Spring 2009

A Chapter of the American College of Emergency Physicians

Government Services EPIC

President's Message

Greetings to all,

It is my privilege to be able to speak to you through this first issue of the 2009 Epic. The 2009 year has begun with a bang as this year's Joint Services Symposium on the River Walk was an incredible success. We were able to bring together a very talented group of speakers to help further everyone's education. The curriculum was one of the best that I have seen to date. This is in great part to the incredible work of LTC Torres. Thanks also to MAJ Brad Younggren who developed the Ultrasound Courses. The attendance was the highest in many years. I want to personally thank all of the speakers and attendees that made this venture such a wonderful success. But our work is not done; preparations have started for the 2010 Joint Services Symposium. Next year we will be travelling to Lake Tahoe for the first time. The conference committee is beginning the preparatory work to plan for this event.. Everyone should mark their calendars as we hope that everyone will join us on the slopes of Lake Tahoe between 11 and 15 April 2010 for another incredible conference.

The month of April will bring new opportunities for growth for our up and coming leaders within the chapter. We are very pleased to announce that GSACEP will be sponsoring the attendance of three residents to the annual Leadership and Advocacy conference in Washington, DC. The selection was performed by members of the Board of Directors, and I must say it was very difficult choosing our winners as we had such an incredible pool of applicants.

For all who are deployed or will be deploying a new benefit has been made available to you. Thanks to the Sullivan Group free CME is now available to those deployed. For more information, please see our website.

During the next year we look forward to working for all our members ensuring that your voices are heard within National ACEP. I also want to thank all of our members as you are the true core of the chapter, but at the same time I would like to challenge EVERYONE to get involved in helping improve our profession. The sky is the limit with the talent that our chapter hosts, if you have any ideas of areas to improve our chapter, please contact myself at jrlairet@pol.net or our Executive Director Bernadette Carr at GSACEP@aol.com.

Regards,

Julio Lairet, Maj, USAF, MC

In This Issue

The President-Elect's Column
Maj Melissa Givens, MC, USA

I am still riding the energy high that infected me at JSS in San Antonio. What a phenomenal conference! I want to extend a special thank you to LTC Ron Torres for producing such a well-orchestrated meeting. JSS will move to Lake Tahoe in 2010 (April 11-15) so I already put it on my calendar and I encourage you to do the same. While you are coordinating your schedule for the conference, ask the others in your department if they are GSACEP members. A trip to Lake Tahoe and an outstanding conference is a great way to introduce someone to the GSACEP chapter.

I'm honored to serve as President-Elect, especially for a group of physicians who are boundless in terms of contributions to the government services and the practice of medicine. Thank you for entrusting me with this opportunity. For those I have not had the opportunity to meet . . . yet . . . here is a little background. I am a native of North Dakota, did my undergraduate degree at The United States Military Academy (ring knocker) and medical school at USUHS (proud Rugby team alumni). I came to EM via a Family Medicine internship at Ft Belvoir, VA and a two-year GMO tour with the 1st Cavalry Division at Ft Hoot with a side trip to Bosnia for the better part of one of those years. I did residency at SAUSHEC and then decided I needed more Army commitment so I did a toxicology fellowship at University of Texas Southwestern Medical Center. After fellowship, I had the pleasure of working as the assistant Residency Director at Madigan Army Medical Center and that opportunity provided the springboard to my current job as Residency Director at Carl R. Darnall Army Medical Center, Fort Hood, TX.

I am writing this brief column three days before I take my Army-sponsored vacation in Baghdad. I am excited to deploy again and see the advances in medicine that are occurring in theater. JSS highlighted the strides Emergency Medicine is making in terms of practice enhancement in the combat environment. There has never been a better time to collaborate and take advantage of the wealth of operational experience within our field. This is also a unique opportunity to build relationships between our DoD hospitals and the VA as the patients we care for transition between these organizations.

We have a lot to look forward to in the next year. I challenge all GSACEP members to get involved in chapter activities. For those that are already actively involved, mentor a new member and identify his or her area of expertise that contributes to the chapter. Cruise the GSACEP website and see all the services the chapter has to offer. Each of these products can be attributed to the hard work of GSACEP members who saw a need and worked to resource that need.

I look forward to my tenure as President-Elect. Please feel free to contact me anytime with questions or concerns. My email is melissa.givens@us.army.mil.

The opinions and assertations in this issue are solely those of the authors, or GSACEP, and are not necessarily those of the Department of Defense or any other US government agency.

The 2009 Resident Leadership Award Winners

The GSACEP Board of Directors reviewed submissions of all three services and selected the following residents as recipients of the 2009 Leadership Award:

LCDR Amy Hubert, MD - NMC Portsmouth, VA

LCDR Lanny F. Littlejohn, MD - NMC Portsmouth, VA

CPT Cameron Olderog, MD - SAUSHEC, San Antonio, TX

Congratulations to the recipients who will attend the ACEP Advocacy & Leadership Conference in Washington, DC, April 19-22. GSACEP pays transportation, hotel and per diem for these future leaders.

The 2009 Research Forum Winners

Best Resident Poster Presentation: Becky Abell, MD, SAUSHEC EM - Rapid, Field Deployable Diagnostics to Fight the War on Dengue

Best Attending Poster Presentation: Brandon K. Wills, MAJ, MC, Sean Bryant, MD, Peter Buckley, LTC, MC, Benjamin Seo, MD - Prevalence of Metformin-associated Lactic Acidosis in Acute Overdose - Madigan Army Medical Center

Best Resident Oral Presentation: Jeffrey Lightfoot, MD, Michael Juliano, MD - Resident Performance in the Setting of Indeterminate First Trimester Ultrasounds - Naval Medical Center Portsmouth, Portsmouth, VA

Best Attending Oral Presentation: Vikhyat Bebarta, MD, Julio Lairet, DO, Patricia Dixon, MS, Anneke Bush, PhD, Rebecca Pitotti, RN, BSN, David Tanen, MD - Hydroxocobalamin And Sodium Thiosulfate Versus Sodium Nitrite And Sodium Thiosulfate In The Treatment Of Acute Cyanide Toxicity In A Swine (Sus Scrofa) Model - SAUSHEC EM

Reflections on my Deployment
by Maj Nora Gerson, USAF, MC

Dr. Gerson recently completed her deployment in Iraq. She is now at Wright-Patterson. She was stationed at Joint Base Balad in Iraq with the 332 AEW/EMDG.

Dr. Annette Williams and Dr. Gerson

Hardest:

1) Several times we received a critically injured patient and discovered that they had non-survivable brain injuries. Unless we were busy with incoming traumas, these patients were usually kept in the trauma bay for comfort care measures until they passed. Although I certainly understood that I would face moments such as these, it never got any easier to sit back and allow them to pass when every bit of me wanted to try and jump in to resuscitate them. It is easy to stay focused on being the "doctor" when there is something we are actively doing to save their lives but I slip into "mommy/sister/daughter" role when the decision has been made to provide comfort care only. I have stood by the gurneys of several patients, holding their hand, stroking their hair, cleaning their faces off, saying a silent prayer for peace for the patient and their family members for several minutes or even hours as they passed.

2) Losing any patient or learning that they only made it to the states to have care withdrawn. It does, however, provide some comfort to realize that the patient made it home to be surrounded by their families and allow the families a chance to say "goodbye."

3) Compartmentalizing grief over the patient we could not save was especially difficult when providing routine, non-emergent care for a detainee caught doing something detrimental to our troops. I believe I successfully did that and provided care to each of these patients to the best of my ability but, sometimes, after a shift like that, I have to remind myself that our young men and women are here fighting and dying to provide the freedom to the people in this country--regardless of people's feeling towards us--and to protect our families at home.

4) Missing my family and friends. Watching my children grow through the webcam. Not being able to be there when my children are not feeling well or sad to comfort them. I guess I found it a bit comical to realize that I was actually feeling bad that I couldn't be there to get puked on when all three of the girls had N/V/D around Thanksgiving. (smile)

"Suck it up and carry on" moments: (these are accurate descriptions but only shared for comic value)

1) Running sick call out of the ED. Actually, this was pretty easy for me to deal with. I just decided from day one that I would be here to support our troops--in any way I could. If that could be done simply by prescribing some Sudafed for their common cold or Motrin for their menstrual cramps, I would do it as cheerfully as possible.

2) Standing on the flight line in 100+ degree heat with full IBA and 40 lb back pack over winter-weight ABUs with no dry spot on my body or clothes trying to get on board a C-130 to fly to Balad and the line stopping while I am halfway up the ramp of the arse-end of the plane with a friend holding on to my uniform to keep me from falling over backwards on the ramp.

3) Coming out of the shower cadillacs in a dust storm and feeling like a powdered donut by the time you reach your hooch since the dust clings to damp skin.

4) Being "groped" by a shower curtain when you tried to avoid that contact at all cost.

5) Salisbury steak or grilled chicken again???

6) Wading through ponds and mud during the rainstorm to get to the gym or work.

7) Dressing up like an insurgent to make it back to your hooch without an eye or lung injury from swirling dust.

8) Discovering that sometimes our patients are much more creative in their attempts to get intoxicated than I initially gave them credit for.

9) Sand flies biting me and leaving welts.

10) Getting two entirely different patient histories by two different interpreters---on the same patient.

11) Having a military working dog as a patient.

12) Getting your "whites" back from the laundry to find that they are now a lovely shade of brown/green. Finding out that your underwear is missing but now you have those that belong to someone else in your bag. Hmmmm.....

Favorable memories/moments:

1) Making a difference, no matter how small, to make someone better. There is simply never a greater reward here than realizing that you were part of a team that brought a patient home alive to their family.

2) Making friends and enjoying the camaraderie of my colleagues.

3) Fulfilling my obligations to our profession, our service, and our country.

4) Realizing how blessed I am, especially to have having the friends and family that I do.

