Methodologies Utilized and Lessons Learned in High Threat Environments and Mass Casualty Environments.

SOMA 2019 Scientific Assembly Study Grant Report

Andrew Bennett[1]

[1] Senior Operator, NSW State Emergency Service

Introduction

In May 2019, the author was awarded the Australian Tactical Medical Association (ATMA) study grant to attend the Special Operations Medicine Scientific Assembly (SOMSA) 2019 in Charlotte, North Carolina in the United States of America. Whilst in the U.S. the author had the opportunity to hear many talks, attend labs and talk to many first responders in high threat and austere environments to learn about how they operate, and the lessons learned from their experiences.

This report highlights the two objectives of the study grant:

1) Record the key content and lessons learned by attendance at SOMSA 2019.
2) Discuss techniques utilized and lessons learned by first responders operating in high threat environments and mass casualty incidents.

The SOMSA brings together many like-minded pre-hospital, tactical, wilderness, austere, disaster and deployed medicine operators from all around the world to share their learnings with a primary goal to advance the art and science of special operations medical care. It is a great opportunity for military and civilian providers to learn, network and engage with industry partners showcasing innovative products and technology.

Summary of key presentations featured at SOMSA 2019.

Mike Clumpner, PhD, MBA, NRP, Threat Suppression Incorporated

Wounding Patterns and Medical Best Practices at Mass Casualty Hostile Events

With the world facing an increasing prevalence of hostile mass casualty events, Mike and his team at Threat Suppression Incorporated are on the forefront of extrapolating the data and lessons learned from these events, communicating these valuable lessons to other first responders for the purpose of enhancing the emergency services response to mass casualty incidents.

When Mike isn't researching, he is working as a SWAT Operator/ Senior Tactical Paramedic with South Carolina's largest law enforcement agency and as a Fire Battalion Chief with Charlotte Fire Department in North Carolina, United States.

He presented a very engaging and well referenced session that evaluated many of the current ways we operate, suggesting that we need to assess the effectiveness and suitability of our current methods in civilian mass casualty and high threat environment response to ensure we are doing all we can to achieve the best outcomes for casualties in a world of evolving threats.

Some of the key statistics, research and findings were mentioned:

• Upon investigation of 100 active shooter events in the US, it was found that on average a death/serious injury occurs every 15 seconds once the shooting starts until the shooter stops or is stopped.

• Recognized threats to communities include; active shooters, mass stabbings,

Journal of
High Threat &
Austere Medicine

JHTAM
The Official Journal of the Australian
Tactical Medical Association

Official journal of the Australian Tactical Medical Association

chemical attacks, fire-as-a-weapon, vehicle-as-a-weapon and explosives to name a few.

- Fire is the new weapon adopted by terrorist group ISIS, with the readily accessible weapon having the ability to terrorize an alarming amount of people. Furthermore, low-level chemical weapon attacks are common among terror groups.

- The amount of time taken by law enforcement to declare a scene secure often takes hours, and in the event of an IED threat it can be unsecured for days.

- In hostile mass casualty events, "time is life".

- "If a victim suffers a major, yet survivable ballistic injury, their odds of mortality increase 2 – 4% every minute until they reach a surgical suite or receive whole blood replacements" (Clumpner, 2019).

- A common pattern in many active shooter/bombing incidents, is that if a patient arrived at hospital alive, they lived through the event. This was the case for many events including the 2009 Fort Hood shooting, 2014 Boston marathon bombing, 2015 San Bernardino shooting, 2017 Las Vegas shooting, 2019 Charlotte shooting, and more.

- The main concepts of triage should include classification as either red or dead at the site of crisis, predominantly focusing on immediate extraction of injured personnel where a more formal triage will proceed outside of the crisis site.

- Several major whitepapers all state that Fire and EMS must be involved early in the care of patients, staging is no longer acceptable, and Fire and EMS personnel must be trained in TCCC/TECC.

- In an analysis of autopsy reports of 139 civilian active shooter events, most potentially survivable injuries involve the head and chest, and showed an average of 2.7 gunshot wounds per patient.

- In a retrospective review it was found that most tension pneumothoraces take an average of 30-40 minutes to develop after point of injury, against popular belief that they typically occur within minutes.

- The benefits of ALS intervention should be weighed against prolonged scene time.

- Cervical spine immobilization, IV therapy, and other therapies have shown little to no benefit in numerous studies, and the time taken to provide these interventions would often be better spent transporting the patient "Attempts at IV access by EMS providers on scene is often greater than the total transport time" (Clumpner, 2019).

