

Committee on Tactical Combat Casualty Care Meeting

San Antonio, TX

5-6 September 2018

Meeting Minutes

**Dr. Frank Butler
Dr. Stephen Giebner**

Wednesday – 5 September 2018

1. Senior Leader Remarks: Maj Gen Lee Payne, Assistant Director, Combat Support Agency, Defense Health Agency

Maj Gen Payne noted that the Joint Trauma System (JTS) is coming on line as part of the Combat Support Directorate at the Defense Health Agency (DHA). As the JTS undergoes this transition, DHA is getting the right people in the right place.

Battlefield trauma care and TCCC is a top priority for the DHA and VADM Bono put a two-star general officer in the Combat Support so that I can be your voice. Our work will help to drive improved combat casualty care at the front lines, but we still need standardization of Tactical Combat Casualty Care (TCCC) across the services. The Defense Health Agency will work hard to make that happen.

2. Chairman's Welcome: Dr. Frank Butler, Chairman of the CoTCCC

Dr. Butler welcomed the group and thanked the attendees for being at the meeting to take part in the ongoing TCCC effort. He reminded everyone to sign the attendance sheet and then had attendees introduce themselves. Special thanks were extended to Danielle Davis, Dallas Burelison, Margarita Carter and Darin Schwartz of the Joint Trauma System for their outstanding work in preparing for this meeting. Dr. Butler extended a call for Combat Medics to present case scenarios at future meetings. He then reviewed this meeting's agenda and requested that attendees reveal any financial interest that they might have in items to be discussed at the meeting. Dr. John Holcomb disclosed a financial interest in Prytime, the company that markets the ER-

REBOA catheters and Dr. Jessica McCann has a financial relationship with Innovative Technologies, the manufacturer of the iTClamp.

3. Combat Medic Presentation: SSG Stephen Meyer

SSG Meyer discussed a mass casualty event during which he and another medic treated seven casualties. Two of the casualties were eventually MEDEVACed, three were CASEVACed, and two exfiltrated with the assault force. His discussion of treatments rendered focused on the three casualties who were most severely injured.

Casualty 1 had a gunshot wound to the right anterior chest with a small entrance wound but a large exit wound on his right back from which he was hemorrhaging heavily. He also had a gunshot wound to his right bicep. The chest wounds were covered with non-vented occlusive dressings, which was in accordance with TCCC guidelines at the time. Hemorrhage from the exit wound required multiple occlusive dressings and Combat Gauze. A Combat Application Tourniquet (CAT) controlled the bleeding from the right arm wound. He later developed a tension pneumothorax and hemorrhagic shock. The tension pneumothorax was managed with finger thoracostomy and multiple “burps” of the occlusive dressings as well as digital manipulation of the finger thoracostomy incision, with continuing improvement with each successive “burp”. His shock was managed with tranexamic acid (TXA) (1 gm IO) and one unit of Cold Stored Low-Titer O-Whole Blood (CS-LTOWB). He received a large dose of 200 mg of ketamine IM by the other medic, (not a member of the 75th Ranger Regiment) which produced nystagmus. He was later noted to be apneic, and, after two unsuccessful attempts to insert a King LT-D by the other medic, a successful cricothyrotomy was performed after which the casualty resumed spontaneous respirations after a few breaths with a bag-valve-mask (BVM). The casualty was breathing adequately and had a return of a radial pulse when he was handed off to the Dustoff medic. This casualty ended up surviving the flight to the Forward Surgical Team (FST) and had a tension pneumothorax upon arrival. SSG Meyer noted that the DUSTOFF medic did not perform a needle decompression and that “burping” the finger thoracostomy was out his scope of practice. After multiple surgeries at the FST, the casualty’s thoracic hemorrhage was controlled and he ultimately survived his injuries.

Casualty 3 also suffered a gunshot wound, with the entrance wound high on his right upper back and a larger exit wound low on his right anterior neck. He had venous bleeding only. The bleeding vein was initially packed with Combat Gauze and then clamped with a curved Kelly. The entrance wound was covered with an occlusive dressing. The casualty was given 800 mcg of fentanyl transbuccally for his pain. No other treatment was needed prior to evacuation.

Casualty 5 suffered a through and through gunshot wound to his right forearm. Partner Force self-aid/buddy-aid CAT’s were applied. The casualty was in pain due to the CAT’s and they were loosened prior to SSG Stephen Meyer’s arrival. The casualty had lost a significant amount of blood and was in hemorrhagic shock. The casualty received an TXA 1 gram IV and received a partial unit of CS-LTOWB. The casualty was assisted to the CASEVAC aircraft and received component therapy at the FST. The casualty survived his wounds and made a full recovery.

Opportunities to improve that were noted in the care of these casualties included the following:

1) Casualty 1 received too much ketamine from the non-Ranger Medic. The intended dose was 50 mg IM; the actual dose was 200 mg IM.

