ET) tube,[41,42] that has been shortened on purpose. A modified standard ET tube comes at only a fraction of the price of purpose-built cricothyroidotomy tubes, making it affordable. Size and cost will usually not warrant the inclusion of a local anesthetic and the means to apply it in an individual-level kit, unless a small pre-filled syringe is used. Cutting the skin will certainly



hurt a conscious casualty, but the lifesaving nature of a surgical airway overrules this concern.

Fluid resuscitation items

Although carrying intravenous (IV) fluids at individual level to treat hypovolemic shock as a result from hemorrhage was recommended by medical training handbooks used by many nations' SOF units[43] and has traditionally been part of many SOF units' standing operating procedures, this recommendation can be seriously questioned. The vast majority of combat casualties are not in shock, and do not need IV fluids.[44] Considering the weight and bulk of a 500ml IV fluid bag and infusion set (which takes all the space in a triple 30-round 5.56mm assault rifle magazine pouch), coupled to the potential difficulties of getting access at night to the narrowed vein of a patient in shock (often hypothermic), the inclusion of IV resuscitation fluids in individual kits may not be warranted. For casualties who are in shock, the chance of survival with a systolic blood pressure of less than 90mmHg will diminish over time, so the ability to maintain vital organ perfusion pressure is critical.[45] This can be achieved not only through the infusion of fluids through IV or intra-osseous (IO) access routes (which are the usual primary and alternate methods used by combat lifesavers and medics), but also by oral hydration.[46] This is a very simple treatment option that is underused yet recommended for all casualties with a normal state of consciousness and the ability to swallow.[47,48] Even in hypovolemic casualties with mild nausea, this is a reasonable option, as conscious casualties will normally have the ability to vomit in case oral fluids are not tolerated, minimizing the risk of aspiration.[49,50] In order to increase water absorption and restore minerals lost with blood, water mixed with oral rehydration salts (containing carbohydrates and sodium, amongst others) are preferred to plain water. Oral hydration with appropriate fluids gives the added benefit to treat dehydration, which, if severe, will significantly lessen the chances of survival in wounded suffering from hemorrhagic shock.[51] The small volume and weight of a sachet containing oral rehydration salts and the fact that water can be expected to be carried anyway, make this a viable option.

In spite of the de-emphasized importance of IV fluid delivery, IV access is a requirement that should be differentiated from IV fluid administration. Even when fluids are not required, casualties may still require IV access for pain medication and antibiotics.[52] However, rapid IV access is less critical than a couple of years ago, as medics now have IO devices in case IV line establishment isn't possible, making an IV access kit not very useful at individual level, especially when IV medication for dealing with pain and infection are carried at the medic level.

Heat reflective blanket

Hypothermia increases the risk of bleeding,[53] and has a remarkably dramatic negative impact on the survivability of combat trauma patients,[54] no matter the ambient temperature or environment.[55] Prevention is the key to deal with hypothermia, as correcting it is often difficult and usually impossible in many Special Operations settings.[56] A heat reflective blanket (also known as survival blanket or space blanket) will provide *some* capability to prevent further hypothermia. This item in itself is not sufficient, but in the absence of dedicated – and relatively heavy – collective hypothermia management equipment, it allows a wind- and waterproof barrier to be wrapped around the patient, which can be complemented by a commonly carried kit, such as a poncho liner and thermal hat. These items are often carried even when large rucksacks have been abandoned. Including this very compact and extremely lightweight – yet easily ripped – item in an individual trauma kit will also help to serve as a reminder not to forget this often overlooked essential aspect of combat trauma care.

Pain control medications

Current TCCC guidelines recommend oral pain medications for mild to moderate pain, combining a 15mg meloxicam tablet with two acetaminophen 650mg bi-layer extended-release caplets,[57] the latter ensuring analgesia before meloxicam reaches its peak level in the patient's bloodstream.[58] Using acetaminophen and meloxicam, which unlike acetylsalicylic acid (aspirin) and most non-steroidal anti-inflammatory drugs such as sodium diclofenac, has the advantage of not causing blood platelet dysfunction (blood thinning), and is a prudent precaution just in case a casualty gets hit and starts bleeding again. The next level of pain control may be provided by oral transmucosal fentanyl citrate, delivered orally via a convenient lozenge. While the initial dose of 800µg currently recommended by TCCC guidelines[59] can be insufficient to stop heavy pain,[60] higher doses may not be recommended in the pre-hospital setting due to the risk of adverse effects,[61] in spite of the fact that doses of 1600µg have been reported as effective.[62] The final level of pain control may be provided by morphine. Although IV administration by medics is the preferred method, auto-injectors for intra-muscular (IM) morphine administration are convenient items that are sometimes recommended even to be used by medics, especially in multiple-casualty situations.[63] If carried by individual Operators, it is important to ensure that they are familiar with the injectors, as previous experiences have shown that these controlled items are sometimes issued at the last moment prior to the launch of a mission, resulting in their incorrect use.[64]

Infection control medication

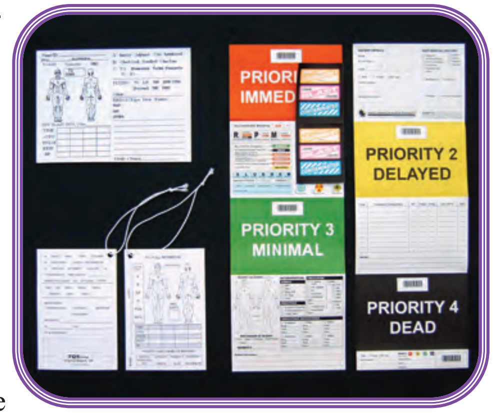
Infection is an important cause of death from combat wounds,[65] so a short course of prophylactic antibiotics is warranted after penetrating injury on the battlefield.[66] To be effective, they should be taken as soon as possible after wounding.[67] Taking into account the tactical situation which may preclude immediate care by the team medic and long delays before evacuation can take place – a common occurrence in Special Operations – as well as the difficulties of having the medic to carry, prepare, and administer antibiotics by IV/IM/IO route, it becomes clear that a single daily oral dose carried by every Operator is a much more practical option. Previous TCCC guidelines recommended gatifloxacin as the oral antibiotic of choice, but following its withdrawal from the market, current TCCC guidelines recommend moxifloxacin 400mg to be used.[68] Although the use of such a broad-spectrum antibiotic may not always be necessary in early wound management,[69] fourth generation fluoroquinolones, such as moxifloxacin, also protect against infection following wound contamination with salt or fresh water,[70] not an unimportant consideration for SOF operating in a maritime or inland water environment.

Trauma shears

In order to be able to properly treat – as opposed to just cover – a wound, it has to be exposed. Trauma shears offer a good option to do so in a safe way. Variable sizes are available, and where small shears may be sufficient at the individual level, many SOF Operators prefer the larger model used by medics, especially when they anticipate having to cut through other pieces of kit other than just clothing, such as load-carrying equipment.

Casualty card

Field medical cards have traditionally been carried only by medical personnel. Even if not absolutely required for treating combat casualties, having a casualty card at the individual level which is pre-filled with personal data, helps to gain time when documenting the care rendered as to the point of injury. Which in turn saves time during patient handover, while providing better information for any follow-on treatment. However, care should be taken to ensure that any pre-filled demographics do not violate operations security instructions. The card should be in a format that can be understood and used by non-medical personnel, a type that could also serve as an easily recognized triage tag may prove beneficial.



Gloves

Gloves should be included to avoid contamination from body fluids; however, it should be noted that initial medical care provided through buddy aid is usually done wearing only tactical gloves. Disposable examination gloves should offer maximum protection, should fit well to the hand, should be strong, and provide maximum sensitivity. Natural rubber latex gloves are the traditional choice, but tend to break down in hot environments,[71] and may cause allergies. Nitrile gloves are a good alternative and just like latex gloves, provide better protection against contamination,[72,73] are stronger, and offer a better fit than vinyl gloves.[74]

Packaging and configuration

All items affected by water or moisture should be waterproofed, if not already done so by the manufacturer.

Airway tubes (NPAs and ET tubes) can be removed from their original sterile package materials.[75] If an NPA comes with a safety pin, this should be fitted through the small flange before packing. If an NPA is vacuum packed, an easily removable cord, slightly smaller in diameter than the tube itself, should be inserted, in order to prevent the airway from not fully reopening after prolonged storage.

Whenever possible, items that are used together should be packed together. If there are any doubts as to the contents of a package, durable labels that clearly identify the contents should be added.

Many dressings and bandages have packages containing notches for rapid opening. If not present or hardly visible, high-visibility quick-tear notches (using adhesive tabs in a contrasting color, with V-shaped cuts) may be added, in order to facilitate rapid opening.

When making a combat wound pill pack, a see-through material will easily allow inspections to check that contents are still intact and not affected by heat or humidity.

The complete kit – usually less the tourniquet(s) – may be packed inside a single vacuum-sealed bag to better protect its contents from wear and tear.[76] A vacuum-sealed 5mils[77] plastic bag is effective to pack a trauma kit for combat swimmers, ensuring it remains functional after multiple subsurface operations.[78]

If a kit is vacuum-packed, think about how to access the kit after it has been opened, without throwing out all its contents, and how to re-pack the separate items no longer needed. A simple stuff sack may work well, but whatever container is used, it should allow rapid packing of remaining items and has to be suitable for future use after the kit has been initially used.

Regardless of the carrying location (discussed below), major bleeding control items should be accessible with either hand, requiring only a single hand to rapidly retrieve them under any light condition. In addition, as tourniquets require immediate application, any packaging material they come in should be removed. They should be configured for single-handed use, so they can be used for self-aid on an injured arm. For leg applications – the majority of cases – the configuration can still be changed using both hands. Any individual unable to do so, due to serious arm wounds in addition to massive bleeding from a leg, can reasonably be expected to require buddy aid anyway.

Although one suggested technique to secure a tourniquet with multiple rubber bands to the Operator's body armor or load-carrying system, may have some benefits,[79] care should be taken to avoid damaging or even losing the tourniquet when going under, through, or over obstacles.

Carrying Locations

An individual trauma kit should be carried on the body, quickly and easily accessible by both the wounded Operator and by any other care provider.

Carrying locations include the following:

- Combat jacket main pocket. Often, this is not an option in hot environments, as lightweight desert or jungle shirts normally don't have large-capacity pockets.
- Trousers cargo pocket. Depending on size and shape, this could interfere with leg movement if not carefully packed and is often not possible if a drop-down pouch with leg straps is worn on the same leg.
- Combat shirt/jacket sleeve pocket. This is only possible if the kit is rather small and when not wearing ballistic protection over the deltoid muscle area. While not being practical for self-aid if wounded in the arm opposite the one carrying the kit.
- Dedicated medical pouch with multiple compartments, attached to the trousers belt (at waist level or on the thigh, using a drop-down extension strap), on the body armor system or load-carrying vest/rig. The quality of any elastic straps is an important consideration, as they may wear out over time. If replacement cost is an issue, mesh compartments closed with a drawstring may be a better alternative. Compartments shouldn't be too item-specific, so as to allow some flexibility to repack the kit when new products or different-sized replacement items become available.
- Many individual medical pouches are quite large (four PALS/MOLLE bars wide),[80] although more compact versions (only two PALS/MOLLE bars wide) are now commercially available. Some medical pouches are designed to be rapidly pulled from a panel that itself can be attached to the PALS loops on a load-carrying system.
- Canteen, ammunition, or utility pouch carried on the body armor system or load-carrying vest/rig. While usually being cheaper and more readily available than dedicated medical pouches, care should be taken that the pouch can be closed properly, so as not to lose a kit. The simple addition of a strong wide elastic strap, sewn on the inside under the lid, may be useful to secure a dressing while allowing instant access.
- Split among several locations, including any of the above. While in theory, the kit could be split in different parts and carried in different locations based on criteria such as the need for immediate or delayed use, the ability to use items for self-aid or not, or a combination of those. In practice, this may hamper rapid retrieval. Possibly, only items that more than one of is carried, should be considered to be carried in different locations and even different layers of equipment, as a precaution against potential partial equipment loss. This can be tricky, especially if no clear and rigidly enforced unit standing operating procedures (SOPs) for this exist.

While being a common practice in many units for a long time, care should be taken when modern field dressings are being taped to weapons or load-bearing equipment, as their thin packaging materials may be more prone to damage than many older standard issue field dressings. When adhesive tape is used, the tape ends should be folded back so as to have a quick access point.

Marking

In order to facilitate identification, the trauma kit could be appropriately marked. Different options exist, such as an embroidered text ("IFAK", for "individual first aid kit"), a patch containing a cross (red, subdued, or reflecting visible or infrared light), or by using two sewn-on crossed webbing tapes. Due to cultural sensitivities, the use of a cross may be ill-advised during overt missions in some areas.

Training implications

Having an excellent trauma kit doesn't provide the capability to deal with injuries on the battlefield. The "train as you fight" principle applies to the use of medical kit. This implies the following:

- Individual trauma kits should be issued on a permanent basis. Most components are single-use-items, some may deteriorate with repeated use and/or be rapidly perishable, and still others may be controlled items or be too expensive to be issued when not on operations, so using a training kit containing mock items with similar size, shape, and weight, should be considered. Expired items can be used to fill this training kit.
- Individual trauma kits should be carried during all field exercises, as per unit SOPs. This not only accustoms Operators to the fact that they carry a trauma kit, it also forces them to think about how to pack it, and more importantly, to identify those items not to pack in the space to be used for this medical kit.

- Operators must be able to effectively use all items carried in their trauma kit. While not all items can be used for self-aid, any item from a casualty's kit may have to be used for the administration of buddy-aid in the absence of a medic.
- Combat gear should be worn during routine medical training, even during classroom training.

This article tried to give some insights on what might be included and why, when building a major trauma kit for SOF. It should be remembered that kit contents should always be adapted to the mission, the environment, and the adversary situation, while only a properly packed and configured kit, carried in a suitable location, will make it truly useful, provided adequate training has been conducted prior to mission execution.

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80. PALS : Pouch Attachment Ladder System : Webbing system utilizing 1" nylon webbing straps stitched to the backing material at 1.5" intervals and spaced 1" apart, designed to attach modular pouches and compatible with MOLLE (modular lightweight load-carrying equipment); Four 'bars' correlate to a width of about 6in or 15cm.

Dirk Geers has been serving in a number of SOF positions and has been heavily involved in the development of medical kits for SOF.

Damage Control Resuscitation for the Special Forces Medic — Simplifying and Improving Prolonged Trauma Care Part Two

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Abstract

Present and future Special Forces missions will require prolonged care of the trauma patient. The Special Forces Medic and Independent Duty Corpsman must be prepared to deal with these situations in the most challenging and austere environments. The implementation of damage control resuscitation for prolonged trauma care can maximize results with minimal support while preventing death, priming the patient for surgical success, and expediting recovery. Establishing this model of care and equipping medics with the essential equipment will have a lasting effect on the survival rate of our casualties, and negate the enemy's political victories when American and allied lives are lost.

Damage control resuscitation (DCR) is a proven and successful model of care that has contributed to saving innumerable lives. The principles of hemostatic and hypovolemic resuscitation combined with an understanding of the "trauma triad" of hypothermia, acidosis, and presenting coagulapathy are the basis of success or failure in a trauma patient, and are instrumental in preparing them for surgical success

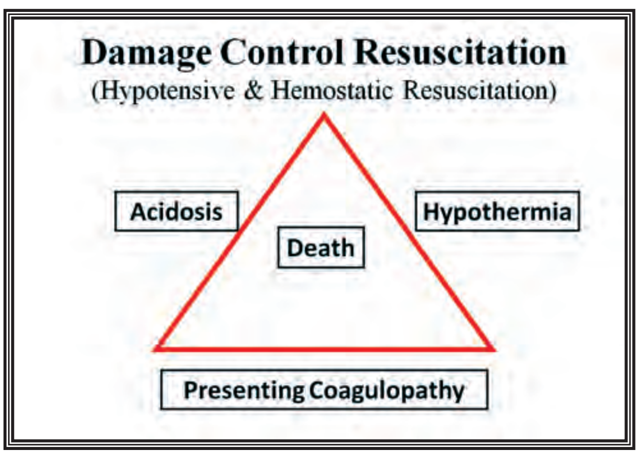

Figure 1:*The lethal triad easily visualized. (attributed to Colonel John Holcomb*)

(Figure 1). The success of damage control resuscitation and its widespread implementation as a therapeutic procedure has established it as a standard of care in both the civilian and military arenas internationally.[1] The Institute of Surgical Research Joint Theater Trauma System Clinical Practice Guidelines (JTTC) has implemented DCR protocols since 2004 with documented success.[2] This model of care has also been adopted by numerous nongovernmental organizations (NGOs) such as Doctors Without Borders and the International Committee of the Red Cross, being implemented in the most remote and primitive places of the world (Figure 2).[3] Since the care of NGOs closely mirrors many of our own Special Operations Forces (SOF) medical requirements, their application is not unlike our own.

Figure 2: *An ICRC medical team working in the austere environment of Sudan. (courtesy of CICR/HEGER, Boris)*

Shock is the absence of adequate perfusion of blood to the tissues causing anaerobic metabolism and thereby increasing acidosis with by-products (see Part One in *JSOM* Summer 09 Vol 9, Ed 3). Shock results in an unbalanced and unnatural physiologic state and impedes the body's ability to survive and recover from traumatic wounds. Depending on the amount of blood lost, the body will move into one of several defined levels of shock (Figure 3). Compensation to save the vital organs occurs naturally in the face of blood loss to ensure survival, but not without harmful results. The harm to the vital organs is compounded by the duration the body has to sustain them (in the face of shock) and at what level of compensation is required. Decompensated shock is the most severe, the least reversible, and is extremely difficult to survive in austere environments. Rapid reversal of the effects of shock will shorten recovery time, prepare the patient for more definitive interventions outside our scope of practice, and increase survivability. The actions required to achieve this are the basis of protocol for damage control resuscitation. The overall goal is to return the patient to global homeostasis and thereby reduce the depth and duration of shock. Resuscitation is complete when the oxygen debt has been paid, tissue acidosis eliminated, and aerobic metabolism restored.[4]

	Blood Loss	HR	B/P	RR	Urine Output
Stage I	<750ml	<100	Normal	14-20	>30 ml/Hr
Stage II	750-1500ml	100-120	Normal	20-30	20-30 ml/Hr
Stage III	1500-2000ml	120-140	Decreased	30-40	5-15 ml/Hr
Stage IV	>2000ml	>140	Decreased	>35	Negligible

Figure 3: *Historical and referenced levels of shock as taught by the Advance Trauma Life Support Program.*

More specifically, the SF medic and Independent Duty Corpsman (SOIDC) should be able to predict and negate decompensated shock, minimize the time of compensated shock, and prepare the patient for surgery and advanced care with the ultimate goal being to decrease morbidity and mortality. New requirements exist with this effort; unfamiliar lab values and equipment to obtain them are essential as advanced diagnostics such as base deficit and serum lactate, and trending results from identified endpoints are important for care and their recording is crucial. These markers can be addressed individually, but for an enhanced understanding we will discuss their role in the trauma triad for better interpretation and implementation as medics. Treatment decisions should be based on evidence-based medicine, justified with appropriate findings.

The most significant benefit to DCR is its ability to provide efficient care with minimal assets, which meets a classic requirement for the SF medic in the austere environment. The profiles of SOF independent operations do not lend themselves to doctrinal levels of care or guaranteed tactical evacuation (TACEVAC) capabilities and therefore cannot be relied on. Future requirements to maintain a lower profile while meeting national goals in the overseas operations will bring additional medical challenges to deployed teams. In order to make best possible use of the "knife to skin time" before casualties reach surgical assets, a proactive and goal oriented model is needed to provide us success under the worst conditions.

SF medics should also appreciate that in line with DCR, conventionally defined prehospital care should now be viewed as ***presurgical care*** and thus, should drive their actions accordingly. Many combat casualties will undergo some level of surgical intervention during their care. It could be anything from debridement, exploration, or reconstruction, to massive damage control surgery. The goal in this respect is to prepare patients both physiologically and hemodynamically to optimize the results of extensive damage control of the unstable patient or multi system trauma.[5] The resuscitation of the patient by SF medics may be the foundation of emergency room and operating room success. Damage control resuscitation is not a separate level of care, but completely integrated. The key to the principles for this approach is that the SF medic must fully appreciate hospital requirements and step away from a 'prehospital' mentality. Without doctrinal levels of care the SF medic must integrate the phases of care, and appreciate that DCR is an integrated model throughout (Figure 4).

The author's intent in Part II is to provide a start point for the establishment of an improved and simplified method of resuscitation based on damage control. We will also provide some initial considerations for endpoints in resuscitation that are safe, reliable, proven, response oriented, and can be based on both objective findings and point of care testing (POCT). These endpoints are established and can be measured independently or in conjunction with each other for greater confidence, and always in combination with the physical exam.

Figure 4: *SF medics use Damage Control Resuscitation in a prolonged care exercise.*

These endpoints may require new proficiencies for SF medics and IDCs in prolonged trauma care, and identify the necessary equipment to provide that. These components are derived from the lessons learned since 9/11 and already exist in modalities of care presently in use and are dependent on simple treatment factors that can be trained and sustained to a high level. They may be used judiciously with or without labs while still being advantageous to the patient. We can now combine them to optimize prolonged care for the trauma patient.

Measuring Shock

We must first appreciate that any therapy is significantly impacted by the austere environment. Logistical challenges, limited or interrupted power, lack of refrigeration, and working with indigenous personnel and patients, all present challenges to the effective delivery of care. The goal is to achieve hospital quality care as far forward as possible with measurements providing tangible endpoints in resuscitation such as seen in the U.S. Advanced diagnostics are critical, and those identified endpoints, in whatever form or function, should be proven to have significant prognostic importance.[6] There may also be times where empiric treatments may be the only recourse. This is better accomplished with a thorough understanding of the traumatic shock state.

Patient history, mechanism of injury, and a detailed physical exam are the hallmarks to success and constitute the primary assessment. Patient presentation and especially the secondary survey will provide essential decision-making tools that are needed. The secondary survey may have lost some function as an evaluation tool in today's fast paced battlefield, but it still plays a significant role in prolonged care. A detailed and thorough inspection of the patient is crucial in ensuring knowledge of the challenges and providing a baseline status. This combined with a thorough history of the patient and mechanism of injury, blood loss, and initial treatments will begin to draw the picture needed for subsequent treatments.

Historically, vital signs including blood pressure, pulse, and respirations, have been important in obtaining a physiological status of the patient, and serve as good predictors for life saving interventions (LSIs).[7] Examples essential to initial point of injury assessment are a blood pressure of 90mmHg, or a radial pulse, and mentation which can be used to immediately evaluate the current status of the patient. However, in the SOF population of healthy young adults, these findings can misrepresent the actual physiological status of the patient due to this population's excellent ability to compensate for shock. Vital signs can remain normal while staying in compensated shock.[8] In fact, a young, well conditioned patient will compensate for severe injuries and blood loss with vasoconstriction, shunting, and markedly increased cardiac output for more prolonged periods than older or more sedentary patients are capable of. Only when the patient "falls off the cliff" into decompensated shock, will these findings change enough to initiate required treatments, and by that time interventions may be too late and ineffective to change outcomes.

Advanced diagnostics are essential to improving the level of field care by providing medics with essential data. The equipment to support point of care testing would include devices not currently included in the current TacSet. Requirements for the equipment are as follows:

- Durable
- Fast
- Reliable
- Meets or exceed the specific measurements desired
- Minimal amount of logistical support as possible; i.e., temperature stability, long duration calibration, and minimal power requirements.

Venous blood sampling should serve as the basis of measurement since the attainment of arterial blood measurement is an advanced and perishable skill. Products for point of care testing such as the iSTAT® 1 lab analyzer have provided diagnostic lab values to government agencies, expedition missions, and non-governmental organizations for years. They may provide medics options for less invasive and more expedient means of obtaining lab values. These measurements will provide the ability to obtain and measure predictive endpoints for evidence-based treatments and evacuations and increase the medic's ability to make sound treatment decisions.

Cellular Effects of Shock

The goal of DCR is to optimize the patient's physiologic state in preparation for definitive care. This focuses on hemorrhage control and the preservation of coagulation factors to prevent the onset of true shock. Shock is defined as the decrease or interruption of adequate tissue perfusion, resulting in lack of adequate oxygen delivery at the cellular level. This leads the cell to undergo rapid conversion from aerobic metabolism generating adenosine triphosphate (ATP), the "cellular energy currency," to anaerobic glycolysis using intracellular glycogen which is approximately 90% less efficient. The hypoxic cell produces pyruvate, but rather than being fed into the Krebs cycle for further oxidative metabolism, it is converted to lactate instead. The accumulation of lactic acid inside the cell, decrease in intracellular pH, and depletion of ATP leads to profound physiologic and structural changes in the cell. The accumulation of toxic byproducts and the reduction in ATP eventually causes the cell wall to lose integrity. As a result, sodium ions begin to leak into the cell along with free water causing cellular swelling or edema. Potassium leaches out to the extracellular space, along with lactate. Depending on the depth and duration of shock, theses disturbances are initially reversible, though with time they become irreversible. Ultimately, cellular death occurs. Understanding shock at the cellular level is essential for appreciating the effects in vivo and potential treatments. It is the ongoing cellular death, which if uncorrected reaches a critical mass and leads to organ dysfunction, massive inflammatory activation, and development of organ failure. This leads to multiple organ dysfunction syndrome (MODS). The ability to appreciate the depth of this shock will be utilized to guide therapy, and to hopefully interrupt this process while still reversible. The ultimate goal to prevent, mitigate, or reverse the effects of this process on coagulation, acidosis, and hypothermia

Oxygen Debt

The concept of oxygen debt was first postulated by Cromwell in 1961.[9] It is the difference between the amount of oxygen delivered to the cells, and the amount required for metabolic needs. This debt must eventually be "repaid" during reperfusion if normal homeostasis is to be restored. The magnitude of oxygen debt correlates with depth and duration of hypoperfusion. This correlates well in both animal and human studies in predicting survival, survival with organ damage, and death.[10, 11] A reasonable analogy for this phenomenon would be that of an underwater diver, who can calculate his risk and nitrogen load by looking at the depth of a dive and the duration of bottom time. The deeper he dives, the less time that can be spent on the bottom, the longer the ascent, and the larger the nitrogen burden. In other words; the deeper the diver goes, the longer and more difficult it is for him to return. As with diving, shock is more dangerous if allowed to progress to a severe depth and if compensation is allowed to continue for too long without restoring perfusion and repaying the oxygen debt. While the total mismatch in oxygen delivery has been measured in animal models, calculating the actual mismatch between oxygen delivery (DO_2) and oxygen consumptions (VO_2) is not practical in trauma patients. There are physiological markers of oxygen debt which have been well studied, and correlate with a high degree of accuracy to the amount of oxygen debt. These can be used to measure the degree of shock, guide therapy, interventions, and predict mortality. These endpoints of resuscitation are considerably more useful than external measures of pulse, blood pressure, and urine output traditionally used in the past to guide field care. In keeping with the new paradigm of DCR, and thinking of this as presurgical care it is necessary to more accurately guide our therapies and correct physiological disturbances with greater speed and accuracy.