- "In a comprehensive review of 49 large studies, Lieberman and colleagues (2000) reported an odds ratio of death 2.59 times higher when a trauma patient receives ALS care versus BLS care." (Clumpner, 2019)

- Multiple large studies have shown that the odds of death increase two to five times for penetrating trauma patients transported to the hospital by ambulance rather than by car.

- Considering that external hemorrhage and rapid transport are keys to survival, rapid transport of MCI patients via police vehicle should be considered as an option by organizations.

Upon reflection of this talk, it can be concluded that focusing on the basics combined with rapid evacuation to surgery are key priorities. ALS interventions should be justified against the known detriments of prolonged scene time. Further, having both EMS and law enforcement trained in hemorrhage control interventions, able to identify patients with internal bleeds and exercised in rapid evacuation from the incident scene to definitive trauma facilities would benefit outcomes of these events.

Brad Keating, MPH, NRP, Rocky Mountain Fire Department

RAMP Mass Casualty Triage

As the world is facing an increasing rate and complexity of mass casualty events, the way these events are responded to can greatly

alter the outcome for many patients. Brad Keating presented a thought-provoking analysis on the presently used triage systems and discussed some of their limitations.

Mr. Keating has responded to numerous mass casualty incidents in his 14 years as a Firefighter Paramedic with the Rocky Mountain Fire Department (RMFD) as well as an international disaster response team leader for nine years which has taken him to disaster zones in Haiti, Japan, Philippines and Nepal. These experiences have provided him with a thorough insight into both the pitfalls and inadequacies of current systems, and conversely, the vision to understand the key aspects that a new triage system should utilize for it to be successful in high threat events.

The current systems certainly have their place in the greater health system, however Mr. Keating states that in the prehospital mass casualty incident setting, there is a need for change. Taking into account the many factors present in a chaotic and hazardous MCI environment that first responders encounter, current systems may not be appropriate in this context for the following reasons:

• Too complicated and not easily remembered, which can lead to mistakes and wasting time when seconds count. As training exercises are few and far between and as first responders often have minimal experience in these events, simple systems should be adopted that are easy to remember under stress to reduce the perishability of this skill.

• Reliance on critical thinking and decision making. Triage systems including numbers and calculations (i.e. respiratory rate) as well as decisions on assumed patient survival (i.e. "Likely to survive given current resources?" and "Minor injuries only?") should be avoided.

• Respiration rates in certain circumstances can be difficult and untimely to obtain. Further, they do not provide great diagnostics on a scene as many patients may have an elevated respiratory rate due to stress or physical exertion while evacuating.

• Global sorting is limited to incidents of a small footprint where patients are able to hear your voice.

For a system to be successful it needs to be both flexible, fast and simple, as seconds saves lives. Some key aspects Mr Keating has highlighted include;

• Rapid identification of most severely wounded

• Ease of use in austere environments

• Easily taught and remembered

• No reliance on numbers or critical thinking

• Utilizes scientific evidence. Taking into account that studies on triage are extremely difficult to perform and the best information to go on is lessons learned and after-action reviews of events retrospectively.

Mr. Keating, in consultation with many other organizations and health care providers, presented what he believes may be a solution that identifies the flaws of previous systems, acknowledging the recommendations from lessons learned in many previous incidents.

RAMP Triage Model
(Rapid Assessment of Mentation and Pulse)
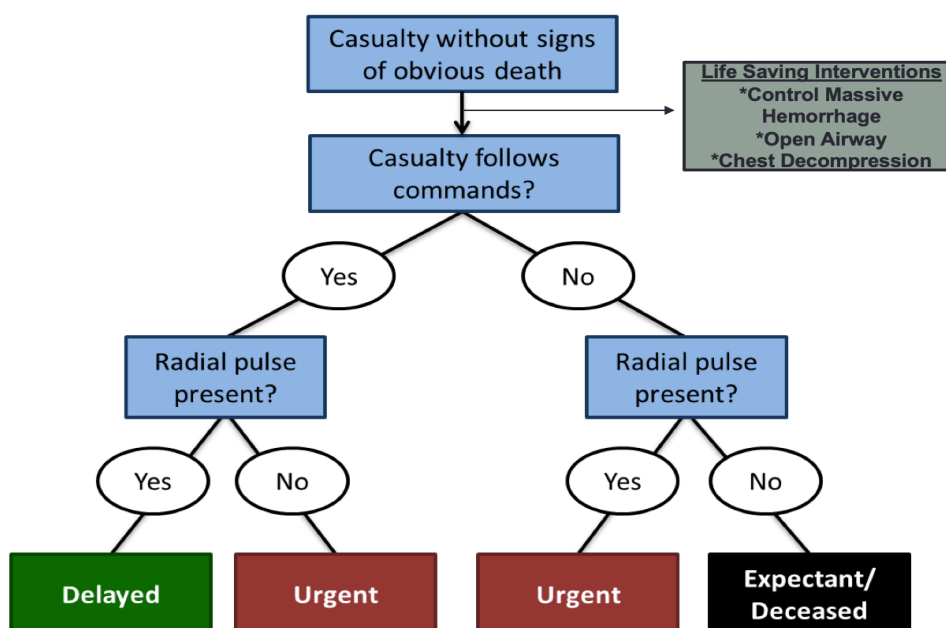
Figure 1. The RAMP Triage Model (Rapid Assessment of Mentation and Pulse) (Keating, 2016).