2) The cricothyroidotomy tube in casualty 1 was ripped out upon landing at the FST when the BVM was removed. The DUSTOFF medic was able to replace the cricothyroidotomy tube through the initial incision.

3) Improper Partner Force self-aid/buddy-aid loosening of the two CAT tourniquets due to the casualty's pain resulted in the casualty going into hemorrhagic shock and requiring a blood transfusion.

SSG Meyer received a sustained standing ovation from the group.

4. JTS Director's Comments: COL Jeff Bailey

Col Bailey is a former Director of the Joint Trauma System (JTS) and is presently the Interim Director of the JTS. COL Bailey reviewed the operational cycle of the JTS focusing on the performance improvement function. We can prevent preventable deaths. We must collect and analyze data for performance improvement in near real time. It shows us what we can do, what we can't do, what we need to develop, and what we need to plan for. This is what the JTS is supposed to do. Col Bailey emphasized the critical importance of documenting the care provided to casualties during the prehospital phase of care, which has not been done very well in the past.

5. Three Things I Would Change About TCCC: Dr. Mark Gestring

Dr. Gestring is a trauma surgeon on staff at the University of Rochester and currently serves as the Chair of the American College of Surgeons Committee on Trauma (ACS COT) Prehospital Trauma Subcommittee.

Asked to speak on the "Three Things He Would Change about TCCC," his comments on the prehospital trauma care recommendations currently made by TCCC were:

1. Recent civilian medical evidence supports the TCCC recommendations on spinal stabilization - i.e., spinal motion restriction is not indicated in casualties who have sustained only penetrating trauma. Similar recommendations are made by the the ACS Committee on Trauma, the American College of Emergency Physicians (ACEP), and the National Association of Emergency Medicine System Physicians (NAEMSP) in their Joint Position Statement on Spinal Motion Restriction. Dr. Gestring noted that consensus among these three groups has historically been difficult to reach, but that they agree on this point.

2. He remarked that intraosseous (IO) access should be the primary vascular access technique used for patients in extremis. In a clinical study,¹ IO access was as

¹ Chreiman KM, Dumas RP, Seamon MJ, et al. The intraosseous have it: A prospective observational study of vascular access success rates in patients in extremis using video review. *J Trauma Acute Care Surg.* 2018 Apr;84(4):558-563.

fast as peripheral IV access, and twice as likely to be successful. IO flow rates are clinically adequate, and TXA can be effectively administered given via this route.²

3. Dr. Gestring also noted that non-medical military personnel have not been uniformly trained in bleeding control, and the ACS Bleeding Control (B-Con) course may be a solution. The B-Con course teaches the use of tourniquets and hemostatic dressings to control external hemorrhage, as recommended by TCCC. It was taught at the 21st Combat Support Hospital in Baghdad and expanded from there to other units on base and to Forward Surgical Teams. One hundred and fifty non-medical personnel were trained in six courses, and 4 of 6 supported Role 2 facilities began teaching B-Con. B-Con is also expanding in civilian world. As of 8/24/18, 30,740 instructors had been trained in all 50 states and 77 countries, and a total of 388,668 students had been trained. He noted the remarkable success of the National Stop the Bleed Day program, which was led by CoTCCC member Major Andy Fisher. Dr. Gestring also noted that civilian B-Con courses accept CoTCCC recommendations regarding tourniquets and hemostatic dressings.

6. TCCC Update: Dr. Frank Butler, CoTCCC Chair

Dr. Butler presented this year's TCCC Award for outstanding accomplishments in TCCC to MAJ Andy Fisher.

A special TCCC award was presented to Dr. Jim Bagian for his many years of chairing the CoTCCC Membership and Bylaws Subcommittee, and thereby leading the effort to help ensure that the CoTCCC continues to recruit new members who have the knowledge and the experience to be valuable members of the TCCC team.

Dr. Butler discussed regulatory and requirements documents pertaining to TCCC training in the US military. The recently promulgated DoD Instruction 1322.24 (Medical Readiness Training) establishes TCCC as the DoD standard for battlefield trauma care and mandates TCCC training for everyone in the US military.

In 2017, there were three approved changes to the TCCC Guidelines: Pelvic binding for suspected pelvic fractures; the comprehensive review (AKA "Monty's MegaChange") to address a number of issues in multiple areas of the TCCC Guidelines; and extraglottic airways in TCCC. In 2018, the tension pneumothorax and Advanced Resuscitative Care changes were passed.

The 2018 edition of the "TCCC for Medical Personnel" curriculum based on the TCCC guidelines dated 1 August 2018 has been released. The presentations have been topically modularized in order to allow for an improved focus on specific areas in self-contained modules. These modules will be synchronized with the topical TCCC material presented on the Deployed Medicine website. There are now 22 PowerPoint presentations, 16 of which cover Tactical Field Care topics. The presentations include 33 videos produced by the Deployed Medicine team and 8 that were carried over from previous versions of the curriculum. The test question bank and learning objectives throughout the curriculum were also updated.