Endpoints of Resuscitation

Various biochemical markers or measurements have been proven to accurately reflect the amount of hemorrhage, depth of shock, and degree of oxygen debt. These also correlate well with development of organ failure, MODS, and mortality. As such, they can be used to establish initial baseline for our patients, develop trends, and act as triggers for decisions and interventions. These measures can include clinical parameters such as heart rate, blood pressure, and urine output, but all of these can significantly lag behind the development of shock in the compensated patient, and all can be normalized well before resuscitation in complete. In over 85% of patients resuscitated from hemorrhagic shock, the traditional markers can be normalized well before patients are fully resuscitated.[12] This state of compensated shock carries significant morbidity and mortality. More technical methods of measurements include cardiac output, pulmonary capillary wedge pressure, oxygen delivery and consumption, gastric tonometry, near infrared spectroscopy (NIRS), pH, serum lactate, and base (deficit) excess (BE). We will focus on the last three, as the others involve invasive procedures, complicated monitoring, or are still experimental/exploratory technologies which are less well established. Lactate, pH, and base deficit can all be measured using venous whole blood sampling and relatively simple handheld diagnostic tools.

Arterial pH has long been used to assess patients for presence of respiratory/metabolic acidosis/alkalosis. There is only a narrow physiologic range of intracellular pH which allows for normal function, typically 7.35-7.45. Acidosis below this range inhibits the proteases which govern the coagulation pathways, and inhibit the generation of thrombin, which is the final common pathway in converting fibrinogen to fibrin monomers. This delays the formation of a thrombus at the site of bleeding. While arterial or vascular pH has a place in the evaluation, without full blood gas analysis, the body's compensation mechanisms such as a respiratory alkalosis may maintain a normal or near normal pH even in the setting of significant shock and metabolic acidosis. Another challenge for the medic is the deceptively small changes in the pH scale, which is logarithmic. Hence, a pH change from 7.4 to 7.1 may seem minor, but actually represents a significant increase in free hydrogen ions. Each decrease of 1.0 on the pH scale represents another ten-fold increase in hydrogen ions free in the circulation. Factor VIIa has only 10% of its biological activity at this 7.1, which becomes one rationale for treating potential acidosis if contemplating administering Factor VII. One finds similar alterations in nearly all physiological processes at acidotic pH ranges below 7.3.

The measurement of serum lactate is a more direct measure of levels of tissue hypoperfusion, being the direct metabolic product of anaerobic metabolism, along with hydrogen ions. The two combine to form lactic acid in the extracellular fluid. Lactate is generated primarily as an intracellular byproduct of anaerobic metabolism. As such, its elevation in the serum only becomes evident as once these level reach a critical mass, cell membrane integrity is compromised, or most worrisome, significant cellular death begins to occur. Multiple studies have all demonstrated that initial and peak lactate levels correlate with likelihood of developing MODS.[13] Other studies show a very strong correlation between the time required to clear serum lactate levels and survival. All patients who were treated and their serum lactate levels were normalized at 24 hours survived. Those patients who normalized their serum lactate levels between 24 and 48 hours had a 25% mortality, and those whose lactate levels were persistently elevated beyond 48 hours had an 86% mortality rate.[14]

Base deficit may well represent the most reliable, predictive, well studied, and utilized measure of the shock state. Before going further, realize that while we discuss base deficit, the measure is actually written as base excess, abbreviated as BE. This represents the amount of a strong acid or base which would be required to correct a metabolic derangement. When the number is positive, it represents an excess of base within the body, and hence an alkalotic state. Conversely, when we are dealing with negative BE values, we refer to them as base deficit values inferring a lack of base in the system, or predominance of acids. In the setting of trauma this is primarily a metabolic acidosis due to the previously discussed disturbances. Base deficit then becomes a true measure of the degree and depth of the shock state. Normal ranges for BE are 0 +/- 2. Base deficits >6 (-6) were predictive of need for blood transfusion in one study.[15] Another study found that a base deficit of 15 (-15) was predictive of a 25% mortality in trauma patients less than 55 years old. Various data from other studies would indicate an LD^{50} (the dose or measure of something which represents a lethal dose to fifty percent of the study population) of base deficit at -19. With this information, we can begin to risk stratify the shock patient, make decisions about initiating treatments to interrupt deterioration of patients, tailor interventions, and guide resuscitation.

One issue which arises in any discussion is which of these endpoints of resuscitation is most ideal for our use. It is better to develop a foundation of knowledge and utilize multiple parameters as part of a larger picture of assessing and treating this group of patients. The goal will be to look at how in the DCR paradigm to aggressively treat ongoing hemorrhage, and to consider administration of blood to the patient in ongoing shock.

Fluid Resuscitation

The last point in this theory of care is fluid resuscitation. The choice, routes, and concerns with resuscitation fluids have undergone significant changes in just the past several years. Favor now falls to plasma and blood as the fluid of choice for combat trauma and in support of hypotensive and hypovolemic resuscitation. Colloids and/or hypertonic saline work as temporizing agents, and therefore might be considered second line agents, or as initial agents while preparing for the administration of blood products. These also seem to cause less cerebral edema in blast type injuries when compared to crystalloids. The ongoing use of normal saline (NS) and lactated Ringer's (LR) on the battlefield in tactical combat casualty care is increasingly being called into question. It is time to realize that by replacing lost blood with various salt water solutions, we are contributing little if anything to the resuscitation of the patient, and may well be causing significant harm. Much like filling an empty gas tank with water raises a car's fuel gauge, it contributes nothing constructive and is ultimately damaging to the engine. Resuscitation stretching beyond initial tactical field care will need to consider how to replace lost blood products, namely plasma, platelets, and red blood cells in an earlier time frame and by methods that are not currently in routine practice. When used properly these blood products provide the greatest therapeutic effect in the smallest amounts with the least potential for side-effects. Intraosseous access has proven to be an effective route providing simple, fast, and durable access throughout the many stages of care. It supports any type of fluid infusion and can remain in site for up to 24 hours. If time and situation permit, consider peripheral IV access. Again, if possible, warm all fluids to prevent hypothermia instead of contributing to it.

Hypotensive resuscitation goes hand-in-hand with hemostatic resuscitation as a key intervention in DCR. Although the premise for a lowered pulse pressure comes from trauma, an immediate and complete return to normal vital signs will do more harm than good. An increased blood pressure, no matter how obtained, can potentially dislodge fragile clots and reduce the normal thrombotic process. By maintaining a lower blood pressure in trauma patients we are setting physiological conditions for a more efficient clotting process.

A systolic blood pressure of 90mmHg is the goal for combat applications.[16] A palpable pulse and mentation can serve as a very accurate triage tool for a quick and immediate evaluation, especially in a mass casualty situation. If the patient has a palpable radial pulse and can lift his hand to command then he is stable enough for you to move on and return to later.

The fluid of choice for damage control and active hemorrhage are natural blood products, most specifically fresh whole blood (FWB). Whole blood serves

SF medics as the best force multiplier for massive hemorrhage providing the greatest amount of good in the smallest package and is independently associated with improved 48 hour and 30 day survival.[17] A unit of FWB has an all encompassing contribution of clotting factors, natural acid/base balance, and red blood cells to support efforts against the lethal triad. A single unit (+/- 500ml) is reported to have a hematocrit of 38% to 50%, a platelet count of 150,000 to 400, complete coagulation function, and 1500mg of fibrinogen.[18] Whole blood provides the best all around impact and while it stands solely as a military practice, it is still one with widespread acclaim and applicability.[19] "Walking blood banks" in the form of your own teammates may provide a safe, typed, warm, fresh, and relatively resupplied blood reserve at any given time. This represents a return to WWII practice, prior to the routine separation of blood into various components. This is reflected in the current theater practice of transfusing products in near 1:1 ratios during massive blood transfusions, with improved results compared to the prior practice of initiating FFP/cryoprecipitate only after a threshold of eight to ten units of packed red blood cells had been administered.[20] Whole blood comes conveniently packaged in the appropriate physiological rations, and requires no thawing or warming. The risks of uncrossmatched type specific blood are minimal when the goal is saving lives under austere conditions. While often discouraged in the past, blood transfusion work should be a standard that all SF medics are proficient in, as one required in prolonged care, and in the face of massive hemorrhage. Blood transfusions at the lowest level are not a new concept, and even unscreened blood transfusions may be a venture worth considering in extreme life saving measures. These are skills that SOF medics must know and sustain for confidence in employment. Their use also provides tools that far outweigh the risks once that expertise is attained.

Fresh frozen plasma (FFP) is presently the most employed blood product in theater hospitals overseas with exceptional and well documented results.[21] Plasma is spun from whole blood. While it has no oxygen carrying capability, it still retains all coagulation factors in normal concentrations. Frozen plasma has a shelf life of 180+/- days, but once thawed in a recirculating warm water bath it must be continuously refrigerated at 39ºF (4ºC) and only has a shelf life of five days. FFP also has a completely different cross matching matrix, so appropriate transfusion protocols must be educated and rehearsed. Although it is possible for SF medics to store FFP in their environment, acquisition would have to come from hospital blood banks since there is no practical capability to separate and package it in isolated area. Plasma could always be considered as an adjunct for prolonged care if storage and supply are possible, but in the most austere locations it is far less feasible. The efforts to overcome the limitations of FFP in storage, volumes needed, and mobility would be better served with more efficient options. In the clinical setting, hospitals also institute a blood component therapy in their trauma protocols whereby packed red blood cells (PRBCs), platelets, and cryoprecipitate are given individually and in ratios according to accepted parameters. But as with plasma, this approach also requires significant logistical support and again is not likely appropriate in our environments.

Colloids, in the form of synthetic starches, provide a valid alternative choice for SOF with far less logistical requirements. Hextend® presently serves as the colloid of choice primarily due to its physiologic comparability to our blood as compared to Hespan®. Drawing free fluid into the vasculature increases volume and for a longer duration; however, immediate effects may be no better than crystalloids. Hextend can also be combined with drugs, used to maintain a line TKO, or followed by blood or blood components taking the place of crystalloids and allowing the SF medic to simplify supplies. Remember that there is a ceiling to resuscitation with the amount of Hextend. Present recommendations quote only a 20ml/kg dose, or approximately one liter per patient before the amount can adversely affect the clotting process.[22]

Crystalloids do have a long history in trauma, but research and findings since 9/11, in both the civilian trauma and military sectors, have advocated a departure from their use as they can worsen the physiological response to damage.[23] Lactated Ringers and 0.9% sodium chloride have long been the universal answers for hemorrhagic resuscitation, electrolyte replenishment, hydration, and burn therapy. However, due to the significant amount of data being obtained overseas and in concurrent studies we now know that these favorites play a part in additional damage to the trauma patient. Both solutions are supraphysiologic providing a higher content of chloride than what naturally exists in blood values; NS is labeled with a pH range of 4.5-7.0, and LR has pH levels of 6.0-7.5 making them both acidic. It is now recognized that both NS and LR (although LR less so), can increase metabolic acidosis producing detrimental effects if not used sparingly and proper indications. Excessive use of crystalloids also hemodilutes blood affecting coagulation by lowering the concentration of clotting factors, and decreasing oxygen delivery due to a diluted hematocrit. Although crystalloids are not contraindicated in DCR, their usefulness should be judged on a minimalist approach.

Other Critical Skills

Advanced surgical techniques such as fasciotomies, escharotomies, and tube thoracostomies are also essential to decrease threats to mortality and morbidity, but also to undermine the unknowns of casualty transport affecting patient status. Again, these advanced procedures must be sustained over the long term, and the inclusion of training and reference materials must be provided to SF medics to support success.

Tube thoracostomies provide definitive care and are the treatment of choice for legitimate indications. They can be diagnostic and negate repeated needle decompressions in evacuation and care. This procedure must be done correctly, as aseptically as possible, and must be secured and reinforced to survive the rigors of combat transport. Antibiotic therapy should be administered before the procedure. Combat AB prophylaxis should cover this concern.[24] Nursing care and documentation of any fluids lost will provide critical diagnostic information both for the SF medic and later care. Newer products on the market may provide other options far forward such as the Uresil Tru-Close® Thoracic Vent or the Cook Emergency Pneumothorax Set®. Both are based on a continuous needle decompression theory. Remember that these choices have other risks such as kinking of their catheters, difficulty in securing the devices, less definitive than a chest tube, and possible unfamiliarity with their use. Complete management of a pnuemo or hemothorax is a SF/SOIDC level skill; however, it must be consistent to ensure the quality of care.

Fasciotomies treating compartment syndrome in prevention of morbidity of extremities is a valid and proven treatment.[25] There is a significant threat pattern when considering the destructive results of IED tactics presently used most frequently by the enemy. The consequences of those explosive and overpressure effects provide a high incidence of occurrence, and thus should rate a high index of suspicion for compartment syndrome. This procedure can also again be done empirically to minimize the chance of unrecognized or untreated compartment syndrome during evacuation by unknown or less-trained personnel. Fasciotomies can also assist medics with possible secondary effects of overextended tourniquet use and the prospect of our management of this condition in prolonged care.

Analgesia

One of the challenges for presurgical care in DCR lasting 24 to 72 hours will be the issue of pain management. Besides the impulse to provide humane care and appropriate analgesia to our patients, our ability to perform necessary procedures such as wound care and debridement will be inhibited without appropriate sedation and analgesia. Additionally, there is mounting evidence that the immune system and wound healing are both impaired by ongoing pain, release of catecholamines, and inflammatory mediators.

While a complete overview of pain management is beyond the scope of this article, pain management for the treatment period will require a different approach than that at the point of injury, which relies primarily on parenteral narcotic administration. The issues with giving prn pain medications over multiple days leads to inevitable peaks and troughs, requires considerable time and attention of the medic, and requires considerable logistics. Administering 2-4mg of morphine every1-2 hours to one patient for several days would require multiple vials, with a potential total of several hundred milligrams. A better model for pain management over a prolonged period would be to consider the use of transdermal medications. This route allows for more consistent delivery of dosages, a steady state of pain control, and requires less time and attention on the part of the medic. Additionally, some transdermal patches are available in three day dosages, thereby requiring less weight and cube than the injectable forms, and limit potential for abuse. This allows injectables to be conserved for use on breakthrough pain.

Other concepts to be reconsidered are the use of nerve blocks for extremity injuries, fracture care, procedures, and wound care. Fracture reduction and stabilization would contribute to reduction of hemorrhage and improvement in pain levels. The adjunctive use of dissociative agents such as ketamine, and benzodiazapenes such as Versed, would be an additional consideration dependent on patient condition and the tactical situation.

Prolonged Care Issues

Nursing care is critical to prolonged care in order to stack the deck in the patients favor by providing the critical information requirements to the surgeons and hospital. Basic patient care to include infection control measures, hygiene, maintaining patient mobility, and providing basic protection are key to rounding out complete care. Early and effective wound care with the goal of reducing bacterial load in any wound will prevent infection, promote early wound healing, and reduce the incidence of bacteremia, gangrene, and sepsis. Without appropriate wound care, the contribution of antibiotics may be minimal. Newer approaches adopted by NGOs allow for reduced frequency of wound care and dressing changes, do not rely on sterile supplies, and reduce the logistical requirements. The use of newer silver impregnated dressings, which are far more expensive, but allow for multiday and multiuse applications, and have bacteriostatic (and in some cases bactericidal) properties.

A final point is the consideration of nutritional requirements. Traditional teaching of basic medic skills has emphasized that patients be given nothing by mouth. In a prolonged care situation as envisioned in DCR, some consideration of nutritional requirements needs to be appreciated. The patient in shock, which has converted to anaerobic metabolism, experiences a marked reduction in energy production. This leads to proteolysis, and rather quickly a catabolic state with breakdown of whatever available substrate. Additionally, any severe injuries such as a tissue violation, fractures, and burns will quickly result in increased caloric requirements. The interaction between reduced energy production, increased metabolic requirements, proteolysis, and catabolism can, in a period of days, lead to a malnourished patient. This negatively impacts the immune system and the production of proteins necessary for wound healing. Consideration of enteral feedings with an intact GI tract should be considered in any scenario lasting beyond 24 hours. Oral intake can be considered in the conscious patient, or nasogastric feedings can be instituted. Though critical care teams employ dieticians to calculate caloric requirements and use complicated formulas, the use of readily available products with balanced proteins, carbohydrates, and fats is justified. Several thousand calories per day divided into small feedings every four to six hours would be a reasonable initial goal.

The prehospital use of ultrasound (US) is an emerging capability that needs to be evaluated for SOF use. Far forward ultrasound can easily provide additional critical information in order to make sound diagnostic and evacuation decisions or to confirm or supplement empiric treatments without lab results. Specifically critical to SF medics in trauma care is the focused assessment with sonography for trauma (FAST) exam which provides the ability to confirm abdominal bleeding, which otherwise may not be detected until decompensation occurs (Figure 5). It is important to point out, the absence of fluid in the abdomen does not negate surgical intervention in the hemodynamically stable patient.[26] Other trauma applications include the ability to identify a tension pneumothorax or a hemothorax. Ultrasound also provides the ability to confirm death in the most difficult environments such as on aircraft, in vehicles, or tactically without having to remove the helmet to confirm vital signs. New products such as the Seimens Acuson P10® or the Signostics Signos Personal Ultrasound™ can provide a small, portable, and durable tool to give high confidence information. In non-emergent situations, US can also provide previously unknown capabilities as well such as confirming fractures without X-Ray equipment, identifying abscesses or foreign bodies, and locating significant organs and vessels. With thorough initial training and minimal sustainment, this breakthrough in technology could be used to great advantage in either the trauma or clinical setting with good sensitivity and specificity. Ultrasound has been used in the most remote parts of the world, by government agencies, and expedition teams, and could be of significant use to the SF medics in the future. It has even been used on the International Space Station by a non-medical care provider with minimal training and sustainment.[27] If validated and acquired, this equipment could be maintained at the B or C Team level for training and use when mission requirements and risk assessments demand it, very similar to X-ray equipment in today's TacSet.

Figure 5: *A FAST exam using ultrasound technology being performed on a helicopter in flight. The ability to use this test on the platform was successful.*

DCR as an operational capability clearly requires preparation. Prestaging or prepositioning the appropriate supplies that are required for prolonged care is absolutely necessary. Keeping them on mobility platforms, preparing a speed bullet, resupply drop, or acquiring them from the civilian economy are all logistic issues medics need to consider and plan for. Knowing your equipment and its limitations is just as crucial as having them in the first place.

With respect to the valuable capabilities above, the context of this proposal for the SF medic is meant to fall between TCCC guidelines and damage control surgery where the levels of care in SF operational medicine contrasts conventional definitions. In the end all of these theories, TCCC, DCR, and damage control surgery, could all be consolidated into a structure of care and continuity for the military medical establishment and this initiative has already been proposed at other levels outside of SOF.[28]

Implementation

All aspects of a DCR theory must be trainable, sustainable, and retainable. These efforts implement universally accepted and successful concepts of care that utilize the most recent and validated therapeutics, including those that meet our most austere requirements. These could be implemented across the force as one standard of care. Essential to this is ensuring that SF medics appreciate the importance of their work and their responsibilities to their team and its mission, which will ensure successful implementation and durability of the care.

An independent unconventional warfare (UW) medical exercise may assist in validating this initiative and define specifics and equipment required. A working group preceding the exercise comprised of committed medics and surgeons from every SF Group and the Special Warfare Center could concentrate those who know these issues most intimately to define the best product possible. The exercise could then meet three key objectives: first, to validate DCR and its use in prolonged care; second, to define new TacSet requirements meeting our scope of practice both clinically and with trauma while testing new technological advances; and lastly, to revisit and update tactics, techniques, and procedures for UW medical operations in support of future austere environments.[29] Additionally, consider the participation of the most knowledgeable and experienced DCR experts to provide the best advice and assist in finding solutions as the effort is refined. The deliverable to the schoolhouse would be a sound and tested theory of care for their evaluation and implementation to include the required special equipment added to the TacSet for use as a complete package. This would all be accomplished in the field environment validating all aspects properly in the most operational approach possible. Any prolonged care theory should also include a mandatory review and periodic update of protocols as additional data and technology will drive our efforts.

Point of injury care with confident TACEVAC assets should include some minimum treatment goals before the patient arrives at a surgical asset. This is the basis for Special Operations Combat Medic (SOCM) DCR care. SOCM standards are the foundation of point of injury trauma proficiency for all of SOF and have evolved directly from TCCC work. This capability has led to the greatest statistical success against preventable death in this conflict when compared historically to other conflicts. Principles for SOCM-level care should include those aspects that would directly contribute to both prolonged care and surgical success. SOCM level medics could concentrate their efforts to hypotensive and hypovolemic resuscitation and hypothermia prevention. Hemostatic proficiency should meet the highest standards at this level, especially in the worst case of massive arterial bleeding in areas with difficult access such as bowl type wounds in anatomical girdles. At this level the adage of perfecting the basics must be met in order to set the foundation for later care. Their knowledge and understanding of DCR principles will lead their efforts setting the patient up for success at higher levels of medical care.

Again, these are presurgical goals for all SOF medics to accomplish before TACEVAC and subsequent hospital care. Ensuring that there is a definitive airway completed before movement is critical. A definitive airway is one that cannot be defined as a bridge, supports care up to 24 hours, is confirmed, and anchored by an anatomical structure. The patient must be normothermic and prepared to remain so. Gaining IO access is arguably the fastest, most confident, and most secure means of attaining initial access for fluids and drugs today when conditions preclude gaining peripheral IV access. The ability to provide blood competently is absolutely critical to gaining hemodynamic stability, replenishing clotting factors, and balancing acidosis. An understanding of the importance of early antibiotic therapy and being able to administer antibiotics appropriately is also crucial for negating post operative infections normally occurring 72 hours later. Lastly, but most importantly, all of these actions must be competently recorded for later use and continuity of care (Figure 6).

Point of Injury
Minimum Presurgical Goals

- Achieve hemostasis to your scope of practice
- Provide a definitive airway if needed
- Maintain a normothermic patient (> 96°F/36°C)
- Obtain Intraosseous/Intravenous access
- Provide fluid resuscitation with natural blood products if necessary
- Administer prophylactic antibiotic therapy
- Record and communicate all trending vitals and lab values to the next level of care

Figure 6: *Minimum recommended presurgical goals to be accomplished either during resuscitation or at the point of injury with a confident TACEVAC.*

The authors hope that an introduction of DCR and its consideration for SF medics provides, or at least initiates discussion of, an option for a modern, efficient, and proven approach to critical care under the worst scenarios. As we move out of the asset rich and developed theater of Iraq, our environments and missions will most likely be those we have been the least familiar and experienced with in recent years. Those environments are the ones that require the skills and scope of practice that only Special Operations can provide. It is under those circumstances that we need to work best. And we must understand that our patient care is integral to the larger effort of negating the enemy of his political victories with our attrition while we engage in his destruction.

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Editorials

Continuing editorial comments by LTC Craig A. Myatt and Dr. Douglas C. Johnson on "Psychological Resilience and Postdeployment Social Support Protect Against Traumatic Stress and Depressive Symptoms in Soldiers Returning from Operations Enduring Freedom and Iraqi Freedom," *Depression and Anxiety* (Pietrzak, et al., 2009a) and "Psychosocial Buffers of Traumatic Stress, Depressive Symptoms, and Psychosocial Difficulties in Veterans of Operations Enduring Freedom and Iraqi Freedom: The Role of Resilience, Unit Support, and Postdeployment Social Support," *Journal of Affective Disorders* (Pietrzak, et al., 2009b).

Ongoing discussion on resilience leads to the following question: "What factors differentiate individuals who respond well to chronic exposure and high-intensity stressors from those who are unable to adapt?" The concept of psychological resilience has received significant attention in recent years from the medical research community as well as military training and operational commands. To be sure, extant research indicates that resilience is a complex, dynamic, and multi-dimensional factor that is difficult to define comprehensively and challenging to measure.

To date, resilience research has focused on outcomes. Namely, who bounces back from stress and who does not. Special Operations Forces (SOF) have an exemplary record of applied resilience outcome research, as their missions are predicated on the ability to identify individuals (i.e. assessment and selection) who adaptively respond to high-intensity stressors. However, resilience outcome research does little to explicate processes of resilience, the "how" and "why" individuals adapt differently. In other words, how do resilient people think, how do they behave, how do they interact with their environment, and how do they regulate emotions?

As resilience research evolves, efforts are beginning to focus more on processes and associated factors. Promising examples of this are two recent articles focusing on unit cohesion and post-deployment social support as protective factors against potentially deleterious effects of combat stress (Pietrzak et al., 2009a, 2009b). Data for these articles were collected cross-sectionally in active-duty combat personnel (N = 272) who served in Operations Enduring Freedom and Iraqi Freedom (OEF/OIF).

Pietrzak et al. (2009a, 2009b) hypothesized that OEF/OIF veterans with PTSD would score lower on measures of resilience and social support than veterans without PTSD. The authors also hypothesized that unit cohesion and social support would protect against depression. They used the PTSD Checklist – Military Version (PCL-M) to measure symptoms of combat stress and the Connor-Davidson Resilience Scale (CD-RISC) to measure psychological resilience in a battery of self-report assessments that also examined combat experiences, depressive symptoms, unit support, and postdeployment social support. The researchers established a cut-off score on the PCL-M to identify veterans with PTSD. Among participants, those in the PTSD group scored lower on the CD-RISC (less resilience) than those in the no-PTSD group. In addition, regression analysis suggested that scores measuring psychological resilience on the CD-RISC and post deployment social support were negatively associated with PTSD and depressive symptoms.

Measures of unit cohesion and post-deployment support were taken from the Deployment Risk and Resilience Inventory (DRRI; King, King, and Vogt, 2003). Assessment of unit cohesion included questions such as, "My unit was like family to me," "Most people in my unit were trustworthy," and "I could go to most people in my unit for help when I had a personal problem." Post-Deployment support was assessed with questions that included, "My supervisor understands when I need time off to take care of personal matters," "When I am unable to attend to daily chores, there is someone who will help me with these tasks," and "Among my friends or relatives, there is someone I go to when I need good advice."

As mentioned in previous editorial comments, the authors fully addressed the limitations in their study, one of which involved the cross-sectional nature of the study. The cross-sectional study provided a snap-shot of the behavioral health of OEF/OIF veterans. They addressed that limitation by emphasizing the need for longitudinal studies that examine the role of resilience and support factors over time. Pietrzak et al. (2009a, 2009b) convincingly conclude that resilience and social support may buffer against symptoms of traumatic stress (e.g. PTSD, depression) by a host of mechanisms. Those mechanisms may include: decreased hypothalamic-pituitary-adrenal axis reactivity; decreased stress related physiological arousal; decreased fear-related appraisals and cognitions; improved emotional regulation; and enhanced self-efficacy and control. Several of those mechanisms suggest the importance of future research and applications to adopt a biopsychosocial framework.