Keating also noted that in a recent study of 29,573 patients, it was found that the ability to follow basic commands was the best overall indicator of survival from trauma. Patients unable to follow commands and lacking a radial pulse have a 92% mortality rate.

Yellow category patients have been excluded from this system as it is the most inaccurately triaged category by EMS providers. Taking into consideration that these incidents are often high threat and complex, the Israeli approach of 'you either need help now, or you don't' has resulted in

the three patient categories, Red, Green, and Black, also known as delayed urgent and expected/deceased.

The RAMP system has rectified many of the weaknesses identified in other systems and may be an appropriate system to be utilized by various agencies. At the very least it is certainly a great conversation starter that challenges the current systems being used, their suitability, and their success.

Capt. Frank Butler, MD

Saving Lives on the Battlefield: TCCC Update

CAPT Butler provided a thorough Tactical Combat Casualty Care update, discussing achievements in recent years, some new changes in curriculum and approved equipment, and some changes we may see on the horizon for the near future.

Some of the recent TCCC Changes between 2017-2019 have included pelvic binding devices, extraglottic airways (iGel), management of suspected tension pneumothorax and advanced resuscitative care. The most recent of changes was a re-look at limb tourniquets in TCCC, resulting in the approval of numerous tourniquets added to the TCCC approved limb tourniquets list where the Combat Arterial Tourniquet, SOF Tactical Tourniquet- Wide and Emergency & Military Tourniquet have held their ground. New additions include the Ratcheting Mechanical Tourniquet- Tactical, SAM Extremity Tourniquet, Tactical Mechanical

Tourniquet, TX2 Tourniquet, TX3 Tourniquet, Tactical Pneumatic Tourniquet 2'. It's great to see a large range of new devices added to the list after an extensive analysis of many available.

CAPT Butler discussed fluids, mentioning the benefits of plasma and whole blood products, and that it could be time to remove hextend and crystalloids from trauma care.

Current pain management recommendations include ketamine and fentanyl lozenges, with a warning on opioids and benzodiazepines due to respiratory depression to avoid when fentanyl lozenges or morphine have been previously administered. Butler (2019) noted that "the production of morphine auto injectors has ceased, and all back orders have been cancelled".

Potential advancements on the horizon for TCCC include a relook at TXA and fine tuning its administration, ITClamp for control of external head and neck hemorrhage, and French LyoPLas a recent FDA approved dried plasma product.

It was great to hear the update from Captain Butler, the grandfather of tactical medicine and it's clear his continual review and innovation has saved countless lives and will continue to do so for many decades to come.

SOMSA Program Lab: K9 Tactical Emergency Casualty Care

Lead Instructor; Lee Palmer DVM, Chair of K9-TECC Working Group

I attended the K9-TECC Course, which was one of many labs on offer in the two days leading up to the scientific assembly, the variety of other labs on offer included SOF Dentistry, Critical Care Skills Cadaver Lab, Moulage, Intro to Wilderness Rescue, REBOA, Prolonged Field Care, Women's health, Ultrasound, Whole Blood & Freeze-Dried Plasma, CONTOMS Medical Directors Course and many more.

The K9-TECC course was led by Lee Palmer, who has a diverse background both

the military and law enforcement/SWAT Medic environments. The course was a combination of presentations and practical skills stations/scenarios assisted by other highly experienced veterinary health professionals.

This course covered the MARCH assessment nuanced for K9s where the M stands for 'Move, Muzzle, Massive Hemorrhage', common causes of civilian operational K9 death, how to effectively restrain a K9 and conduct a thorough secondary assessment including the use of ultrasound, how to perform many human treatments on K9s given the different anatomy and landmarks, this course also provided great insight into some key vulnerabilities that K9s have that we don't see in humans like Gastric Dilatation Volvulus (GDV or bloat), ingestion of explosive material and a higher prevalence of heat-related illness.

The take home messages from this course was that many of the treatments we already provide to humans will also work for K9s and that in fact many of the interventions currently on scope for health care professionals were originally tested on animals including dogs.