5) The comedy routine of Major Aaron Quinn, Lt Brad Clower, and SrA Emilio Martinez. You just have to experience this yourself to appreciate it.

6) Realizing that I am not only a good emergency medicine doctor but a good military doc as well and it is my future to stay in for the long haul.

7) The present my girls made and sent me for Christmas. It was a white shirt box that was decorated with lots of finger paint and glitter by my daughters. Although the box may seem empty, it was stuffed full of love that I could keep and hold close whenever I needed it.

8) Getting my mission home assignment on Christmas day and then booking the trip to Disneyworld that I am surprising my girls with when I get home!

Your Resident Representative
By Capt Joseph D. Novak, USAF, MC

I am excited to begin my two-year tenure as the new Resident Representative to GSACEP, and I would like to start by briefly introducing myself. My military career began in 1994, when I joined the ROTC program at Cornell University. It was a great unit with a very strong Tri-service legacy and sense of community. Four years later, after earning degrees in engineering I found myself at a joint-NATO pilot training program. I then went on to fly the F-15C and flew sorties throughout the world including in Iraq with Army, Navy, and coalition forces. Later, I attended medical school at the University of Chicago, and I am currently an intern at the joint Army-USAF SAMMC EM program in San Antonio.

I feel that the Resident Representative has several roles. My first job is to represent the views of the resident members of GSACEP to the Board. This involves two way communications between the Board and the resident members of GSAEP. I plan on utilizing the web to disseminate high-yield information and to solicit feedback on initiatives and policy. Second, I will ensure that I advocate for policies that concern us all. Regardless of our long term career plans, policies being put into place now will affect us on the line and beyond. This is why it is critically important that the Resident Representative position exists, and through advocacy for residents, I plan on protecting our interests.

My focus for this first year is to increase chapter membership, communication, and coordination. Regarding membership, I plan on first focusing on ACEP members who are not GSACEP chapter members, then on those residents who are not ACEP members. In this day of sweeping healthcare policy change, I believe that ACEP membership sells itself and I hope to convey this to non-members. Increasing communication among chapter residents is also very important. There is a tactical significance to this. Deploying often requires working with a multitude of different agencies in very trying circumstances. Whenever I deployed and saw familiar faces from pilot training, Red Flag, or elsewhere, this immediately made things easier. A common background and language was called upon to increase mission effectiveness and make life easier. This is what GSACEP provides for us and this role cannot be understated. With the ops tempo at a shocking rate and the consolidation of DOD healthcare resources moving forward it is up to organizations like GSACEP to do what they can to make things easier. Finally, I would like to increase coordination within the chapter. The annual convention has been a great vehicle for communication and coordination for years. Another opportunity for increased coordination that we cannot lose sight of is the opportunity to conduct research among our different programs. The data that exists from the recent conflicts and that is being created within our individual programs is a gold mine of knowledge that cannot be lost between the cracks. Working together as a chapter, I believe we can facilitate harnessing more of this data for the good of our patients.

I look forward to the coming years and would love to hear from you. Please e-mail me with any questions or concerns at joseph.novak@lackland.af.mil. It is a privilege to be a part of GSACEP, thank you for voting me in as your Resident Representative.

Sincerely,

Capt Joseph Novak

Col Lee E. Payne
2009 Recipient
of GSACEP Excellence Award

Col Lee Payne, USAF MC, Commander of the David Grant Medical Center, Travis AFB, CA, was voted the recipient of the GSACEP Excellence in Military Emergency Medicine Award. Col Payne was presented with the award at the GSACEP Chapter Lunch on February 10 in San Antonio.

After completion of his medical training at Vanderbilt University, Col Payne completed his residency at The University of Colorado Health Science Center. He entered Active Duty in 1987. His first assignment as an Air Force emergency physician was at Madigan Army Medical Center Dept. of Emergency Medicine. After five years at MAMC, he went to Wilford Hall as a staff EM physician and later became the Chief, Acute Care Division. In the eight years when his career was focused on emergency medicine, he participated in grant funded research, presented at multiple conferences and published. He was an active leader in GSACEP serving on the Board as Alternate Councilor to ACEP.

In 1995 Col Payne's military career took him down the Command track causing him to leave the full-time practice of EM. This aspect of his career would include three tours as MTF Commander including his current assignment as Commander David Grant Medical Center, the second largest MTF in the Air Force Medical System. He has also served as USCENTAF Command Surgeon where his EM background helped him be a strong advocate promoting military medical operations with the proper focus on trauma and critical care management.

In his current assignment he has found time to remain clinically active as an EM physician, re-engaged with GSACEP, serving as an alternate and then regular Councillor since 2006 and member of the GSACEP Board of Directors. He has maintained his ABEM certification throughout his career. He is also nationally active as a member of the ACEP Quality & Performance Committee since 2007.

Col Lee Payne is a respected role model for emergency medicine doctors, especially in the Air Force. He has demonstrated that is possible to ascend to leadership positions et remain true to one's roots as an emergency physician. His commitment to emergency medicine is demonstrated by his continuous ABEM certification and return to leadership and clinical EM when his career brought him back to a hospital setting. His participation in organized EM while executing the highly demanding job as MTF Commander is impressive.

There are few who find the ability to balance the demands of military leadership and, yet, in the later years of their career still volunteer to be a leader within their own specialty. Col Payne's career impact has been felt beyond the Air Force which is why he was chosen for the Triservice recognition.

Academic Announcements Grants

COL Robert A. De Lorenzo, MD, MSM, FACEP has received over one million dollars in combined grants for the study of combat casualty care. He recently received $450,000 in grants from US Special Operations Command for a demonstration of bedside ultrasound to detect pneumothorax and an engineering design of a blast wave sensor. These are in addition to $600,000 in active grants from the Telemedicine and Advanced Technology Research Center to study intraosseous infusion physiology, ultrasound estimation of fluid status, and diagnostic screening and biosurvelillence of respiratory pathogens. Dr. De Lorenzo is a senior research fellow at Brooke Army Medical Center, Fort Sam Houston, Texas, and a Professor of Military and Emergency Medicine at the Uniformed Services University of the Health Sciences.

Abstracts Presented at The Joint Services Symposium 2009

Title: **Comparison of four hemostatic agents, CELOX-A™ , ChitoFlex®, WoundStat™ and Combat Gauze™, versus standard gauze dressing in control of extremity hemorrhage in a limited access swine model of penetrating combat trauma.**

Naval Medical Center, Portsmouth, VA IRB/IACUC protocol (CIP # P08-045).

Primary Investigator and POC: Lanny F. Littlejohn, MD Emergency Medicine Resident (PGY-4) lanny.littlejohn@med.navy.mil **Assistant Investigators**: John J. Devlin, MD, Sara S. Kircher, BS, RLAT, Robert Lueken, MD, Michael R. Melia, MD, Andrew S. Johnson, MD, Department of Emergency Medicine, Naval Medical Center, Portsmouth

Study Objectives: Exsanguination from extremity wounds remains the leading etiology of preventable combat death. We conducted a randomized, prospective, unblinded trial to investigate the efficacy of the most commonly used hemostatic agents in a model of severe vascular injury with mixed high pressure arterial and venous bleeding in a small, linear tract wound that was designed to replicate a penetrating injury from a projectile such as a rifle round or shrapnel where the bleeding site cannot be directly visualized.

Methods: A complex groin injury with transection of the femoral vessels through a 3 cm entrance wound and 45 seconds of uncontrolled hemorrhage was created in 40 swine prior to randomization to 5 groups. Group 1 included standard gauze (SD); Group 2 Celox (CX); Group 3 Chitoflex (CF); Group 4 Combat Gauze (CG); and Group 5 WoundStat (WS). Each agent was applied with 5 minutes of manual pressure prior to resuscitation.Hemodynamic parameters were recorded over 180 minutes. Primary endpoints included incidence (failure of initial hemostasis) and amount of rebleeding.

RESULTS: Rebleeding was seen in 3 of 8 (38%) CX, 3 of 8 (38%) CF, 1 of 8 (13%) CG, 3 of 8 (38%) WS, and 2 of 8 (25%) SD subjects. Post-treatment hemorrhage (rebleeding) volume was 6.088 ml/kg for CX, 7.009 ml/kg for CF, 5.266 ml/kg for CG, 11.148 ml/kg for WS, and 5.576 ml/kg for SD subjects. Sequential sampling indicated a trend toward significance between CG subjects and WS subjects (p=0.133).

Conclusions: Our study demonstrated no statistically significant differences among the five treatment arms in the primary outcomes measured. To determine if the observed trend continues, and thus a difference exists, sampling will be extended to enlarge the current sample size. Keywords: hemostatic agent; trauma; combat; hemorrhage; swine

---

Prospective Randomized Trial of Antibiotic Treatment for Uncomplicated Skin Abscesses in Patients at Risk for Community Acquired Methicillin-Resistant Staphylococcus Aureus Infection.

Timothy Livengood, MD, CPT, USA[1]; Gillian Schmitz, MD[2]; Cameron Olderog, MD, CPT, USA[1]; Justin Williams, MD[3]; Michael Barakat, MD, Capt, USAF[2].

[1]SAUSHEC Emergency Medicine Residency, San Antonio, Texas. [2]Wilford Hall Medical Center, San Antonio, Texas. [3]Brooke Army Medical Center, San Antonio, Texas.

Study Objective: Community-acquired methicillin-resistant Staphylococcus aureus (cMRSA) abscesses have been increasing in prevalence in the emergency room. Retrospective studies have had mixed results in determining whether or not antibiotics improve outcome or decrease recurrence rates. One randomized prospective study using keflex failed to show antibiotics to be of benefit beyond incision and drainage (I&D) alone in treatment of uncomplicated abscesses, however keflex does not have activity against MRSA. Our study seeks to determine whether incision and drainage followed by the administration of trimethoprim-sulfamethoxazole, which has activity against cMRSA, may prevent recurrence of abscesses better than I&D alone.

