Military Trauma: Lessons for Civilian Care

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Background

“...he who desires to practice surgery must go to war” Hippocrates (circa 400 BC)

Critical Care Medicine and Trauma

Wounds in Afghanistan and Iraq (2001 – Current)

Wounded: >50,000
Deaths: >7,000
defense.gov/news/casualty

Lesson’s Learned

• Point of Injury and En-route Care
  - Tactical Combat Casualty Care
• Hemorrhage control
  - Tourniquets
  - Reappraisal of endovascular techniques
• Resuscitation
  - Component-based, balanced resuscitation
  - Tranexamic acid (TXA)
  - Cryoprecipitate (Fibrinogen)
• Management of vascular trauma
  - Benefit temporary vascular shunts in management of extremity vascular injury
Point of Injury Care

Battlefield trauma care then and now: A decade of Tactical Combat Casualty Care
Frank K. Butter Jr., MD, CAPT, MC, USN (Ret) and Lenore H. Blackbourne, MD, COL, MC, USA


• All US combat medics, corpsmen and pararescuemen are taught battlefield care techniques based on TCCC guidelines
• Pre-Hospital Trauma Life Support (PHTLS)

Point of Injury Care

• Assures good medicine is combined with good small unit tactics to minimize potentially preventable death
• Three phases:
  - Care under fire
  - Tactical field care
  - Tactical evacuation (TACEVAC) care
• Phase I: Tactical advantage with use of tourniquets
• Phase II: Control hemorrhage (Combat Gauze and tourniquets), maneuvers to open airway, needle thoracostomy, IV or IO access with saline lock for medications or hypotensive resuscitation
• Phase III: Supplemental oxygen, consideration of plasma, tranexamic acid (TXA)

Point of Injury Care

Eliminating Preventable Death on the Battlefield

Dennis R. Keane, MD, MPH; Harold E. Montgomery, MD; (MINF) Bart M. Keirnald, MD; Howard R. Champion, FRCPC; Frank K. Butter Jr, MD; Robert L. Malley, MD; Jeffrey S. Cain, MD; Lenore H. Blackbourne, MD; Geetha R. Mehta, MD, RN, John R. Holcomb, MD

CONCLUSIONS: A command-directed casualty response system that trains all personnel in Tactical Combat Casualty Care and receives continuous feedback from prehospital trauma registry data facilitated Tactical Combat Casualty Care performance improvements centered on clinical outcomes that reduced unpreventable deaths and decreased preventable combat death. This data-driven approach is the model for improving prehospital trauma care and casualty outcomes on the battlefield and has considerable implications for civilian trauma systems.

• Reduced KIA (5.7%) & DOW (4.1%) rates
• No preventable deaths
• Non-medical personnel

Lesson 1

• A uniform casualty response system including required training for all personnel in the tenants of Tactical Combat Casualty Care reduces potentially preventable death following major trauma
Tourniquets

FEATURE

Survival With Emergency Tourniquet Use to Stop Bleeding in Major Limb Trauma

COL John F. Kragh, Jr., MC, USA*; Thomas J. Walls, MD, PhD*; David G. Brown, PA-C*;
LTC Charles J. Fee, MC, USA; Charles E. Wade, PA-C; Jose Salas, PA-C;* and COL John B. Kociw, MC, USA*.

Emergency Military Tourniquet (EMT™)

Combat Application Tourniquet (C-A-T®)

Ann Surg 2009;249:1

Tourniquets


Graph showing survival with and without shock.

Lesson 2

• The broad availability of tourniquets combined with basic first aid instruction saves lives following major trauma

Translation to Civilian Care

Emergency tourniquets, war lessons saved lives in Boston
Janice Lloyd, USA TODAY 2:05 p.m. EDT April 18, 2013
Translation to Civilian Care

From Baghdad to Boston: War Lessons on Amputations Help Blast Victims Walk Again
Tara Haelle
April 16th, 2013

Translation to Civilian Care

The Return of the Tourniquet What we learned from war led to lives saved in Boston
Lydia DePillis
April 17, 2013

Translation to Civilian Care

Improving Survival from Active Shooter Events: The Hartford Consensus Joint Committee to Create a National Policy to Enhance Survivability From Mass Casualty Shooting Events
Hartford, CT April 2, 2013
Jacobs L., McSwain N., Rotondo M., Wade D., Fabbri W., Eastman A, Butler F., Sinclair J.