Recommendations

Recommendation 1: All emergency services to be TECC Trained

Fire, EMS and Law Enforcement should have training in TECC and be involved in the early care of patients. This training should include phases of care, focusing on situational awareness in a high threat environment, a trauma patient assessment centered around hemorrhage control techniques, application of vented chest seals and identifying patients' severe internal injuries for rapid evacuation to surgery. This training should be at their first aid or clinical provider skill level, focusing on their core roles within an MCI environment.

Recommendation 2: All emergency services to have basic TECC equipment

All agencies should be equipped with devices to provide basic lifesaving medical interventions and extrication. TCCC approved medical equipment including tourniquets, wound packing gauze and vented chest seals as well as compact soft litters for rapid evacuation of numerous casualties through complex scenes.

Recommendation 3: Review of Triage process for complex incidents

Review of current triage process and implementation of a method that is relevant in a complex mass casualty incident. Adopting the main key aspects of; rapid identification of most severely wounded, ease of use in austere environments, easily taught and remembered, no reliance on numbers or critical thinking, utilizing scientific evidence.

Recommendation 4: Regular Interagency Exercises

Emergency services should conduct more regular and thorough interagency mass casualty incident exercises to test multiple levels of their response to provide personnel with much needed practice. These exercises should be designed to be as realistic as possible to maximize learning and consider lessons learned from previous incidents around the world.

Recommendation 5: Supporting operational working K9s

EMS should consider awareness training in K9 TECC in the event they are requested to treat injured operational police working K9s, their organization should also implement policy to support this.

As K9s play a vital role in law enforcement, they are a valuable resource and simple steps can be taken to support their safety and wellbeing, simple training that identifies preventable causes of death, how to apply the medical skills we already use on humans onto K9s taking into account differences in anatomy, landmarks and physiological vulnerabilities. To support this, organizations should implement policy and protocol around treatment and transport of injured K9 with handler to permit this in certain circumstances.

References

Blair, J., & Schweit K.W. (2014). *A study of active shooter incidents, 2000-2013. Texas State University and the Federal Bureau of Investigation.* United States Department of Justice: Washington, D.C.

Blair, J.P. & Martaindale, M.H. (2011). *United States active shooter events from 2000 to 2010: Training and equipment implications.* San Marcos, TX: Texas State University.

Brown, et al. (2016). Not all prehospital time is equal: Influence of scene time on mortality. Journal of Trauma and Acute Care Surgery, 81(1):93-100.

Carr, B.G., Brachet, T. David, G., Dusei, R. & Branas C.C. (2008). The time cost of prehospital intubation and intravenous access in trauma patients. *Prehospital Emergency Care,* 12(3):327-332.

Cicero, M., Whitfill, T., Baird, J., Walsh, B., Yarzebski, J… Auerbach, M. (2017). Pediatric disaster triage: Multiple simulation curriculum improves prehospital providers assessment skills. *Prehospital Emergency Care, 21*(2), 201-208. doi:10.1080/10903127.2016.1235239

Crandall, M., Sharp, D., Unger, E., Straus, D., Brasel, K., Hsia, R., & Esposito, T. (2013, April). Trauma deserts: Distance from a trauma center, transport times, and mortality from gunshot wounds in Chicago. *American Journal of Public Health*, 103(6), 1103-1109.

Eastride, BJ, Butler F., Wade, C., et al. Field triage score in battle field casualties, validation of a novel technique in a combat environment. *Am J Surg*. 2010 (2006)6. 724-7

Kahn, C., Schultz, C., Miller K., & Anderson C. (2009). Does START triage work? An outcomes assessment after a disaster. *Annals of Emergency Medicine, 54*(3) 424-30. doi:10.1016/j.annemergmed.2008.12.035

Lee, C., McLeod, S., & Peddle, M. (2015). First responder accuracy using SALT after a brief training. *Prehospital and Disaster Medicine, 30*(5), 447-51. doi:10.1017/S1049023X15004975

Leigh-Smith, S. (2007). Tension pneumothorax prevalence grossly exaggerated. *Emergency Medical Journal*, 24(12):865.

Lieberman, M., Mulder, D., Sampalis, J. (2000) Advanced or basic life support for trauma: A meta-analysis and critical review of the literature. *Journal of Trauma* 49(4):584-599.

Meredith W., Rutledge, R., Hansen A., Oller D., Thomason R.,… Baker, C. (1995). Field triage of trauma patients based upon the ability to follow commands: a study in 29,573 injured patients. *Journal of Trauma 38*(1), 129-35.

Zafar, S. N., Haider, A. H., Stevens, K. A., Ray-Mazumder, N., Kisat, M. T., Schneider, E. B. Haut. (2014). Increased mortality associated with EMS transport of gunshot wound victims when compared to private vehicle transport. *Injury, 45*, 1320-1326.