Methods: Immunocompetent patients ages 18-55 with uncomplicated cutaneous abscesses were randomized either to receive I&D followed by one week of trimethoprim-sulfamethoxazole or to receive I&D alone. At the end of 30 days the patients were contacted by investigators who were blinded to the study groups and asked whether or not they had formed a new abscess. Recurrence was defined as a new abscess in the same or different location requiring additional incision and drainage or treatment. Results: 28 of the 31 patients initially enrolled were able to be reached on follow up at 30 days. 8.3% (1/12) of those who received I&D alone had a recurrence, while 0/16 of those who received antibiotics had a recurrent abscess. The prevalence of MRSA in this study group was 55% (17/31) and the only patient who had a recurrence was MRSA positive.

Conclusions: Our preliminary data suggests that antibiotics may have some benefit in the prevention of recurrence of cMRSA abscesses, but the sample size is too small yet to draw any conclusions as there was only one recurrence. A larger prospective trial using medications with activity against cMRSA is necessary to fully answer the question.

MRSA+	17			
Non-MRSA	14			
Abx	16			
	MRSA	9	Recurrence	0
	No MRSA	4	.Recurrence	0
	Unknown	3	Recurrence	0
No Abx	13			
	MRSA	7	Recurrence	1
	No MRSA	4	Recurrence	0

Title: Hydroxocobalamin and Sodium Thiosulfate Versus Sodium Nitrite And Sodium Thiosulfate In The Treatment Of Acute Cyanide Toxicity In A Swine (Sus Scrofa) Model

Authors: Bebarta, Vikhyat MD 2: Lairet, Julio DO 3: Dixon, Patricia MS 4: Bush, Anneke PhD 5:Pitotti, Rebecca 6: Tanen, David MD

Background: Hydroxocobalamin (HOCOB) is considered a more practical antidote for cyanide (CN) toxicity because of fewer serious adverse effects. No study has directly compared HOCOB and sodium nitrite (SN) with sodium thiosulfate (ST) in an acute CN toxicity model.

Objective: To compare the return to baseline of mean arterial blood pressure (MAP) between 2 groups of swine suffering from acute CN toxicity and treated with HOCOB+ST or SN+ST

Methods: 24 swine (38-42 kg) were intubated, anesthetized and instrumented (continuous arterial and cardiac output (CO) monitoring) and then poisoned with a continuous CN infusion (0.20 mg/kg/min), until severe hypotension (50% of baseline MAP). Animals were then randomly assigned to HOCOB (150 mg/kg) + ST (25 mg/kg) or SN (10 mg/kg) + ST (25 mg/kg) infused over 10 minutes and monitored for 40 minutes after start of antidotal infusion. Twenty animals were needed for 80% power (alpha 0.05). RMANOVA and post hoc t-test were used for determining significance.

Results: Baseline mean weights, time to hypotension (31 min 3 sec vs. 28 min 6 sec), and CN dose at hypotension (5.57 vs 5.91 mg/kg) were similar. One animal in the HOCOB and 2 animals in the SN group died during the study and were excluded from analysis.HOCOB resulted in a faster return to baseline MAP with statistically significant improvement beginning at 5 minutes and lasting through the conclusion of the study ($p < 0.05$). No statistically significant difference was detected between groups for CO, HR, SVR, or mortality. Mean CN blood levels (4.03 vs. 4.05) and lactate levels (peak 7.9 vs. 8.1 mmol/L) at hypotension were similar. Lactate levels (5.1 vs 4.48 mmol/L), pH (7.40 vs. 7.37) and base excess (-0.75 vs. 1.27) at 40 minutes were also similar.

Conclusion: HOCOB+ST led to a faster return to baseline MAP compared to SN+ST in this acute CN toxicity hypotensive swine model. Given HOCOBs lack of serious adverse effects, it may be the best choice in the treatment of acute CN toxicity.

Title: Bedside Emergency Ultrasound Training In The Dominican Republic

Type: Process Improvement, Poster – IRB oversight not applicable

Institution: Department of Emergency Medicine, Naval Medical Center, Portsmouth, 620 John Paul Jones Circle, Portsmouth, VA 23708

Primary Investigator: LCDR Jonathan E. Clarke, M.D., PGY-4 EM Resident, Jonathan.Clarke@med.navy.mil,(757)953-1365, DSN 388

Secondary Investigators: LCDR Michael Juliano, M.D., NMCP Attending Emergency Physician, Michael Owens, M.D., NMCP Attending Emergency Physician

Background: Use of bedside ultrasound as an aid for diagnostic and procedural purposes in emergency departments is quickly becoming standard of care in the United States. However, this modality remains underused in developing countries. Improved access to equipment and training in these settings may improve quality of healthcare.

Objective: Our aim was to provide formal training in bedside emergency ultrasound to residents of a newly founded emergency medicine program in a developing country. Prior to this course, there was limited instruction in bedside ultrasound and little practical experience among trainees.

Methods: We delivered a three day ultrasound course to 29 emergency medicine and general surgery residents at Hospital General Plaza de la Salud, Santo Domingo, Dominican Republic. This is an urban emergency department with approximate annual census of 35,000 patients. The course was proctored by two attending staff and five residents from our program, and consisted of lectures and hands on practical sessions with volunteer patients and procedural simulators. Topics included ultrasound physics, FAST, cardiac and critical care ultrasound, diagnosis of deep vein thrombosis, aorta, gallbladder, and renal disease, first trimester pregnancy, and ultrasound guided procedures.

Results: Informal surveys were completed by trainees to assess their knowledge and proficiency with emergency ultrasound before and after the course. Course feedback was very positive and all participants reported significant gains in their knowledge and practical skill in emergency ultrasound.

Conclusions: With improved access to equipment and ongoing formal training, the use of bedside emergency ultrasound in developing countries has the potential to positively impact the quality of healthcare.

Experience with Thrombolytic Use for ST Elevation Myocardial Infarction Among Emergency Medicine Residents in the United States

Authors: MAJ Melissa Givens MD, MPH, Carl R. Darnall Army Medical Center, Fort

(continued on page 6)

(continued from page 5)
Hood, TX, Melissa.givens@us.army.mil • MAJ David Masneri DO, Womack Army Medical Center, Fort Bragg, NC • CPT Michael Thomas PA, Carl R. Darnall Army Medical Center, Fort Hood, TX

Objective: The purpose of this study is to describe patterns of thrombolytic use for ST elevation myocardial infarction (STEMI) in Emergency Medicine Residencies in the United States

Methods: This is an IRB approved observational study in which investigators emailed a survey to all Emergency Medicine Residency Program Directors in the United States. Follow up emails were sent to non-responders one week following the initial mailing and then follow-up phone calls were made to those not responding electronically. The relationship between setting, on-site access to cardiac catheterization laboratory, emergency medicine (EM) rotations at community medicine sites and experience with the use of thrombolytics for STEMI was determined using logistic regression analysis.

Results: Sixty-five programs of 142 responded. For the 64 who described their residency setting 49 (78%) were urban, 8 (13%) suburban, and 7(11%) community hospitals. Sixty-one (95%) of the respondents reported on-site access to a cardiac catheterization lab. Twenty-five (39%) of the respondent programs have away EM rotations at facilities with no catheterization lab on site. Nineteen programs (30% 95CI 18%-40%) reported thrombolytic use as "none" in both parent and away sites. There was a significant relationshipin use of thrombolytics between practice settings in the parent EM facility ($p<0.001$) but not at away rotations ($p<0.05$). There was a significant relationship between the availability of on-site catheterization and the use of thrombolytics at the parent EM facility ($p<0.001$) and also between rotations that have no access to cardiac catheterization laboratory and the use of thrombolytics ($p<0.001$).

Conclusions: Many Emergency Medicine training programs rely on cardiac catheterization labs for the treatment of STEMI. Residents may graduate from training without the opportunity to manage a patient with STEMI with thrombolytic therapy. EM rotations away from the parent facility may provide the opportunity for thombolytic use but this is dependent on the availability of a cardiac catheterization lab. Residents entering the workforce may be unprepared to manage STEMI patients in hospital settings without access to cardiac catheterization. Residency programs should take this into consideration when designing the curriculum.

Ultrasound Detection of Pneumothorax with Minimally Trained Sonographers: A Preliminary Study

CPT Jonathan D. Monti PA-C, MAJ Bradley Younggren MD, Robert Blankenship MD, Department of Emergency Medicice, Madigan Army Medical Center, Ft Lewis, WA

Primary Investigator is a physician assistant currently enrolled in the joint US Army/ Baylor University DSc Emergency Medicine Physician Assistant Program at Madigan Army Medical Center

This study was accepted for presentation at the December 2008 Special Operations Medical Association Conference in Tampa, FL and is currently pending review for publication in AMSUS Journal of Military Medicine. This study was approved by the Madigan Army Medical Center Institute for Animal Care and Use Committee.

BACKGROUND: Prompt recognition and treatment of a tension pneumothorax is critical to reducing mortality in both military and civilian settings. Non-physician providers are often the first medical providers to care for combat trauma patients with penetrating chest trauma and frequently have limited diagnostic capabilities available to them. This study demonstrates that with minimal training non-physician providers can accurately determine the a bsence or presence of a pneumothorax with a portable ultrasound machine.

METHODS: Physician Assistants, SOF and conventional force medics, veterinary technicians, and food service inspectors, all naïve to ultrasound, were recruited for this study. Participants underwent a brief presentation on detection of a pneumothorax by ultrasound and were then asked to perform a thoracic ultrasound examination on euthanized, ventilated swine. Some of the swine were induced with a pneumothorax prior to these examinations, and all participants were blinded to the absence or presence of a pneumothorax.