² Lallemand MS, Moe DM, McClellan JM, et al. No intravenous access, no problem: Intraosseous administration of tranexamic acid is as effective as intravenous in a porcine hemorrhage model. *J Trauma Acute Care Surg.* 2018 Feb;84(2):379-385.

HR 4374 amends the Food, Drug and Cosmetic Act so that the Secretary of Defense may request the Secretary of Health and Human Services to expedite the FDA process for medical products that have special applicability to battlefield trauma care. Examples of such products include dried plasma, ketamine, fentanyl lozenges, and tranexamic acid. This paves the way for accelerated FDA approval and battlefield-specific indications for medical items of special interest identified by TCCC (eg, ketamine, oral transmucosal fentanyl citrate (OTFC) lozenges, and TXA) and the other committees in the Defense Committee on Trauma.

7. Early High-Dose TXA in TBI: Dr. Martin Schreiber

Dr. Schreiber is Professor of Surgery at Oregon Health and Science University. He presented the results of a multi-center, multi-national double-blinded randomized controlled trial to study the effect of a 2-gram bolus of tranexamic acid (TXA) in patients with traumatic brain injury (TBI) and intracranial hemorrhage (ICH).

Zetabchi and others³ had pooled results from two previous randomized controlled trials of TXA. Though neither had shown improved outcomes in TBI patients, analysis of the pooled data demonstrated statistically significant reduction in ICH progression with TXA and a non-statistically significant improvement of clinical outcomes in emergency department patients with TBI.

In Dr. Schreiber's study, 967 patients were randomized to three arms:

- 2 gm prehospital bolus followed by an 8-hour in-hospital placebo infusion
- 1 gm prehospital bolus, followed by an 8-hour in-hospital 1 gm TXA infusion (as for non-compressible hemorrhage in the TCCC guidelines)
- Placebo prehospital bolus, followed by an 8-hour in-hospital placebo infusion

In patients who were noted to have intracranial hemorrhage on initial CT scan, the 2 gm prehospital bolus of TXA resulted in a 28-day mortality of 18%; the mortality in the 1 gm TXA bolus/1 gm maintenance TXA infusion group was 28%; and the mortality in the placebo group was 28%. For 2 gm TXA bolus vs placebo, the difference in outcome was highly significant ($p= 0.0035$) The TCCC-like regimen was not different from placebo. Pre-hospital administration of TXA is feasible and the 2 gram bolus does not affect thrombelastography.

Dr. Schreiber recommends that the CoTCCC consider changing the TCCC guidelines to a 2 gm prehospital bolus of TXA for casualties with TBI. He further recommends consideration of the same regimen for severe hemorrhage.

8. Proposed Change: A Relook at Tourniquets in TCCC: Mr. Harold Montgomery

Mr. Montgomery is heading an effort by a working group of CoTCCC members and advisors to:

- Comprehensively review of recent tourniquet literature, data, studies, case reports, and product data.
- Re-evaluate currently recommended commercial tourniquets.

³ Zehtabchi S, Abdel Baki SG, Falzon L, Nishijima DK. Tranexamic acid for traumatic brain injury: a systematic review and meta-analysis. *Am J Emerg Med.* 2014 Dec;32(12):1503-9.

- Codify CoTCCC protocol for reviewing previously recommended devices when they are significantly modified by the manufacturer.
- Evaluate new tourniquets for consideration as CoTCCC-recommended devices.
- Identify tourniquets that should NOT be recommended.
- Publish supporting evidence for the tourniquet recommendations made.
- Publish a CoTCCC Preferred Features list for future tourniquet development and R&DTE requirements.
- Evaluate the efficacy of tourniquet training methods.
- Recommend a rationale and process for recommending specific commercial products by name in the TCCC Guidelines.

The CoTCCC has not changed its tourniquet recommendations since 2005. Since then, a number of new commercial tourniquets have emerged and some of the originally recommended tourniquets have undergone further development by the manufacturers. These newer tourniquet iterations have not been subjected to the same testing and evaluation that the originally recommended versions were. Without appropriate testing of new tourniquets and new versions of old tourniquets, we cannot be sure we are recommending the best of the currently available devices to help our country's medics control extremity hemorrhage.

9. A Re-Look at the iTClamp: CDR Dana Onifer

Except for ballistic eyewear, the face and neck are not covered by Personal Protective Equipment, resulting in disproportionately high rates of fatal injury in the cranio-maxillofacial (CMF) and neck regions. 6.5% of potentially preventable deaths are caused by cervical hemorrhage (*Eastridge 2012*), despite the use of hemostatic dressings and direct pressure. Another hemostatic adjunct for hemorrhage in the neck region is needed.