LTC Craig A. Myatt is currently assigned to the U.S. Special Operations Command as the Command Psychologist. He earned his PhD in Health Psychology at Walden University with a two-year pre-doctoral fellowship in the Neuropsychology Section, Department of Neuro-Oncology, at the University of Texas M.D. Anderson Cancer Center. His previous assignments include command of the 145th Medical Logistics Bn; command of Delta Comp, 232d Medical Bn; and medical platoon leader for the 2/11th Armored Cavalry Reg and the 1-52d Infantry (Mechanized). His staff officer assignments include deputy G-4 for Task Force 3 Medical Command (Iraq); observer-controller and trainer in Task Force Bravo, 1st Brigade, 75th Division (Training Support); executive officer of the 10th Bn, 5th Medical Brigade; assistant S-3 and S-6 in the 228th Combat Support Hospital; biomedical information systems course developer in the Center for Healthcare Education and Studies at the U.S. Army Medical Department Center and School; and biomedical information systems officer in the Office of the Deputy Chief of Staff for Information Management at the United States Army Medical Command.

Douglas C. Johnson is the Department Head for Research Facilitation at the Naval Center for Combat Operational Stress Control (NC-COSC), and is currently Asst. Professor in Psychiatry at the University of California-San Diego (UCSD) School of Medicine. He earned his PhD in clinical and cognitive psychology at the University of California-Los Angeles (UCLA), followed by two-years of post-doctoral training at Yale University School of Medicine and the Clinical Neurosciences Division of the National Center for PTSD. Dr. Johnson is a former counter-terrorism analyst with the FBI and in 2006 was selected as the American Psychological Association (APA) Summer Research Fellow in Counterintelligence. Prior to graduate training Dr. Johnson served 10-years on active duty, as both enlisted and officer, in the U.S. Coast Guard, and is a 1993 graduate of the U.S. Coast Guard Academy.

ABSTRACTS FROM CURRENT LITERATURE

Parachute Use to Prevent Death and Major Trauma Related to Gravitational Challenge: Systematic Review of Randomized Controlled Trials

Gordon C. S. Smith; Jill P. Pell

BMJ 2003; 327:1459-1461

Abstract

Objectives: To determine whether parachutes are effective in preventing major trauma related to gravitational challenge. **Design:** Systematic review of randomized controlled trials. Data sources: Medline, Web of Science, Embase, and the Cochrane Library databases; appropriate internet sites and citation lists. Study selection: Studies showing the effects of using a parachute during free fall. **Main outcome measure:** Death or major trauma, defined as an injury severity score> 15. **Results:** We were unable to identify any randomized controlled trials of parachute intervention. **Conclusions:** As with many interventions intended to prevent ill health, the effectiveness of parachutes has not been subjected to rigorous evaluation by using randomized controlled trials. Advocates of evidence based medicine have criticized the adoption of interventions evaluated by using only observational data. We think that everyone might benefit if the most radical protagonists of evidence based medicine organized and participated in a double blind, randomized, placebo controlled, crossover trial of the parachute.

Pulmonary Barotrauma in Divers During Emergency Free Ascent Training: Review of 124 Cases

Lafère, Pierre; Germonpré, Peter; Balestra, Costantino

Aviation, Space, and Environmental Medicine; Volume 80, Number 4, Apr 2009, pp. 371-375(5)

Abstract

Introduction: Experience from treating diving accidents indicates that a large proportion of divers suffering from pulmonary barotraumas (PBT) or arterial gas embolism (AGE) were engaged in training dives, specifically emergency free ascent (EFA). We tried to verify this relationship and to calculate, if possible, the risk associated with normal recreational dives, training dives, and EFA training dives. **Methods:** All diving accidents treated at the Centre for Hyperbaric Oxygen Therapy (Brussels, Belgium) from January 1995 until October 2005 were reviewed. Data on the average number of dives performed and the proportion of in-water skills training dives were obtained from the major Belgian dive associations. **Results:** A total of 124 divers were treated, of whom 34 (27.4%) were diagnosed with PBT. Of those, 20 divers (58.8%) had symptoms of AGE. In 16 of those, EFA training exercise was deemed responsible for the injury. The association between EFA training and PBT proved to be very significant, with an odds ratio of 11.33 (95% confidence interval: 2.186 to 58.758). It was possible to calculate that a training dive (0.456 to 1.36/10,000) carries a 100 to 400 times higher risk, and an ascent training dive (1.82 to 5.46/10,000 dives) a 500 to 1500 times higher risk for PBT than a non-training dive (0.0041 to 0.0043/10,000 dives). **Discussion:** This study confirms a significant association between EFA training dives and the occurrence of PBT.

Adverse Design of Defibrillators: Turning Off the Machine When Trying to Shock

Christian S. Hoyer; Erika F. Christensen; Berit Eika

Annals of Emergency Medicine, Nov 2008 Vol. 52, Issue 5, Pages 512-514

Abstract

A recent publication demonstrated the possibility of erroneous operation of 2 widely used monitor-defibrillators and observed that the design of user interfaces might contribute to error during operation. During an ambulance simulation training exercise for 72 junior internal medicine physicians that called for defibrillation in the management of cardiac arrest, we observed that in 5 of 192 defibrillation attempts by the physicians, the monitor-defibrillator was inadvertently powered off. When the device is inadvertently powered off, recognition and subsequent steps to defibrillate delayed defibrillation an average of 24 seconds (range 14 to 32 seconds). Our analysis of the controls of this monitor-defibrillator found that the device could be powered off even if fully charged and ready to shock. Redesign of the equipment might prevent this inadvertent event.

Out-of-Hospital Combat Casualty Care in the Current War in Iraq

Robert T. Gerhardt; Robert A. De Lorenzo; Jeffrey Oliver; John B. Holcomb; James A. Pfaff

Annals of Emergency Medicine; Feb 2009 Volume 53, Issue 2, Pages 169-174

Study objective: We describe outcomes for battle casualties receiving initial treatment at a U.S. Army consolidated battalion aid station augmented with emergency medicine practitioners, advanced medic treatment protocols, and active medical direction. Battalion aid stations are mobile facilities integral to combat units, providing initial phases of advanced trauma life support and then evacuation. The setting was a forward base in central Iraq, with units engaged in urban combat operations. **Methods:** This was a retrospective observational study. Rates of battle casualties, mechanism, evacuations, and outcome were calculated. Corresponding Iraqi theater-wide U.S. casualty rates were also calculated for indirect comparison. **Results:** The study population consisted of 1.1% of the total U.S. military population in the Iraqi theater. Data were available for all battle casualties. The study facility's battle casualty rate was 22.2%. The case fatality rate was 7.14%, and the out-of-theater evacuation rate was 27%. Analysis of evacuated patients revealed a study average Injury Severity Score of 10 (95% confidence interval [CI] 8 to 12). Concurrent theater aggregate U.S. casualty rates are provided for contextual reference and include battle casualty rate of 6.7%, case fatality rate of 10.45%, out-of-theater evacuation rate of 18%, and average out-of-theater evacuation casualty Injury Severity Score of 10 (95% CI 9.5 to 10.5). **Conclusion:** The study battalion aid station experienced high casualty and evacuation rates while also demonstrating relatively low case fatality rates. A relatively high proportion of patients were evacuated out of the combat zone, reflecting both the battle casualty rate and number of patients surviving. Future effort should focus on improving out-of-hospital combat casualty data collection and prospective validation of emergency medicine–based out-of-hospital battlefield care and medical direction.

Changes in Cardiovascular Performance During an 8-Week Military Basic Training Period Combined With Added Endurance or Strength Training

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Military Medicine; Volume 173, Number 12, Dec 2008 , pp. 1173-1179(7)

Abstract

The purpose of the present study was to examine the changes in cardiovascular performance (VO2 max) and maximal strength development during an 8-week basic training (BT) combined with emphasized endurance training (ET) or strength training (ST) among 72 conscripts. The emphasized ST and ET programs combined with BT improved VO2 max by 12.0% ($p < 0.01$) and 8.5% ($p < 0.05$), while the increase in the control group (normal training) was 13.4% ($p < 0.001$). Body fat and waist circumference decreased in all groups. Normal training did not increase maximal strength of leg extensors but both ST (9.1%; $p < 0.05$) and ET (12.9%; $p < 0.01$) did. In con-

clusion, the current BT program including a high amount of endurance training improved cardiovascular performance. However, no further improvements in VO2 max were obtained by added endurance training for three times a week. BT positively influenced body composition but BT alone was not a sufficient stimulus to increase the maximal strength of leg extensors.

Post-Traumatic Stress Reactions Before the Advent of Post-Traumatic Stress Disorder - Potential Effects on the Lives and Legacies of Alexander the Great, Captain James Cook, Emily Dickinson, and Florence Nightingale

Mackowiak, Philip A.; Batten, Sonja V.

Military Medicine; Volume 173, Number 12, Dec 2008 , pp. 1158-1163(6)

Abstract

Evidence is presented that Alexander the Great, Captain James Cook, Emily Dickinson, and Florence Nightingale each developed symptoms consistent with post-traumatic stress disorder in the aftermath of repeated potentially traumatizing events of differing character. Their case histories also varied with respect to background, premorbid personality style, risk factors, clinical presentation, and course of the illness, illustrating the pleomorphic character of the disorder, as well as the special problems in diagnosing it in historical figures.

Effect of Carbohydrate Administration on Recovery From Stress-Induced Deficits in Cognitive Function: A Double-Blind, Placebo-Controlled Study of Soldiers Exposed to Survival School Stress

Morgan III, Charles A.; Hazlett, Gary; Southwick, Steven; Rasmusson, Ann; Lieberman, Harris R.

Military Medicine; Volume 174, Number 2, Feb 2009, pp. 132-138(7)

Abstract

Objective: The goal of this project was to evaluate the effects of energy supplementation, as liquid carbohydrate (CHO), on facilitating recovery of cognitive function in soldiers who have been exposed to sustained psychological and physical stress during Survival School Training. **Project Design:** A double-blind, placebo-controlled design was used. Healthy, male volunteers attending survival training were recruited for participation in the study. At the conclusion of the mock captivity phase of survival training and before a recovery night of sleep, subjects participated in cognitive testing. After this, subjects were randomly assigned to one of three treatment groups. Subjects received either a 6% CHO (35.1 kJ/kg), 12% CHO (70.2 kJ/kg), or placebo beverage in four isovolemic doses. In the morning of the following day, all subjects participated in a second assessment of cognitive functioning. **Results:** Compared to subjects who received placebo, those who received supplemental CHO beverages exhibited significantly improved performance on a complex cognitive task (i.e., Stroop Test) involving concentration effectiveness associated with selective attention and response inhibition. No differences were observed on a variety of cognitive tasks of lesser complexity. **Discussion:** These data suggest nutritional interventions enhance the rapid recovery of complex cognitive functions impaired by exposure to significant or sustained stressful conditions In addition to enhancing speed of recovery of function between operational intervals,

the current data suggest that dietary supplement strategies may hold promise for enhancing field performance and a capacity to assist in sustaining operations by military personnel over time.

The Relationship of Blood Product Ratio to Mortality: Survival Benefit or Survival Bias?

Snyder, Christopher W. MD; Weinberg, Jordan A. MD; McGwin, Gerald Jr MS, PhD; Melton, Sherry M. MD; George, Richard L. MD; Reiff, Donald A. MD; Cross, James M. MD; Hubbard-Brown, Jennifer BS; Rue, Loring W. III MD; Kerby, Jeffrey D. MD, PhD

Journal of Trauma-Injury Infection & Critical Care; 66(2):358-364, Feb 2009

Abstract

Background: Recent studies show an apparent survival advantage associated with the administration of higher cumulative ratios of fresh frozen plasma (FFP) to packed red blood cells (PRBC). It remains unclear how temporal factors and survival bias may influence these results. The objective of this study was to evaluate the temporal relationship between blood product ratios and mortality in massively transfused trauma patients. **Methods:** Patients requiring massive transfusion (>10 units of PRBC within 24 hours of admission) between 2005 and 2007 were identified (n = 134). In-hospital mortality was compared between patients receiving high (>1:2) versus low (<1:2) FFP:PRBC ratios with a regression model, using the FFP:PRBC ratio as a fixed value at 24 hours (method I) and as a time-varying covariate (method II). **Results:** The FFP:PRBC ratio for all patients was low early and increased over time. Sixty-eight percent of total blood products were given and 54% of deaths occurred during the first 6 hours. Using method I, patients receiving a high FFP:PRBC ratio (mean, 1:1.3) by 24 hours had a 63% lower risk of death (RR, 0.37; 95% CI, 0.22-0.64) compared with those receiving a low ratio (mean, 1:3.7). However, this association was no longer statistically significant (RR, 0.84; 95% CI, 0.47-1.50) when the timing of component product transfusion was taken into account (method II). **Conclusions:** Similar to previous studies, an association between higher FFP:PRBC ratios at 24 hours and improved survival was observed. However, after adjustment for survival bias in the analysis, the association was no longer statistically significant. Prospective trials are necessary to evaluate whether hemostatic resuscitation is clinically beneficial.

Reversal of Coagulopathy in Critically Ill Patients With Traumatic Brain Injury: Recombinant Factor VIIa is More Cost-Effective Than Plasma

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Journal of Trauma-Injury Infection & Critical Care; 66(1):63-75, Jan 2009.

Abstract

Background: Traumatic brain injury (TBI) is the leading cause of death and disability after trauma. Coagulopathy is common in this patient population and requires rapid reversal to allow for safe neurosurgical intervention and prevent worsening of the primary injury. Typically reversal of coagulopathy is accomplished with the use of plasma. Recombinant factor VIIa (rFVIIa; NovoSeven, Novo Nordisk, Bagsvaerd, Denmark) has become increasingly used "off-label" in patients with neurosurgical emergencies to rapidly reverse coagulopathy. We hypothesized that the use of rFVIIa in this patient population would prove to be cost-effective as well as demonstrate clinical benefit. **Methods:** The trauma registry at the R Adams Cowley Shock Trauma Center was used to identify all coagulopathic trauma patients admitted between January 2002 and December 2007 with relatively isolated TBI (head Abbreviated Injury Scale score of >=4). The medical records of patients were reviewed and demographics, injury-specific data, medications administered, laboratory values, blood product utilization, neurosurgical procedures, length of stay (LOS), discharge disposition, and outcome data were abstracted. Patients who received rFVIIa for reversal of coagulopathy were compared against those who did not receive rFVIIa. t Tests were used to compare differences be-

tween continuous variables, and [chi]2 analysis was used to compare categorical variables. A p value of <0.05 was considered significant for all statistical tests. **Results:** During a 6-year period, there were 179 patients who met inclusion criteria. One hundred eleven patients (62.0%) were treated with conventional therapy alone whereas 68 (38.0%) received rFVIIa. Baseline characteristics between the two groups were similar except that Injury Severity Score and admission international normalized ratio were higher in the rFVIIa group and the rFVIIa group had a higher percentage of patients with head Abbreviated Injury Scale score of 5 injuries, patients who underwent neurosurgical procedures and patients with preinjury warfarin use. There was no difference in total charges between these groups (mean US $63,403 in the conventionally treated group vs. $66,086). When patients who required admission to the intensive care unit were analyzed (n = 110, 50% received rFVIIa), total mean charges and costs were significantly lower in the group that received rFVIIa (mean US $108,900 vs. $77,907). Hospital LOS, days of mechanical ventilation, and plasma utilization were lower in the rFVIIa group. Mortality and thromboembolic complication rates were not different between the two groups. **Conclusion:** In this study, we were able to demonstrate a significant economic benefit of the use of rFVIIa for reversal of coagulopathy in severely injured patients with TBI. Not all patients with coagulopathy and an anatomic brain injury benefit, but in patients who are neurologically or physiologically compromised, using rFVIIa decreases total charges and costs of hospitalization. This decrease in overall cost is directly attributable to the significant decrease in LOS and decrease in the need for mechanical ventilation. This study demonstrates that in coagulopathic patients with TBI who require intensive care unit admission, rFVIIa is cost-effective and safe. Prospective studies are needed to confirm these findings and establish clinical effectiveness.

Case 15-2008 — A 55-Year-Old Man with an Elevated Prostate-Specific Antigen Level and Early-Stage Prostate Cancer

Michael J. Barry, MD; Donald S. Kaufman, MD; Chin-Lee Wu, MD, PhD

The New England Journal of Medicine; Volume 358:2161-2168 May 15,2008 Number 20

Presentation of Case

Dr. Donald S. Kaufman: A 55-year-old man was referred to this hospital for management of prostate cancer. He had been well until approximately 1 year earlier, when he noted the progressively decreasing force of his urinary stream, increasing urinary urgency, and nocturia up to four times per night. At that time, he had noted decreased libido for several months, but his erections were adequate for intercourse. His primary care physician obtained a measurement of serum prostate-specific antigen (PSA), which was 6.6ng per milliliter. The patient was referred to a local urologist. On examination, the abdomen and external genitalia were . . .

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

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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 automated 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.

Tactical Emergency Medical Support: Physician Involvement and InjuryPatterns in Tactical Teams

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Abstract

Medical support provided by physicians in police tactical teams has been firmly embraced by the medical community. Our study revisited the 1995 study inquiring into injury patterns in police tactical teams. A national survey was completed by 209 members of tactical teams throughout the country over a 6-week period. An electronic survey was submitted to the National Tactical Officers Association, the International Tactical Emergency Medical Support Association, and state tactical associations. Teams reporting physician utilization were 47% of the whole (69% were present ≤ 6 years and 65% were Emergency Physicians). Law enforcement certification was indicated in 64%. Most teams (83%) were involved in training exercises. Physician benefit was reported in 94%. Most injuries were low acuity, occurring during training. Fatalities were low, mostly occurring during call-outs. The study findings support physician presence within police tactical teams and a need for extensive involvement in all aspects of team health, with special attention to daily health and physical fitness.

The Pandemic Influenza Policy Model: A Planning Tool for Military Public Health Officials

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Abstract

The Pandemic Influenza Policy Model (PIPM) is a collaborative computer modeling effort between the U.S. Department of Defense (DoD) and the Johns Hopkins University Applied Physics Laboratory. Many helpful computer simulations exist for examining the propagation of pandemic influenza in civilian populations. We believe the mission-oriented nature and structured social composition of military installations may result in pandemic influenza intervention strategies that differ from those recommended for civilian populations. Intervention strategies may differ between military bases because of differences in mission, location, or composition of the population at risk. The PIPM is a web-accessible, user-configurable, installation-specific disease model allowing military planners to evaluate various intervention strategies. Innovations in the PIPM include expanding on the mathematics of prior sto-

chastic models, using military-specific social network epidemiology, utilization of DoD personnel databases to more accurately characterize the population at risk, and the incorporation of possible interventions, e.g., pneumococcal vaccine, not examined in previous models.

High Stress Immunity in Special Operations Forces

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Prospectus

Background: Discussion of resilience as high stress immunity in Special Operations Forces (SOF) requires straight forward and simple answers to a complex question: "What factors differentiate individuals who respond well to chronic exposure and high-intensity stressors from those who are unable to adapt?" The application of straight forward answers derived empirically or anecdotally requires specified approaches that subsequently yield efficient and enduring results. Resilience is a complex, dynamic, multi-dimensional factor that is difficult to define comprehensively and challenging to measure. Traditionally it has been measured mainly from a psychological perspective, to include psychosocial and spiritual domains. SOF resilience uniquely is a biopsychosocial framework that keeps SOF personnel at peak performance when stressed by combat and threatening situations in hostile operating environments. Warriors drawn to SOF have similar attitudes and goals. Institutionally, SOF capabilities are predicated on the ability to identify individuals (i.e., selection and assessment) who adaptively respond to high-intensity stressors. **Hypothesis:** Selection and assessment, stress inoculation, positively focused leadership with embedded psychosocial support systems, performance training, and enhanced situational awareness for SOF and Families increase high stress immunity. **Methods:** The design provides a cohort study implementing the scaling of demographic information on selection and assessment, stress inoculation, leadership attribution, psychosocial support systems hierarchy, performance training biomarkers, and behavioral indicators of situational awareness in SOF and family members. Pre-hoc comparison measures of depression, anxiety, and fatigue will be assessed for high stress immunity outcome variable selection and included in multiple regression modeling techniques that incorporate the demographic data as regressor variables entered in a stepwise fashion.

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Previously Published

Clinical Review

Diving Medicine: A Review of Current Evidence

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ABSTRACT

Recreational scuba diving is a growing sport worldwide, with an estimated 4 million sport divers in the United States alone. Because divers may seek medical care for a disorder acquired in a remote location, physicians everywhere should be familiar with the physiology, injury patterns, and treatment of injuries and illnesses unique to the underwater environment. Failure to properly recognize, diagnose, and appropriately treat some diving injuries can have catastrophic results. In addition, recreational dive certification organizations require physical examinations for medical clearance to dive. This article will review both common and potentially life-threatening conditions associated with diving and will review current evidence behind fitness to dive considerations for elderly divers and those with common medical conditions.

Recreational scuba diving is a growing sport across the globe. Worldwide, the number of annual diving certifications has tripled during the past 20 years.[1] In the United States alone there are an estimated 4 million sport divers.[2] Apart from the coastlines, recreational diving takes place in lakes and quarries throughout the country, and divers may present to their local emergency departments or office practices with injuries or illnesses unique to diving and the underwater environment. Because of the popularity of diving in tropical waters and the ease of travel, divers may seek medical care for a disorder acquired in a remote and often unfamiliar location. Failure to properly diagnose and appropriately treat some diving injuries can result in catastrophic outcomes, particularly those involving the brain and spinal cord. In addition, more than ever before, patients of all ages are seeking medical clearance to dive from their primary care physicians, who must be aware of recommendations for fitness to dive. These include some controversial topics in diving medicine, which will be reviewed in this manuscript.

Pressure Environment

The most significant environmental exposure in diving is the increased ambient pressure. Underwater, pressure increases in a linear fashion with depth (Table 1).[3] Exposure to increased pressure can result in several pathophysiologic changes. One is related to compression and expansion of gas according to Boyle's Law; another is related to increased content of dissolved inert gas in blood and tissues according to Henry's law.[3]

Table 1. **Effects of Depth on Ambient Pressure**

Sea Water (feet)	Absolute Pressure (atm)	Mercury (mm)	Pounds per Square Inch
0 (sea level)	1	760	14.7
33	2	1520	29.4
66	3	2280	44.1
99	4	3040	58.8
132	5	3800	73.5

Ear and Sinus Barotrauma

Although pulmonary barotrauma receives much attention because of the seriousness of its sequelae, barotrauma to the ears and sinuses is a far more common and potentially debilitating injury for divers. Barotrauma is defined as the tissue damage that results from the inability of the body to equalize pressure in a gas-filled space (eg, the middle ear). During ascent and descent, the body is exposed to changes in ambient pressure. According to Boyle's Law, as ambient pressure increases during descent, the volume of gas-filled space decreases. In the ear, for example, the tympanic membrane is deflected inward to the point of rupture unless air is allowed to enter the middle ear via the Eustachian tube.[4] Middle ear barotrauma (middle ear squeeze) is the most common diving injury, occurring in 30% of first-time divers and 10% of experienced divers. It manifests as acute onset of ear pain and is sometimes associated with vertigo and conductive hearing loss. Clinical findings range from injection of the tympanic membrane to hemotympanum with or without ruptured tympanic membrane.[5]

Sinus barotrauma (sinus squeeze) is another relatively common diving injury usually resulting from transient nasal pathology or chronic sinusitis. Blockage of the sinus ostium may cause a relative negative pressure in a sinus cavity during descent. This causes engorgement with mucosal edema and can result in bleeding into the sinuses. Sinus barotrauma manifests as acute onset of facial pain with epistaxis.[6] Other types of barotrauma include barodontalgia (tooth squeeze), inner ear barotrauma, and mask squeeze. Treatment for both sinus and middle ear barotrauma includes the use of decongestants and analgesics. Systemic antibiotics for prophylactic treatment of otitis media may be considered in middle ear barotrauma with tympanic membrane perforation. Tympanic membrane rupture should be allowed to completely heal before diving again.

Prevention of these common diving injuries consists primarily of careful attention to pressure equilibration and a slow, feet-first descent. The use of nasal and/or systemic decongestants, such as oxymetazoline and pseudoephedrine, before diving may be helpful; however, they must be used with caution to avoid the rebound effect sometimes associated with a reverse block during ascent at the end of the dive.[7] Prevention of otic barotrauma is best accomplished through the use of a Valsalva maneuver during descent. Explanation of this maneuver should be part of the diving evaluation. When performing fitness to dive evaluations, the primary care physician must consider the risk of ostial insufficiency from upper respiratory infection, rhinosinusitis, or other conditions that will put a patient at risk for barotrauma when diving.[8]

Inner ear barotrauma is a condition related to middle ear barotrauma. Forceful attempts to equalize the middle ear with the Valsalva maneuver may elicit a pressure gradient between the middle ear and the perilymph of the inner ear large enough to rupture the round or oval window, causing perilymph leakage. This condition presents as acute sensorineural hearing loss, tinnitus, and vertigo. The treatment is not recompression therapy but rather bed rest, head elevation, avoidance of straining, and referral to an otolaryngologist. A detailed dive history is helpful when distinguishing inner ear barotrauma from inner ear decompression sickness (DCS; discussed later).[4]

Pulmonary Barotrauma

According to Boyle's Law, during ascent, as ambient pressure is reduced, gas inside the lungs expands. If a diver breathing compressed air at depth does not allow the compressed air in the lungs to escape by exhaling, or if air empties slowly from a lung segment because of obstructive pulmonary conditions, then the gas expands during ascent as ambient pressure falls, causing alveoli to rupture. This air under pressure then escapes the alveoli and rushes into surrounding tissues, resulting in mediastinal or subcutaneous emphysema or pneumothorax. In the most severe cases, air will enter the bloodstream via pulmonary veins, traveling through the left heart as an arterial gas embolism (AGE). These air bubbles distribute throughout the arterial circulation and reach the brain where they occlude bloodflow, compromise the blood-brain barrier, and result in stroke-like events.[9] Almost all cases of AGE present within five minutes of ascent and manifest as gross neurologic deficits, including stupor; bilateral or unilateral motor and sensory changes; unconsciousness; visual disturbances; vertigo; convulsions; and, in approximately 5%, complete cardiovascular collapse (Table 2).[10]

Table 2. **Presenting Signs and Symptoms in Patients with Arterial Gas Embolism**

Sign or Symptom	Percentage
Stupor or confusion	24
Coma without seizures	22
Coma with seizures	18
Unilateral motor deficits	14
Visual disturbances	9
Vertigo	8
Unilateral sensory deficits	8
Bilateral motor deficits	8
Collapse	4

Of note, the greatest change in lung volume per change in depth occurs nearest the surface. Therefore, it is possible for divers breathing compressed air in a pool as shallow as four feet to develop pulmonary barotrauma if they ascend to the surface while holding their breath at maximum lung volume.[11] Treatment of AGE consists of advanced cardiac life support, 100% oxygen, hydration, and immediate recompression using the U.S. Navy Diving Manual Table 6 algorithm, which is a standard protocol that involves recompression to 60 feet in a hyperbaric chamber while breathing oxygen.[10] The majority of individuals with AGE fully recover with prompt recompression therapy.[9]

Decompression Sickness

DCS is caused by injury due to bubble formation in blood and tissues. As ambient pressure increases at depth, the partial pressures of inspired gases increase proportionately. Inert gas — primarily nitrogen — is dissolved in tissues, creating in the body a supersaturated state; if ascent is too rapid, the dissolved nitrogen in the blood and tissues will become supersaturated and form bubbles that cause tissue injury through mechanical effects, vascular occlusion, and activation of the clotting cascade and inflammatory mediators. Bubbles are often detected initially in the venous system and pose a further risk for systemic injury by entering the arterial circulation through a patent foramen ovale (PFO), which produces a right-to-left cardiac shunt. Bubbles entering the arterial circulation via a shunt produce symptoms similar to AGE.[12] The incidence of DCS among recreational scuba divers is approximately two to three cases per 10,000 dives.[13] As could be predicted by the pathophysiology, DCS may manifest with a wide array of signs and symptoms and is typically classified into either type I or type II.