RESULTS: Twenty-two participants examined a total of 44 hemithoraces. A total of 21 out of 22 pneumothoraces were correctly identified with one false-negative. 22 of 22 normal hemithoraces were correctly identified for a sensitivity of 95.4% (95 % CI 0.75-0.99), and a specificity of 100% (95% CI 0.81-1.00), with PPV of 100%, NPV of 95.6%.

CONCLUSIONS: Non-physician healthcare providers can accurately detect a pneumothorax with portable ultrasound after receiving minimal focused training. Consideration should be made for the incorporation of concise ermergency ultrasound training into the training of non-physician providers such as physician assistants, SOF, and conventional force medics.

Impact of operational conditions on medication concentration: A Pilot Study

Authors: MAJ Melissa Givens MD, MPH, Carl R. Darnall Army Medical Center, Fort Hood, TX, Melissa.givens@us.army.mil • CPT Cynthia McPherson MPAS, PA-C, Carl R. Darnall Army Medical Center, Fort Hood, TX • CPT Andrew Kagel MD, 1ST BCT, 4ID • COL Bruce Adams MD, William Beaumont Army Medical Center, Fort Bliss, TX

Objective: Military providers need to be able to deliver the right medication, to the right patient, with the right dose, at the right time. Stability of medications in austere environments has not been fully elucidated. EMS literature describes degradation of resuscitation medication in pre-hospital conditions inside ambulances. Other studies have shown a degradation of succinylcholine at a rate of up to 30% per month at room temperature. The purpose of this study is to conduct a pilot study of remaining drug concentration in medications routinely carried in a deployed environment to determine if significant degradation occurs.

Methods: Four medications (naloxone 0.4mg/mL, succinylcholine 20mg/mL, epinephrine 0.3mg (Epipen®), and etomidate 20mg/10mL) were obtained from the operational theater, specifically those carried in an aid bag of a brigade surgeon on missions with exposure to typical conditions outside a temperature regulated environment with extremes of heat for a period of 9 months. The medication concentration was measured using standard protocol for reverse-phase HPLC and results reported as percent purity as compared to standard sample.

Results: Four medications were tested for remaining drug concentration.Naloxone and etomidate maintained 100% purity. Epinephrine remained 99% pure and succinylcholine retained 97% purity. All medications had reached their expiration date at the time of testing.

Conclusions: Stability of drugs in operational environments is crucial to quality care of the soldier in forward operations. Despite previous reports in literature of medication degradation in non-standardized storage conditions, our pilot study did not show significant degradation of medication purity despite exposure to extremes of temperature and medication reaching the end of its shelf life. Further studies need to be undertaken that explore the effects of operational conditions on medication stability.

Resident Performance in the Setting of Indeterminate First Trimester Ultrasounds

Authors: Jeffrey Lightfoot MD, Michael Juliano MD

Institution: Naval Medical Center Portsmouth, Portsmouth, VA

IRB approval: Yes

POC: Dr. Jeffrey Lightfoot 240-460-9023, jeffrey.d.lightfoot@med.navy.mil, Jeffrey Lightfoot, PGY-4, 3rd year resident, Michael Juliano, Staff Attending

Objective: In early pregnancy the essential element of the Emergency Department (ED) ultrasound (US) is its ability to diagnose an intrauterine pregnancy (IUP). The ED US can be indeterminate, finding an empty uterus or empty gestational sac. This study assessed how well ED residents performed in the setting of indeterminate US in first trimester pregnancies as compared to US performed in the radiology department.

Methods: Naval Medical Center Portsmouth is a military teaching hospital with an average of 80,000 ED visits per year. First trimester symptomatic pregnancy complaints account for approximately 150 patient encounters per month. We performed a retrospective chart review of all patients diagnosed with: pregnancy, abortion (threatened, spontaneous, complete, incomplete or missed), embryonic demise or ectopic pregnancy who presented to the ED between the dates of December 2005 and September 2006. Those charts were then evaluated for the following inclusion criteria: 1) positive pregnancy test in the first trimester, as determined by last menstrual period; 2) US evaluation by the emergency physician that is deemed to be indeterminate; 3) subsequent formal US prior to ED discharge. The results of the ED US were then compared to the formal US findings.

Results: 209 women met inclusion criteria. Of those, 158[m1] (75.6%; 95% CI 69.8-81.2%) had similar findings on both formal and ED US; 35 (16.7%; 95% CI 11.6-21.8%) had an IUP on formal US (fetal pole or yolk sac) and 16 (7.7%; 95% CI 4.1-11.3%) had signs suggestive of ectopic pregnancy (adnexal mass or free fluid) that weren't seen on ED US. 38 total formal US had signs of ectopic pregnancy of which 22 were also documented on the ED US.

Conclusion: ED US performed by residents have a high level of accuracy when compared to formal US. However, 7.7% of formal ultrasounds had findings suggestive of ectopic pregnancy that weren't seen in the ED.

Intern Training: Educational Innovations

LCDR A. Hubert (Res.), LCDR W. Dennis (Attending)

Objective: Implementation of a new procedure-based teaching curriculum to enhance the educational experience of rotating interns in the emergency medicine department of a military teaching hospital.

Background: Prior emergency medicine intern training was an unstructured combination of bedside teaching and lecture-based didactics.Interns would occasionally complete their rotation without experiencing procedures essential to emergency medicine practice.Moreover, informal sampling demonstrated that many interns begin their residency training with minimal procedural experience.The intern curriculum was therefore restructured.

(continued on page 7)

(continued from page 6)

Methods: A curriculum utilizing weekly, 4 hour, hands-on training precepted by Naval Medical Center Portsmouth senior emergency medicine residents and staff was developed. Emphasis was placed on airway skills, central lines, lumbar puncture, slit lamp exams, ultrasound, "tricks of the trade," and utilization of the command simulation center.

Results: Formalized feedback from rotating interns has uniformly positive. We now routinely entertain requests from matriculated interns, medical students, physician assistants and Navy general medical officers to enroll in this training program. Due to the positive feedback, we have taken these training exercises to the military's tri-service medical school to teach students basic procedural skills.

Conclusion: Patient care has changed and young trainees are unable to complete an adequate number of procedures. Qualifications must be done, sign-off's need to be finished, verified, and senior residents/staff get priority. Interns and medical students are not obtaining the procedural experience necessary to become competent physicians. Our educational sessions provide a unique opportunity for interns and medical students to practice and to master basic qualifications essential in every field of medicine.

An Army Aviator with Buldging Neck Veins

Benjamin L. Baker, DO (house staff) • Chris Strode, MD (attending staff), Department of Emergency Medicine, Madigan Army Medical Center, Fort Lewis, WA.

Study Objective: To discuss the common presenting signs and symptoms, classic and evolving etiologies and emergency department (ED) adjuncts and definitive treatments of Superior Vena Cava (SVC) Syndrome.

Method: Case report and clinical images of an Army OH-58D pilot presenting with buldging neck veins, two months of dry cough and recent counseling by his unit for increasing run time on his Physical Fitness Test.

Results: Not applicable for case report with clinical images.

Conclusion: SVC Syndrome is caused by intraluminal thrombosis or external compression. ED adjuncts can temporize effects of this syndrome while definitive treatment depends on the etiology-which is currently evolving. A wide differential diagnosis must be considered when patients present to the ED.

Consent: The author has the patient's signed photo consent available upon request.

Address for correspondence: Benjamin L. Baker, DO. Department of Emergency Medicine, Madigan Army Medical Center, 9040 Jackson Avenue, Tacoma, WA, 98431. Email: benjamin.lee.baker@us.army.mil

Correlation of a portable, non-invasive hemoglobin monitor with venous blood levels

Eric Tomich, DO • Tristan Knutson, MD • David Della-Giustina, MD • Brandon Wills, DO, MS • Emily Merchant, MD, Department of Emergency Medicine, Madigan Army Medical Center, Tacoma, WA

Study Objective: In most medical settings throughout the world, the only way a medical practitioner can determine hemoglobin concentration is through a percutaneous blood draw, a process that can take over an hour to yield results. The Masimo Rainbow SET® is a recently FDA approved device which performs non-invasive oximetry and estimates venous hemoglobin measurements. Within one minute of placing the probe on a patient's finger, an estimated hemoglobin level is determined. This technology has the potential to positively impact the care of our sickest patients in the Emergency Department (ED) and patients in austere environments without modern laboratory capabilities. Our study evaluates the accuracy of this technology by comparing non-invasive hemoglobin measurements with venous levels in ED patients. This is the first study using this technology in an ED population.

Methods: This is a prospective, observational, cross-sectional study of adult patients presenting to a high-volume, military Emergency Department. A convenience sample of patients requiring a complete blood count is being enrolled. We are evaluating the performance of non-invasive hemoglobin determinations over both normal and abnormal hemoglobin concentrations. Venous hemoglobin values are categorized into four groups. Group one represents the normal reference range for venous hemoglobin which is 11.5-17. Group two represents values less than 11.5. Group three represents values greater than 17. Group four represents all measurements. Data is summarized for each hemoglobin group with the mean absolute difference between venous and probe values with a 95% confidence interval.

Results: Pilot data collected from 37 patients is presented. The mean probe and venous hemoglobin were 12.4 and 12.8 g/dL respectively. The probe averaged 0.4 g/dL less than the actual venous sample. The mean absolute difference between probe and venous hemoglobin concentration was 1.3 g/dL (95%CI 0.9-1.7) with a correlation coefficient of 0.7.

Conclusion: Within relatively normal hemoglobin ranges, estimates of venous hemoglobin were generally within 1.3 g/dL of actual measurements. Further study will need to correlate estimates in abnormal hemoglobin ranges.