The iTClamp is a lightweight, small-volume tool indicated for hemorrhage control in CMF and penetrating neck injuries (PNI). It re-opposes wound edges yielding a fluid-tight seal. Blood accumulates inside the closed wound, creating a tamponade. The 4-mm needles lining the jaws of the device cannot reach major vessels in the neck and cause no additional tissue damage if the device is ripped off.

The iTClamp can and should be combined with hemostatic dressings or XStat in large wounds. The iTClamp applied over Combat Gauze results in less blood loss than packing with Combat Gauze alone. (*Filips 2013; Stuart 2018*) Direct pressure is not needed after the iTClamp has been applied. Multiple iTClamps can be applied in series on wounds more than two inches long. Dr. Onifer discussed the literature on the efficacy

of the iTClamp in hemorrhage control that has accumulated since the device was first reviewed by the CoTCCC.

This device should not be used in cases of non-compressible torso hemorrhage, on wounds in which the edges of which cannot be re-approximated, or on the eyes or eyelids. When the iTClamp is used on a PNI, the airway should be closely monitored for compromise by hematoma formation.

Training on the iTClamp is easy and well-retained even amongst non-medical personnel. (*McKee 2015; Filips 2014; Reuter 2016; Mckee 2016*) CDR Onifer recommends the CoTCCC add the iTClamp to the TCCC guidelines.

10. US Army TCCC Training Survey: COL Jennifer Gurney

COL Gurney is a trauma surgeon at the JTS and Deputy Director of the Army Burn Center at the Institute for Surgical Research. She posed two questions to the group:

1) High-level providers (physicians and PAs) rarely perform common TCCC procedures, so can they teach medics these skills and adequately supervise them in performing these interventions on the battlefield?

2) Is lack of physician/PA knowledge regarding TCCC a causative factor in the problems that have been noted in implementing these lifesaving skills throughout the US military?

COL Gurney and her colleagues designed a study to determine the degree to which physicians and PAs have been trained in TCCC. Approximately 1800 surveys were distributed via email. Of the 700 responses received, 613 responses were satisfactory for inclusion.

Findings from the study included:

- Although ATLS is required to deploy, only approximately 50% of the surveyed group had had this training;

- Despite the emphasis on TCCC, 70% either had not taken it or were not sure whether or not they had taken it;

- If the deployer's unit mandated TCCC training, there was 93% compliance;

- 46% of those who had taken TCCC obtained their training from the Tactical Combat Medical Care course;

- 8% of the individuals who had had TCCC training obtained it from the Defense Medical Readiness Training Institute;

- 41% of providers surveyed had NEVER taken TCCC;

COL Gurney's research concluded that most deploying Army providers do not have an adequate base of TCCC training. More senior providers were less likely to have had TCCC training.

11. Update on DODI 1322.24: Mr. Ed Whitt

Mr. Ed Whitt from the Office of ASD Health Affairs discussed the DoD Instruction on Medical Readiness Training went into effect on March 16, 2018. It took six years to get this done. It specifies that TCCC is the DoD standard of care for first responders (both medical and non-medical) and requires that all service members receive role-based TCCC training and certification in accordance with their skill levels (i.e., All Service Members, Combat Lifesaver, Combat Medic/Corpsmen, and Combat Paramedic/Provider).

Section 708 (b)(6) (OPR: DHA) of the FY17 National Defense Authorization Act (Public Law 114-328) requires that the DoD develop standardized TCCC instruction for all members of the Armed Forces. A working group has been chartered by Health Affairs to create a proposed set of core skills and curriculum for TCCC for All Service Members training.

12. TCCC for All Service Members Update: Mr. Harold Montgomery

Mr. Montgomery presented a progress report on the development of the new All Service Members (ASM) course. The course is designed to familiarize non-medical military personnel with the basic concepts of TCCC and provide the knowledge and skills to succeed in rendering care that is appropriate for non-medical first responders to help eliminate preventable deaths in combat casualties. The estimated initial training audience for the course is 1.5 million active duty and reserve personnel. ASM is currently planned to include five terminal learning objectives:

- Introduction to Tactical Combat Casualty Care
- First Aid Kit Familiarization
- Casualty Assessment
- External Hemorrhage Control
- Airway & Breathing

Mr. Montgomery reviewed the course's plan of objectives and milestones; the planned launch of the TCCC-ASM course is scheduled for May 2019.

13. Web Mobile Project Update: Mr. Harold Montgomery

Mr. Montgomery began with a brief of the TCCC content currently available on the Joint Trauma System website including the casualty after action reporting system and the DoD Trauma Registry. He continued with a detailed overview of the DHA Deployed Medicine (DM) project.