Type I (nonsystemic or musculoskeletal) DCS is characterized by the absence of neurologic and other systemic symptoms and usually manifests as musculoskeletal symptoms, such as pain that is often dull or throbbing and poorly localized around a joint — the shoulder and elbow being the most common sites. Skin rash and pruritis are common cutaneous manifestations; less common is cutis marmorata or skin marbling. This condition, which has been reportedly associated with PFO, may be a harbinger of more serious symptoms that could require recompression therapy.[14] Type I DCS usually presents soon after the dive; 95% of people affected have onset of pain within six hours of surfacing. Joint pain is rapidly relieved with recompression therapy. Cutaneous manifestations usually resolve spontaneously in 12 to 24 hours. The treatment for type I, or musculoskeletal, DCS is recompression using U.S. Navy Diving Manual Table 6 algorithm.[15]

Type II (neurologic or systemic) DCS describes that which affects the neurologic, vestibular, or pulmonary systems. Neurologic involvement is most common among sport divers and can be caused by either spinal cord or cerebral involvement. Like pain – only DCS is rapid in onset – with half of patients developing symptoms within one hour of surfacing and 90% reporting symptoms within six hours. The neurologic symptoms that present most often include numbness, dizziness, weakness, gait abnormality, and hypoesthesia (Table 3).[10]

Inner ear DCS (the "staggers") may be caused by bubble formation in the semicircular canals and presents as acute vertigo, nystagmus, tinnitus, and nausea with vomiting. Pulmonary DCS (the "chokes") is a rare condition probably caused by a massive pulmonary gas embolism. This usually follows a rapid or uncontrolled ascent and presents with immediate substernal pain, cough, and cardiovascular shock resembling adult respiratory distress syndrome.[16] The treatment for type II DCS is hydration, 100% oxygen, and immediate transport to a recompression facility for treatment under Table 6 algorithm of the U.S. Navy Diving Manual. If the patient must be flown to a chamber, it is important to limit altitude to less than 1000 feet or use an aircraft that can be pressurized to sea level to prevent the exacerbation of symptoms.

Table 3. **Presenting Signs and Symptoms in Patients with Decompression Sickness**

Sign or Symptom	Percentage
Numbness	59
Pain	55
Dizziness	27
Extreme fatigue	25
Headache	24
Weakness	23
Nausea	14
Gait abnormality	12
Hypoesthesia	10
Visual Disturbance	8
Itching	5

Decompression Illness

Decompression illness (DCI), a term that encompasses DCS and AGE, was introduced because treatment of either condition is recompression. However, distinction between the two is important for prognosis in future diving exposures. For clinical management, the greatest challenge may be to distinguish between DCI and nondiving conditions because of the vague nature of symptoms and because there are no specific diagnostic tests for DCI. However, diagnostic certainty is not required because divers with suspected DCI should be recompressed if there are no medical contraindications and a chamber is available (Table 4).[17]

Flying After Diving

Flying after diving deserves mention because many recreational dives take place away from home, which may involve air travel. The Diver's Alert Network (DAN) 2002 Consensus Guidelines for Flying After Recreational Diving (which apply to air dives followed by flights at cabin altitudes of 2000 to 8000 feet for divers without DCS symptoms) are summarized here: for a single no-decompression dive, one should wait at least 12 hours before flying; for multiple dives per day or multiple days of diving, 18 hours is suggested, and for any decompression dives, "substantially longer than 18 hours appears prudent."[18]

Common Medical Disorders and Diving

There are several medical issues that may be contraindications to diving. The conditions covered here are some of the more controversial topics or ones that generate the most questions from primary care physicians. These include coronary artery disease, PFO, asthma, diabetes, spontaneous pneumothorax, and older age. Detailed fitness to dive considerations

Table 4. **Summary of Diving-Related Conditions**[4,6,7,10,15,16]

Condition	Presentation	Dive History	Prevention/Treatment
Barotrauma			
Middle ear	Acute ear pain, vertigo, tympanic membrane rupture	Usually during descent	Slow equalization on descent, decongestants, consider antibiotics for tympanic membrane perforation
Inner ear	Acute vertigo, nausea, vomiting, hearing loss	Usually during descent	Bed rest, elevated head, avoidance of Valsalva, otolaryngology consult
Sinus	Acute facial pain, epistaxis	Usually during descent	Slow equalization on descent, decongestants
Arterial gas embolism	Stupor, coma, focal weakness, visual disturbances	Immediately upon surfacing or during ascent	100% oxygen, supportive care, U.S. Navy Table 6 Algorithm
Decompression Sickness			
Type I	Poorly localized joint pain, rash, itching	Significant time at depth; 50% develop symptoms within one hour of surfacing, 90% within six hours	100% oxygen, supportive care, U.S. Navy Table 6 Algorithm
Type II	Numbness, dizziness, weakness, gait abnormality, hypoesthesia	Significant time at depth; 50% develop symptoms within one hour of surfacing, 90% within six hours	100% oxygen, supportive care, U.S. Navy Table 6 Algorithm

and a more comprehensive list of conditions can be found in Guidelines for Recreational Scuba Diver's Physical Examination[19] or the Divers Alert Network webpage[20] and in standard texts.[21,22] Alternatively, DAN is available for phone consultation during business hours at (800) 446-2671 or for emergency calls 24 hours a day, 7 days a week at (919) 684-8111.[20]

Coronary Disease

According to 2005 American Heart Association statistics, an estimated 16 million Americans have coronary heart disease — the single leading cause of death in the United States. This year an estimated 1.2 million Americans will suffer an acute coronary syndrome, and approximately 310,000 of them will die from the heart attack in an emergency department or without being hospitalized.[23] DAN fatality surveillance data reveals that cardiac conditions are the number two cause of death, second only to drowning, in the 89 U.S. and Canadian recreational diving-related deaths in 2005. Approximately 80% of fatalities were in people 40 years or older, and for those whose medical history was available, hypertension and heart disease were the most common conditions reported.[13]

Any physician caring for prospective divers must consider their patients' cardiac risk factors in light of the unique stresses diving puts on the heart. Aside from increased myocardial oxygen demands from swimming, preload is also increased because of immersion-induced increase in central venous return, whereas afterload is increased from cold-induced peripheral vasoconstriction. The Recreational Scuba Training Council, Undersea and Hyperbaric Medical Society (UHMS), and DAN recommend that divers over the age of 40 undergo risk assessment for coronary artery disease. Exercise stress testing may be recommended for asymptomatic divers with multiple cardiac risk factors.[24] Routine screening would not be advised for young, low-risk divers because of the low positive predictive value of exercise stress testing in these individuals.[25] Fitness to dive is optimal when a diver can reach a maximum capacity of 13 metabolic equivalents (METS) or stage-four of the Bruce protocol. This peak capacity allows a diver to exercise comfortably at eight to nine METS.[26] With increasing numbers of older divers, screening for coronary disease is essential for patients seeking medical clearance for sport diving. Individuals with known coronary artery disease, including those with previous heart attacks or revascularization procedures, may be cleared for low-stress sport diving after six to twelve months of healing and stabilization if a thorough cardiovascular evaluation including stress testing determines that age-adjusted cardiopulmonary fitness is not impaired.[27]

Patent Foramen Ovale

The foramen ovale is open during fetal life to allow for right to left shunting. For most people this opening is closed at birth by a flap that seals against the atrial septum. However, the flap is not sealed in approximately one third of the population and can open with changes in intrathoracic pressure.[28] For years, there has been considerable controversy over the relationship between PFO and DCS. Ultrasound examination of divers has demonstrated that venous gas bubbles, which are common after diving and usually filtered by the pulmonary vasculature, can pass through a PFO and embolize the arterial circulation.[29] Shunting through a PFO may not be apparent at rest because left atrial pressure is usually greater than right atrial pressure almost entirely throughout the cardiac cycle. The exception to this may be during times of certain respiratory movements, such as the period after a Valsalva maneuver when a surge of venous blood transiently increases right atrial pressure. Actions such as straining to lift heavy objects (i.e., scuba tanks after a dive) produce a similar effect on venous return.

Regardless of the improbability of paradoxical gas embolism, there have been several reports of possible associations between PFO and DCS. Causality is still unproven, but there seems to be an increased relative risk of developing DCS with a PFO versus without. The exact prevalence of PFO in divers with DCS is not known because of a combination of factors. Interpreting available data is complicated by imprecise diagnosis of DCS and poorly standardized methods of detecting PFO.[30] The most widely quoted odds radio (OR) for serious DCS with PFO versus without PFO is 2.52 (95%CI, 1.5–4.25) as determined by a meta-analysis published in 1998.[31] This was with a reported per-dive incidence of DCS of 3.41 in 10,000 dives. In 2003, an extensive bibliographic review of 145 peer-reviewed journal articles related to PFO found no clear agreement regarding the role of PFO in DCS.[32] From a combined analysis of the contrast transesophageal echocardiogram studies, an OR of 2.6 has been calculated for the development of DCS in divers with a PFO versus those without.[30] Other authors have concluded that PFO increases the risk for DCS as much as 4.5 times.[33] A more recent investigation into the functional and anatomic characteristics of PFO has yielded a possible higher risk subgroup. The unadjusted OR to develop DCS for divers with PFO was 5.5 (95% CI 1.8–16.5). However, if stratifying by PFO characteristics, there was no statistically significant difference in risk for DCS for divers with PFO detected only during Valsalva than divers without PFO. There was a significant risk of divers with PFO at rest, with an OR of 24.8 (95% CI 2.9–210.5).[34]

With this knowledge, we should consider our recommendations for diving and PFO based on the absolute increased risk. DCS in recreational divers is extremely rare, occurring after only 0.005% to 0.08% of dives. Presented differently, actual data from DAN's Project Dive Exploration recorded four cases of DCS in approximately 14,000 dives.[13] Evidence supports that the average recreational sport diver need not be screened for PFO. For those already diagnosed as having a PFO, this is not a contraindication for diving. Until we know more, a safe strategy would be to reduce the venous bubble load because it is the bubbles — not the PFO — that are the cause of DCS. This can be accomplished by avoiding dives that require decompression stops, by limiting bottom time, or by the appropriate use of oxygen-enriched breathing mixes.[35]

Asthma

More than 22 million Americans have asthma, which is roughly 7% of the total population.[36] Several surveys have revealed the prevalence of active asthmatic disease among divers from 4% to 7%.[37–40] There is obvious theoretical concern for asthmatic divers. Pulmonary obstruction, air trapping, and hyperinflation that accompany an acute asthma attack would seemingly place the asthmatic diver at increased risk for pulmonary barotrauma. In addition, conditions such as cold and exercise serve as triggers for many asthmatics. Based on this, asthma had been traditionally considered an absolute contraindication to diving.[9]

Despite these facts and documented decrements in pulmonary function studies after diving, the evidence is equivocal for risk of pulmonary barotrauma or DCS among divers with asthma. A comprehensive review of the literature in 2003 found no epidemiologic evidence for an increased relative risk of pulmonary barotrauma, DCS, or death among divers with asthma.[41] However, this information may be biased because it accounts only for asthmatics with mild disease who have chosen to dive against medical advice. The actual risk for all asthmatics is probably higher than what is shown in published studies.[42]

With such vast differences among patients with respect to precipitating factors, pulmonary function, and degree of airway obstruction and reversibility, it is difficult to consider asthma as a single disease when assessing fitness to dive. Rather, this condition demands individualized consideration based on each specific diver's history and disease syndrome.[9] There are several published guidelines with a variety of recommendations for diving with asthma. In Australia, all divers with asthma must pass spirometry before certification, but in the United Kingdom, well-controlled asthmatics (excluding cold-, exercise-, or emotion-induced asthmatics) may dive as long as they do not require a bronchodilator within 48 hours.[43,44] Among experts and other major diving organizations, the consensus is that lung function must be normal before an asthmatic can dive. Carefully selected mild to moderate, well-controlled asthmatics with normal screening spirometry can be considered candidates for diving per recommendations by the Recreational Scuba Training Council and the UHMS.[45] Spirometry should be normal before and after exercise testing. Medication used to maintain normal spirometry is not a contraindication to diving. Inhalation challenge tests, including methacholine or hypertonic saline, are not recommended.[19]

Diabetes

Individuals with diabetes mellitus (DM) who are treated with insulin or oral hypoglycemic agents are at increased risk for hypoglycemia during or after exercise. Because of the potential for underwater hypoglycemic events, diabetics have historically been prohibited from diving.[46] The Recreational Scuba Training Council, UHMS, and DAN consider diabetes a severe risk condition in accordance with the Scuba Schools International guidelines.[19] This guideline warns that a rapidly changing level of consciousness associated with hypoglycemia can contribute to drowning and specifies that "diving is therefore generally contraindicated, unless associated with a specialized program that addresses these issues."[19] Because the Diabetes and Diving Committee (joint UHMS/American Diabetes Association) established the first fitness to dive criteria in 1994 for physically fit diabetics with well-controlled disease, multiple studies have demonstrated that select diabetics can safely participate in recreational diving and that evidence is lacking for a widespread ban on diving for all diabetics.[46] However, expert recommendations support holding diabetic divers to a very high standard of physical fitness and experience in diabetes management, including monitoring daily glucose patterns and the effects of strenuous exercise and excluding divers with any significant systemic diabetic sequelae, recent history of hypoglycemia, or poorly controlled blood glucose.[24,46] A workshop jointly sponsored by the

UHMS and DAN in 2005 published guidelines for diabetes and recreational diving. These guidelines stipulate that adults with DM may qualify as fit to dive during their physician's annual review if they have been on a stable dose of insulin for one year or oral hypoglycemic agents for three months; have a glycosylated hemoglobin level of 9%; have had no significant episodes of hypo- or hyperglycemia for one year; have no secondary complications of DM; and have no hypoglycemia unawareness. In addition, these guidelines provide scope of diving limitations and recommendations for glucose management on the day of diving.[47]

Spontaneous Pneumothorax

Some individuals have weak areas (blebs) in the pleural lining of the lung that can rupture without provocation, resulting in pneumothorax. Approximately half of those who suffer a spontaneous pneumothorax are likely to have another because they usually have multiple pleural blebs, which are all prone to leak at one time or another.[48] Because there is evidence that divers who have experienced spontaneous pneumothorax are at greater risk of pneumothorax or gas embolism while diving, most dive physicians recommend that individuals who have experienced spontaneous pneumothorax should not dive.[10] In diving, these blebs or bullae in the lungs predispose a diver to pulmonary barotrauma because they are weaker than normal lung tissue, empty their air slowly during exhalation, and can build up pressure during ascent causing rupture. Computed tomography scanning may be recommended to detect blebs; however, even if imaging shows no evidence of underlying lung disease, patients with a history of spontaneous pneumothorax are recommended not to dive under any circumstances.[49] Even if a surgical procedure designed to prevent recurrent spontaneous pneumothorax, such as pleurodesis, has been used, recommendations remain to avoid diving, although individual divers have returned to diving without incident after surgical blebectomy.[19]

The Elderly and Diving

With growing physical activity among older Americans, primary care physicians are being asked with increased frequency to evaluate their elderly patients for fitness to dive. Similarly, the diving population is aging along with the U.S. population at large. The following evidence can support recommendations for older patients who wish to participate in sport diving. There is no formal age limitation for recreational scuba diving. Recommendations for diving in the elderly are based on the presence of acute or chronic illness and especially on the physical conditioning of the individual. Physical capacity is known to decline with age, yet, as we know, there are many older individuals who have attained a higher level of fitness than many of their younger counterparts. However, there are some basic physiologic responses to aging that should be considered when reviewing older patients' fitness to dive.[50]

Known cardiovascular changes with age include increases in blood pressure and peripheral vascular resistance and decreases in oxygen update, work capacity, and maximal heart rate. Some of these cardiovascular parameters that have been thought to change with age may actually be associated more with fitness level.[51] In addition, as stated earlier, coronary artery disease, higher rates of which are seen among the elderly, is a major contributor to diving-related deaths in North America. Therefore, emphasis is placed on assessing physical capacity and screening for coronary disease during evaluation for fitness to dive. As previously mentioned, individuals aged 40 or older should undergo risk assessment for coronary artery disease, which may require formal exercise testing. A maximum capacity of 13 METS is the suggested criteria for stress testing to allow a diver to swim comfortably with diving gear in a 1-knot current expending eight to nine METS.[19] Other physiologic changes with age include breathing difficulties from increased dead space, glucose intolerance, heat and cold intolerance, decreased range of motion from changes in collagen structure, and alterations of neurological function.

Because many diving accidents are caused by inadequate training, poor physical conditioning, and human error, all of these factors must be considered for a given individual before recommending diving. Any combination of minor physical deficits in an older diver may contribute to an increased risk for diving injuries or mishaps. With careful evaluation, it is certainly reasonable for some elderly people in good health to undertake safe recreational diving. It would be prudent; however, to recommend a diving program that may not be as rigorous as programs recommended for their younger counterparts.[50]

Conclusion

Scuba diving is an increasingly popular recreational sport. An understanding of the pathophysiology, injury patterns, and treatment for both common and life-threatening diving injuries is critical for the primary care physician to advise, diagnose, and treat the recreational diver.

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Dr. Bove has made significant contributions to the health and safety of sport divers as medical editor of Skin Diver magazine where he wrote a monthly diving medicine column from 1982 until 2002. He is the author of over 270 scientific articles including 38 on diving medicine and physiology, and 10 book chapters on diving medicine and physiology. He is the editor of the textbook Diving Medicine, 4th edition Published by W.B.Saunders, 2003.

Dr. Bove is a practicing cardiologist at Temple University Medical School. He has made numerous contributions to the literature in cardiovascular medicine and physiology, has authored a textbook on coronary disease, and a text on exercise physiology and medicine. He was the founding editor of www.cardiosource.com. He is considered a national expert on cardiovascular disorders and diving, and consults for the U.S. Navy, the National Academy of Science, NOAA, and the Divers Alert Network (DAN). His website www.scubamed.com is a worldwide resource for information on diving medicine.

OPERATION SAMS

Dwight Jon Zimmerman

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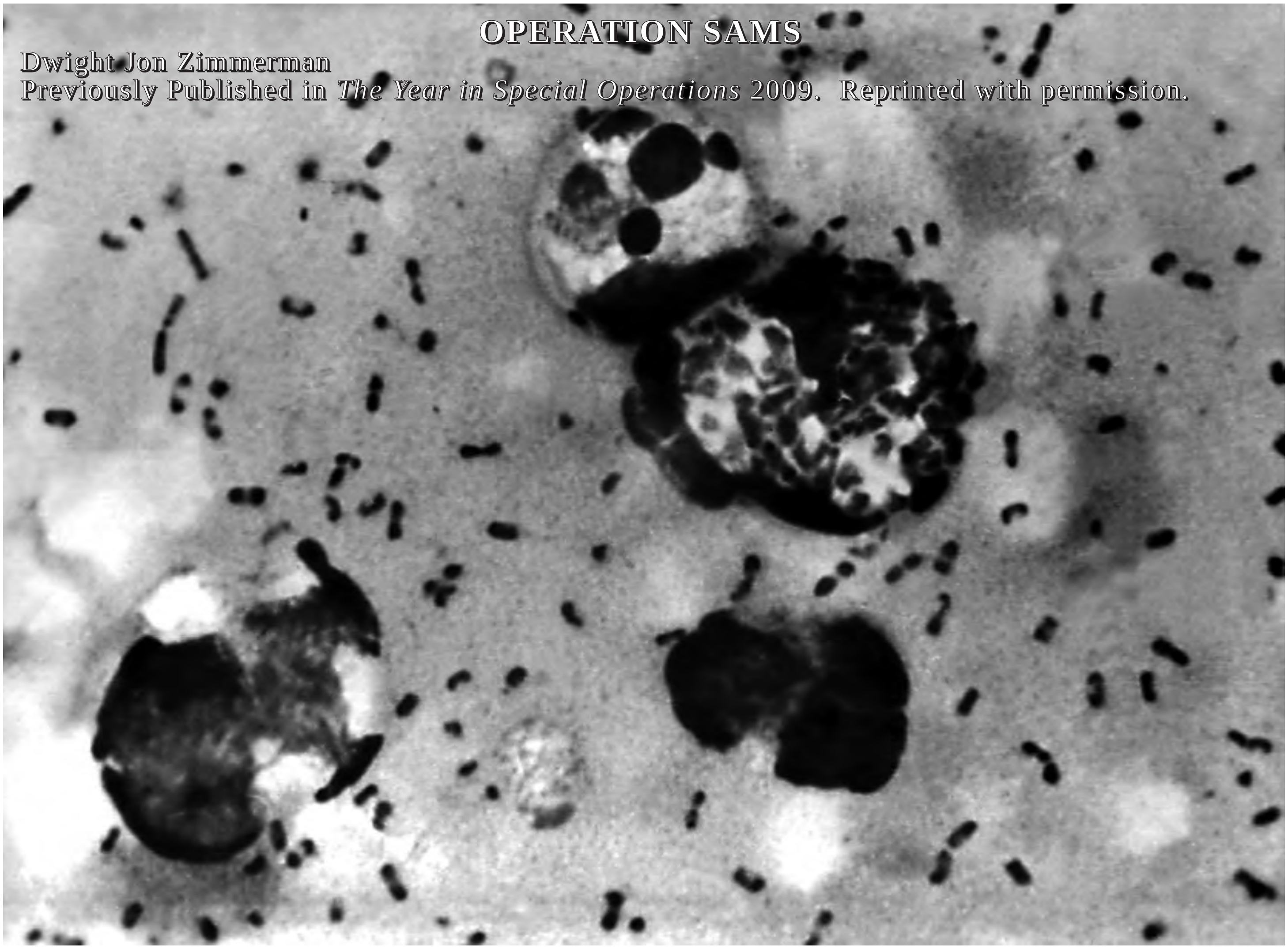


A smear showing the feared barbell-shaped yersina pestis bubonic plague bacteria.

" If we find that this disease is for sure the bubonic plague, then I'll have no other choice than to order the immediate and complete withdrawal of our troops from the Korean Peninsula." – General of the Army Douglas MacArthur

BG Crawford F. Sams, an unlikely Special Operator for a single, extremely important, mission.

The ideological conflict between the United States and communist Soviet Union known as the Cold War officially went "hot" on June 25, 1950, when tanks and troops of the communist North Korean army crossed the 38th parallel and invaded democratic South Korea. North Korea's leader, Kim Il Sung, dreamt of uniting all of Korea under his banner; and he almost succeeded. But U.N. troops, led by General of the Army Douglas MacArthur, successfully stopped the North Korean advance at the Pusan Perimeter and then routed the communists with the dramatic amphibious landing at Inchon. After MacArthur ordered his troops north, it appeared that Korea would become a united country – but under South Korean rule. But that dream also was shattered when, on Oct. 19, 1950, the first contingent of more than a million troops of the "Chinese People's Volunteers" – in reality the Chinese Communist People's Liberation Army – crossed the Chinese/North Korean border of the Yalu River. This force brought two things into North Korea. The first was 260,000 troops to help North Korea fight the United Nations troops. The second was contagious diseases.

News of the first became brutally evident in November 1950, when the Chinese troops attacked the outnumbered American and South Korean units and forced a long retreat out of North Korea that did not end until those troops stabilized a defensive line south of Seoul, the South Korean capital. But news of deadly contagious disease outbreaks did not reach MacArthur's headquarters until January 1951. As it was preparing a counteroffensive to drive the communists completely out of South Korea, CIA-controlled agents operating behind enemy lines began sending reports of disease epidemics among the military and civilian populations in the communist controlled territory.

When the allied troops recaptured Seoul and advanced to the 38th parallel, they discovered a civilian population decimated by epidemics of typhus, smallpox, and typhoid. In addition, thousands of captured Chinese and North Korean troops were found to be ill with these and other contagious diseases. Reports quickly made their way to MacArthur's top medical officer, Chief of the Public Health and Welfare Section of Supreme Command Allied Powers (SCAP) Brig. Gen. Crawford F. Sams. Some reports indicated that entire villages were wiped out by disease. He also received transcripts of prisoner debriefings. In a 1979 interview, Sams recalled that the POWs stated such things as, "Half my unit's sick. [Men] turned black when they were dying." Mentions of victims turning black shortly before their death particularly worried him. It suggested that bubonic plague – "the Black Death" – was in Korea.

When the United Nations troops entered the Korean theater of operations, they were vaccinated for a variety of diseases they were expected to encounter. The one exception was bubonic plague. Bubonic plague vaccines then available conferred immunity for only a short duration. As a result, vaccinations for the disease were conducted on an as-needed basis. Because the plague threatened both the United Nations troops and approximately 23 million civilians in South Korea and it would take time to produce sufficient vaccine to inoculate everyone, confirming the presence of bubonic plague became a top priority.

In February, as news of the epidemic outbreaks became generally known, the North Koreans and Chinese Communists launched an aggressive propaganda campaign regarding them. According to Peking Radio and the *People's Daily*, the United Nations forces were conducting biological warfare – dropping canisters filled with insects carrying cholera and other diseases and that germ bombs and artillery shells were being used to infect civilians and troops with smallpox and plague. Kim II Sung demanded that U.N. commanders Gen. Matthew B. Ridgway and MacArthur be tried for this crime against humanity and he issued an emergency decree calling for the National Extraordinary Anti-Epidemic Committee and other bureaucracies to destroy the insects. At the same time, the communist authorities refused requests to allow independent health inspectors from the International Red Cross and other humanitarian organizations into the infected areas.