Prevalence of Metformin-associated Lactic Acidosis in Acute Overdose

Brandon K. Wills, MAJ, MC[1,2] Sean Bryant, MD[3], Peter Buckley, LTC, MC[1], Benjamin Seo, MD[1]

[1]Department of Emergency Medicine, Madigan Army Medical Center, Tacoma, WA [2]Washington Poison Center, Seattle, WA [3]Illinois Poison Center, Chicago, IL

Corresponding Author: Brandon Wills, MAJ, MC, MCHJ-EM, Tacoma, WA 98431 (253) 968-1250, (253)968-2550 fax, bkwills@gmail.com

Introduction: Metformin associated lactic acidosis (MALA) is well described in patients taking therapeutic metformin who develop renal failure or other serious co-morbid conditions. MALA from acute overdose has also been described in case reports but is debated by some clinicians, arguing that metformin overdose does not cause lactic acidosis. Our aim was to perform a multi-center poison control database review to determine the prevalence of MALA in mono-overdose in patients with no co-morbid conditions.

Methods: This was a retrospective chart review of the Illinois and Washington Poison Centers between the 2001-2006 and 1999-2006 respectively. Metformin overdoses that were referred to healthcare facilities were categorized into mono-overdose with or with out MALA, and polypharmacy overdose with or without MALA.

Results: The overall prevalence of MALA was 14 out of 412 (3.4%) cases referred to a healthcare facility. MALA prevalence in mono-overdose and polypharmacy overdose were 9.1% and 0.7% respectively. There was one death out of 132 mono-overdoses referred to healthcare facilities. There was no evidence of hypotension in 57% of the mono-overdose MALA cases.

Conclusions: Metformin associated lactic acidosis can occur from a mono-overdose even with preserved hemodynamics and no co-morbidities. Dosages which place patients at risk for MALA will require additional study.

Success of Endotracheal Intubation by Novice Users: A Comparison of Glidescope, Airtraq and Macintosh Laryngoscopes

Authors: Ryan G. K. Mihata MD; James E. Brown MD; Thomas Masters MD; Gregory Kennebeck MD

Objectives: We compared the Airtraq (King System Corporation), Glidescope Ranger (Verathon, Inc.), and direct laryngoscopy (Macintosh) in time required for successful intubation and perceived ease of use in novice intubators.

Methods: After institutional IRB approval, a prospective crossover trial with 48 medical students with no prior intubation experience was accomplished. We used a convenience sample of volunteer medical students. Students were randomized to one of six groups using the devices in different orders. Each student intubated a manikin with each of the three devices in four scenarios: normal airway, difficult airway (cervical spine immobility), difficult airway (pharyngeal swelling), and repeat normal airway.

Results: After each attempt subjects rated the ease of use of the device using a Likert scale. Airtraq and Glidescope were consistently rated easier to use than the Macintosh. In most scenarios, Airtraq was rated easier to use than Glidescope. In the initial scenario, Airtraq (mean=15.8) was faster ($p=0.026$) than Glidescope (mean= 21.5), which was faster than Macintosh (mean=26.0) ($p<0.01$). No significant differences in time to intubation between the devices in the cervical spine immobilization scenario were seen. With pharngeal swellling, Airtraw (mean=10.3) yielded faster times than Glidescope (mean=13.9) and Macintosh (mean=16.8) ($p<0.05$). There was a significant decrease in time to intubation and a significant increase in ease-of-use with all devices between the first and last scenarios.

Conclusions: For novice users, Airtraq and Glidescope show significant advantages in time to intubation as well as perceived ease-of-use when compared to direct laryngoscopy. Airtraq outperfromed Glidescope in most scenarios. We saw improvement in time to intubation as well as ease-of-use over a short training period.

Prospective Randomized Trial of Septra for Uncomplicated Skin Abscesses in Patients at Risk for Community Acquired Methicillin-Resistant Staphylococcus Aureus Infection.

Cameron Olderog, MD, CPT, USA[1]; Gillian Schmitz, MD[2]; Timothy Livengood, MD, CPT, USA[1]; Justin Williams, MD[3]; Michael Barakat, MD, Capt, USAF[2]

[1]SAUSHEC Emergency Medicine Residency, San Antonio, Texas. [2]Wilford Hall Medical Center, San Antonio, Texas. [3]Brooke Army Medical Center, San Antonio, Texas.

Study Objective: Communtiy-acquired methicillin resistant staphylococcus aureus (CA-MRSA) is emerging as a common etiology of skin and soft tissue infections. The treatment of abscess caused by CA-MRSA is controversial and the role of antibiotics in the treatment is debatable. This study sought to determine whether antibiotics in addition to incision and drainage improved outcome at 7 days of therapy.

Military Relevance: MRSA is particularly common among athletes and military personnel. Identifying an optimal treatment strategy will have a significant impact on treatment on basic military trainees and other military personnel who are at risk of skin and soft tissue infections.

Methods: Patients age 18-55 presenting to the ED with uncomplicated skin abscess who meet study criteria were prospectively enrolled at two military academic emergency departments in San Antonio, Texas. Patients were randomized on enrollment to either re

(continued on page 8)

(continued from page 7)
ceive incision and drainage alone or incision and drainage plus a 7 day course of sulfamethoxazole/trimethoprim. Physicians were blinded on patient re-evaluation at days 3 and 7. The presence of erythema, warmth, purulent drainage, fever, or persistent abscess requiring additional incision and drainage was documentation of treatment failure. Inclusion and exclusion criteria?

Results: Twenty one patients (67%) presented for wound recheck at 7 days. 55% of patients (17) were MRSA positive. 1 patient did not have wound cultures sent. At Day 3, there were 3 treatment failures, one requiring admission for IV antibiotics. All three patients had been randomized to antibiotics. Two of the three patients were MRSA positive. By day 7, there were 7 total treatment failures and 5 were MRSA positive. Of the seven total treatment failures, 4 had been on antibiotics and 3 had I&D only. Of those who were MRSA positive, 9 received antibiotics and 8 did not receive antibiotics. In the MRSA + subset, 33% of patients on antibiotics failed treatment. 25% of those not on antibiotics failed treatment.

Conclusions: In the small amount of data collected, antibiotics did not appear to improve outcome at 7 days, though it is inadequately powered. A prospective, double-blinded, randomized trial is needed to definitively answer the question of the utility of antibiotics in the treatment of CA-MRSA skin abcesses.

Ultrasound in the diagnosis of knee pain in a young adult male

Eric Tomich, DO, Resident Physician-Emergency Medicine, Madigan Army Medical Center; Dept of Emergency Medicine, ERIC.TOMICH@AMEDD.ARMY.MIL, 253-968-2997 or 614-266-6584 • Todd McArthur, MD, Staff Physician-Emergency Medicine, Madigan Army Medical Center; Dept of Emergency Medicine, TODD.MCARTHUR@AMEDD.ARMY.MIL

A 27 year old male presented to the emergency department complaining of left knee pain. He states he injured it while playing basketball just prior to arrival. While attempting a jump shot he felt his knee give out from under him, noted a deformity, and was unable to walk. He admits to mild numbness to the medial aspect of his foot. On physical exam he is unable to ambulate or perform a straight leg raise; the knee is edematous, tender to palpation and has limited range of motion. There is a high riding patella. Sensation is intact distal to the injury, dorsalis pedis pulse is strong and equal.

A plain film radiograph was taken (Figure 1) followed by a bedside ultrasound with a high frequency linear probe of both the affected (Figure 2) and uninjured knee (Figure 3).

Patella tendon rupture is the third most common injury to the knee extensor mechanism behind quadriceps tendon rupture and patella fracture. It is seen primarily in active males <40 years of age. Rupture usually results during eccentric contraction of the quadriceps when the foot is planted and the knee flexed.[1] A force >17 times body weight will often result in rupture, however most patients who tear have pre-existing degenerative changes to the tendon and therefore require less force for injury to occur.[2] Patellar tendon rupture is prevalent in athletes, especially those with patellar tendinopathy, also called jumper's knee, a clinical diagnosis that involves aching pain at the inferior pole of the patella with activity and point tenderness to palpation. Patellar tendinopathy is often a precursor to tendon rupture and has characteristic histopathologic and radiographic appearance. Studies comparing ultrasound (US) and magnetic resonance imaging (MRI) found that US has a better diagnostic accuracy when compared head to head for confirming clinical suspicion.[3] Patients with tendon rupture often complain of sudden pain, a popping or tearing sensation, high riding patella, edema, inability to bear weight or straighten leg against resistance.[2]

While history and physical is often sufficient for diagnosis there is a role for plain film radiographs and bedside US in the emergency department. Plain films may show avulsion fractures or patella alta when the patella resides in a more superior position than normal. Soft tissue swelling and joint effusion may also be seen.[2] US in the diagnosis of patellar tendon rupture is considered by many to be the imaging modality of choice. Its single greatest advantage over MRI is the ability to perform dynamic scanning.[4] Differentiating between partial and complete tears is important in terms of disposition, where complete tears require early operative repair, partial tears can be treated conservatively. This can be difficult at times to determine, as one study showed that up to 1/3 of patients are misdiagnosed initially.[2] Small studies looking at accuracy20of US in diagnosing quadriceps tendon rupture confirmed by surgical findings showed a high degree of correlation.The only misdiagnosis resulted from a patient with delayed presentation, which is a known pitfall of US due to scar tissue formation.[5] Emergency physicians can make rapid and accurate diagnosis using US in civilian and austere environments with little training where MRI is not available or practical.