DM is a web-based education system developed under the Learning Strategy, Tactics, and Technology Research Program that develops support mechanisms for the DHA Combat Support Agency mission. TCCC is the pilot topic area for DM, which will later cover other topics in deployed medical care such as Preventive Medicine and Sick Call Medicine. DM functions to trial innovative learning models, improve readiness and performance of deployed medical personnel, and deliver personalized learning via the

most current technology available. This will enable a self-directed and continuous study of best practices and lessons learned. The DM platform is designed to deliver synchronized, portable content across multiple electronic platforms. Mr. Montgomery reviewed the array of student and instructor materials currently available (i.e., videos, references, podcasts, etc.); adjuncts to courses (pre-training, in-course references, post-course sustainment); and registration and CEU functions under development. He also reviewed use statistics for TCCC via social media that show that TCCC is reaching an increasingly large audience via those routes.

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14. Senior Leader Remarks: Dr. Arthur Kellerman

Dr. Kellerman is the Dean of the F. Edward Hébert School of Medicine at the Uniformed Services University (USU).

Out of the Crucible is a book from the Borden Institute that chronicles the transformation of combat casualty care during Operation Enduring Freedom and Operation Iraqi Freedom.

TCCC is an important topic at the USU School of Medicine and has been since the university participated in its initial development in 1996. Medical students are trained in TCCC and required to demonstrate proficiency in it before they graduate. The university's Advanced Combat Medicine Experience, Gunpowder, and Bushmaster courses are all based on TCCC. USU wants to continue its strong partnership with the CoTCCC through the participation of faculty members such as Col Todd Rasmussen and Dr. Craig Goolsby in the pioneering work that the group is doing.

15. Prehospital Air Medical Plasma (PAMPer) Trial: Dr. Jason Sperry

Dr. Sperry is a trauma surgeon at the University of Pittsburgh Medical Center and was the principal investigator in a multi-center trial funded by the Army Medical Research and Materiel Command that examined the efficacy and safety of prehospital administration of thawed plasma in injured patients who are at risk for hemorrhagic shock.⁴ PAMPer was a phase III, 4-Year, multicenter, prospective, randomized, open-label, interventional trial designed to determine if plasma delivered as the initial prehospital resuscitation fluid administered during aeromedical improved outcomes as compared to standard (either crystalloids alone or crystalloids plus blood component therapy) aeromedical fluid resuscitation.

Aeromedical transport helicopters from bases at each participating center carried AB or A low titer B (universal donor) thawed plasma in a cooler on each flight during one-month periods. Aircraft from each air base either had plasma on board for the

⁴ Sperry JL, Guyette FX, Brown JB, et al. Prehospital Plasma during Air Medical Transport in Trauma Patients at Risk for Hemorrhagic Shock. *N Engl J Med*. 2018 Jul 26;379(4):315-326.
<https://clinicaltrials.gov/ct2/show/NCT01818427>

month or were considered control helicopters for the month carrying dummy plasma bags. During plasma months, 2 units of AB/A low titer B thawed plasma were initiated en route during aeromedical transport if inclusion criteria (systolic blood pressure less than 90 mmHg and heart rate greater than 108) criteria were met. The full intervention (2 units) was given with continuation of infusion following arrival if not completed during transport.

Results: Assignment to prehospital plasma was associated with a 39% reduction in the odds of 30-day mortality (adjusted OR 0.61; 95%CI 0.40-0.91, p=0.02). Dr. Sperry and his colleagues concluded that in injured patients at risk for hemorrhagic shock, the prehospital administration of thawed plasma was safe and decreased mortality. Due to its shelf life and storage and logistical requirements, though, thawed plasma is difficult to incorporate into civilian or military practice. Freeze dried plasma may be a better option.

16. Advanced Resuscitative Care: Dr. Frank Butler

According to Eastridge et al,⁵ 40 of every 100 potentially preventable prehospital combat deaths are due to abdominopelvic bleeding. Casualties who are in shock from non-compressible torso hemorrhage (NCTH) in the prehospital phase of care have a very high mortality and need lifesaving interventions as soon as possible. The two most important of these interventions could be provided in prehospital settings by Advanced Resuscitative Care (ARC): whole blood resuscitation to optimally resuscitate the casualty from shock and Zone 1 REBOA (Resuscitative Endovascular Balloon Occlusion of the Aorta) to temporarily control NCTH below the diaphragm.

Cold-Stored Low-Titer Type O Whole Blood (LTOWB) is the best option for far-forward blood. It can be collected from Type O low-titer donors in CONUS or closer to theater, screened for pathogens so that it is FDA compliant, and moved far-forward in long-duration or powered coolers. Alternatively, Type O (preferred) or type-specific fresh whole blood can be drawn from donors through a unit-based walking blood bank and transfused at the point of injury or during TACEVAC.