MacArthur and his commanders knew the charges that they were conducting biological warfare were false. The truth was that North Korea's rudimentary healthcare system had collapsed under the combined weight of thousands of infected troops spread throughout the country, a large displaced population, contaminated water, unhygienic living conditions, and other problems. Before he could refute the charges, MacArthur needed proof – an unimpeachable firsthand report from the most senior medical authority possessing experience in dealing with bubonic plague. Only one man in the entire theater fit those criteria: Sams.

Sams' early military career was rather eclectic. Born in East St. Louis in 1902, he enlisted in the Army during World War I and served one year. In 1922, while attending the University of California at Berkeley, he enlisted in the California National Guard as a private. A year later, he was commissioned as a second lieutenant in the infantry. He transferred to the Field Artillery and in 1925 graduated from the Field Artillery School at Fort Sill, Okla. Wishing to pursue a medical career, he resigned from active duty in December 1925 with the rank of captain. While attending medical school, he was re-commissioned first lieutenant, Field Artillery Reserve. Upon receiving his medical degree in 1929, he was commissioned first lieutenant, Medical Corps, and ordered to active duty; within two years he accepted a commission in the regular Army Medical Corps. In 1941, he became the first medical officer and one of the first line officers to qualify as a U.S. Army paratrooper. During World War II, Sams saw service in Africa, the Middle East, and Europe. In October 1945, Sams, now a colonel, was assigned to be SCAP's top medical officer. Three years later, he was promoted to brigadier general. Over the years, Sams gained vast experience in broad-scale public health issues. He treated bubonic plague epidemics in December 1941 in Haifa, Jaffa, Palestine, and later in Port Said, Egypt. It was this personal experience that was needed now.

Having gotten the ball rolling by alerting the senior members of MacArthur's staff of the possible outbreak of bubonic plague, Sams was not about to take to the sidelines now and he volunteered to lead the mission into North Korea. On the one hand, since he was the only medical doctor with hands-on experience dealing with the disease, it made sense. But the political stakes of such a move were enormous. If the theater's surgeon general, and a general officer, were killed or captured during the operation, the communists would achieve an immense propaganda coup. Nonetheless, MacArthur agreed and signed off on it.

Sams treating a Japanese encephalitis patient. His experience treating bubonic plague epidemics was vital to the operation.

Reports indicated that bubonic plague victims were concentrated in hospitals in and around the North Korean port city of Wonsan. A joint CIA and Navy operation was quickly organized. The CIA's Z Unit, based in Tokyo and led by Maj. Jack Y. Canon, was in overall command. Leading the small team into North Korea was one of the Navy's most outstanding junior officers in the war, Lt. Eugene F. Clark. Clark, who entered the Navy during World War II, was a mustang, commissioned from the ranks. Described as having "the nerves of a burglar and the flair of a Barbary Coast pirate," Clark led the reconnaissance team on Yonghung-do Island in Flying Fish Channel in advance of Operation Chromite, the amphibious landing at Inchon on Sept. 15, 1950. For his role in Chromite, he was awarded both the Silver Star and the Legion of Merit. Clark received a second Silver Star for the Sinuiju Operation, a series of CIA-sponsored intelligence gathering raids up the west coast of North Korea. It was in this operation that Clark became the first to discover Chinese Communist troop presence in the country.

Assisting Clark would be Lt. Cmdr. Joung Youn of the South Korean navy, who had helped Clark at Inchon and in the Sinuiju Operation. Like Clark, he also received two Silver Stars and the Legion of Merit for his role in those missions. Joining them would be a third Korean, a native of Wonsan and the chief of the Wonsan area spy network, known by the nom de guerre "Ko."

Every mission needs a name, and in honor of the general who initiated it and who would accompany them, Clark christened the mission Operation Sams.

Operation Sams began at the end of February 1951 when the team boarded at Pusan an APD – one of four high-speed transports that the Navy had refitted for special operations missions. This particular APD also included the kind of medical laboratory Sams would need. Needless to say, everyone connected to the mission was properly vaccinated. As the APD made its way north, nine teams were inserted in the Wonsan area. Their purpose was to provide real-time reconnaissance and other assistance to Clark's team once it landed. The mission itself was simple: Upon landing (at night), Sams would be taken to where there were infected patients. One would be selected and brought aboard the APD. If for some reason transporting the patient was not possible, then Sams would conduct on-the-spot examinations and draw enough blood samples for later analysis.

Operation Sams encountered problems almost immediately after the APD rendezvoused with the destroyer *Wallace L. Lind* (DD 703), tasked with supporting the mission, off Wonsan. The seas in the area during this time of the year are often rough, and for almost two weeks the ships were forced to remain on station, a situation made perilous by harbor mines that broke free from their moorings and floated out to sea.

During this time, the team established a forward base on one of the islands off the coast of Wonsan where the CIA had a secret base to monitor its agent network in the region. Clark began conducting reconnaissance, attempting to find a suitable landing site. Unfortunately, the communists, fearing another Inchon-style amphibious assault, had constructed an in-depth defense network along the beaches and harbor of Wonsan that included mined beaches, barbed wire, and gun emplacements. Several times their scouting boats came under fire. Sams, meanwhile, was examining the island's inhabitants. He discovered many cases of typhus and smallpox. From the survivors he learned that epidemics of these and other diseases had been so severe that only about 10% of the population had survived. Then, the team discovered that an even greater danger awaited them on the mainland. The communists knew Sams was coming.

During his search for a suitable landing site, Clark also attempted to establish radio contact with the recon teams. It was then that he received devastating news. Of the nine teams sent out, all but two men from one team had been captured or killed. Their radios also picked up North Korean People's Army (NKPA) broadcasts that cited Sams by his name and rank and gave some details of the operation – information that could only have been provided by captured members of the recon teams. Despite the increased danger, the team decided to continue with the mission.

Clark finally found a promising landing site south of Wonsan, near the small village of Chilbo-ri. Final arrangements were quickly made. The *Wallace L. Lind* would take them to Chilbo-ri, where they would transfer to a whaleboat. Once the whaleboat neared the shore, the team would transfer to a black, four-man rubber raft that the whaleboat towed and paddle onto the beach. There they would rendezvous with the two surviving agents.

On the night of March 12, the team left the island, boarded the *Lind*, and headed south. After the destroyer got into position beyond radar range about 20 miles off the coast, the team transferred to the whaleboat. As the team approached the coast, one of the Korean agents on the whaleboat established radio contact with the agents on the mainland who gave landing instructions. But Clark and the others became suspicious when the agents on the mainland proved unable to give the correct responses to code words transmitted from the whaleboat. The decision was quickly made to abort the landing that evening and return to the *Lind*. The team subsequently learned from a radio message sent by the two surviving agents that they had been in contact with communist troops using one of the captured walkie-talkies. Had the Operation Sams team continued ashore, they would have landed in a trap.

The team now had to make the toughest decision of the mission. The captain of the *Lind* recommended that the entire mission be scrapped. He felt that if they continued their chances of survival were nil. But Sams insisted that one more try must be made. Clark, Youn, and Ko also volunteered to make another attempt.

The next night, the *Lind* once again got into position 20 miles opposite Chilbori and once again the Operation Sams team embarked for shore. As the whaleboat approached the coast, the men could see the lights of a truck convoy heading down the coastal highway toward their landing site; the convoy was also spotted by naval aircraft flying a night mission. Suddenly the ground shook with the sounds of explosions as the airplanes bombed and strafed the convoy. The possibility of encountering dispersed communist troops who had abandoned their trucks, in addition to avoiding the regular patrols, added yet another complication to the mission. As the team paddled the rubber raft toward shore, Sams later noted, "it was with some trepidation that we finally approached the beach." This time they were successful in establishing contact with the two agents and, upon receiving final instructions, safely beached.

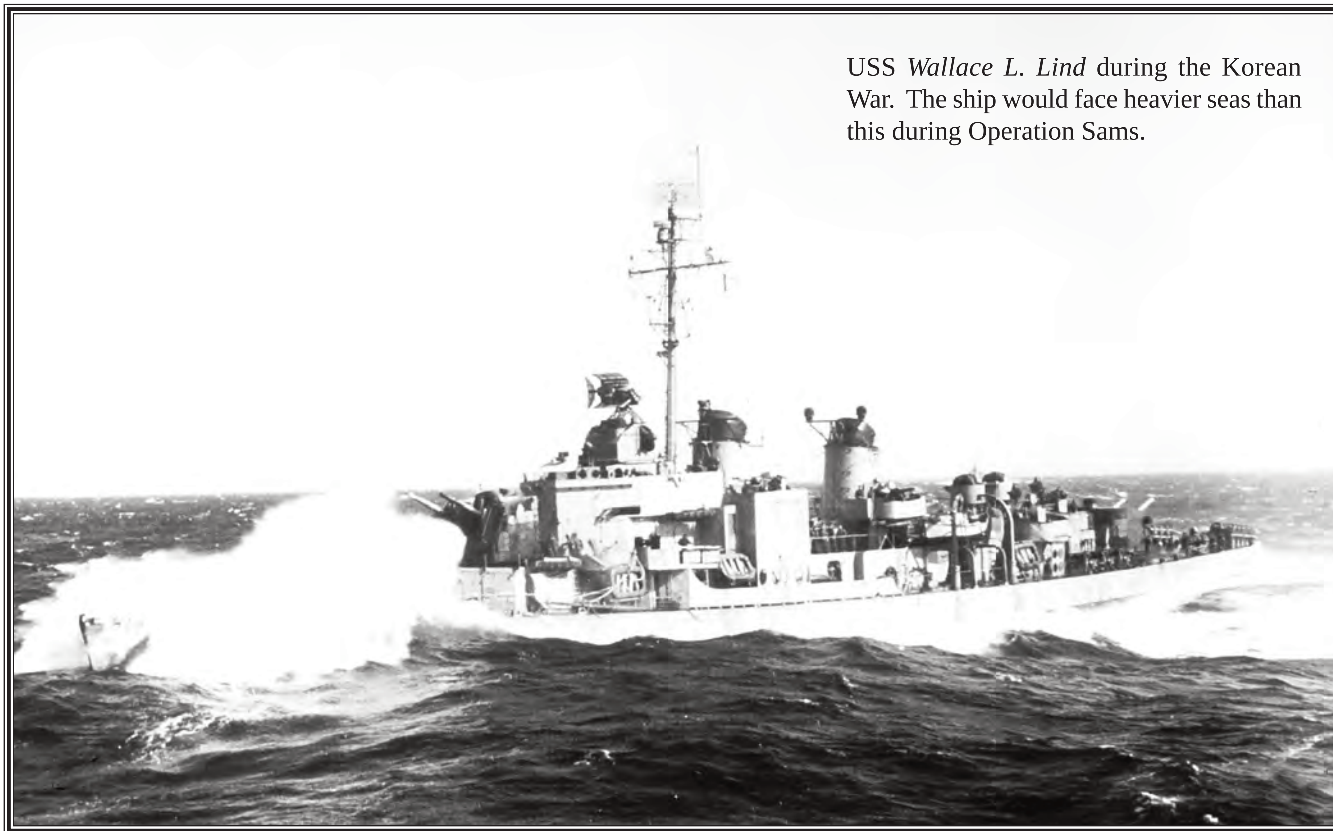
The team linked up with their two agents and a small group of other Korean CIA agents. Sams was taken to a cave located a few yards from the village. There he began interrogating agents who worked as hospital staffers and had seen the patients suspected of carrying bubonic plague. Meanwhile, Clark, Youn, and some of the other agents silently ambushed and eliminated a North Korean patrol in the village. Sams was then able to conduct examinations of patients in Chilbo-ri. He discovered that the village itself had been turned into a makeshift hospital whose medical support service ranged from primitive to non-existent.

Sams had hoped to spend two additional days in the area, visiting other villages in order to gather as much information as possible. But the agents based in North Korea dissuaded him, stating that the risk of discovery and capture was far too great. Nonetheless, Sams was able to confirm epidemics of typhus, typhoid, and smallpox. And most importantly, he determined that there was no evidence of bubonic plague. As it turned out, the "Black Death" plague was actually a virulent form of smallpox known as hemorrhagic smallpox. The reason it was mistaken for bubonic plague was because it also causes the body to turn black as the victim nears death. Though circumstances prevented him from bringing back a body for further lab study, Sams later said, "I felt confident in my clinical diagnosis of the cases."

The team successfully returned to the *Lind* the following evening. After they reboarded the ship, Sams radioed a brief message to headquarters in Tokyo summarizing his findings. Upon his return to Tokyo, Sams submitted a full report of his mission. In addition to an official announcement released to the international press, Sams presented his medical findings to a special United Nations commission and other public forums. Though the communists would continue their propaganda campaign with additional charges, the Operation Sams mission had effectively destroyed the accusations' credibility. And because Sams had proved that bubonic plague was not in the theater, U.N. forces could continue operations without the risk of encountering that deadly disease.

In the following weeks, through his own findings and additional confirmed reports, Sams was able to determine that because of North Korean inability to control the epidemics, the North Korean prewar population of 11 million had shrunk to about 3 million people.

The success of the mission resulted in decorations for Clark, Youn, and Sams. As it turned out, Operation Sams was Clark's last mission in Korea. He soon left the theater on a new assignment. In recognition of his efforts on the mission, he was awarded the Navy Cross. Clark retired from the Navy in 1966 with the rank of commander and died in 1998 at the age of 86. Youn was awarded his third Silver Star. He went on to participate in more special operations missions in Korea. In 1970, he retired from the service due to wounds suffered in the war and moved to the United States. Sams was awarded the Distinguished Service Cross. Sams returned to the United States in 1951 and retired from the Army in 1955. He died in 1994 at the age of 92, and was buried at Arlington National Cemetery, Va.

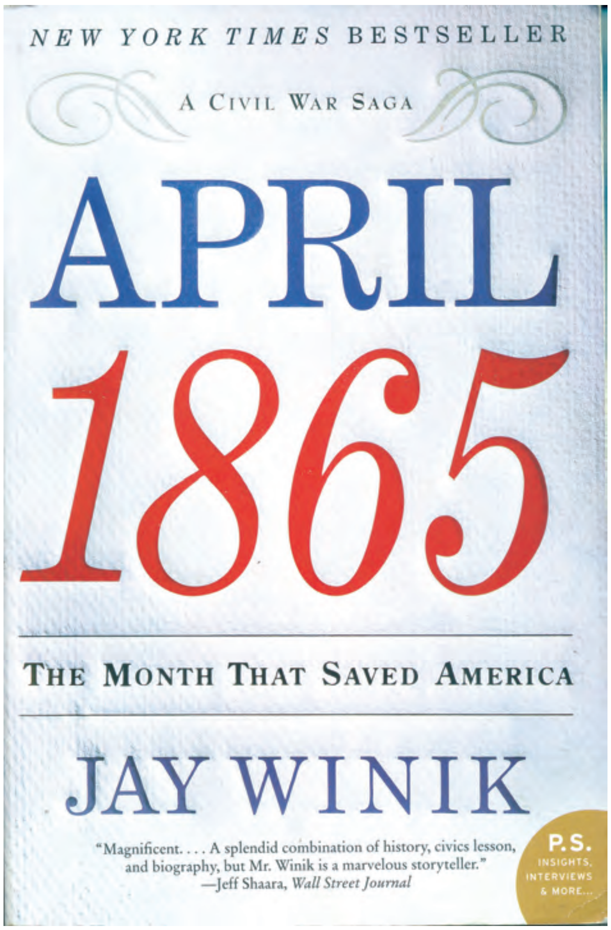


USS *Wallace L. Lind* during the Korean War. The ship would face heavier seas than this during Operation Sams.

Book Review

April 1865: The Month That Saved America

By Jay Winik. New York: Harper Perennial. 2006. ISBN: 978-0-06-089968-4.
Review by LTC Craig A. Myatt



"I will deal with political questions and negotiate for peace. Your job is to fight," stated President Abraham Lincoln in an uncompromising order to General Ulysses Grant in March 1865. One month later, in April, the major Confederate armies surrendered, and Lincoln was dead. In *April 1865: The Month That Saved America*, by Jay Winik, interpretations of volatile social, political, and economic tensions at the close of the United States Civil War reveal how a young nation ultimately emerged into a stronger republic due to the tenacity of Union and Confederate civilian and military leadership willing to uphold civil unity in the last days of civil war.

Winik demonstrates how the final military contests in the Civil War were waged under the persistent wills of both the Union and Confederate presidents. Lincoln urged civil reconciliation, yet his push for decisive warfare in order to end the war, combined with Jefferson Davis' desire to keep fighting at all costs, laid the seeds for greater turmoil, guerilla warfare, and intensified hatreds. Opportunities abounded for civil war in America to incite the abolishment of two opposing nation states and/or the implosion of a young nation that might have limped its postbellum way into future subjugation by imperialistic nations from across the seas.

April 1865 is a month filled with uncertainty and ambiguity. The author depicts a saga of fast-moving events that could easily have altered history, leaving the United States of America in decades-long turmoil. The panoramic flow of events in 1865, from March through May, depicts how the whole of one nation could have been altered but for a few crucial decisions made in the war-torn days of April, by great men instilled with a providential grace, favoring civil union over civil war.

Winik shows that the pivotal turn in the Civil War actually occurred in May 1864, at the Battle of the Wilderness (near Chancellorsville), as the Union army demonstrated to Lincoln its ability to push Lee's army south to Richmond and mount the siege of Petersburg to Richmond's south. Lincoln labored for almost a year establishing preliminary plans for Confederate surrender and the reconciliation of the nation. Lincoln understood and respected the leadership of Lee both on-and-off, the battlefield. He knew that Lee possessed the wherewithal to turn the tide against the Union – if the Union generals were not relentless in their pursuit of the Confederate armies.

Davis and Lee were as resolute in achieving victory in March 1865 as were Lincoln and Grant. All possessed the will to fight. Lincoln viewed decisive warfare as the only means to thwart the will of Davis and his generals. Following decisive battles in the spring and summer of 1864 and Lincoln's re-election later that year, the Union president forged a concept of compassion toward a wartime foe that set an unprecedented tone for peace. Though not fully stricken in March 1865, the Confederate army was waning. “Grant sensed opportunity,” writes Winik, especially as he obtained battlefield updates from General Philip Sheridan. Total war made the Shenandoah a barren wasteland by the end of March. Still the Confederate will to fight remained strong in Virginia and to the west and south.

By the early days of April, General Nathan Forrest had lost none of his fight or spirit, despite his growing awareness of fatigue and broken logistical lines of communication. As Lee scrambled through Virginia, Forrest’s resolve for war remained the only vindicating hope for the Confederates. Davis recognized that Forrest possessed skill at imposing on the Union armies a psychology of war capable of invoking nothing short of sustained fear in battle. Forrest knew how to rattle his opponent by undermining morale and inciting panic. Forrest served as Davis’ leading proponent of guerilla warfare if the Confederate armies needed to disband in order to continue fighting for their cause.

In the first few days of April 1865, Lee offered no sense of being willing to surrender. Grant continued to fight facing potential guerilla warfare against his own armies throughout all of the Confederate states. The sudden fall of Richmond on 4 April, and Lee’s surrender at Appomattox on 9 April, signaled the end of the Civil War. Winik demonstrates that civil unity was by no means automatic on 9 April. The reader witnesses the strength of his arguments in two series of actions by both Lee and Grant.

First, Lee opted for civil unity over continued civil war in April 1865. Second, Grant adhered to Lincoln’s tone for reconciliation. The concern that Lee might opt for guerilla warfare was ever present. What if Lee had decided not to surrender, but instead, even as he negotiated with Grant for terms of peace at Appomattox, turned his army into guerrilla fighters tasked to disrupt and terrorize the Union armies? Lincoln’s fervor for national reconciliation, according to Winik, might have been derailed if that were the case. Grant too saw the advantages of civil unity over civil war. Though chided by Lincoln a month earlier for exercising diplomacy over war, Grant presented himself in grand diplomatic fashion at Appomattox when he met with Lee to discuss terms for establishing peace. By 10 April Lincoln’s tone for reconciliation was established in the terms of surrender Grant offered Lee and in Lee’s prolific General Orders Number 9.

Grant ensured that Lee’s army received rations for as many as 25,000 men. Lee’s affectionate recognition of the four years of arduous service given to him by his men, and his extended blessings to them upon his farewell, helped quell persistent civil war. The two generals realigned under their one national president and together fostered civil reconciliation.

By the end of that week, on Good Friday 1865 the shooting of Lincoln, and his death a day later on 15 April, did not stop the emergence of civil reconciliation inspired by Lincoln and exercised initially by Grant and Lee. The Secretary of War, Edwin Stanton, the Lincoln Cabinet and Supreme Court, responded quickly to the simultaneous assassination of Lincoln and the assassination attempt on his secretary of state, William Seward. Chief Justice Salmon Chase swore Vice President Andrew Johnson into office as president within three hours of Lincoln’s death. Tenuous, but intact, the civil-military leadership of the United States did not falter. The Union and Confederate military leadership ensured that no military coup would attempt to overthrow the United States government.

Winik writes, “Lee condemned the assassination of Lincoln in the strongest terms.” When Confederate General Joseph Johnston accepted terms of surrender from Union General William Sherman on 29 April at the Bennett House in North Carolina, he too condemned the assassination of Lincoln and asserted that his men had nothing to do with it. Similar to Lee, Johnston communicated to his men terms of the 29 April surrender of his armies in General Orders Number 22. Civil unity began to spread. The final blows to the Confederate anvil came from Lee, Forrest, and General Richard Taylor.

Lee told a scout who sought him out on behalf of Colonel John Mosby and his Rangers, “Go home, all you boys who fought with me. Help build the shattered ruins of our state.” Mosby and his men received that message near mid April. Later in the month, Lee interviewed with Thomas Cook of the *New York Herald*. In the interview, Lee spoke clearly as a citizen of the United States who recognized that the Confederate states were “anxious to get back into the Union and to peace,” according to Winik’s account. Forrest decided not to follow Davis’ orders to continue fighting, and Taylor met with Union General Edward Canby at Citronelle, Alabama, in late April to discuss terms of surrender that were finalized on 4 May. Taylor, Commander of the Confederate Army, served as a superior to Forrest.

In April 1865 the union transformed from a loose federation of states into a stronger-bodied nation united by a fabric of civility uncommon historically in the aftermath of civil war. The final battle of the Civil War took place on the banks of the Rio Grande River at Palmito Ranch in Texas on 12-13 May. By 22 May, 1865, the emblems of mourning in Washington, DC, were removed in preparation for the Grand Review of Armies for the Republic. The nation managed to uphold civil union over civil peril.

My recommendation for Winik’s text is that it be read by all Americans. Discussion for, and against, the Confederate use of guerilla warfare and terrorist tactics to continue the war may spark the interest of the more strategic minded in the Special Operations Forces community. Winik’s literary style is rhythmic and easy to follow. The prose is informative, non-intrusive, and insightful. The author provides a tone for healing among any who remain anxiously perplexed by the viciousness, distrust, and hatred that seethed across America in the aftermath of the Civil War. Winik eloquently supports his thesis that April 1865 marked a turning point in American history.

From the Command Surgeon

Virgil "Tom" Deal, MD
COL, USA
Command Surgeon
HQ USSOCOM

Although the calendar indicates the end of summer, you can't tell it where most of you are currently deployed or in Tampa. We'll hope for perfect weather here for the SOMA, beginning this year on 12 December 2009, and hope to see as many of you as possible there.

It's been a great year so far for the recognition that's been given to the Special Operations Forces Medics in terms of expert care on the battlefields as well as the value of "first responder" medical training to every member of the force in harm's way. I was also privileged to be able to sit in on a Joint Working Group tasked with furthering the electronic medical record's role in casualty care where the Ranger Prehospital Trauma Registry was presented as the most practical current tool for documentation of battle injury and the care given (for when you can get around to the documenting).

Thanks to all for the work contributions to the Resilience Enterprise Working Group as it moves forward with recommendations for dealing with the stress on the force. Now with many years invested in this fight, how we deal with maintaining the psychological resilience of the force is a critical task. I appreciate the thought and work that has gone into all of your programs and efforts.

Another great effort that continues to gather momentum is the Warfighter Rehabilitation and Performance Center, now a program of record, headed by Master Chief Mercer. After our recent huddle, hosted by the National Strength and Conditioning Association headquarters in Colorado Springs, there's little doubt in my mind that this is going to mature into a program that will be the standard for optimizing the performance of the Warfighter. If you're not up on how the program is progressing, either Master Chief or I can bring you up to date. A full briefing will cost you a beer at the SOMA.

The technology aspect of our trade continues to evolve. As many industry sectors become more focused on producing better tools for monitoring and intervening in casualty care, we're going to work harder to better communicate to researchers and industry what you guys tells us you need for the fight we're in today and for the one you think we may be in a few years from now. We're looking forward to seeing what will be showcased for us at the SOMA in that regard.

Component Surgeon

USASOC

Peter J. Benson, MD
COL, USA
Command Surgeon

This fall has brought some potential for interesting changes in how Army Special Operations Forces (ARSOF) may be focused in the future, and by inference, what the role of Special Operations Medicine may be. As U.S. strategy changes to a more truly central counterinsurgency (COIN) role that is population centric, Special Operations Medicine must keep pace with the change. The mindset, training, and equipping of ARSOF medical providers must match with their employment in a refocused COIN strategy. It is uncertain what the impact of any strategic changes may be, but an increased focus on population security and assistance necessarily impacts Health Service Support (HSS) Operations. ARSOF providers will need to refresh and enhance medical skills and training that will support Humanitarian Assistance (HA) and Civil Military Operations (CMO). Certainly, exceptional efforts have been made in indigenous clinic support, such as medical, veterinary, and dental civic action program (MEDCAP / VETCAP / DENTCAP) operations and coalition support, but an altered strategic focus may bring new challenges. Operational emphasis may be placed on indigenous medical infrastructure training and support to increase capacity, public health, and sanitation and basic services. There will certainly be a greater stress on Civil Affairs (CA) operations to engender and coordinate U.S. and Allied military, non-governmental organization (NGO), Inter-Governmental Organization (IGO), and Host Nation medical efforts. ARSOF providers at all levels need to plan for the effects of these strategic changes. I recommend that all review CMO and HA policies and doctrines, as well as unit and individual requirements for public health, sanitation, and civilian medical support operations.

I would like to highlight a new initiative that is on the horizon that will affect all of ARSOF. The Tactical Human Optimization Rapid Rehabilitation and Reconditioning (THOR^3) Program is a U.S. Special Operations Command (USSOCOM) funded initiative to provide resources to units to improve and enhance functional capacity, performance, and injury recovery. This program will provide certified athletic strength coaches, athletic trainers, physical therapists, and nutritionists to work directly with ARSOF Soldiers to improve operational performance and decrease injuries. THOR^3 is an entirely "new start" enterprise; program development, hiring, and fielding are ongoing. This program will bring physical fitness and athletic functional performance for ARSOF Soldiers in line with best practices of Olympic and professional athlete training.