US of the patellar tendon is best performed with a high frequency linear probe. Optimal visualization of the tendon occurs when the knee is flexed to 30-45 degrees. In a longitudinal plane the tendon is scanned, but it is important that the probe be kept parallel to the fibers so as to prevent anisotropy, a phenomenon that will create the appearance of hypoechoic bands, which can mimic tears or fluid. The normal appearance of the tendon is a series of parallel hyperechoic bands except at places of insertion. Peritendinous fluid or hypoechoic spaces between fibrils may represent patellar tendinosis.[6] Tendon ruptures will show a discontinuity of the hyperechoic fibrils with hematoma filling the void.Dynamic scanning is accomplished by observing the presence or lack of tendon translation across the area of abnormality when the thigh is squeezed, patella is manipulated or patient attempts to extend the knee.[7] Patients with any type of patellar tendon rupture should be referred to an orthopedist. Delays in repair result in worse outcomes from muscle atropy and contracture. Scar tissue and adhesions also complicate repair. Patients should be kept non-weight bearing, placed in a knee immobilizer and given analgesics.[2]

[1] Enad JG. Patellar tendon ruptures. *South Med J*. 1999;92:563-66.

[2] Maffulli N, Wong J. Ruptures of the Achilles and patellar tendons. *Clin Sports Med*. 2003;22:761-76.
[3] Warden SJ, Kiss ZS, Malara FA, *et al*. Comparative accuracy of magnetic resonance imaging and ultrasonography in confirming clinically diagnosed patellar tendinopathy. *Am J Sports Med*. 2007;35:427-36.
[4] Girish G, Finlay K, Landry D, *et al*. Musculoskeletal disorders of the lower limb-ultrasound and magnetic resonance imaging correlation. *Can Assoc Radiol J*. 2007;58:152–66.
[5] La S, Fessell DP, Femino JE, *et al*. Sonographic of partial-thickness quadriceps tendon tears with surgical correlation. *J Ultrasound Med*. 2003;22:1323-29.
[6] Friedman L, Finlay K, Jurriaans E. Ultrasound of the knee. *Skeletal Radiol*. 2001;30:361-77.
[7] Jacobson J. Musculoskeletal ultrasound and mri: which do I choose? *Seminars in Musculoskeletal Radiol*. 2005;9:135-49.

Rapid, Field Deployable Diagnostics to Fight the War on Dengue

Author: Becky Abell, MD, SAUSHEC

Dengue is a vector-borne disease without an available vaccination or cure that affects populations in tropical and subtropical regions worldwide and poses a significant threat to military operations. Dengue is recognized as an emerging infectious disease globally to include the US. Traditionally virus culturing and identification would take weeks in a laboratory.The development of a rapid field-deployable diagnostic method would allow for a population transmission risk assessment, environmental control, and symptom control avoiding unnecessary medical tests, expenses, and improper treatments that have potentially harmful side effects.The JBAIDS and RAPID are DoD approved analytic platforms that have been previously used to identify biological warfare agents and infectious diseases. A dengue virus RT-PCR freeze dried assay that can detect all four serotypes of the dengue virus in adult mosquitos has previously been documented. Sample preparation and analyses requires less than two hours. This assay was combined with the vector surveillance technique ovitrapping while under austere conditions in Thailand during the rainy season. Of the 4,180 larvae, 202 pupae, and 2,370 eggs collected the RT-PCR performed with the RAPID showed that transovarial transmission of the Dengue Virus does not occur during the rainy season, and has a prevalence of 0.01% during the dry season. The importance of this data combined with previous studies allows for a better understanding of dengue virus transmission and therefore prevention and eradication to decrease patient morbidity and mortality while protecting the fighting force.

Feasibility of nurses and paramedics to establish intraosseous access using the EZ-IO® device in the distal femur of pediatric patients

Author Block: J. R. Lairet[1,2], C. Beamer[3], G.Garcia[4], R. Philo[4]

[1]Wilford Hall Medical Center, Lackland AFB, TX, [2] Indiana University School of Medicine, Indianapolis, IN. [3] Christus Santa Rosa Children's Hospital, San Antonio, TX, [4] The University of Texas Health Science Center at San Antonio, San Antonio, TX

Objective: To establish the feasibility of nurses and paramedics to establish intraosseous access using the EZ-IO® device in the distal femur of pediatric patients.

Methods: We performed an observational study in which 2 paramedics and 3 nurses inserted the EZ-IO® device into the distal femur of pediatric cadavers. The site of insertion was established as 2 cm proximal to the patella on the anterior aspect of the femur. The participants were consented and trained in the placement of the EZ-IO® device. Three (3)complete embalmed pediatric cadavers (average weight 3.3 kg) were selected by availability for the study. Each participant placed an EZ-IO® needle set 9 times between the 6 cadaver legs. Morticians wax was used following each insertion, to cover and fill any external signs of previous insertion attempts. Time of insertion was recorded. A digital x-ray AP and lateral, using a GE C-arm, was taken to determine the precise placement and the presence of complications. Successful placement was defined as placing the EZ-IO® catheter tip securely within the medullary cavity of the anterior distal femur. All data was manually recorded on standardized data collection forms.

Results: A total of 45 insertion attempts were performed. The EZ-IO® was placed correctly on the first attempt in 44 of 45 insertions, (97.8%) success. The catheter was securely seated in 44 of 45 insertions (97.8%). One placement error occurred, defined as improper placement of the needle set. The needle set was placed in the soft tissue medial to the distal femur. There were no cases of placing the needle tip adjacent to the opposite cortex or growth plate, or penetrating the opposite cortex or joint capsule. Average time of insertion was recorded at 3.45 seconds (range 1.2- 6.2seconds).

Conclusion: Our results support the feasibility of nurses and paramedics ability to successfully place the EZ-IO® device in the distal femur of pediatric patients. Limitations include using cadavers for anatomical IO placement analysis and the small number of cadavers used. Further studies should be performed to further evaluate the placement and flow capabilities of the EZ-IO® device in the distal femur of pediatric patients.

Combat Fluid Resuscitation 2009: An Update

Lanny F. Littlejohn, M.D., LCDR MC (FS/DMO) USN
Resident, Emergency Medicine, Medical Director, Tactical Combat Casualty Care
Naval Medical Center Portsmouth, VA

After reading, you can receive a CME credit for this article by visiting gsacep.org, going to the membership section, taking the quiz, and providing the information required. You must be registered at gsacep.org to participate in the quiz, so please do so.

Hemorrhage control and resuscitation are the top priorities in trauma care. Advancement has been made in combat casualty care over the past decade, bringing the killed in action (KIA) rate down for the first time since the Crimean War. Changing strategies in fluid resuscitation are no small part of this, but due to a lack of definitive randomized controlled trials, the optimal resuscitation strategy remains to be elucidated. The ideal combat resuscitative fluid should be durable under a variety of environmental conditions, have the ability to expand plasma volume, be capable of delivering adequate oxygen to the periphery, have a good duration of effect, prevent or reverse coagulopathies, and have no risk of disease transmission or need of crossmatching. These characteristics should be kept in mind when reviewing the following case examples:

Case 1: Baghdad – A 29 year old Marine was on foot patrol when a nearby IED detonated. Open left radius/ulna fractures and open left tib/fib fractures were splinted in the field and proximal tourniquets were applied. Intravenous access was unable to be obtained in the field or enroute. He arrives 40 minutes after his injuries, combative and in shock despite tourniquet use: blood pressure 81/49 mmHg, heart rate 125 .

Case 2: In the mountains of Afghanistan, 10,000 feet above sea level, a 26 year old member of a Ranger Quick Reaction Force is shot in the lower right flank. Hostile fire is suppressed but the only landing zone is still "hot" – Tactical evacuation (TACEVAC) will not be able to arrive until nightfall. His mental status slowly deteriorates over hours.

The Combat Environment

As practitioners of military medicine, a familiarity with the entire spectrum of combat casualty care is essential. If this familiarity does not exist, inappropriate direction and feedback may be given both to the front line medic and to commanders in the tactical operations center. In addition, units such as the Army Forward Surgical Team (FST), the Air Force Mobile Forward Air Surgical Team, and the Navy Shock Trauma Platoon (STP) may encounter combat conditions by the very nature of their missions.[1] Further, the placement of far-forward Emergency Physicians has been shown to bring the case fatality rate (CFR) from 10.45% to 7.14%[2]. Tactical Combat Casualty Care (TCCC) dates back to 1996 when the principles were first published in Military Medicine[3] and has now become the standard for medic/corpsman training throughout the U.S. Armed Services[4]. Because of this, physicians must be aware that current concepts call for little or no resuscitation in the field. TCCC calls for an initial 500 ml bolus of colloid (Hextend) only if there is a poor radial pulse (SBP<80) oraltered mental status (a sign of poor perfusion). This is repeated in 30 minutes only if signs of shock remain. No casualty should receive more than 1L of Hextend in the field. TACEVAC (formerly CASEVAC) is the final phase of TCCC and begins when a vehicle of opportunity engages to transport casualties to the next higher echelon of care. TCCC ends when the casualty has arrived at a higher level of care, usually the Combat Support Hospital.

Resuscitative Fluids

The ideal resuscitative fluid is yet to be found. The debate of crystalloids versus colloids in the treatment of shock has continued unabated for the past five decades. Blood components, while necessary to transport hemoglobin, bring with them increased morbidity and mortality.[5] Artificial hemoglobin carriers have significant side effects that continue to restrict their use in humans. No resuscitative fluid is totally benign and all may potentiate the cellular injury associated with hemorrhagic shock if not used judiciously. These agents should be viewed as medications with specific indications and dosing parameters.