REBOA can be safely performed in prehospital settings with appropriate attention to aortic occlusion level and balloon inflation times. This intervention is indicated in TCCC when:

- Relevant Tactical Field Care interventions (external hemorrhage control, pelvic binding, TXA, etc) have been accomplished AND
- Advanced monitoring (electronic BP measurement) has been established AND
- ARC resuscitation has been previously initiated with whole blood if feasible or other blood products AND
- SBP remains < 90 mmHg immediately after 1 unit of whole blood or 1 unit each of RBCs/plasma have been administered as quickly as possible AND
- The casualty has penetrating or severe blunt force injury to the abdomen or pelvis AND a positive Focused Assessment with Sonography in Trauma

⁵ Eastridge BJ, Mabry RL, Seguin P, et al. Death on the battlefield (2001-2011): implications for the future of combat casualty care. *J Trauma Acute Care Surg.* 2012 Dec;73(6 Suppl 5):S431-7.

(FAST) exam OR is judged to be at high risk for NCTH OR is noted to have difficult-to-control junctional hemorrhage AND

- Intra-thoracic bleeding and cardiac tamponade have not been found on bilateral chest tube insertion and Extended Focused Assessment with Sonography for Trauma (EFAST).

ARC is not designed to be accomplished by a single prehospital provider, but by a resuscitation team consisting of 4 or more specially trained and equipped individuals. Whenever tactically feasible, a resuscitation team with an ARC capability should be positioned as close to the anticipated point of wounding as possible, since many casualties with NCTH will die within just 15-30 minutes without ARC.

The addition of ARC to the TCCC guidelines has been passed by the CoTCCC and approved by the JTS. Designing ARC pilot programs and planning for the requisite documentation of care and casualty outcomes capture is the next step in the rollout.

17. Far-Forward REBOA in Combat Casualties: The SOST Experience: MAJ Marc Northern

Special Operations Surgical Teams (SOSTs) are US Air Force mobile surgical teams with advanced medical and tactical training. A SOST can provide advanced trauma resuscitation, far-forward damage control surgery (DCS), post-op critical care, and critical care evacuation. SOST physicians are trained in REBOA via the Basic Endovascular Skills for Trauma (BEST) course. They use ultrasound for E-FAST and for femoral access.

MAJ Northern presented the results from the largest series of REBOA use on severely injured combat casualties to date.⁶ Over an 18-month period, austere surgical teams provided initial damage control resuscitation and surgical stabilization prior to transferring patients to the next level of care. The team performed REBOA on 20 casualties with NCTH from explosion and gunshot wounds. Among these, mean initial heart rate was 129 bpm and mean initial systolic blood pressure was 71 mm Hg. Aortic occlusion was achieved with REBOA catheter placement in Zone 1 (n = 17) and Zone 3 (n = 2). Average time to REBOA was less than 30 minutes from the time of wounding. Upon occlusion of the aorta, systolic blood pressure increased by an average of 56 mm Hg with aortic occlusion. Mean occlusion time was 21 minutes. All twenty survived long enough to be transferred to the next higher level of care.

As this case series demonstrates, REBOA is a lifesaving technique for casualties with hemodynamic instability and NCTH on their way to surgery. REBOA should be performed with concurrent transfusion of blood products, and whole blood is the best option.

⁶ Northern DM1, Manley JD, Lyon R, et al. Recent advances in austere combat surgery: Use of aortic balloon occlusion as well as blood challenges by special operations medical forces in recent combat operations. *J Trauma Acute Care Surg.* 2018 Jul;85(1S Suppl 2):S98-S103.

18. Training for Far-Forward REBOA: MAJ Andy Fisher

MAJ Fisher reviewed the medical literature covering the evolution of REBOA as a component of pre-surgical damage control resuscitation. There are two civilian courses that teach REBOA: the Endovascular Skills for Trauma and Resuscitative Surgery (ESTARS) and Basic Endovascular Skills for Trauma (BESTJ). The status of the ESTARS course has not been recently re-evaluated for the purposes of this discussion, but historically, it has been a valued course. There are also some smaller local courses.

In the military, the 160th Special Operations Aviation Regiment has developed a proposed training program in prehospital REBOA for their physicians, physician assistants, and Special Operations Combat Medics. Their course consists of 1-hour didactics followed by training on the REBOA Access Task Trainer, which features:

- a pulsatile pump
- an ultrasound-guided technique
- percutaneous puncture
- a monitor to show increased pressures and waveforms

Each student is required to perform three procedures to demonstrate proficiency. Then, they are required to perform five REBOA procedures on a cadaver or animal model to become qualified and then two per year for sustainment.

The 160th SOAR REBOA protocol includes:

- Attempt first to perform ultrasound-guided percutaneous vascular access
- If not successful after 5 minutes, move to open access and attempt a femoral artery cutdown.
- If that is not successful after 10 minutes or if a loss of vital signs occurs, move to the Failure Pathway.
- Failure Pathway: Place Abdominal and Aortic Junctional Tourniquet (AAJT) if the injury is amenable to Zone 3 occlusion.
- Cease efforts if the injury not amenable to AAJT placement and continue Standard DCR.