I look forward to seeing many of you at the SOMA Conference in December. I recommend that all who can attend do so. The best work done there takes place outside of the formal presentations! The ability to share information and network within the community of worldwide SOF Medicine is unparalleled. I encourage all attendees to welcome the allied and foreign representatives and get outside the U.S.-centric SOF world. There are great contacts and lessons to be learned from our international counterparts – but you have to talk to them to find out. I hope to see you there. Sine Pari.

COMPONENT SURGEON

AFSOC

Bart Iddins, MD
Brig Gen, USAF
Command Surgeon

This article continues with further discussion of AFSOC Surgeon's priorities and focuses on **Priority 5:** Develop and publish AFSOC medical doctrine, instructions, tactics, techniques, and procedures (see *JSOM*, Winter 2009 edition for complete priority list; *JSOM*, Spring 2009 edition for detailed review of Priorities 1 through 3; *JSOM*, Summer 2009 edition for detailed review of Priority 4).

General A. A. Svechin said, "Military doctrine is military, and particularly tactical philosophy; doctrine creates certainty, which is the soul of every action." In other words, in order to achieve optimal operational effectiveness, military forces must have sound doctrine and battlefield-proven tactics, techniques, and procedures (TTP). Furthermore, in the words of Marshal Maurice de Saxe, "It is not big armies that win battles, it is the good ones!" What makes military forces "good ones" is directly and indirectly related to numerous factors of which sound doctrine and TTPs are critical ingredients. For several years now, however, AFSOC medical personnel have been operating without adequate formal doctrine and TTPs. This formal doctrine/TTP shortfall has resulted in a tendency for AFSOC operational medical units to periodically reinvent themselves. When this "reinvention" is based upon changing mission requirements, and when it is accompanied by changes in doctrine and TTPs, it is beneficial—it helps maintain the force as one of the "good ones." Unfortunately, when a force is not guided by formal doctrine and TTPs, this periodic "reinvention" is often triggered by an influx of new personnel and/or by changes in the opinions, motivations, and personal agendas of unit leaders/members. To be clear, unit reinvention driven by changing mission requirements is essential and almost always precedes and drives subsequent changes in doctrine and TTPs. Military units that operate continuously without formal doctrine and TTPs are at risk of reinvention/change driven by factors other than mission requirements. Consequently, AFSOC/SG staff are developing and publishing formal doctrine and TTPs that capture current mission requirements. Since doctrine is authoritative rather than directive, it does not restrict innovation and change based upon a change in mission requirements; similarly, TTPs do not restrict innovation and change. Bottom line: Formal doctrine and TTPs serve as guides that should be adapted to reflect changes in mission requirements; they should neither be developed, nor altered, for reasons not related to bona fide mission requirements or changes in same.

Lt Col John Felins, Mr. Jim Bosak, Capt Tracie Tippins and Capt Kevin Ramsey are rapidly correcting AFSOC's medical doctrine and TTP shortfalls. Lt Col Felins and his team recently developed, coordinated, and published TTPs for AFSOC Special Operations Forces Medical Elements (SOFME). This TTP, *Air Force Tactics, Techniques and Procedures (AFTTP) 3-42.64* was signed by USAF Assistant Surgeon General, Healthcare Operations on 23 Sep 2009. It is the first of several pending AFTTPs concerning AFSOC medical operations. Furthermore, the publication of *AFTTP 3-42.64* represents the culmination of efforts to promote interoperability and consistency between AFSOC SOFMEs and other USSOCOM medical assets.

The development, approval, and publication of *AFTTP 3-42.64* is a major step forward for AFSOC medical operations; however, it is not the end of the journey — it is the beginning. Currently, an AFTTP regarding AFSOC's Special Operations Surgical Teams (SOST)/Special Operations Critical Care Evacuation Teams (SOCCET) is undergoing the coordination and approval process. Accordingly, additional formal doctrine is being written. Heeding Anton Chekhov's advice, "If you cry 'Forward,' you must without fail make plain in what direction to go." AFSOC is ensuring that its medical forces understand "... what direction to go" and are guided by clear, concise, approved, and published formal doctrine, TTPs, and instructions.

COMPONENT SURGEON

NAVSPECWARCOM

Gary Gluck, MD
CAPT, USN
Command Surgeon

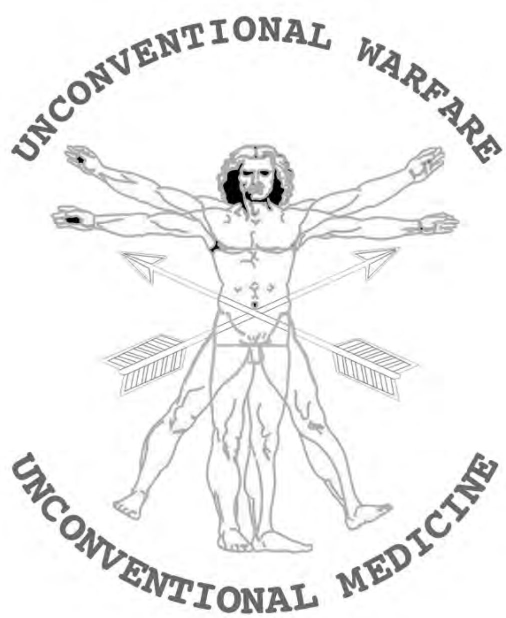
It's exciting to be on-board and delving into the many issues facing Naval Special Warfare medicine. I turned over with CAPT Jay Sourbeer this July and it's been a whirlwind ever since. I was in denial that Jay really had to travel every three to four weeks, but that has proven true. It seems that once you become an Echelon II medical officer, everyone wants you on their committee. I was hoping my reputation might persuade them otherwise, but to no avail.

We have undergone a complete changing of the guard in my office. A few folks I would be remiss not to recognize are CAPT Lanny Boswell, physical tTherapist and Deputy Force Medical Officer, a devoted Biomedical Initiatives Steering Committee (BISC) mover and shaker, who is executing orders down the road to the Naval Health Research Center. Lanny directly contributed to all of NSW's leading medical programs including the NSW Tactical Athlete Program (TAP), Combat Operational Stress Control (COSC), and origins of the Expeditionary Resuscitative Surgical System (ERSS). Likewise, we're losing SOCM Michael Brown, who is retiring after 27 years of transformative and dedicated service in NSW and transitioning to his new job as the West Coast SOF Care Coalition representative. Lastly, I whole-heartedly thank my predecessor, CAPT Jay Sourbeer, the ultimate gentleman who laid out the red carpet for my arrival and made tremendous contributions to NSW during his tenure. Jay is out of sight but not out of mind, as he works toward completion of his studies at the Navy War College in Newport, Rhode Island.

One of the most exciting aspects of taking on a new job is meeting a completely new group of colleagues and learning from there experiences. First, I'd like to introduce CAPT Scott Jonson, PT, ATC, CSCS, the new Deputy Force Medical Officer and BISC member. He has already proven himself an invaluable team member. I'm honored to be working with the likes of COL Deal and all of the SOCOM component surgeons. Though early in our tenure together, I look forward to our interactions and progress toward developing medical programs across the Special Operations community. I also look forward to our contributions to advancing meaningful research in our capacity as BISC members.

The project that has clearly consumed most of my effort has been the NSW Tactical Athlete Program (TAP). This is the new NSW name for SOCOM's Warrior Rehabilitation Performance Center/ Human Performance Initiative (WRPC/HPI). As you may be aware, NSW has had elements of this program in development for over a decade, with significant gaps in Human Performance resources and buy-in between east and west coast commands and even between adjacent commands. With introduction of the NSW TAP instruction, and roll-out of our first wave of SOCOM funded personnel in this program, NSW will finally reach a uniform state across the force with respect to its commitment and execution of this program. Likewise, CNSWC is developing its leadership piece to centrally manage and uniformly promulgate new TAP developments and best practices. I am daily motivated by the incredible energy that our TAP staff members bring to the program and I look forward to seeing where this program goes in coming years. Top shelf issues include developing a Force-wide database to collect SEAL and SWCC fitness and injury metrics, and applying the University of Pittsburgh and Old Dominion University research findings toward focused and mission specific fitness training, nutrition and injury prevention programs. As we are all aware, Special Operations training and duty exacts a heavy toll on the long term physical well being of our Operators. We all need to continuously focus our efforts on eliminating avoidable injury, maximizing Operator career longevity, and minimizing career ending physical disabilities.

Lastly, as the holidays are quickly approaching, I eagerly anticipate returning to Tampa for the annual SOMA conference. I look forward to interacting with my colleagues at the BISC, the NSW medical component surgeon's conference, and the SOMA general conference. Be safe and see you there!



COMPONENT SURGEON

MARSOC

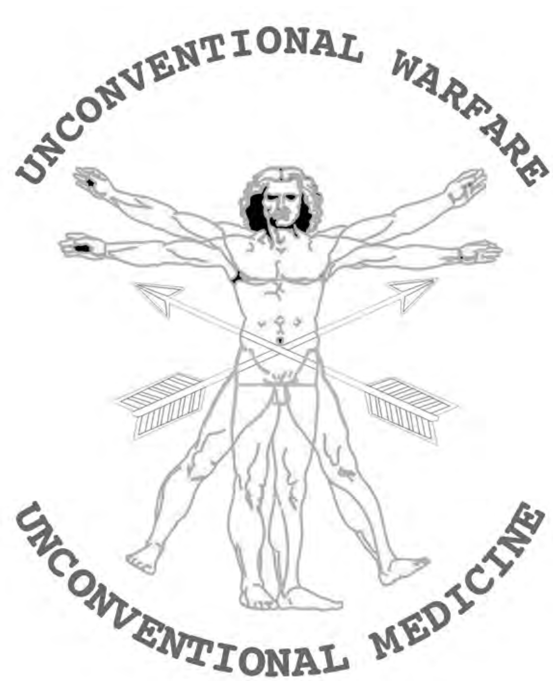
Anthony M. Griffay, MD
CAPT, USN
Command Surgeon

I never thought the time would come when I would be the one saying "back in my days…" because to me looking forward holds much more promise than looking back. On the other hand, it takes two points in time to determine which direction forward is actually going and these last three months have given me two vantage points from which to share some insights on the future of Special Operations Forces (SOF) in general and Marine Special Operations Command (MARSOC) specifically.

The first event this quarter was my thirty year anniversary of graduating from the Special Forces Qualification Course and joining a team in 10th Special Forces Group (Airborne) (SFG (A)). The second was a series of three temporary duty (TAD) trips in the last three weeks: 1) Ft Irwin, California, to observe the 1st Marine Special Operations Battalion (MSOB) and teams participating in pre-deployment exercises; 2) Ft Carson, Colorado, to attend the Integrated Planning Team on the U.S. Special Operations Command (USSOCOM) Warrior Rehabilitation and Performance (WRP) program; and 3) Marine Corps Base (MCB) Quantico, Virginia, to attend the Medical Officer (TMO) of the Marine Corps's operational advisory group.

What struck me – what really continued to amaze me – day after day during those three weeks, was the number of quality people I met. At every location from west coast to east, every person I met had one driving focus: To man, train, equip, deploy, and recover the best Special Operations Force in the world. People like Chief Walker from 1st MSOB learning everything he can to create an Annex Q for his battalion's deployment to Afghanistan. Or Senior Chief Shattuck (still recovering), put working teams in "the box" through realistic medical scenarios so they are prepared to go down range. People like Master Chief Mercer from U.S. Special Operations command (USSOCOM) and the whole WRP program, working and partnering with civilian organizations like the National Strength and Conditioning Association. Together they are leading the development of facilities and programs to not only help our wounded recover faster, but also work to increase performance and reduce the likelihood of injuries before they occur. For me the ultimate example of how complete, how thoroughly unified this focus is from top to bottom, was at MCB Quantico, Virginia. There, at the operational advisory group for the two star TMO, when the opening presenter, who spoke about Navy manning within the Marine Corps, gave his briefing, the first slide, the first line, read: "CMC number 1 priority: MARSOC".

For you non-Marine readers, the CMC is the Commandant of the Marine Corps. Most of you probably know the history but, for me, having been on a "pre-Desert One" Special Forces team, support from above-the-company level was always suspect at best, if present at all. Now seeing for myself the focus, effort, and commitment which envelopes our community, from the Commandant to the operational teams, has truly been remarkable and inspiring. However, regardless of how far SOF has come, the fight is still before us. I have asked the TMO to help me find and fix the choke points in the 8425/8403 pipeline. I also asked him to help me develop MARSOC-specific, Level II surgical teams to support units operating outside the conventional evacuation umbrella. I will continue to keep the focused commitment I saw these last three weeks as MARSOC grows to take its place in the SOF community. As always if there is anything I can do to help please do not hesitate to contact me: Anthony.griffay@usmc.mil.



TSOC SURGEON

SOCCENT

Warner D. "Rocky"Farr, MD
COL USA
SOCCENT Surgeon

I am well settled into SOCCENT and CFSOCC and utterly delighted to be back in with a bunch of Special Forces troopers. I am spending most of my time forward, getting into mischief – but hope to make it back to Tampa for SOMA in December.

Congratulations to Colonels Deal, Benson, and Landers for stepping up to their new "positions of higher responsibility" otherwise known as, "Tag, you're it!" I am reachable at warner.farr@cfsocc.soccent.centcom.mil or warner.farr@soccent.centcom.mil

We are looking at a lot of moving pieces in the CENTCOM AOR; HQ USSOCOM PAO release follows:

MACDILL AIR FORCE BASE, FL – The U.S. Special Operations Command Commander announced on 8 SEP the command will transition to a new, flatter headquarters staff organization beginning on 1 OCT. The new organization will do away with the current structure, which combines staff sections together into centers, and will be based on Department of Defense's joint staff structure.

The reorganization is driven by several factors; the predominate factors are the recognition of the value of having a three-star flag or general officer representing the Command in Washington, DC, and the sense the organization based on centers does not promote effective communication across the headquarters. The command will create a three-star vice commander position. The vice commander will serve as the command's senior representative in the National Capital Region.

The reorganization will be fully implemented by 31 OCT. There will not be any additional flag officers, general officers, or senior executive servicemembers immediately assigned to the command as a result of the reorganization.

The new headquarters structure will not impact the organizational structure of USSOCOM's components' or sub-unified command.

The last USSOCOM headquarters reorganization, which was a realignment of the centers in the centers-based structure, took place in MAY 2004.

TSOC SURGEON

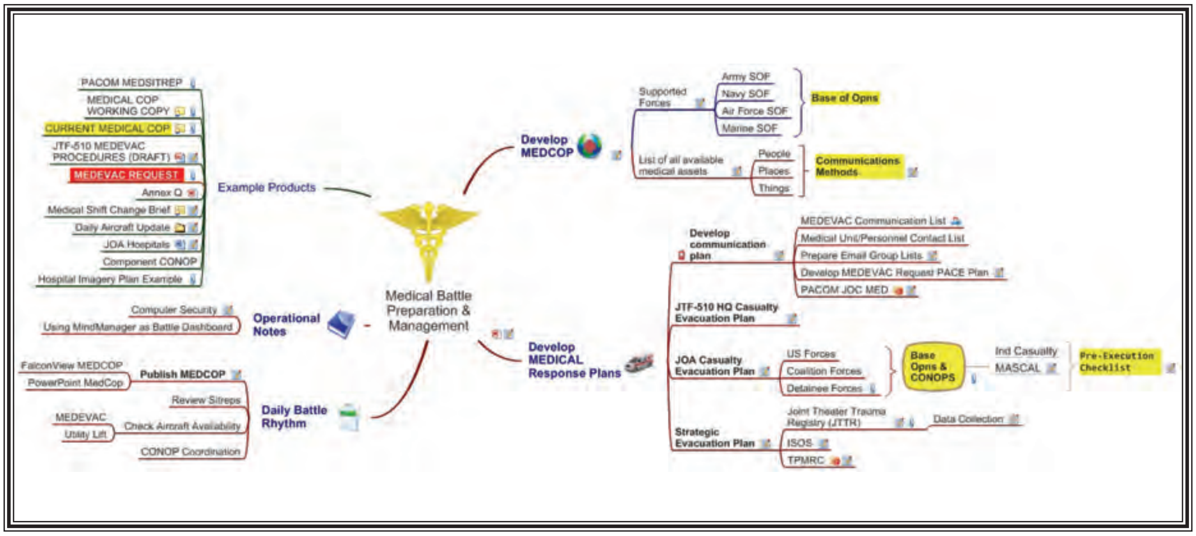
SOCPAC

Frank J. Newton, MD
COL USA
Command Surgeon

Special Operations medicine involves the range of medical treatment in austere locations, from time-tested basics such as stopping bleeding with a cravat and windlass to the most advanced medical devices available for medical practitioners. The practice of Special Operations medicine applied to a wounded warrior is certainly the "tip of the spear" for our medical community, but what about the practice of preparing for and executing missions performed by our plans officers? What attention, tools, and time have been allocated to advance their practice and proficiency? Medical planning to support the dynamic missions conducted by Special Operations Forces more than ever requires collaboration with ground, air and maritime SOF and conventional units to insure that interoperability, integration and synchronization occur. This is an overlooked, yet critical function, particularly in complex and multi-focal engagements. Following this, my deputy LTC Brady Reed will elaborate on two important planning tools that ensure we stay ahead of our enemy in mission planning and execution. The planning tools discussed are Mind Mapping and Falcon View. Like the cravat and windlass that have been improved over time, these new techniques enhance operational battle space management. The article is intended to put some emphasis on our planners and spur discussion about their professional development within SOF.

Advancing the Art and Science of Medical Plans

LTC Brady Reed, MS 70H
SOCPAC Deputy Surgeon



Medical Battle Preparation Map

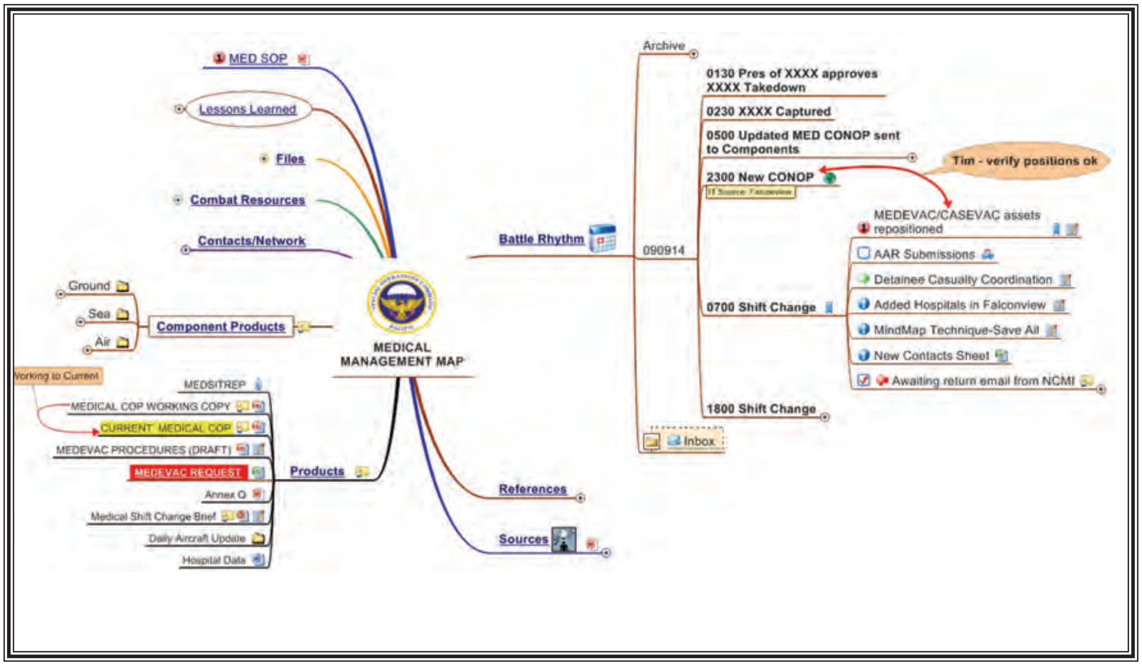
At SOCPAC, MAJ Tim Christison, Chief of Medical Plans and myself, have experimented with new techniques for both plans and operational battle management using old concepts and new technologies that have proven to be very valuable. Both techniques employ visual information which most neuroscientists and cognitive researchers agree are the most powerful means to organize and make sense of information (a picture is worth a thousand words).

The first planning tool, mind-mapping, involves the use of an old technique which dates back to Porphyry of Tyre, an ancient Greek philosopher who famously wrote Introduction to Categories – introducing the world to the subject of logic and classification of objects into groups.[1] Early visual mapping techniques have also been seen in notes by Leonardo DaVinci.[2] He used words and pictures in combination to illustrate ideas and inventions on single pages.[3] In the 1970s British author Tony Buzan developed the modern version of mind-mapping[4] that is growing rapidly among the Fortune 1000 thanks largely to advances in software.[5] Mind-mapping can also be found in several books on speed-reading and advanced comprehension.

The use of mind-mapping techniques has several intellectual and practical advantages of which we will cover a few. First, visualizing information has shown to be a powerful way to organize, spur creative thinking, and allow one to view complex problems as a whole. The later benefit is especially important in plans development – particularly when collaborating with others to prevent planning in a vacuum. We use mind-mapping techniques regularly in our office for brainstorming, meeting notes, and as an organizational "dashboard;" however, we'll limit this discussion to two applications – Annex Q development and battle management.

Recently, we did a significant re-write of Annex Q for OEF-P using MindManager 8 (MM8),[6] a commercial-off-the-shelf (COTS) mind-mapping program. When viewed on a computer, the application allows the entire operations order (OPORD) to be viewed in a single frame and allows rapid access to all parts therein. The technology also allows the efficient use of hyperlinks, embedded documents, references, AAR notes, and contact notes unlike any other program available. It is at once an OPORD, a SOP, an AAR collector, a continuity guide, and it can be transformed into an execution management tool. (Reference OEF-P Map above) The software also allows the map to be rapidly exported into MS Word, Powerpoint, Project, and other formats for different uses. The Word export feature, for example, allows use of a JOPES-formatted template. Thus, an "old-fashioned" OPORD can be rapidly published if necessary.

The second application of this software was first used during a computer-based exercise and recently refined again during a forward-deployed exercise. We created a "battle management dashboard" whereby all applicable and related information was harnessed in a single space (See Medical Management Map on next page). There are some unique and practical capabilities with MindManager that make it useful. For example, we used MM8 maps to develop our operations SOP and a host of other reference material. These maps were then saved as sub-maps and stored in MM8s map library as "map parts." When we launched into the exercise we were able to quickly assemble a custom management tool by attaching "parts" from the library. In addition to hyperlinking to portal locations, websites, and other software, we attached emails, reports, and other pertinent documents as needed. The software also allows one to embed or attach bookmarks, comments (think MS Outlook notes), and notes (think MS Word) to each topic. This combination of tools makes for a very efficient, yet thorough, shift

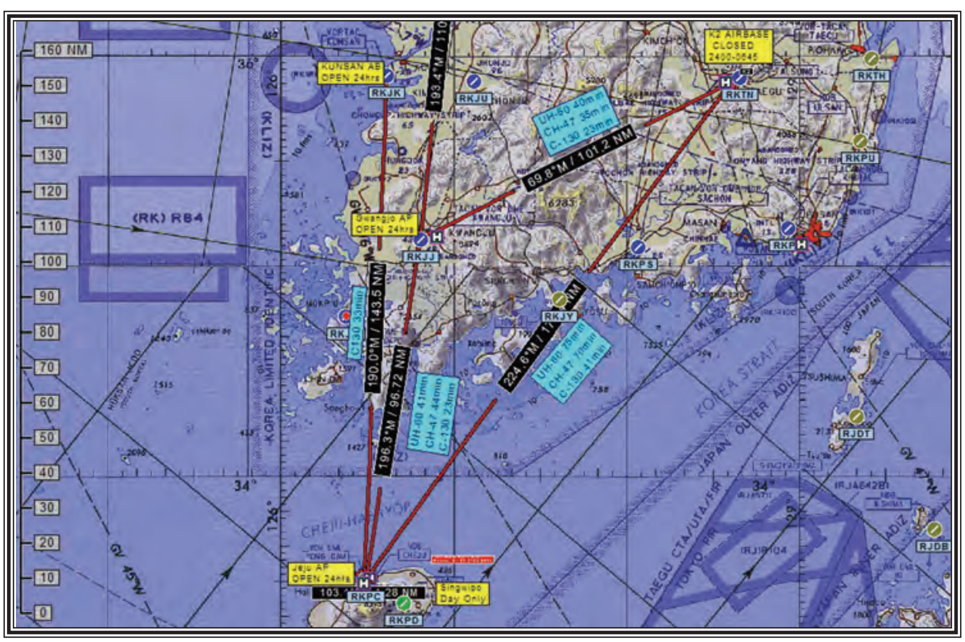


Medical Battle Mangement Map Example

turnover even when the previous person on duty is not present. It's a capability that needs to be seen to fully appreciate its simplicity and effectiveness.

The second planning tool is using FalconView (FV) software for rapid development and dissemination of medical planning information. This package is one of the many applications within the Portable Flight Planning System (PFPS), but has, at least at SOCPAC, been underutilized for CONOP development. Although the Joint Medical Assessment Tool (JMAT) is being pushed and promoted to all medical planners across the DoD, we find FV more useful for SOF medical planning.

The program is incredibly feature-rich. Like the mind-mapping software it would take many pages to explain its full range of capabilities. (Air planners and some within Intelligence are our most skilled users.) For any geographic planning, FalconView replaces the old map and acetate overlays plus much more. For the past many years, planners have widely used PowerPoint to depict maps and overlay-type information, but this is time-consuming, can create large file sizes, and is an inefficient, poor reference for detailed planning. During the most recent exercise, we used FV to develop the joint operations area (JOA) medical capabilities map using a series of separate overlays depicting hospital locations, airfields, HLZs, units locations, MEDEVAC/CASEVAC flight paths/times/distances, and even ground routes across a vast area. (See FalconView MEDCOP Example) We also used a feature called "Skyview" to select a map site and conduct a ground-level virtual 360-deg look at the terrain – very helpful for selecting potentl HLZs. Additionally, we embedded crucial information into each map icon and hyperlinked to more thorough data and imagery. These overlays, pushed down as "mission packages," were highly appreciated by our subordinate component planners. This process allowed them to develop detailed plans rapidly and more easily, and in a format compatible with their own operations planners. Our SOCJFCOM observer/trainer considered the visual continuity between all medical players and the operations planners a key, mission-critical planning tool.[7]



FalconView MEDCOP Example

The use of MindManager and FalconView greatly enhanced our battle management, situational awareness, and dissemination of medical plans. The use of mind-mapping techniques originated in our office and has since evolved into a pilot program at SOCPAC to include Joint Special Operations Task Force-Philippines. Additionally, the technology is available now for real-time, simultaneous development of plans and orders in the form of mind-maps along with imbedded chat and video.[8] Harnessing this power within USSOCOM could dramatically improve the way we develop and execute plans and share information. It's my opinion that it is simpler, easier, and more effective than Sharepoint and other collaboration platforms. An additional key advantage is, since this is a COTS program, user proficiency can be very high. Several staff members at SOCPAC now use MindManager or other mind-mapping software at home.