Crystalloids:

Crystalloids designed for resuscitation can be divided into solutions that are either isotonic or hypertonic relative to plasma. Isotonic crystalloids include normal saline (NS) and lactated Ringer's solution (LR). Since the Vietnam War, these have been the primary resuscitative fluids. Aggressive crystalloid resuscitation became the standard of care during this time and volume replacement was recommended at three times the amount of blood loss.[6] This approach was later found to not improve outcomes – contributing to the development of abdominal compartment syndrome and ARDS (known as Da Nang Lung from the era in which it was first characterized).[7],[8] A change in approach to fluid resuscitation did not occur until the mid-1990's when a landmark paper was published demonstrating that delayed fluid resuscitation until the time of definitive hemorrhage control demonstrated at least no difference in mortality, and at best a survival advantage.[9] This is not a new concept – Cannon having written in 1918 that "inaccessible or uncontrolled sources of blood loss should not be treated with intravenous fluids until the time of surgical control."[10] Fluid resuscitation in uncontrolled hemorrhage is now known to dilute clotting factors and exacerbate coagulopathy, worsen acidosis (NS and LR have pH's of 5.0 and 6.5, respectively), and disrupt early thrombus.[11] Although important theoretical differences do favor the use of LR over NS, most studies do not show a difference in outcomes except in severe hemorrhagic shock where NS is associated with greater mortality.[12]

Modification of LR began after the 1999 Institute of Medicine's report on fluid resuscitation indicated that the D-isomer of lactate found in LR was responsible for most of its unfavorable properties.[13] These included increased neutrophil oxidative burst,[14] exacerbation of acute lung injury, and an increase in apoptosis in multiple organ systems.[15] LR in the pure L-isomer form is commercially available and should be favored over the racemic form. Experimental versions of this crystalloid, with lactate replaced by beta-hydroxybutyrate or pyruvate, are now being studied and show a more favorable profile over the racemic form.[16] Since the third phase of TCCC calls for continued resuscitation with LR after colloid has been utilized, the adverse effects of racemic LR must be considered, and all measures taken to ensure supplies are stocked with the pure L-isomer until better versions become available.

Hypertonic Saline (HTS) was first studied as early as 1919 (Weed, McKibben) but its use in hemorrhagic shock was not popularized until 1980 when it was described separately by Velasco[17] and DeFelippe.[18] The concentration in various studies have ranged from 2.5% to as high as 30%.[19] It rapidly expands blood volume after major blood loss with little adverse effects. HTS (7.5%), at a dose of 250 ml, compares with a resuscitative volume of 2 to 3 L of NS. HTS is also a potent attenuator of immune mediated cellular injury which is a major component of the late effects of hemorrhagic shock. The IOM report of 1999 recommended that combat casualties be resuscitated first with 250 ml of HTS.[12] HTS 7.5% is yet to be FDA-approved in the United States so this recommendation has not been implemented in the U.S. Military, although other NATO countries currently use this or HTS-Dextran as their initial resuscitative fluid of choice. HTS-Dextran may be used at one-tenth the volume of isotonic crystalloids.[20] Because of its smaller volume and weight, HTS has a significant logistical advantage and seems to be the most ideal resuscitative fluid for combat operations. At this time there are two multicenter trials ongoing in the U.S. on HTS in the trauma population and we may yet see 7.5% concentration as an FDA-approved resuscitative fluid in the near future.[21]

Special mention must be made for the casualty with multi-trauma who also sustains traumatic brain injury (TBI). In TBI, secondary injury is avoidable and is usually related to some degree of hypotension or hypoxia. Mortality doubles in the hypotensive patient with TBI when compared to normotensive TBI casualties.[22] HTS or HTS-Dextran may be the optimal resuscitative fluids for these patients when hypotension must be treated and cerebral edema avoided.[18] HTS in a 3% concentration is currently available for use in Combat Support Hospitals. The osmotic actions have been well categorized, but the discovery of extra-osmotic actions such as immune modulation and augmentation of cerebral blood flow are intriguing and invite further study. A meta-analysis of six trials

and 604 subjects showed that HTS-Dextran provided a discharge survival rate of 38% versus 27% for the NS control in the subgroup of patients who had sustained multi-trauma with concomitant TBI.[23] Once started, HTS should be titrated to keep serum Na concentrations at 145-155 mEq/L and cessation should be gradual secondary to concerns of rebound cerebral edema and herniation

Artificial Colloids:

Colloids are large molecular weight substances that are effective in exerting an osmotic force across the walls of capillaries, thereby maintaining intravascular volume. A recent Cochrane review indicates that when fluid resuscitation is required, there is no appreciable difference in outcomes after resuscitation with colloids versus crystalloids.[24] Crystalloids are less expensive which lends support for their primary use in civilian trauma resuscitation. Due to the far different environment in which combat casualties take place, however, colloids offer the distinct advantage of less volume and weight. The hydroxyethyl starches (HES), Hespan and Hextend, are colloids composed of 6% hetastarch, a synthetic colloid derived from a starch composed almost entirely of amylopectin. Hespan is hetastarch in NS. Hextend consists of high-molecular-weight 6% hetastarch in a balanced lactated solution containing calcium, magnesium, glucose, and potassium in addition to NaCl, thus resembling the composition of normal plasma. Resuscitation with Hextend results in one third the volume requirement of LR.[25] This artificial colloid has replaced LR as the fluid of choice carried by medics in the field for reasons discussed previously.[26]
It has a favorable acid-base profile and has been shown to decrease overall fluid requirements.[27] The degree of substitution of the various hydroxylethyl starches determines their duration of effects as well the effects on coagulation. Hespan is more highly substituted than Hextend, leading to Hextend's recommendation as the initial colloid of choice for resuscitation. A newer HES, Voluven, has just been FDA approved and appears to have the least pronounced effect on coagulation than any of the other HES formulations.[28]
Dextran is a complex, branched chain polysaccharide made of many glucose molecules. Although osmotically active, it does have a significant antiplatelet effect and some formulations are used by microsurgeons to decrease thrombosis – properties not favorable in traumatic injury.[29]
Both artificial colloids activate neutrophils. When Dextran is given in conjunction with HTS, however, the latter blunts this immune system response, while the colloid prolongs the duration of effect of the HTS.[17] What effect this combination has on the anticoagulant effect of dextran remains to be seen.

Artificial Oxygen Carriers:

In combat theaters, donor blood is a precious resource that is not always available near the point of injury. Current Hemoglobin Based Oxygen Carriers (HBOCs) provide volume, O2 transport and unloading, are universally compatible, easy to administer, and can survive a variety of conditions. All are characterized by a sigmoidal oxygen dissociation curve that allows O2 transport and unloading similar to blood.[30] Diaspirin Cross linked Hemoglobin (DCLHb) was the first generation HBOC. Phase III clinical trials in the late 1990's were halted prematurely after a higher mortality rate was seen when compared to NS.[31] DCLHb contained 100% tetrameric Hb which contributed heavily to the HBOC-associated vasoconstriction and hypoperfusion of end organs which remains the primary concern today.
Second generation HBOCs were developed with the goal of decreasing this vasoconstrictive effect by polymerization into larger molecules. Two of these have shown great promise to date. Human trials with human polymerized hemoglobin (Polyheme, Northfield laboratories) have shown decreased mortality in trauma patients. Phase III trials have been completed showing polyheme to provide a survival benefit to patients without access to blood products.[32] HBOC-201 is a bovine, polymerized Hb that has been studied in phase III trials as a blood substitute in surgical patients, decreasing transfusion requirements.[33] It is now approved for human use in South Africa for acute anemia in surgery patients. Side effects of HBOC-201 include mild liver transaminase elevations, methemoglobinemia, and elevated blood pressure (primarily with the first and second dose). Recent studies indicate that this increase in vascular resistance may not be as high as once thought.[34]
Several other products capable of carrying oxygen are also in development. MP4 is a modified hemoglobin molecule designed to overcome the vasoconstrictive effects found with the other HBOCs. It has a high oncotic pressure which also makes it promising as a plasma expander. PFC emulsions (Oxygent) carry oxygen as dissolved gas. They have a linear relationship between O2 partial pressure and O2 transport capacity, thus they work well only when Fi02 is high, restricting its utility in a prehospital setting.
Overall, there has been tremendous progress in the area of artificial O2 carriers, although none have achieved approval for use in the U.S., Canada, or Europe. Colloids and crystalloids will continue to be used to replace plasma volume. Further research on combined HBOC/hypertonic solutions may prove to offer greater survival for the injured combatant, particularly when evacuation times are prolonged.[35]

Blood Products:

Blood transfusion is not without major complications and is an independent predictor of mortality in civilian trauma.[36] However, nothing replaces blood loss like fresh whole blood (FWB). Only in the military is FWB, available via the "walking blood bank", utilized. Thawed plasma at a 1:1 ratio with PRBC's is the current resuscitation strategy for hypovolemic shock due to blood loss at combat support hospitals. Simultaneously, a whole blood donor drive is initiated. In OIF III, 13% of all transfused patients have received FWB[37] with one unit having the hemostatic power of 10 units of platelets.[38]
Plasma alone is an effective volume expander, does not activate the pathways of cellular injury, and provides physiologic quantities and ratios of clotting factors. However, it does have all the drawbacks of blood product transfusion, storage, and transport. Investigations funded by the DoD are \ underway on autologous freeze-dried plasma which can be reconstituted when needed, lessening its logistic impact.

Case Reviews

The cases presented here are not hypothetical, they are actual cases from OIF and OEF. This first case represents a common scenario in a mature operating theatre where blood loss can still be significant before hemostatic control can be achieved, but the evacuation times are relatively short. Because the casualty is showing altered mental status he should have received at least one 500ml bolus of hextend enroute. As IV access is difficult in the field, one should not hesitate to recommend a sternal IO for fluid resuscitation. Blood loss is significant in this case and blood products, either FWB or RBC's and plasma in a 1:1 ratio, should be given early. As resuscitation progresses, keep in mind that wounds with tourniquets and hemostatic agents may start to rebleed as blood pressure overcomes the smaller force that was required to stop blood flow to once underperfused extremities. The second case is from the battle at Takur Gahr during Operation Anaconda and describes the USAF PJ that died from a bleeding groin/pelvic wound 6 hours after injury and 2 hours prior to planned evacuation.[39],[40] In this case there are two complex points of interest that may have resulted in preserving his life. First, he had brought PRBC's with him \on the mission and these were apparently administered. If he had access to a HBOC, could he have held on longer? Particularly at 10,000 feet when alveolar pO2 is 60 mmHg (103 at sea level) and SaO2 is at best 87%[41]. Second, he did continue to bleed internally and externally. His trauma, acidosis, hypothermia, and cold PRBC's would have exacerbated his hemorrhage. Prevention of hypothermia, in conjunction with some form of IV hemostatic agent may have improved his outcome as well.
The past decade has shown a tremendous amount of research in solving the hemostasis and resuscitation dilemma. As this science advances into the clinical realm we will assuredly continue to see significant changes in the way combat casualties are treated in the prehospital and hospital settings. As resuscitative physicians this will require continuous vigilance in assessing the literature, thereby providing combat casualties with the best chance for survival.