In developing a course for the DoD, it is recommended that a prerequisite preparatory training include an ultrasound course within the previous year, TCCC or the Tactical Combat Medical Care Course within the previous 6 months, and anatomy and procedure reviews with videos and reading. The course has a 1.5-day curriculum that supports this protocol:

Day One:

- U/S familiarization with any of the following:
- Blue phantom (U/S simulation device)
- Imaging and hand/eye coordination proficiency
- Find anatomy on each other-with instructor confirmation
- Ultrasound on a Swine model and Cadavers
- Full DCR demo

Day Two:

- Theory followed by the steps of REBOA.
- Aftercare of REBOA placement.
- CPG review

- Documentation in the prehospital setting
- Balloon management, whether it is confirming placement, partial, full, or taken down with aggressive DCR.
- Waveforms

The students will perform REBOA on LTT and/or cadavers with a final practical, that is graded by instructors. There must be aggressive DCR with whole blood therefore, to get the non-surgeon more comfortable with whole blood, there would be an option to pull blood off swine models. A pilot course is planned for the near future.

19. Reflections of a Deployed Trauma Surgeon: COL Jay Johannigman

COL Johannigman from the University of Cincinnati Medical Center recently returned from his seventh deployment, this time with a far-forward surgical team. His observations on that deployment included:

- He saw 10 crics, but only one may have been indicated. A less invasive airway would have sufficed in most of the others.
- Needle decompression for tension pneumothorax is performed too often. There may be a perception that this procedure is without risk or potential harm.
- Needles used for chest decompression wind up in scary places, especially the ones placed too medially.
- Needles inserted in the midclavicular line are at greater risk of being dislodged when the casualty is moved than those inserted in the anterior axillary line.
- It is imperative to continue to track procedures and complications; especially when ops tempo slows. It is important to assure that the right procedures are done on the right patient in the right time.

20. Breakout Session Feedback

Advanced Resuscitative Care: Dr. Frank Butler

Questions that were discussed during the ARC breakout sessions included the following:

- Should we add point-of-care lactate monitors to ARC?
- Should we address arterial rupture secondary to REBOA?
- Should we address REBOA-induced mesenteric emboli?
- How do you know when the REBOA balloon is completely inflated?
- How large should the ARC team be?
- Can we identify existing far forward resuscitation teams that can add prehospital REBOA to their capabilities?

TCCC Critical Decision Case Studies: CDR Lanny Littlejohn

- Critical Decision Case Studies are a new feature of the TCCC for Medical Personnel course.
- We should develop more of these cases than the 28 we have now. The target is 50.
- A number of potential case studies were identified. CDR Littlejohn's working group will continue to work on these. He called for attendees to forward his team real cases.

Tourniquets in TCCC: Mr. Harold Montgomery

The breakout group agreed that five criteria that should be assessed when evaluating limb tourniquets:

- Arterial occlusion
- Application time
- Optimal pressure to occlusion
- Turns/pumps to occlusion
- Blood loss during application

TCCC for Medical Personnel Course Appraisals: Mr. Dom Greydanus

TCCC Course Appraisals is a new function of the CoTCCC. This group reviewed the current draft of the CoTCCC course appraisal instrument for TCCC-MP courses. This instrument will be used to appraise the accuracy of the messaging in TCCC-MP courses as well as to describe the time that each segment of the training takes and what sort of training aids were used.

21. CoTCCC Action Items: Dr. Frank Butler

Dr. Butler reviewed all of the changes to the guidelines approved by the CoTCCC since the group was relocated to the JTS in 2013.

He also discussed a number of proposed changes to the TCCC Guidelines that are currently being developed:

- **a re-evaluation of the TCCC recommendation regarding extremity tourniquets. (Change Leader: Mr. Harold Montgomery)**
- **a relook at incorporating the iTClamp into the TCCC Guidelines with a special emphasis on its use to control head and neck hemorrhage. (Change Leader: CDR Dana Onifer)**

- **an update to the TCCC recommendations on the use of tranexamic acid (TXA):**

- 2 gm dose for TBI?
- Second dose given like the first?
- Should TXA be given prehospital at all?
- Do we really need a second dose of TXA in TCCC?
- What is "Initial Fluid Resuscitation?" And when does it end?
- Change the second dose of TXA if there is ongoing hemorrhage?
- Should the second dose of TXA be given if more than 3 hours have

- elapsed since the time of wounding
- Can TXA be mixed with Hextend?
- Can TXA be given as a slow 1-minute IV Push vs 10 minutes?
(Change Leader: CAPT Brendon Drew)
- **an update to the hypothermia prevention** section of the TCCC Guidelines.
 - Are there better warming devices than the HPMK?
 - Is there a specific IV fluid warmer that should be recommended in TCCC? **(Change Leader: Dr. Brad Bennett)**
- **Management of eviscerating injuries in TCCC**
 - Requested for TCCC for All Service Members curriculum
(Change Leader: LTC Jamie Riesberg)
- **Is It time to remove Hextend and crystalloids from the TCCC fluid resuscitation recommendations?**
 - the FDA has approved the battlefield use of dried plasma
(Change Leader: Maj Marc Northern)