FalconView has proven to be a giant leap from geographic planning and information-sharing using PowerPoint. Although there is still some utility in the later, FV-based plans are far more efficient, precise, and useful since they are cross-compatible with other planners. Additionally, sharing FV-based information requires very little bandwidth since only overlays can be transmitted and they are small files. Future plans for the software are even better; According to our resident SOF IT software expert, FalconView is expected to be renamed "X-Plan" with even more capability, cross-database compatibility, and Google-Earth-like features.

Medical planners need to embrace the forefront of technology to advance our craft. Joint Pub 3-13 states "The Joint campaign should fully exploit the informational differential, that is … (the) ability to effectively employ information on the strategy, operational and tactical situation which advanced U.S. technologies provide our forces." Furthermore, our "Annex Qs" (or more abbreviated CONOPs) should assist in visualizing and describing an operation, assist subordinates in comprehending the plan, and provide quick reference to information and instructions during execution. During the deployed exercise, our observer/trainer noted the benefits of using MM8 & FV: "The integration of these two programs (Mind Mapping & Falcon View) provided "real time planning", the end result established a fluid environment that decreased the time required to validate plans." These programs help advance the practice of our craft and are worthy of further discussion, experimentation, and training for USSOCOM medical planners.

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Reed in Jolo crop

Rhett Wallace MD FAAFP
LTC MC SFS DMO
Senior Medical Advisor
NATO SOF Coordination Center

The past six months flew by here at the NATO Special Operations Coordination Center (NSCC) at SHAPE in Mons, Belgium. Progress within the NSCC Medical Branch includes:

Generating an initial draft of the NATO SOF Medical Standards and Training Directive, with multinational input

Providing SOF relevant planning considerations to upcoming NATO Medical Directives

Updating the Headquarters International Security Assistance Forces Special Operation Forces (HQ ISAF SOF) Medical Plan for ISAF SOF elements.

Note: If you are heading into the ISAF Theater please contact my office to get a current copy of the latest update. If you have recently left, or are about to leave ISAF Theater, please provide me with suggested updates, new requirements or concerns, or constructive comments to improve this living document.

The North Atlantic Council (NAC) approved transition of the NSCC to the NATO Special Operations Headquarters (NSHQ). With this transition we will focus more on direct support and integration into current NATO operations (such as ISAF), polices, and exercises. Over the next six months, I hope to begin to see the payoff for all the work put into re-writing job descriptions and justifications for staffing requirements. My goal is to create an adequately manned and trained Joint Medical Section under the Deputy Chief of Staff for Support, while maintaining status as one of the Special Staff to the Commander. Current manning is a NSHQ Surgeon and Medical Operations Officer. Over the next year, I hope to have four additional posts approved: A Deputy Surgeon position, a Training and Readiness position, a Preventative Medicine/Environmental Science/Medical Information and Intelligence position, and finally a Senior Enlisted Medical Advisor position to round out the medical branch. Medical Logisticians are key elements for deployments and would be an essential element to be leveraged early as an augmentation of the deployed NSHQ as a Combined Joint Forces Special Operations Component Command (CJFSOCC), Special Operations Command Element (SOCE) or Special Operations Command and Control Element (SOCCE). Medical Planners (70Hs) who are senior Majors or junior Lieutenant Colonels and are looking for an opportunity to work in a fast moving combined joint operational environment should contact me for further information.

In October 2009, the NSCC will host the first NATO SOF Medical Operations Conference in Heidelberg, Germany in conjunction with the NATO Medical Operations Conference. This conference will highlight the nuances of SOF Force Health Protection and Health Service Support requirements to senior international military medical leaders. The intent is to develop a common vision for capability requirements that will enable international SOF elements to work towards a common training and equipping standard and foster interoperability. The NSCC Medical Standards and Training Directive is published as the current draft version of this concept. The intent is to move this through committee to gain consensus and publication next year as NATO Medical Doctrine. Taking these steps now will lay a solid foundation, and enable future operational success, both within the Alliance and in current and future coalition operations.

Another measure of progress will be to establish the requirements for developing a NATO SOF Joint Medical Planner's Course. The target audience is Surgeons, Medical Planners, and Senior Enlisted Medical Advisors of Special Operations Task Groups (SOTGs) — the equivalent of a U.S. SOF Battalion. On a larger scale, this same target audience applies to the CJFSOCC level, as well. The fostering of mid-level leaders and knowledge base will work to improve Health Service Support for future NATO SOF operations. I would like to have the first course online by the end of next summer.

I look forward to seeing you all at the SOMA Conference in Tampa this December, and to opportunities to collaborate in the future with you to support our Soldiers on point. Through unity of purpose, certainty of action!

Education & Training

USSOCOM Education and Training Update

LTC Doug McDowell, APA-C
Director of Medical Education and Training

Advanced Tactical Practitioner Program

The USSOCOM Critical Task List and Advanced Tactical Practitioner certification are the baseline interoperable standard and certification for all SOF Combat Medics.

Administration of the ATP program is carried out by the USSOCOM Department of Emergency Medical Services and Public Health. USSOCOM sponsorship allows rapid review and adoption of skills and knowledge gained from Joint Lessons Learned and the flexibility to respond to the individual needs of a frequently deployed constituency.

The SOCM and PJ curriculum supports those critical medical tasks based on unique SOF requirements common to all five USSOCOM components. The SOCM and PJ program of instruction (POI) and ATP examination will be based on the critical task list (CTL) identified by the Requirements Board (RB), recommended by the Board of Regents (BOR), and approved by the Director, J7/J9.

An ATP is defined as an enlisted servicemember who meets all of the following standards:

- A designated combatant, doctrinally defined by Service standards.
- Employed by or assigned to USSOCOM and its subordinate units.
- Tactically trained, assessed, selected, or qualified to a SOF combat standard.
- Utilized in a Level 1 (Role 1) environment.
- A graduate of SOCM COI, or equivalent, who has passed the ATP examination.

The ATP exam is given at the end of the SOCM and PJ courses. If you need to take the exam, or have individuals in your unit that need to take the exam, please contact us at ATP@socom.mil for upcoming testing dates and locations.

The ATP must attend the Special Operations Combat Medic Skills Sustainment Course every two years to maintain a current ATP certification.

For all ATP questions or requests please e-mail us at ATP@socom.mil.

There are two opportunities for ATPs to gain civilian certifications resulting from their military training.

Georgia EMT-P Reciprocity.

- Georgia will issue a state EMT-P license based on the medic being a current ATP, and having an ATP score on file.
- You must have taken and passed the ATP exam to be eligible for reciprocity.

One common problem is that the ATP was trained prior to FY 2006 (SOCM) or FY 2007 (PJ) and does not have a valid ATP test score on file. If you fall into this category, please contact us at ATP@socom.mil for a schedule of ATP tests.

Contact Information for the Georgia EMT-P:
Jassene Williams, Program Assistant
Personnel Licensing & Compliance
GA Dept of Community Health
2600 Skyland Dr Lower Level
Atlanta, GA 30319
Phone: (404) 679-0544

Certified Flight Paramedic Examination (FP-C), Certified Critical Care Paramedic (CCP-C) Examination

- Current ATPs are eligible to take the FP-C and CCP-C exam administered by the Board for Critical Care Transport Paramedic Certification (BCCTPC).
- The CCP-C exam is currently being beta tested and should be available for the ATP sometime in 2010. This provides an option for both air and ground critical care certifications.
- ATPs can apply to take the test via computer at a testing site rather than wait for a formal (paper pencil) exam.

Register online at: www.bcctpc.org. In the Exam Information section, you can register to take a computer-based test. It is self-guided, and will walk you through what you will need as far as copies of the ATP card, etc. For questions or comments, contact us at ATP@socom.mil

NREMT Registration/ Examination Information

The U.S. Army EMS Programs Management Office has granted approval for those completing the Special Operations Combat (SOCM) course to challenge the NREMT-Paramedic examination. Below are instructions and guidelines to follow should you want to take the NREMT-P exam.

1. Personnel who have completed the SOCM course are eligible to challenge the NREMT-Paramedic exam, Computer Based Test (CBT) and the Practical Skills evaluation (both are required.) Also, personnel who allowed their NREMT certification to lapse and attended SOCMSSC since 2002 are eligible to challenge the NREMT-Basic (CBT only) or Paramedic exams.

2. Examination fee for the Computer Based Test (CBT) is $110.00, payable three ways to NREMT:

   a. Check/ money order (slow process as this must be mailed)
   b. Credit card (secure site)
   c. Payment voucher purchased through the NREMT website

3. The NREMT Computer Based Test should be available at any Post/Base DANTES testing center (Education Center). Check with them to find out if that location is able to receive the NREMT-P examination. Otherwise, you will have to follow the directions in the Authority To Test letter from NREMT to contact Pearson VUE.

4. Practical Skills Examination location can be found through the website and maybe check with a local community college/ hospital based or fire service based paramedic training program. These usually require scheduling through them in order to attend their examination(s) dates. Additionally, be prepared to pay a "site fee" at the practical skills exam location. This may range from no fee to in excess of $150.00

5. To register for an examination, go to the www.nremt.org website

   a. At the website, click on "Apply to be nationally certified."
   b. If you have not registered with NREMT before, you will be required to establish a username and password. Like any other username and password, don't forget them!

6. When registering, the website will ask what state the course was attended: Use "AM" (Army), rather than your state of residence. Course site codes are:

   a. Completed SOCM and registering to take the NREMT-Basic exam; site code AM-800
   b. Completed SOCM and registering to take the NREMT-Paramedic exam: P-001
   c. Completed SOCMSSC and registering to take either the NREMT-Basic or Paramedic exam: PB-001

7. After registering for the Paramedic exam, email Mr. Cox at the JSOMTC, coxkl@soc.mil. Mr. Cox will verify your completion of the SOCM course which let the NREMT know you are eligible to challenge the NREMT-P exam.

8. **Study/ Review**! Whether attempting the Paramedic exam for the 3rd time or the first time, review is necessary. The SOCM course did a great job of teaching basic/paramedic and beyond knowledge and skills; but, some material addressed by the NREMT examination were not covered well: IE; EMS operations, OB/Gyn, peds, geriatrics, crime scene awareness, HAZMAT and cardiology. Practical Skills Examination check sheets can be printed from the www.nrmet.org website. Practice with them in order to learn/ retain the flow NREMT expects skills to be demonstrated.

   a. Other study guides, reference material are available at your local bookstore, e.g.: Barnes & Noble, Walden books, Books-a-Million, Amazon.com, Borders, libraries, etc. Any of the current edition texts/review books should have the latest material necessary to pass the NREMT exam.
   b. Be prepared to test when scheduling for the Practical Exams. There is no review/ train-up time at an examination site. A brief familiarization will be given to a piece of unfamiliar equipment … otherwise be ready with your knowledge and psychomotor skill ability.
   c. If you feel a refresher is needed before scheduling, check with a local medical training facility (community college, hospital, EMS service, medical training company.)

9. NREMT Practical Skill sheets are available through the www.nremt.org website:

Basic:
http://www.nremt.org/nremt/about/exam_coord_man.asp#BSkillSheets

Advanced:
http://www.nremt.org/nremt/about/exam_coord_man.asp#ASkillSheets

DEPARTMENT OF THE ARMY
UNITED STATES ARMY MEDICAL DEPARTMENT CENTER AND SCHOOL
U.S. Army EMS Programs Management Office
2405 Reynolds Road, Bldg 2266 Suite A
Fort Sam Houston, Texas 78234-6100

REPLY TO
ATTENTION OF

MCCS-OP-E 30 July 2009

MEMORANDUM FOR RECORD

SUBJECT: Termination of 90-day deployment extension agreement between National Registry of Emergency Medical Technician (NREMT) and U.S. Army EMS

1. Effective 1 January 2010, the automatic NREMT 90-day deployment extension agreed upon between NREMT and U.S. Army EMS is terminated.

2. Soldiers that deploy after 1 January 2010 no longer have an option for the NREMT 90-day extension, and will not allow their NREMT Certification to expire. It is an individual Soldier's responsibility to recertify NREMT certification to remain MOS qualified IAW AR 40-68.

3. U.S. Army EMS maintains the authority to approve late NREMT re-registrations on an individual basis. Soldiers in unique circumstances must submit re-registration application with an endorsement letter from the first O6 in the chain of command explaining the reason for late submission.

4. The point of contact for this memorandum is Mr. Ismael Diaz, Sustainment Branch, U.S. Army EMS at 221-0837.

PATRICIA R. HASTINGS
COL, MC
Director, U.S. Army EMS

MEDICAL LOGISTICS

MAJ Marc Bustamante
USSOCOM, Office of the Command Surgeon
Medical Logistics Plans and Operations

New Addition to the Special Operations Command Surgeon Team

The United States Special Operations Command (USSOCOM) Command Surgeon Office recently received approval for the addition of a Medical Acquisition Officer by the Joint Staff. The effective date of the Medical Acquisition Officer billet is 1 October 2010. The specific billet identifies an O5 with the Army Military Occupation Specialty 70K (Medical Logistics Officer) and the Additional Skill Identifier 8X (Acquisition-Contracting). The Army Medical Department is currently the only Component with a training and utilization program that provides Medical Service Corps Officers with acquisition credentials to geographically dispersed positions throughout the Department of Defense (DoD).

The requirement for an officer with a background in acquisition had been met by COL Jose Baez until his departure in December 2008 for O6 level Acquisition Corps Command. COL Baez was certified by the Defense Acquisition University in Contracting and Program Management. On 1 July 2009 MAJ Marc Bustamante, who is also certified in contracting and program management, reported to the USSOCOM Team to fill this requirement.

The SOCOM Command Surgeon dedicates significant time and resources to management of programs of record that impact all Components of USSOCOM. Current programs of record include Special Operations Forces (SOF) Tactical Combat Casualty Care (TCCC) and Human Performance, Restoration, and Pre-Habilitation (HPRP). SOF TCCC consists of Increment I-Operator and Medic Kit, Increment II-Casualty Evacuation (CASEVAC) Set, and Increment III-Theater Special Operations Surgical Team (TSOST) Kit. The HPRP program is a component of the Warrior Rehabilitation Performance Center (WRPC) program which is focused on maintaining SOF at their above-average level of mental and physical performance and resiliency.

The medical logistics and acquisitions staff in the Command Surgeon Office is currently projected to receive an Army Medical Logistics Officer Combatant Command (COCOM) intern in the summer of 2010. In addition, the former COCOM intern and current Chief of Medical Logistics and Acquisitions, LTC Kevin Cooper, is projected to depart the USSOCOM Command Surgeon Office in the summer of 2010.

Current State of the Special Operations Forces (SOF) Tactical Combat Casualty Care (TCCC) Casualty Evacuation (CASEVAC) Set Procurement

The USSOCOM Command Surgeon's Office currently fields the SOF TCCC Operator Kit and Medic Kit as part of the SOF TCCC Program of Record. The Operator Kit, commonly referred to as an individual First Aid Kit (IFAK), provides SOF Operators with the capability to address self and buddy aid for controlling life-threatening external hemorrhage, maintaining airways, providing fluid resuscitation, and administering medications for pain and infection intervention. The SOF TCCC Medic Kit supports the SOF Medic with the capabilities to provide advanced airway intervention, intravenous (IV) medications, hypothermia prevention, advanced monitoring and diagnostic capabilities, and intraosseous infusions. It has the capability to augment the capabilities of the Operator Kit.

The USSOCOM Command Surgeon's Office continues to work with the Program Executive Office – SOF Warrior and the Natick Soldier Systems Center Program Manager (PM) to address the next phase of the SOF TCCC program, i.e., the Casualty Evacuation (CASEVAC) Set. The CASEVAC Set is designed to use sets, kits, and outfits (SKO) logistics approach consisting of kits/modules organized according to field functionality, i.e., extraction, mobility, transport, and sustainment. Depending on the type of mission, anticipated casualty types, mission environment, and available transportation, the SOF team selects specific modules to optimize medical support to the anticipated mission. The various modules will include medical supplies and equipment as well as non-medical extrication and rescue components.

The USSOCOM Command Surgeon Office, the USSOCOM Contracting Office, and the Natick Soldier Systems Center PM have been working thru various means of involving Industry in order to exploit innovation, technology, and capability as well as enhance the SOF Operator's performance and survivability.

Industry Day was hosted by the PM at Natick, MA, 21-22 Oct 2009, in an effort to facilitate the partnering of Industry and eliminate any ambiguities associated with this program. A pre-proposal conference is scheduled to be held at McDill AFB 2-4 Feb, 2010, in an effort to resolve any new issues that may have surfaced. Multiple awards are projected using a best value approach. It is anticipated that the awardees will then provide the full kit for a field assessment of all components in varying environments and user groups over a period of eight to ten months. The desired end state is to identify the right product(s) for the right purposes and serve as a combat multiplier to SOF operating in hazardous and austere environments. Products will be required by USSOCOM from the prime integrators for determination of future purchases. Delivery of the SOF TCC-CASEVAC Kit is anticipated on or around 1 Jul 2011.

The SOF TCCC Program is focused on preserving SOF and facilitating its reconstitution by reducing preventable battlefield deaths and minimizing effects from injuries. In this light, the USSOCOM Command Surgeon's Office continues to address solutions to current capability gaps that exist in the SOF medical community.

USSOCOM Psychology

LTC Craig A. Myatt, PhD, HQ USSOCOM Psychologist

The human dimension in our global, contemporary, operating environment is challenging to comprehend, evaluate, and support. It is tough to do so for almost any servicemember. The challenge is no easier for SOF personnel. Unique operational demands in the SOF community yield unique challenges that require innovative, and creative, applications in upholding concern for the human dimension related to our work. The SOF Human Capital Preservation Strategy is our benchmark by all standards. Defined as either Operators, enablers, or supporters, all SOF personnel (and we can add families to this discussion too), possess a measure of hardiness and resilience relevant not only to our mission-focused framework, but also to national strategic interests.

As we focus on people and families, our goal is to optimize performance by building high stress immunity regardless of the environment. Imagine the stress-inoculated SOF enabler parent with high stress immunity (operationally) whose child is sick at home with an influenza A H1N1 viral infection. Can that SOF enabler, whether physically at home or not, adequately cope with the spouse and the ailing child throughout the illness? When we view such a challenge from a systems orientation, is it even remotely possible that the enduring operational effectiveness of that SOF enabler at home with his ailing child and family can be linked remotely to effectiveness on a larger community, state, and national level? One might argue that influence at the individual and family level can have broader social implications at a national level. Not always, but perhaps often enough to make a difference in yielding positive outcomes.

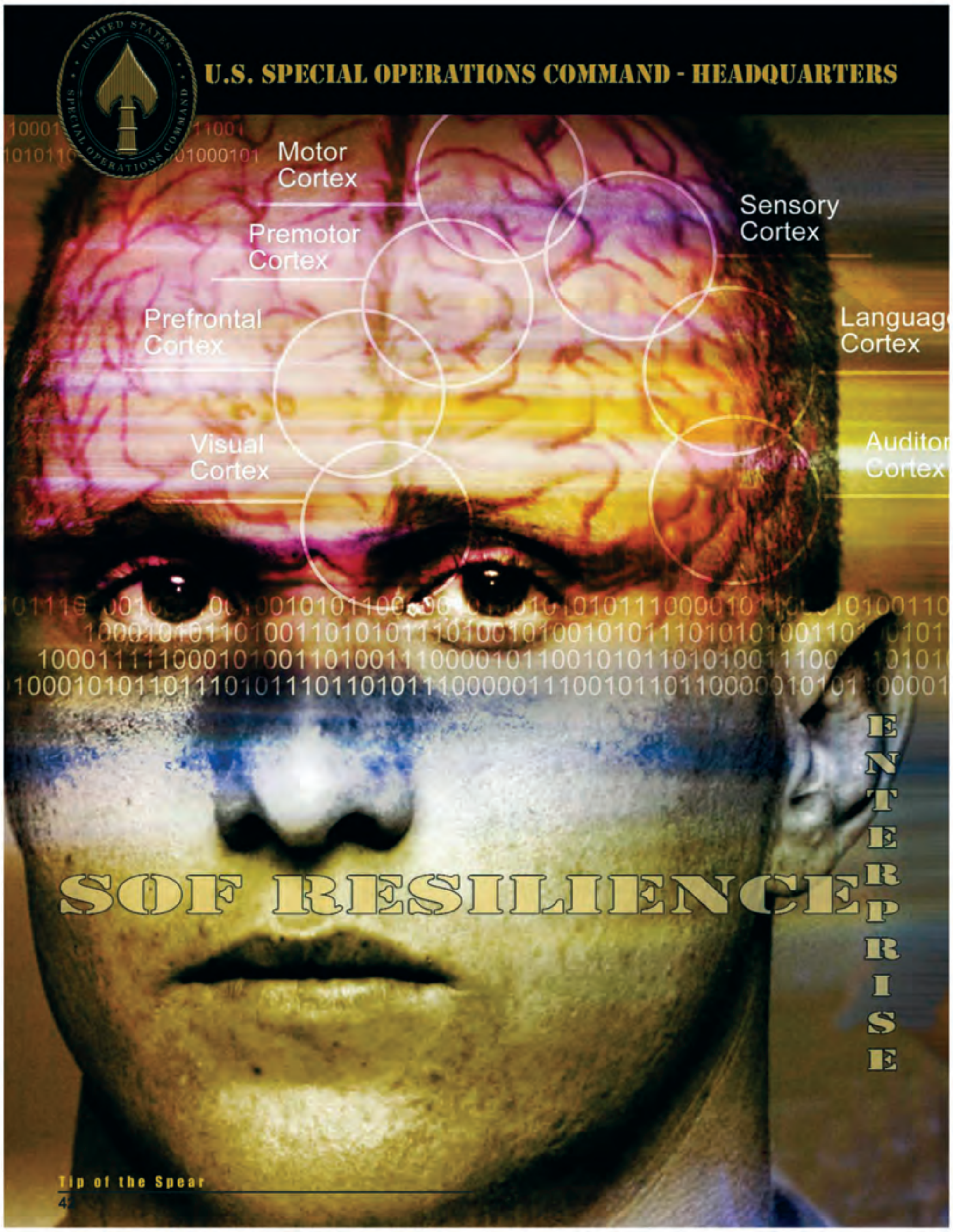
Regardless of one's mission focus, whether it is tactical, operational, or strategic, every leader in the SOF community serves as a contributing element in our national strategic interests. Our families also factor into that no matter how much, or how little, they embrace our commitment to the work we do. Thus, talk of the human dimension and institutional applications supporting the SOF Human Capital Preservation Strategy requires clarity in the midst of behavioral complexity. A pervasive challenge is to sustain a resolve which keeps us, our families, and our nation on the path of victory.

A systems approach applied to simplifying complexity for us, our families, and our nation is one approach that offers utility for the psychologist working in the SOF community. For example, when an embedded operational psychologist uses a battery of tests to evaluate behavior, the scores from that test can help identify individual behavior and relevant support factors that sustain or modify a specified behavior. When the psychologist ventures beyond the prescribed setting of individual or small group interactions and explores how the bigger picture influences, or is influenced by, individual or small group interactions, the challenges become for that trained professional as monumental as they do for the cardiothoracic surgeon who is challenged to perform surgery outside the confines of a sterile operating room. The work can be done. The process may not always be pleasant, but the outcomes can yield productive results with focused application.

Like the surgeon removed from the sterile operating room and asked to deliver efficacious surgical outcomes, the psychologists who have been contributing to the efforts of the Resilience Enterprise Working Group (REWG) face challenges that require focused application beyond the normal scope of their daily work. They, along with other members of the REWG from other professional disciplines (psychiatry, chaplain services, social work, etc.) are continually stepping beyond their comfort zones to provide effective input for the development of the SOF Resilience Enterprise Program. They are defining it, shaping it, and applying it to meet SOF-specific requirements. The REWG members are overcoming the challenges of comprehending, evaluating, and supporting the human dimension in our global contemporary operating environment in a way that ultimately must make sense for us, our families, and our nation.

SOF Leadership in the Face of Stress

By Mike Bottoms
USSOCOM Public Affairs



Not all stress is bad. Stress balanced with good leadership and adequate situational awareness can build resilience. Resilience in psychology is the positive capacity of people to cope with stress and catastrophe.

About a year ago, in an effort to bolster resilience within the Special Operations Forces community, ADM Eric T. Olson, Commander of U.S. Special Operations Command, charged the USSOCOM Command Surgeon with the responsibility of identifying the source of stressors leading to adverse behaviors in SOF and their families. The result was the formation of the USSOCOM Resilience Enterprise Working Group. The Command Surgeon at that time, COL Warner (Rocky) Farr, established a team of psychologists in the Command Surgeon's Office that would work to assess and mitigate adverse behavioral effects in SOF. The team of two included an Army active component research psychologist, LTC Craig Myatt, and an Army Reserve component clinical psychologist, MAJ Paul Boccio.

Under Farr's direction, Myatt and Boccio reviewed data from several of the component command psychologists and psychiatrists and studied material furnished by the USSOCOM Lessons Learned staff. The data review involved a trend analysis of issues ranging from traumatic brain injury to marital discord. Among those issues, and others such as misconduct and suicide, SOF personnel showed a relatively lower frequency of adverse behaviors over a nine-year period of sustained operations than servicemembers outside of the SOF community.

The initial effort by Myatt and Boccio also defined a methodological approach for assessing the challenges faced by SOF personnel. That approach targeted a process for reviewing the long-term effects of contemporary operations and endorsed the formulation of existing and new partnerships inside and outside of USSOCOM in support of a proposed command sponsored program.

In February, ADM Olson directed Myatt to develop a program serving the needs of SOF personnel and families against the adverse effects of stress associated with current and projected operations. The first step toward program development involved charter approval for a working group consisting of members from the USSOCOM headquarters and each component. March 13, Brig Gen Steven Hummer, then Chief of Staff, approved the charter for the USSOCOM Resilience Enterprise Working Group. The designated component command representatives in the working group are command psychologists and a command psychiatrist who function as behavioral health and psychology subject matter experts in their respective commands.

The REWG met initially to review best practices in each of the components. That review led to approval of an Initial Capabilities Document sanctioning the REWG as a chartered body representing the command to improve psychological performance and to reduce the likelihood and severity of psychological injury in SOF and their families. The REWG was established through an existing program in the Command Surgeon's Office, the Warrior Rehabilitation Performance Centers Program.

The REWG met again in July to define SOF resilience and to refine the mission and goals of the REWG. The contributions of the component psychologists at that conference signified a measure of commitment and rapid action among all of the command psychologists in support of resilience education, leadership operational and strategic support, and families in transition to health. All USSOCOM components support resilience education, ongoing operational psychology in SOF units, and the use of Care Coalition Military Family Life consultants. Partnered internally with the USSOCOM headquarters directorates, the WRPC, the Care Coalition and the Command Chaplain, the panel of member psychologists in the REWG have asked the question, "Is there a problem with our SOF personnel?" The answer the REWG generated is, "no."