Combat Fluid Resuscitation continued.

Questions:

_____ 1. The initial resuscitative fluid for U.S. combat casualties in the prehospital phase is:
A) Lactated Ringer's
B) Hextend
C) Normal Saline
D) Hypertonic Saline

_____ 2. All of the following are true with respect to the use of blood products in combat casualties EXCEPT:
A) PRBC's and thawed plasma should be given in a 1:1 ratio.
B) Transfusion of PRBC's is an independent risk factor for mortality in trauma.
C) Fresh Whole Blood represents the majority of blood transfusions during OIF
D) One unit of Fresh Whole Blood has the hemostatic properties of 10 units of platelets.

_____ 3. Which is true with regards to hypertonic saline (HTS)?
A) Does not appear to be ideal in the initial phases of hemorrhagic shock resuscitation.
B) Exacerbates the immune activation seen in shock.
C) Is not as effective as a volume expander when compared to isotonic fluids
D) May be the optimal fluid of choice in TBI when hypotension and cerebral edema must be avoided

_____ 4. All of the following are properties of Hemoglobin-based Oxygen Carriers EXCEPT:
A) Have a sigmoidal shaped oxygen dissociation curve.
B) Have few side effects and have proven safe in animal and human studies.
C) Are universally compatible with no need for cross-matching.
D) Can survive a variety conditons making them more ideal with respect to this than blood for far-forward resuscitation.

_____ 5. Which artificial colloid has the highest molecular weight, giving it the least favorable profile with respect to preventing coagulopathy?
A) Hextend
B) Albumin
C) Voluven
D) Hespan

[1] Sallee DR, Love JW, Welling LE. The United States Marine Corps Shock Trauma Platoon: The modern battlefield's emergency room. *Prehospital Emergency Care* 2008; 12:80-86

[2] Gerhardt RT, DeLorenzo RA, Oliver J, et al. Out-of-hospital combat casualty care in the current war in Iraq. *Ann Emerg Med*. 2009;53(2):169-174

[3] Butler FK, et al. Tactical Combat Casualty Care 2007: Evolving concepts and battlefield experience. *Committee on TCCC, Naval Operational Medicine Institute*. Technical Report, 27 March, 2007.

[4] Holcomb JB. The 2004 Fitts Lecture: Current perspective on combat casualty care. *J Trauma*. 2005; 59(4): 990-1002

[5] Malone DL, Dunne J, Tracy JK, et al. Blood transfusion, independent of shock severity, is associated with worse outcome in trauma. *J Trauma* 2003;54:898-905.

[6] Shires GT, Carrico CJ, Baxter, CR, et al. Fluid therapy in hemorrhagic shock. *Arch Surg* 1964; 88:688-93.

[7] Kirkpatrick AW, et al. The secondary abdominal compartment syndrome: iatrogenic or unavoidable? *J Am Coll Surg* 2006; 202:668-79

[8] Ashbaugh DG, et al. Acute respiratory distress in adults. *Lancet* 1967;12:319-23.

[9] Bickel WH, Wall MJ, Pepe PE, et al. Immediate versus delayed fluid resuscitation for hypotensive patients with penetrating torso injuries. *N Engl J Med* 1994; 331:1105-9.

[10] Cannon WB, Faser J, Collew EM. The preventive treatment of wound shock. *JAMA* 1918; 47:618

[11] Selby JB, Mathis JE, Berry CF, et al. Effects of isotonic saline solution resuscitation on blood coagulation in uncontrolled hemorrhage. *Surgery* 1996; 119:528-33.

[12] Healey MA, Davis RE, Liu FC, et al. Lactated Ringer's is superior to normal saline in a model of massive hemorrhage and resuscitation. *J Trauma* 1998;45:894-99.

[13] Committee on Fluid Resuscitation for Combat Casualties. Fluid Resuscitation: state of the science for treating combat casualties and civilian trauma. *Report of the Institute of Medicine*. Washington: National Academy Press; 1999.

[14] Rhee P, Wang D, Ruff P, et al. Human neutrophil activation and increased adhesion by various resuscitation fluids. *Crit Care Med* 2000;28:74-8.

[15] Deb S, Sun L, Martin B, et al. Resuscitation with lactated Ringer's solution in rats with hemorrhagic shock induces immediate apoptosis. *J Trauma* 1999; 46: 582-9.

[16] Shires GT, Browder LK, Steljes TP, et al. The effect of shock resuscitation on apoptosis.

[17] Velasco IT, Ponieri V, Rocha M, et al. Hyperosmotic NaCl and severe hemorrhagic shock. Am J Physiol 1980; 239:H664.

[18] DeFelippe J Jr, Timoner IJ, Velasco IT, et al. Treatment of refractory hypovolemic shock by 7.5% sodium chloride injections. *Lancet* 1980;2:1002.

[19] Bhardwaj A, Ulatowski J. Hypertonic salinesolutions in brain injury. *Curr Opin Crit Care* 2004; 10:126-131.

[20] Dubick MA. Small volume resuscitation for the far-forward combat environment: current concepts. *J Trauma* 2003; 54: S43-S45.

[21] Alam HB, Rhee P. New Developments in fluid resuscitation. *Surg Clin N Am* 2007; 87:55-72.

[22] Bullock MR, et al. The Brain Foundation and American Association of Neurological Surgeons. Guidelines for the management of severe traumatic brain injury. *J. Neurotrauma* 2000;17:471-8. Alam HB, Rhee P. New Developments in fluid resuscitation. *Surg Clin N Am* 2007; 87:55-72.

[23] Wade CE, et al. Efficacy of hypertonic 7.5% saline and 6% Dextran 70 in treating trauma: a meta-analysis of controlle clinical studies. *Surgery* 1997:122:609-16.

[24] Perel P, Roberts I. Colloids versus crystalloids for fluid resuscitation in critically ill patients. [Systematic Review] Cochrane Injuries Group, Cochrane Database of Systematic Reviews. 4, 2007.

[25] Todd SR, Malinoski D, Muller PJ, et al. Hextend attenuates hypercoagulability after severe liver injury in swine. *J Trauma* 2005; 59:589-93.

[26] Beekley AC, Starnes BW, Sebesta JA. Lessons learned from modern military surgery. *Surg Clin N Am* 2007; 87:157-84

[27] Handrigan MT, Bentley TB, Oliver JD, et al. Choice of fluid influences outcome in prolonged hypotensive resuscitation after hemorrhage in awake rats. *Shock* 2005;23(4):337-43.

[28] Langeron O, et al. Voluven, a lower substituted novel hydroxyethyl starch (HES 130/0.4), causes fewer effects on coagulation in major orthopedic surgery than HES 200/0.5. *Anesth Analg* 2001; 92:855-62.

[29] Abir F, Barkhordarian S, Sumpio BE. Efficacy of dextran solutions in vascular surgery. *Vascular and Endovascular Surgery* 2004;38 (6):483-91.

[30] Stowell CP, Levin J, Spiess BD, et al. Progress in the development of RBC substitutes. *Transfusion* 2001;41:287-99.

[31] Sloan E, Koenigsberg M, Gens D, et al. Diaspirin cross-linked Hemoglobin (DCLHb) in the treatment of severe hemorrhagic shock. *JAMA* 1999;282:1857-64.

[32] Northfield Laboratories Presentation at 11th Annual International Symposium on Blood Substitutes, Oct 2007. C2

[33] Levy JH, Goodnough LT, Greilich PE, et al. Polymerized bovine hemoglobin solution as a replacement for allogeneic red blood cell transfusion after cardiac surgery: results of a randomized, double-blind trial. *J Thor Cardiovasc Surg* 2002;31:299-308.

[34] Rice J, Philbin N, Handrigan M, et al. Vasoactivity of bovine polymerized hemoglobin (HBOC-201) in swine with traumatic hemorrhagic shock with and without brain injury. *J Trauma* 2006;61:1085-99.

[35] Rivera-Chavez FA, Huerta S, Brown R, et al. Resuscitation from hemorrhagic shock comparing standard hemoglobin-based oxygen carrier (HBOC-201) versus 7.5% Hypertonic HBOC-201. *J Trauma* 2007;63:1113-19.

[36] Malone DL, Dunne J, Tracy JK, et al. Blood transfusion, independent of shock severity, is associated with worse outcome in trauma. *J Trauma* 2003;54:898-905.

[37] Kauvar DS, Holcomb JB, Norris GC, et al. Fresh Whole Blood transfusion: a controversial military practice. *J Trauma* 2006;61:181-4.

[38] Mohr R, Goor DA, Yellin A, et al. Fresh blood units contain large potent platelets that improve hemostasis after open heart operations. *Ann Thoracic Surg* 1992;53:650-4.

[39] MacPherson M. Roberts Ridge, Bantam Dell Books, NY. 2005

[40] Graham B. Ambush at Takur Ghar: fighting for survival in the Afghan snow. The Washington Post. May 25, 2002

[41] Dehart RL. Fundamentals of Aerospace Medicine, 2nd ed. Williams and Wilkins, Baltimore MD. 1996, pp 92-95.

GSACEP
328 Eighth Avenue, Suite 142
New York, NY 10001

WWW.GSACEP.ORG