Dr Butler also discussed a number of other proposed changes to the TCCC that may be developed in the near future:

- Management of TBI
 - Use high-dose TXA?
 - Higher target systolic BP?
 - Different recommendations for controlled vs Uncontrolled Hemorrhage?
 - Plasma rather than crystalloids/colloids?
 - Whole blood for resuscitation? Good O2 saturation may be less helpful if there are not enough red cells
 - Or at least plasma and RBCs?
 - Valproic acid?
- Add a CBRN section in the TCCC Guidelines
 - Requested for TCCC for the All Service Members curriculum
- Consider additional measures in Advanced Resuscitative Care
 - Wound care – irrigation and Wound-Vac?
 - Stump dressings?
 - Burn dressings?
 - Progesterone?
 - Valproic Acid for TBI?
 - Vasopressin?
 - Ventilators?
 - Glidescope intubation?
 - Suction for chest tubes?
 - Automated External Defibrillator?
- Replace moxifloxacin with levofloxacin? (COL Clint Murray)
- Increase the initial ketamine dose? (MAJ Andy Fisher)
- Specify the two vented chest seals with laminar vents be recommended as the chest seals of choice in TCCC? (Dr. Bijan Kheirabadi)
- Further changes in TCCC for All Service Members curriculum?
 - Snakebite?

- Near drowning?
- Future technology items:
 - ResQ Foam
 - Compensatory Reserve Index Monitor

A business practice question was also discussed: How and when should the CoTCCC reconsider its recommendations for TCCC equipment items when the manufacturers' Make significant changes to previously-recommended items? The sense of the group was that items believed to warrant reconsideration should be referred to the CoTCCC New Technology Subcommittee for consideration.

Acknowledgments: The authors gratefully acknowledge the ongoing efforts of all of the members of the TCCC working group, our invited speakers, and other meeting attendees to improve the battlefield trauma care provided to our nations' combat wounded.

Disclaimers: The opinions or assertions contained herein reflect the events of the September 2018 meeting of the CoTCCC. They are not to be construed as reflecting the views of the Department of the Army or the Department of Defense.



22 Jan 2019

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CAPT, MC, USN (Ret)
Developmental Editor
Committee on TCCC



13 Feb 2019

Frank K. Butler, M.D. Date
CAPT, MC, USN (Ret)
Chairman
Committee on TCCC

Enclosure 1
Attendance
CoTCCC Meeting
5-6 September 2018

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Dr. Jim Bagian
Col Jeff Bailey
SCPO Mark Boyle
Dr. Frank Butler
MSG Curt Conklin
COL Cord Cunningham
COL Jim Czarnik
COL Erin Edgar
MAJ Andy Fisher
COL Kirby Gross
Dr. Jay Johannigman
Col Chet Kharod
CAPT Lanny Littlejohn
COL Bob Mabry
SOCS Matt McClain
COL Shawn Nessen
Maj Marc Northern
LCDR Dana Onifer
Mr. Don Parsons
Mr. Gary Pesquera
MSG Michael Remley
LTC Jamie Reisburg
HSCM Glenn Royes
MSgt Travis Shaw
CSM Tim Sprunger
CDR Matthew Tadlock
CAPT Jeff Timby
HMCS Jeremy Torrisi

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Dr. Jeff Cain
Dr. Howard Champion
Dr. Warren Dorlac
Dr. John Gandy
Dr. James Geracci
Dr. John Holcomb
Dr. Russ Kotwal
Mr. Steve Viola

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Mr. Harold Montgomery

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Dr. Geir Strandenes

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Australia
Japan
Norway

Interagency and TEMS Liaisons

Dr. Alex Eastman
Dr. Geoff Zeldes

DHS
State Dept

Speakers

Dr. Arthur Kellerman
SSG Steve Meyers
Dr. Martin Schreiber
Dr. Jason Sperry

Senior Leader Remarks
Combat Medic
Portland (Via Ring Central)
Plasma Fluid Resuscitation

Invited Guests

MAJ Steve Adamson
Dr. Abdulrahman Blooshi
COL JB Buller
Col Scott Calder
COL Andre Cap
Dr. Victor Convertino
CDR Brendon Drew
CDR Stefan Embuske
Dr. Mark Gestring
Mr. Dominique Greydanus
MAJ Ryan Knight
Mr. Richard Kollar
Maj Marie-Claude Labrie
Mr. Constantine Pappamihiel
LTC Nadia Pearson
SGM David Poist
Dr. Kathy Ryan
Dr. Aaron Sawyer
COL Kai Schlolaut
Ms. Connie Welch
CSM Tony Williams
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