SOF often face seemingly unimaginable stress in combat yet are equipped to cope and become biologically and psychologically stronger. The survival and coping mechanisms developed in SOF are both intuitive and learned. Individual survival and coping mechanisms, especially in small team elements, enhance operational success.

Current overseas contingency operations challenge first-line supervisors and commanders to expand their situational awareness not only on behalf of SOF and the support teams around them, but also to families. The family is an additional psychosocial support element for the SOF warrior that is being given increased attention because of its powerful influence on mission accomplishment. Leadership doctrine throughout the services is being rewritten to reflect the dynamic and diverse roles of family, as well as the human dimension of the warrior ethos. In the SOF community, the family is increasingly being recognized as an operational support team on par with, if not even more important than, any other operational support team designated for mission support by unit commanders.

In generations past, the typical line NCO could utter unchallenged, "If Uncle Sam wanted you to have a family, then he would have issued you one." Not so today in the military. Single or married, U.S. servicemembers in the 21st century serve under leadership that acknowledges the value of family and strives to accommodate the human dimension of the warrior ethos. That stance is taken because military leadership now recognizes the ingenuity which won wars and conflicts for America in the past resides in the sanctity of self preservation, unit cohesion, and healthy family relationship.

Leadership in the Services over the past several years, but particularly in the SOF community, is expanding the role of behavioral health personnel. The USSOCOM headquarters and its components are using more psychologists in a consultative role working directly for commanders as special staff officers to help sustain combat power and the virtues of human dignity in the family. The cadre of component command psychologists serves each component commander and its subordinate units with psychological services for SOF warriors and their families. In the SOF community, the behavioral health support provided to SOF personnel and their families is formulated to surpass any stressor that tough training, intense operations, irregular warfare or an astute adversary can bring upon our forces.

According to the REWG, there is no problem behaviorally with SOF personnel. Nor is there a problem with the families. However, the REWG members concede the pace of ongoing mission-focused demands require close scrutiny from a command, supervisory, operational, and behavioral health standpoint on behalf of the SOF personnel and their families. That close scrutiny entails the identification of not only the adverse effects of stress, but also the positive benefits of stress in the SOF community. As stated earlier, not all stress is bad. The enduring process SOF personnel go through for selection itself singles out SOF personnel as hardy and resilient. SOF personnel are tough, determined, and committed. Can the same be expected of the SOF family members? "Yes, but in a different way," according to Myatt. "As we develop a program that supports the five SOF Truths (1. Humans are more important than hardware. 2. SOF cannot be mass produced. 3. Quality is better than quantity. 4. Competent SOF cannot be created after emergencies arise. 5. Most Special Operations require non-SOF support.) for SOF leaders and other personnel at the small unit level and institutionally, we can include the family in promoting education, communication, and support as a means of sustaining combat power over time. Our operational concerns extend to the family. There is perhaps no other community in the military except SOF that can define the family as an operational support element that sustains combat power for commanders and first-line supervisors," Myatt said. "The family is a system among systems that supports the SOF warrior, deployed or otherwise."

A resilient person recovers quickly and adapts to illness, change, or injury in a positive way. SOF personnel are already resilient because their rigorous selection process. SOF families are more resilient than most. That does not, however, negate a leadership responsibility to ensure that SOF personnel and their families remain resilient in the face of stress.

"The developing goal of the SOF Resilience Enterprise Program is to sustain combat power by increasing resilience in SOF and SOF families to meet the challenges of a changing environment," Myatt said

Each component has developed a separate program to address resilience and other aspects of operational psychology designed to its unique warrior culture. For example, Air Force Special Operations Command approaches its resiliency program with a "battle mind."

"The battle mind is a warrior's inner strength to face fear and adversity in combat," said AFSOC's command psychologist, Col Carroll Greene III. "The battle mind merges powerful physical and mental survival response that helps to ensure survival."

AFSOC holds pre-deployment and post-deployment seminars. Greene explains in the seminars that warriors drawn to SOF have similar attitudes and goals.

"The warriors want to confront personal fears and challenges, develop personal strength for success in life, are energetic, value adversity as a strength builder, and look for excitement to energize their life. They also want to be part of a close knit team, want to secure a future for themselves and their families, want to earn their peers' respect and feel pride in their service to the nation," Greene said. "These attitudes and goals produce strength and resilience."

Greene also argues there are powerful positive effects to combat stress.

"Combat stress increases respect for other cultures and people, increases your appreciation for American values, strengthens commitment to loved ones, strengthens spiritual development, and affirms service at the 'nation's tip of the spear.' Combat stress also strengthens part of your self image, strengthens you for future challenges, and energizes your personal goals," he said. "Positively focused leaders help shape resilience."

In the AFSOC pre-deployment seminars, techniques are taught to manage adrenaline, how to transition from deployment to combat, and how to deal with other adversities of deployment. In the post-deployment seminars, Airmen are trained in how to reduce their combat adrenaline and what to expect physically and emotionally in the first six weeks upon returning home. Assimilation back into family life is an integral part of the seminar and stress reduction services are offered.

Naval Special Warfare Command's resiliency program falls under the Center for Military Relationships and Families. The center is chartered to prevent and treat combat stress. Group One builds resiliency through the NSW Resiliency Enterprise and FOCUS (Families Overcoming Under Stress) Project.

Group One's efforts focuses on resiliency in seven ways: psychological, neuropsychological, physiological, psychosocial, lifestyle, financial, and spiritual. The FOCUS Project provides resiliency services for children through workshops building their skills to cope with separating from a parent or parents due to a deployment.

LCDR Ray Nairn is the first psychologist at NSWG-2, and reports receiving excellent command support for programs that he and the other NSW psychologists have proposed. He said he sees one of his most important unaccomplished missions as accurately identifying the needs of family members via a comprehensive needs assessment survey.

"I would like to ensure that when NSW spends money to support the families, it is being spent on exactly what the families' need versus an individual's conjecture or a small sample size of opinions," Nairn said. "I am optimistic the Resilience Enterprise Working Group will provide a forum to exchange the best practices from each of the services."

"My commodore wants to support the families," Nairn said. "He wants a committee of our family readiness coordinator, our chaplain and me to advise him."

AFSOC's and NSW's resiliency programs are but two examples of USSOCOM's commitment to the well being of SOF and their families. U.S. Army Special Operations and Marine Corps Forces Special Operation commands also have existing resiliency programs as well.

"Behavioral health readiness in theater and back in the United States is an operational force health protection issue," Myatt said. "As we build stronger behavioral health readiness and resilience within the SOF community, we then improve overall operational readiness and performance in the teams and units."

Key Facts on Resilience and Response to Stress for Navy and USMC Leaders

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Background

Resilience research has proven to be both promising and misunderstood. Such research holds promise for its potential to inform treatment of stress-related pathology. Likewise, a better understanding of the mechanisms that promote resilience can inform training programs aimed at preventing maladaptive responses to trauma (e.g. stress inoculation training). However, the emergence of programs offering methods to make individuals resilient suggests the term may be misunderstood, and suffering from definitional bracket-creep.

In the wake of the terrorist attacks of Sept 11th, 2001, and the subsequent increase in military op tempo abroad, there is a renewed interest in creating resilience-based interventions. Yet, resilience as a construct has traditionally lacked a consistent, complete, and measurable definition. Such definitional ambiguity has contributed, at least in part, to the term "resilience" being imprecisely applied to myriad treatment programs and outcomes. As a result, asymptomatic individuals are often deemed resilient. Moreover, what were previously known as treatment and training have been renamed "resilience building". At best, such relabeling might reduce the stigma of traditional mental health treatment – but this too is lacking direct empirical support. At worst, an expanding use of the term may confound a growing database of evidence-based factors that really do differentiate those who do bounce back from stress from those who don't.

The aim of this paper is to help put resilience in proper perspective. To do so, various definitions of resilience are briefly examined, and one possible guiding definition of resilience is proposed for future clinical research in military medicine. Factors known to be related to resilience via empirical support are highlighted. Specific mention is given to psychosocial variables and biological markers of resilience.

Resilience

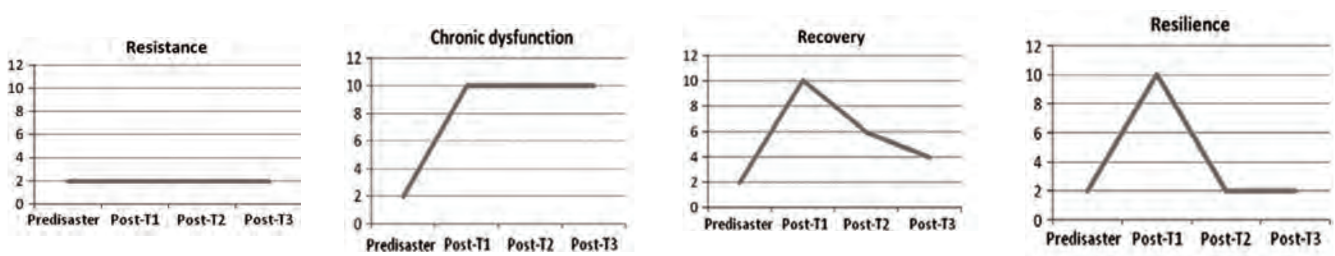
Resilience has generically has been defined as "bouncing back from a stressor." Slight variations in the definition of resilience include the absence of symptoms following trauma, an absence of risk factors for disease, and sustained performance during an intense physical or psychological challenge. Such definitions are cause to question whether resilience is a valid construct at all. To be sure, most individuals exposed to life-changing stressors do not develop stress-related psychopathology. A vast literature indicates that the overwhelming majority of military personnel exposed to combat do not develop PTSD. Given these outcomes, is the term resilience merely defining the default?

Available evidence suggests the answer to this question is "no," resilience is not the default. Some helpful context for understanding resilience is found by considering risk factors. Framed within the context of risk factors, resilience then becomes defined by a positive, adaptive outcome despite significant risk factors for stress-related pathology.

	Pathology	**Healthy**
High Risk	Predisposed	**Resilient**
Low Risk	Unique Stressor	Resistant

Such a framework is also helpful because we know far more about risk factors for stress-related disease than we know about resilience. Thus, resilience research, in its proper context, is focused on individuals who are identified as "high risk" for developing pathology, yet for some collection of factors (i.e. resilience factors) do not develop disease or a permanent decline in functioning.

Definitional precision of resilience can be improved by differentiating trajectories of recovery following exposure to traumatic stressors. For example, a two-year longitudinal assessment of (N = 1828) survivors of natural disaster and terrorist attacks found em-



pirical support for four distinct patterns of symptom change: resistance, chronic dysfunction, recovery, and resilience (Norris, Tracy, & Galea, 2009).

Thus, resilience can be conceptualized as having four pre-requisites:

1) Risk (biopsychosocial or environmental)
2) Exposure to a high-magnitude stressor
3) Stress response
4) Return to baseline functioning and symptom levels

Resilience Defined

A working group of experts in the field of psychiatry, psychology, behavioral health, and psychometrics constructed a scale that attempts to measure psychosocial processes associated with resilience. The Response to Stressful Experiences Scale (RSES; Johnson, Polusny, Erbes, et al., 2008) is the only scale to date that has been validated exclusively in an active-duty and reserve component military sample (N = 1078) with experience in Operations Enduring Freedom and Iraqi Freedom (OEF/OIF). Scale development and evaluation of reliability and validity were predicated on the following working definition of resilience.

Resilience comprises

a) A set of predispositions manifest as adaptive responses to stressful events.
b) Intrapersonal processes that promote stability through change.

Resilience was defined as: *"A multidimensional psychological process manifest in response to intense life-stressors that facilitate healthy functioning or psychological growth*."

Psychosocial Resilience Factors

Psychosocial factors identified by the RSES are defined below. Though this list is not comprehensive, these factors were theorized and then empirically supported with data from military personnel deployed in support of OEF/OIF.

Cognitive Flexibility

Adjusting beliefs about the self, the world, and the future in a manner that leads to a positive response to stress. Confronting fears and reframing stressful events as opportunities for positive change; overcoming cognitive and behavioral avoidance.

Spirituality

Belief that life has dimension beyond the physical, and that there is a higher power, greater than the "self," that can help guide, shape, influence, and inform experiences.

Active Coping

Thoughts, behaviors, or emotions aimed at altering external or internal sources of stress.

Self-efficacy

Expectation of ability to direct fate and manage reactions effectively should bad things happen unexpectedly. Confidence in the ability to do something positive in response to serious life challenges or to mitigate their impact.

Meaning-making

Appreciating the informational value of stressors and challenges. Recognizing stress-related thoughts, behaviors, and emotions as potentially useful; willingness to allow these to instruct a response to future events. Living with intentionality and extracting purpose from suffering and challenge.

Restoration

Self-care intended to maintain stability in response to stress and rejuvenate following stress. Restoration involves both repair of stress-related damage and preparation for anticipated stressors.

Biological & Genetic Factors

The precise roles of biological and genetic factors that contribute to a resilient response to stress are dynamic and complex. What we do know about biological and genetic resilience factors is largely correlative, therefore claims about a particular candidate gene, allele, or neuropeptide *causing* resilience is premature. A challenge is to determine whether biological factors associated with resilience are the consequence, or the cause, of being resilient.

A complete description of the genetic and biological variables that have been implicated in resilient response to stress is well beyond the scope of this paper. Biological and genetic factors that have been implicated in resilience include,

Human serotonin transporter gene (5-HTTLPR):

Also known as SLC6A4, the long allele is associated with increased serotonin availability, decreased risk of depression, and stronger emotion regulation skills.

Neuropeptide Y (NPY):

Research conducted in high-intensity military settings (e.g. SERE) indicate that higher baseline levels of NPY are associated with better performance during prolonged stress. NPY is also associated with more efficient return of cortisol levels to baseline following activation of the HPA axis.

Brain-derived neurotrophic factor (BDNF):

BDNF has been implicated with adaptive responses to stress and enhanced learning under stress, primarily in rodent research. However, the role of BDNF in resilience is not completely understood, as some findings suggest this nerve-growth factor has differential effects on various brain regions. Thus, an increased level of BDNF in one area is associated with increased risk for stress-related pathology, whereas in other areas is confers resilience promoting properties.

Catechol-O-methyltransferase (COMT):

COMT is an enzyme that affects synthesis of two primary neurotransmitters: dopamine and noradrenaline (norepinephrine). COMT is negatively correlated with levels of dopamine and noradrenaline. Evidence suggests that decreased amounts of COMT are associated with emotion lability and poor tolerance of negative affect.

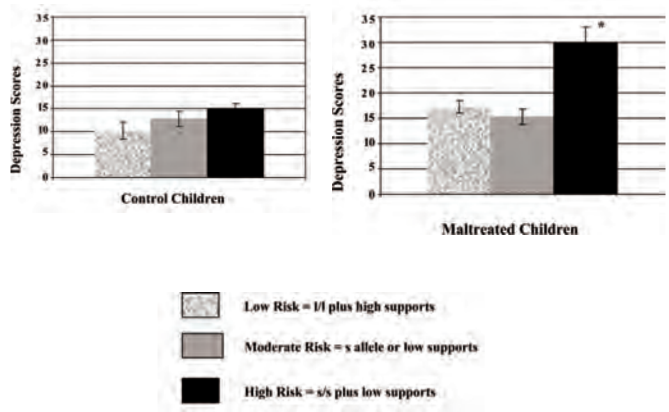
Dehydroepiandrosterone (DHEA):

DHEA is known to counteract the deleterious effect of elevated glucocorticoid levels found in the brain resulting from prolonged stress reactivity of the HPA axis. A study of U.S. Army Special Forces personnel undergoing combat diver qualification training found that higher levels of DHEA were correlated with better scores on an underwater navigation task.

Note: For a more complete review of bio-genetic resilience factors see Feder, Nestler, and Charney (2009).

Interaction of Resilience Factors

What is known about psychosocial and biological resilience factors is that they are dynamic and multidimensional. An example of the complex interaction of biological and environmental resilience factors has been demonstrated in children at-risk for depression. Kaufman et al., (2004) found that children who inherited both short alleles (s/s) of the 5-HT serotonin transporter gene had higher depressive symptoms, thus demonstrating a genetic vulnerability to psychopathology. Results also showed that children with a genetic vulnerability who were also abused had the highest level of depressive symptoms. Most noteworthy, however, was that high levels of social support was associated with decreased levels of depression, and served as a stress buffer even in those children who were abused and genetically at risk. These findings highlight the import of psychosocial factors like social support that can interact with genetic and other environmental risk factors.



Associated Resilience Factors

- Resilience in OEF/OIF veterans is associated with higher levels of unit support, unit cohesion, and post-deployment social support.
- Resilience is negatively correlated with dimensions of personality in active-duty and reserve component personnel: Namely neuroticism and introversion
- Resilience is associated with hardiness
- Resilience is negatively correlated with baseline levels of dissociation

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Need to Know

When servicemembers head for deployment, they ensure they have all of their legal, financial, and family affairs in order. Of course, no one likes to think about the possibility of not coming home, but that is the brutal reality of the jobs and sacrifices of our servicemen and women. Now there's a new twist in servicemember's preparations for the unthinkable: Some of the men are leaving deposits at sperm banks before heading overseas and there are two main reasons why they are doing this.

One is obvious: If they are killed, then their wife will still be able to have their baby. The other reason is fear of injury or illness. While the ultimate choice is yours to make, it is something you may want to consider. (Some information extracted from a past article printed by MSNBC)

Unfortunately, this is a procedure that is not covered by TRICARE. However, the 6th Medical Group may be able to do some of preliminary blood work which can add up to modest savings for the member. To obtain additional information regarding cryopreservation, visit the The Reproductive Medicine Group at: http://floridafertility.com/Male/sperm cryo.aspx.

The following testimonial was submitted by a Sergeant First Class from the 3rd Special Forces Group who currently serves as theWest Coast Liaison Officer for the Care Coalition.

It's not something you talk about in everyday conversation. My wife and I never even thought about it until after we needed it, but it is something that every servicemember should do before a deployment.

I'm not going to tell you that you must do this, but I will tell you why we wish we had. June 2004, I'm deploying to Afghanistan again for the third time; this is my fourth combat deployment including Iraq as well.

I was 26 and I had been in a couple of good scraps with the bad guys and I walked away every time. I got married the September before, and this would be the third deployment that my wife would experience. It was routine by this point for both of us. We had talked about starting a family but like a lot of young couples, we found excuses for waiting and we agreed that we would wait until after this deployment before we tried.

Three and a half months into the deployment and things are going as usual. The bad guys try to kill us, we kill them, and things are good. Then, September 23rd happened and everything changed. As we were rolling back into our firebase, my vehicle was hit by an IED. Out of the eight men on my team, I was the only one critically wounded. I was aeromedcally evacuated out of theater all the way to Walter ReedArmy Medical Center.

I don't remember the first couple of weeks. When I did start to come around, the only thing that worked was my right hand and right eye. So, needless to say, my first priority wasn't in procreation but in more basic functions like walking or using the bathroom on my own. So a few months and about thirty surgeries later, I'm beginning to become myself again. At this point, the wife and I are curious to know how bad the damage was to my genitals. We approached my urologist and ask him to do a sperm count. The results came back and it devastated us; I had a sperm count of zero. The doctor said we would never have children but I should be thankful that I'm alive and functioning. This affected me more than the loss of my leg. I went around in a catatonic state for a week or more, unsure of how we would get past this.

For the next year I continued rehab and surgeries but the issue of a family kept coming back. We looked into adoption as an option. I'm not against adoption and I'm fairly positive we will adopt in the future at some point, but there was always that lingering question "What would a child of ours look like?" Would it look like me or my wife?

But we then found hope through in vitro fertilization (IVF). One of the doctors was optimistic that he may be able to find viable sperm. But he told us from the beginning that we should be prepared for him to not find anything and that we should have a backup plan. The backup was to go shopping for sperm. There are several websites out there that sell donor sperm. They give you background info, IQ scores, baby photos, and even voice samples of sperm donors out there. This bothered me a bit and my wife asked me if I was ok with it. Being the good husband I am, I lied.

We looked through these websites together trying to find donors that looked like me. I'm sure I would have loved and cared for any child produced by this process, but I would always know that it wasn't my kid. It didn't help that at this very time there was a special on 20/20 about IVF kids searching for their biological donor fathers. To me it was an insult to the mother that gave birth to them and the father that helped raise them. Would our kid do this same thing? But amazingly, they managed to harvest some viable sperm. We went through the IVF cycle and they created the embryos but nothing has ever been easy since I was wounded. The day of the embryo transfer into the womb, they warned us that the embryos were of poor quality and our chance of success were slim. We would not know if it worked for three weeks. We went home, we prayed, and we waited.

The day finally came to find out and we got the call; negative on the pregnancy test. My wife cried all day and wouldn't speak to me. A week later she said she needed to get away so she went and visited friends in Kansas. I thought we were done. I had finally hit rock bottom in my life. I was a 28 year old "has been" Green Beret that barely classifies as a man anymore. I thought about suicide but other events in the family came up and managed to distract us long enough to get us past this period of our lives.

Another year went by and we decided to give IVF another try. Fortunately we still had some frozen sperm of mine from the last IVF cycle. We went in again knowing as a fact that it may not to work. We did some research into alternative methods that may help our chances with IVF. My wife changed her diet, tried herbal remedies, and went to acupuncture. This time around everything went better. The embryos were of high quality and one took hold in the womb. It wasn't smooth sailing after that though. Somewhere around week 9 or 10 my wife started spotting one morning and it freaked us both out because we thought it may be a spontaneous abortion. Fortunately, it was nothing and we had a relatively uneventful pregnancy. Our son Wyatt was born on February 5th, 2009. He's happy, healthy, and we couldn't be happier.

Our story had a happy ending thankfully. But others may not be as fortunate as we were. I implore you to consider sperm banking if you are still deploying. Many sperm banks offer free storage for the first year for military members. Storage fees after that are minimal, less than $400 a year. Like I said earlier I wish we had done it before that deployment. If we had it would have alleviated more than half of our troubles throughout this process.

Photo Gallery

Afghan dental patients wait for their chance to be treated at a village site in Zabul Province.
Photo courtesy of CPT Charles F Craft

Proper field sterilization of dental surgical instruments is a key safety concern in rural areas of Afghanistan.
Photo courtesy of CPT Charles F Craft

Joint Afghan-U.S. dental team performing emergency dental care in Zabul Province.*Photo courtesy of CPT Charles F Craft*

Young Afghan boy receives oral hygiene items during a village dental outreach mission in Zabul Province.
Photo courtesy of CPT Charles F Craft

Girl gets quick dental check outside her village in Zabul Province. *Photo courtesy of CPT Charles F Craft*

Afghan boys show their smiles outside their village in Zabul Province. *Photo courtesy of CPT Charles F Craft*

Young Afghan boy gets a fast oral inspection by a U.S. team member near the dental outreach site. *Photo compliments of LTC Bob Harrington*

A smile in the Deh Rawud clinic after treatment for a painful dental abcess.
Photo compliments of LTC Bob Harrington

An Afghan man receives a dental exam while holding his young daughter in a rural village location. *Photo courtesy of CPT Charles F Craft*

18D performing an extraction on a Iraqi soldier on Syrian border.
Photo compliments of LTC Bob Harrington

18D performing an extraction on a Iraqi soldier on Syrian border.
Photo compliments of LTC Bob Harrington

18D using portable electric drill to treat cavity on a Iraqi soldier
Photo compliments of LTC Bob Harrington

Meet Your JSOM Staff

EXECUTIVE EDITOR

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Prior to becoming the USSOCOM Command Surgeon, COL "Tom" Deal served in staff positions at USASOC, JSOC, 7th SFG, and XVIII Airborne Corps. He has commanded field and stateside hospitals and served as Chief of Surgery in the 86th Evac Hospital in ODSS and at Army and civilian community hospitals.

COL Deal obtained his medical degree from University of Tennessee College of Medicine, Memphis, Tennessee, 1974. He completeted his general surgery residency at Brooke Army Medical Center 1977-1981 and is certified by the American Board of Surgery.

COL Deal competed his Flight Surgeon's Course – 2003, Army War College – 1997, Command & General Staff College – 1994, AMEDD Officer Advanced Course – 1991, Military Free Fall School – 1977, Special Forces Officers Course – 1976, and Airborne School – 1975.

COL Deal has also completed Combat Casualty Care Leadership Course (C4A) –1991, Pre-Command Course, Fort Leavenworth – 1994, Senior Officer's Legal Orientation, Charlottesville -- 1994, Combatant Commander's Surgeons Course – 1996, AMEDD Pre-Command Course, Fort Sam Houston – 1998, Basic Life Support – current, Advanced Cardiac Life Support, Advanced Trauma Life Support, and Pilot, single engine, land, instrument.

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Lt Col Landers joined the Army Reserve in 1987 and served as a nurse in a Combat Support Hospital unit for three years before switching services in 1990 to become an Air Force C-130 Flight Nurse. She is currently an IMA reservist attached to the SOCOM/SG office where she has been in charge of management, production, publication, and distribution of the JSOM since its inception in Dec 2000. Lt Col Landers has a Bachelors in Nursing and a Masters in Business Administration/Management. Her 24 year nursing career includes being a flight nurse in both the military and private sector, 15 years of clinical experience in emergency and critical care nursing as well as being an EMT and a legal nurse consultant. She also served as the military liaison to the FL 3 Disaster Medical Assistance Team (DMAT). Prior to the SG office, Lt Col Landers' experience at USSOCOM includes an assignment in the Center for Force Structure, Resources, Requirements, and Strategic Assessments.

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4. **Important:** Include an abstract, biography, and headshot photo of yourself as part of the article. Important: Include an abstract, biography, and headshot photo of yourself as part of the article. Include three learning objectives and ten test questions if article is submitted for continuing education.
5. Use a minimum of acronyms; spell out all acronyms when first used. Remember that your audience is inter-service, civilian, and international.
6. Put the point of the article in the introductory paragraph and restate it in the closing or summary. Subtlety is not usually a virtue in a medical publication.
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Special Forces Aidman's Pledge

As a Special Forces Aidman of the United States Army, I pledge my honor and my conscience to the service of my country and the art of medicine. I recognize the responsibility which may be placed upon me for the health, and even lives, of others. I confess the limitation of my skill and knowledge in the caring for the sick and injured. I promise to follow the maxim "Primum non- nocere" ("First, thou shalt do no harm"), and to seek the assistance of more competent medical authority whenever it is available. These confidences which come to me in my attendance on the sick, I will treat as secret. I recognize my responsibility to impart to others who seek the service of medicine such knowledge of its art and practice as I possess, and I resolve to continue to improve my capability to this purpose. As an American Soldier, I have determined ultimately to place above all considerations of self the mission of my team and the cause of my nation.

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".

~ Harry D. Penny, Jr. USN Copyright 1975

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