Need For Hemorrhage Control

ORIGINAL ARTICLE

Death on the battlefield (2001-2011): Implications for the future of combat casualty care

Brian L. Edgell, MD, Robert L. Malley, MD, Peter Segal, MD, Joyce Courtois, MD, Terrell Tope, MD, Paul Urie, MD, Olga Malott, Tamara Zelikin, Lyman Ochsner-Gardner, Todd E. H⽀iman, MD, Frank K. Bodin, MD, Russell S. Korteweg, MD, John R. Holcomb, MD, Charles Wade, PhD, Howard Champion, MD, Mimi Levitt, Lou Moore, MD, and Louise H. Blackbourne, MD

J Trauma Acute Care Surg 2012;73(Suppl1):S431-S437
Need for Hemorrhage Control

• Approach to resuscitative aortic occlusion hasn’t changed in decades

• What can we translate from modern approach to ruptured abdominal aortic aneurysms?
Translation of Specialty Skills

10 Years of Emergency Endovascular Aneurysm Repair for Ruptured Abdominal Aortic Aneurysms: Lessons Learned

1. Quantitative study of aortic & torso anatomy
2. Low profile, self centering balloon catheter
3. Pressure regulated inflation
4. Resist balloon retreat from pulse pressure
**Translation of Specialty Skills**

Breakdown of professional silos and translation of subspecialty skill set in endovascular surgery may provide novel, life-saving approach to hemorrhage control and resuscitation from shock.

**Lesson 3**

**Resuscitation from Shock**

- Balanced plasma to packed red blood cell resuscitation associated with reduced mortality.

**Resuscitation from Shock**

- The use of tranexamic acid (TXA) as an adjunct with component-based resuscitation is associated with improved survival.
Resuscitation from Shock

**Online First**

Association of Cryoprecipitate and Tranexamic Acid With Improved Survival Following Wartime Injury

Findings From the MATTERs II Study

Jonathan J. Morrison, MB, CH, AFGCS, Jonathan D. Ross, PhD, Joseph J. Dalake, MD, Jack O. James, FRCS, FRCM

Mark J. Huberthery, PhD, MD, FRCS, Todd E. Rawlance, MD

*JAMA Surg* 2013;148(3):218-25

**Conclusions:** Cryoprecipitate may independently add to the survival benefit of tranexamic acid in the seriously injured requiring transfusion. Additional study is necessary to define the role of fibrinogen in resuscitation from hemorrhagic shock.

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Resuscitation from Shock

**MATTERs II**

*JAMA Surg* 2013;148(3):218-25

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Lesson 4

- Tranexamic acid alone and with cryoprecipitate as an adjunct with a component-based resuscitation provide a survival advantage in the setting of severe injury and hemorrhagic shock.

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Extremity Vascular Trauma

**Effect of temporary shunting on extremity vascular injury: An outcome analysis from the Global War on Terror vascular injury initiative**


- Temporary vascular shunts used as a surgical adjunct in the setting of extremity vascular injury are effective in restoring perfusion and promoting limb salvage.
Temporary vascular shunts are an effective adjunct to be used in select patterns of extremity vascular injury.

These devices are useful in restoring perfusion in an expedited fashion limiting limb ischemia and promoting limb salvage.
Conclusion

• Combat casualty care research performed over a decade of war has provided evidence-based lessons which improve survivability following major trauma

• Advances in trauma care stemming from the military’s experience during the wars in Afghanistan and Iraq are being translated to the care of severely injured civilian patients